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Final Thesis

**Economic Complexity,  
Human Capital, and Trade:  
what the fast growth of South Korea  
can teach the Italian economy**

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*Per aspera ad astra*



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## Introduction

South Korea and Italy. Two nations in the opposite parts of the world, two peninsulas in strategic positions, two totally different cultures, two examples of economic growth led by the forward-looking of the politics. Obviously, there are many differences between these two countries, but, also, there are many similar aspects that incredibly connect one of the Asian Tigers to *the Boot*. In this work we are going to analyze and to discuss the two countries by the economic point of view. The Korean War (1950-1953) and the WWII (1939-1945) had levelled to zero the two countries' economies and societies. "*From zero to hero*" someone could say. Indeed, the economic and social improvements were remarkable for both countries in the following decades. Today, they are two of the greatest manufacture economies of the world, but with very different paths: Italy became a democracy already in 1946 and, since the 1950s, it started a period of fast economic growth, the *Italian boom*, thanks also to the decision of its politicians to undertake the first embryonic form of EU and to launch campaigns to rebuild the infrastructures of the country. Since then, Italy has always been one of the most important economies of the world. South Korea, on the other hand, experienced many dictatorships until the 1980s, but, especially thanks to the controversial figure of the dictator Park Chung Hee, this built the basis for the fast development that began in the 1990s. In 2019, South Korea has definitely reached the Italian economic standards and, in fact, it has the same GDP per capita: the Asian tiger does not show any intentions to stop its growth in the next years while the Italian economic situation of the last two decades has remained almost static. We are going to see how these incredible achievements reached by South Korea were made possible by analyzing the two countries under the Complexity Economics point of view. This investigation will take into account all those features that are fundamental to build an accurate study of the level of complexity of the productive structures of the countries: the exports and the openness to the global markets, the function of ICTs as a catalyst, and, above all, the crucial role of a high level of human capital throughout the country. The highest levels of these three aspects, compared to Italy, has led South Korea to a successful economic growth and forecasts for the future are even better; in this work we will see what Italy can learn from the Korean example.



## 1. Economic Complexity Index: a measure of Economic Complexity

Economic Complexity Index (ECI) is one of the ways and the tools to study countries using the Complexity Economics approach. The aim of this work is to look at the economies of South Korea and Italy by the ECI point of view, by using all those tools that are related to it: Tree Maps, ECI trends, Product Complexity Index (PCI) and Product Space Map. For this reason, this initial part will be dedicated to the learning of all these helpful instruments that we are going to use later in the analysis of the two countries.

### 1.1. Prologue to the ECI: the growth of information

In the last few decades, we are facing the biggest changes and developments of the entire history of humanity. This was due to many factors and improvements but clearly one of the most important is represented by the exceptional growth of information and the ways how it is still increasing and shared.

Information is a complex concept and thereby we won't deal with it. But, just looking for the meaning of the word "information" and why it grows and spreads, we are not only going to discover the evolution of physics in the last century but also the evolution of economy. Information theory allows to link physical principles to the theories of human capital, of knowledge, of social capital and economic sociology up until to find the connection to the concepts of industrial diversification and economic development. The growth of information can also explain the theory of the evolution of prosperity, the reason why in the world there are rich and poor nations, their productive abilities and their capacity to collect knowledge and knowhow to produce those products filled by information and hence with an added economic value.

César Hidalgo<sup>1</sup> properly explains in his masterpiece "*Why Information Grows: The Evolution of Order, from Atoms to Economies*"<sup>2</sup> how, starting from information, it is

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<sup>1</sup> César A. Hidalgo is a Chilean physicist born in 1979. Former professor at MIT, nowadays he teaches at University of Toulouse. Hidalgo is the pioneer of the theory of Economic Complexity and he studied complex systems and networks related to economic development. He is the Author of "*Why Information Grows*" and the co-author of "*The Atlas of Economic Complexity*". Hidalgo was awarded with Lagrange Prize in 2018.

<sup>2</sup> C. A. Hidalgo, "*Why Information Grows: The Evolution of Order from Atoms to Economies*" Ed. Basic Books, New York (2015).

possible to describe the complexity of the economies and to do predictable forecasts about the economic growth and development.

Coming back to the system of information, we collect them and thanks to our energy, our intellectual and manual abilities, we are able to transfer them into solid objects. Hidalgo calls these objects *Crystals of Imagination*, referring to items in which we accumulate not only information, but also imagination i.e. knowledge and knowhow. At this step we put the incredible injection of imagination that makes some products unique and complex. Let's consider now these crystallized pieces of imagination in the international trade. The export of those goods full of imagination tells us that there are some countries in the world that are importers and other that are exporters of knowledge and knowhow, and that the export structure of a country is a significant indicator to demonstrate that in that country there are people who are able to create particular and sophisticated products, which reveals the level of knowledge and knowhow inherent to that country's population. Imagination balance is a remarkable way to understand the role and importance of a country in the international trade chessboard. Indeed, high export levels of complex products indicate that this country is selling something with a high economic value and by that it is improving its income. Country's exports and imports are relatively easy to gather and hence it is quite easy to understand and compute the trade balance of imagination between two countries.

Sometimes, however, the balance of trade - intended as the monetary value difference between exports and imports - differs or even runs opposite to the balance of imagination traded between two economies. Let's consider the South Korean economic structure as an example, not only because it is the main character of this thesis but especially because it is an export-orientated economy with an extremely positive trade balance with the rest of the world. Going through the Republic of Korea's economy more in details, we can discover that it has a negative trade balance with some countries. For this analysis I will use the visualization trade data made by the Observatory of Economic Complexity<sup>3</sup>, the so called "Tree Map"<sup>4</sup>. A Tree Map represents all exports made by a country subdivided in product categories depending on the share of the exports of each sector. In 2017, for example, South Korea had a negative trade balance with countries like Kuwait, South Africa and Chile.

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<sup>3</sup> The Observatory of Economic Complexity is a tool which allow to visualize and analyze countries and the products they produce and exchange. This project was initially started at the MIT Media Lab Macro Connections Group by César Hidalgo and Alexander Simoes.

<sup>4</sup> Tree map is a visualization engine created and developed by Alexander Simoes for the Observatory of Economic Complexity. It consists in the representation of the product's share of trade of a nation (imports or exports). Simoes made this project as his master's thesis while he was in Hidalgo's research group at the MIT Media Lab.

These nations are all similar because they are all exporters of raw materials and resources. In 2017, South Korea imported from Kuwait products for a total of 8.68 billion dollars<sup>5</sup>, whereas it exported to the small state on the Persian Gulf items to the value of 1.34 billion dollars<sup>6</sup>.



FIGURE 1: TREE MAP OF EXPORTS FROM KUWAIT TO SOUTH KOREA.  
SOURCE: OBSERVATORY OF ECONOMIC COMPLEXITY (OEC)

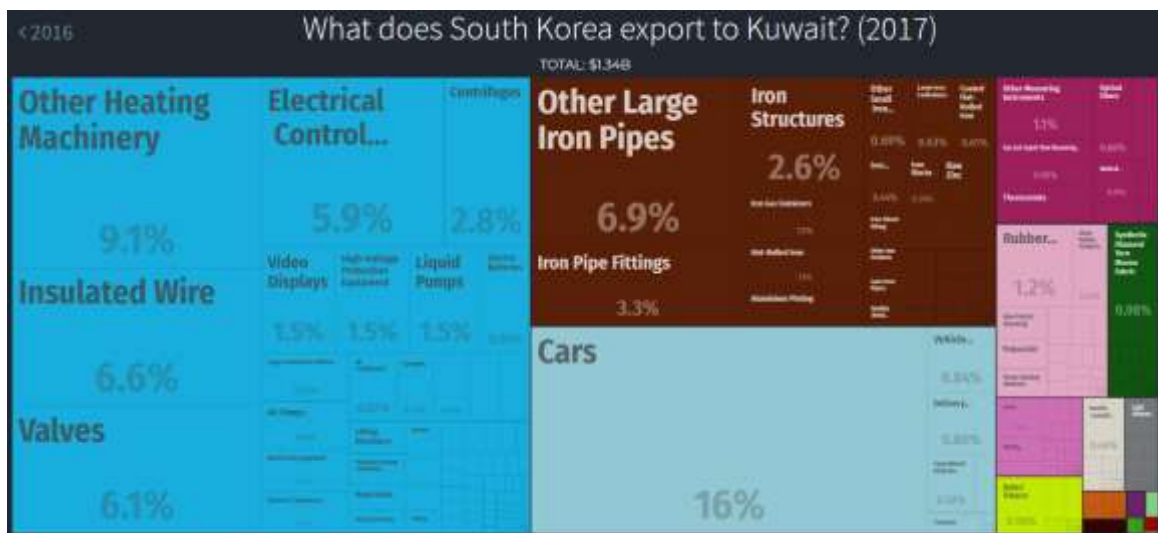


FIGURE 2: TREE MAP OF EXPORTS FROM SOUTH KOREA TO KUWAIT.  
SOURCE: OBSERVATORY OF ECONOMIC COMPLEXITY (OEC)

<sup>5</sup> [https://oec.world/en/visualize/tree\\_map/hs92/export/kwt/kor/show/2017/](https://oec.world/en/visualize/tree_map/hs92/export/kwt/kor/show/2017/)

<sup>6</sup> [https://oec.world/en/visualize/tree\\_map/hs92/export/kor/kwt/show/2017/](https://oec.world/en/visualize/tree_map/hs92/export/kor/kwt/show/2017/)

As we can see from the two *Tree Maps* (Figure 1 and Figure 2), the 87% of Kuwait's exportations to South Korea was crude petroleum and it was worth \$7.51B, whereas in the same year South Korea exported for the 45% of products related to machinery sector, for a value of \$608M, and for the 16% cars with a value of 211 million dollars. Despite Kuwait's trade balance with Korea was clearly positive, if we look at the imported objects, we can also state that its *imagination balance* was negative. The middle east country didn't sell objects embodied of imagination, meanwhile bought from Korea goods plenty of knowledge and knowhow. In 2017, the same happened also with South Africa and Chile. With the African country, South Korea imported goods for \$2.38 billion and exported for \$1.04 billion; with the South American state the imports were worth 4.06 billion dollars whereas the exports just 1.8 billion dollars (World Bank Data, 2017).

Classic economic theories, like the trade balance between two countries based on labor and capital, jump to different conclusions than Hidalgo's theory of *Crystals of Imagination*, which considers products as goods embodied of human imagination. With this point of view, especially developing and underdeveloped countries can learn that the real economic value comes from the knowledge and knowhow inside a sophisticated product and not just from the extractive activity of an abundant raw material. The imagination inherent the products exported also shows the general level of knowledge and knowhow of a country, which corresponds to the level of education of its the population. Better educated people are able to produce more complex products which cannot be easily duplicated by less educated people. So, these objects full of imagination can be exported and can create positive trade balance with importers: indeed, these products cannot be reproduced by competitors and, so, they can generate economic advantage. In this way, we can give a new and different interpretation of the economy as a trade of objects embodied of different level of information and as an amplifier of the practical use of knowledge and knowhow.

## 1.2. Economic Complexity: a new and different way to look at the economy

In the previous paragraph we introduced some concepts which will be the basis for this part of the work. We talked about how we had the opportunity to collect knowledge and

knowhow from the growth of information in the last century. Thanks to the accumulation of knowledge and knowhow, people started to transfer their imagination into the creation of even more complex products. This process of making imagination real produced all those goods that Hidalgo calls *Crystals of Imagination*. These products correspond to what countries then export worldwide and allow them to have benefits from the international trade. That was the first initial approach to enter in the Economic Complexity issue.

First of all, it is important to understand the concepts of Complexity and Complex Systems. A complex system is a system made of many parts that may have interactions between them. The collective behavior and the properties of the system, however, cannot be easily, or not at all, reconducted to the properties of the single parts. It's very hard to find interactions, dependencies or relationships between the parts of a system or between a system and other systems or environments. They are such a dynamical and unstable systems and, mathematically talking, they are related to non-linear dependencies and is hard to discover inferences between properties.

In the last century, thanks to the increasingly large quantity of data (*information* according to Hidalgo's point of view) gathered, the Complex System's Science started to be used as a new approach in multiple field, included the economic one, helping to put in touch different scientific, and non-scientific, disciplines.

As we said, one of the branches of Complexity Science is related to the economic issues and problems and it is the so-called Complexity Economics. Introducing complexity in Economics means describing economics under a different perspective, in a fluctuating way, that is in contrast with the historical equilibrium theories of neoclassical economics. This change of vision is a switch from a "perfect, well-structured, rational and simplified" perspective, with average agents with illimited rational decisions, to a "complexity" vision characterized by economic agents (firms, consumers, investors) who interact without having a complete knowledge of the environment in which they act and they are always changing their behavior and strategies. In simple words, there was a shift from an equilibrium approach to non-equilibrium point of view.

According to Adam Smith, the division of the labor was the secret of the wealth of nations where people and firms increased economic efficiency by specializing in different activities: in his view, the bigger the market was, the more participants specialized and the greater the division of the labor was. As reported by another classical view, the differences between poor and rich countries depended on the relative proportions of productive factors (physical capital, labor, land, human capital or skills, institutions and infrastructure) they

owned (Flam and Flanders 1991). Another approach focuses on the technological differences between countries (Romer 1990). On the other hand, under an economic complexity point of view, the economic development was characterized by the level of sophistication of products, which means that the ability to make a product is strictly related to the knowledge of the individuals. In order to create sophisticated products, a society can expand the knowledge and knowhow of its individuals by facilitating their interactions in increasingly complex networks.

The discipline of Complexity Economics is still recent and not developed yet. Only in the last 15 years it started to spread and to be more studied. The very first researches about complexity in economics were conducted by Santa Fe Institute<sup>7</sup> in 1989 by a team coordinated by W. Brian Arthur<sup>8</sup>. They first demonstrated that using an artificial stock market it could be possible to obtain two different outcomes by the same agents. This non-intuitive results at the macrolevel showed for the first time that the interactions and actions at the microlevel by the agents cannot be summed up as the results of the actions and interactions of average and rational agents. This first archetypal and simple example started the era of application of Complexity in the Economic field. Economic complexity studies are still at their initial stages and there are many different ways to approach at this vision of the economy. We will focus on the approach introduced for the first time by Hidalgo and Hausmann, which is based on the concepts of diversity of country's production and ubiquity of products exported by that country. These two concepts combined together enable the measurement of the economic complexity of one country's productive structure and then to compare it with the one of others.

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<sup>7</sup> Nonprofit and independent research institute located in Santa Fe, New Mexico (US) specialized on the studies of complexity in multiple disciplines such economy, biology, genetics, physics, artificial life and sociology since '80.

<sup>8</sup> W. Brian Arthur is Northern Ireland born but American living economist (1945-). He is an external professor at Santa Fe institute and a visiting researcher at PARC, California. Former professor at Stanford, he received the Lagrange Prize for his studies in Complexity Science, and the Schumpeter Prize in Economics. He served at the Santa Fe Institute's Science Board and Board of Trustees.



### 1.3. Economic Complexity Index: how it is measured and how to understand it

In the first decade of the new millennium, César A. Hidalgo and Ricardo Hausmann<sup>9</sup> developed the Economic Complexity Index (ECI), an innovative tool able to measure a large and complex economic system. In 2009, they published the original explanation and formal formulation of ECI with a research article entitled “*The building blocks of economic complexity*”<sup>10</sup> in the Proceedings of the National Academy of Sciences of the United States of America<sup>11</sup>: thanks to the mix of the products that countries are able to make and export, it is possible to measure their economic complexity.

Indeed, the Economic Complexity Index measures how sophisticated a country’s productive structure is thanks to the combination of information about the number of products it exports (defined as *diversity* of a country) and the number of countries that export that specific product (*ubiquity* of country’s product). Diversity and ubiquity are two concepts that combined together define the economic complexity of the country. If a country has a high level of diversity, it means that it is able to make and to export many different products, so it has a very diversified industrial structure. The ubiquity of a product is related to the concept that the easier the production of a product is, the more ubiquitous the products is around the world and, for this reason, many countries have the ability to replicate and produce it. In opposition, a less ubiquitous product requires a more complex production. Hence, a country with a low ubiquity level has a productive structure which is able to produce sophisticated goods that embody high levels of knowledge and knowhow replicable with difficulty.

Products differ among them for the different amount of knowledge and knowhow embodied in themselves, which is the result of different and efficient networks of people and

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<sup>9</sup> Ricardo Hausmann is a Venezuelan economist born in 1956. Former Director of the Center for International Development (CID) at Harvard University from 2005 to 2019. Nowadays he is Director of the Growth Lab at Harvard’s Center for International Development. Previously, he was Chief Economist of Inter-American Development Bank (1994-2000) and he served before as a member of the Central Bank of Venezuela and later as Minister of Planning of Venezuela (1992-1993). He also was in the board of the IMF’s World Bank Development Committee.

<sup>10</sup> César A. Hidalgo and Ricardo Hausmann, “*The building blocks of economic complexity*”, PNAS June 30, 2009.

<sup>11</sup> Proceedings of the National Academy of Sciences (PNAS) is a US scientific journal, official agency of the United States National Academy of Sciences. It was founded in 1915 and it publishes articles in fields as biomedical, biological, physical, mathematical and social sciences.

organizations. Only those countries with specific abilities of network and knowledge at both individual and collective level can produce sophisticated products, which differ and enrich their economy from the others. Moreover, the combination of the ubiquity of a product and the diversity of the country exporting it is important also because it allows to differentiate between products that have the same low level of ubiquity but very different sophistication: a low ubiquity could be stated because a product is just rare (like a rare mineral) or because it is very complex (like an biomedical instrument). So, to conclude, the low ubiquity concept is usually strictly related to the complexity of products, but only in combination with the diversity it is possible to define the economic complexity of the economy of a country.

As mentioned above, the first mathematical formulation of ECI was published by Hidalgo and Hausmann. The ECI's calculation takes in consideration simultaneously:

- Only those countries with a population greater or equal to 1.25 million people;
- Only those countries whose traded value is greater or equal to 1 billion;
- Only those products whose traded value is greater or equal to 10 million dollars.

These preconditions are made in order to avoid distortions.

The computation of the Economic Complexity Index takes origin from the exports data that connect countries to the products in which they have Revealed Comparative Advantage (RCA). To make possible a comparison between countries and products, Hidalgo and Hausmann used Balassa<sup>12</sup>'s definition of RCA: it affirms that a country has a Revealed Comparative Advantage in a product if it exports more than its "fair" share, i.e. a share that is equal to the share of total world trade that the product represents.

First of all, there is the need to gather countries' trade data from country's product associations with products disaggregated, using and combining three different data sources and classifications:

- The first one is the Standard International Trade Classification (SITC)<sup>13</sup> revision 4 at the 4-digit level;
- The second one the COMTRADE Harmonized System<sup>14</sup> at the 4-digit level;

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<sup>12</sup> Béla Balassa was a Hungarian economist lived in the XX century (1928-1991) that he taught at John Hopkins University. His most famous work, with Paul Samuelson, is the formulation of the effect Balassa-Samuelson.

<sup>13</sup> Standard International Trade Classification (SITC) is a classification of products that classify import and export of a country and allow to make comparisons among different countries and years. SITC is maintained by the United Nations.

<sup>14</sup> The COMTRADE Harmonized System at the 4-digit level is a dataset used by the authors. The Harmonized System (HS) is an international nomenclature for the classification of products. The authors used United

- And lastly the North American Industry Classification System (NAICS)<sup>15</sup> at the 6-digit level.

Thanks to these data, it is possible to give a definition of networks in which countries are connected to the products they export. Basically, the mathematical representation of this network is made by a matrix  $M_{cp}$  which gives  $M_{cp} = 1$  if the country  $c$  is a significant exporters of a product  $p$  (in other words, if country  $c$  has a *RCA* on this product  $p$ ), otherwise  $M_{cp} = 0$ .

Let's calculate this mathematically.

Let:

$X_{cp}$  = the total quantity (in USD) of a product  $p$  that a country  $c$  exports

$C$  = number of considered countries

$P$  = number of considered products

Define  $RCA_{cp}$ , i.e. the Revealed Comparative Advantage of a country  $c$  un a product  $p$ , as:

(1)

$$RCA_{cp} = X_{cp} \frac{X_{cp}}{\sum_c X_{cp}} / \frac{\sum_p X_{cp}}{\sum_{c,p} X_{cp}}$$

If a country's export of a product is larger than what would be expected from the size of the country's export economy and the product's global market, *RCA* is larger than 1 and that indicates that a country has a comparative advantage in that product.

We use (1) to build a matrix where each country is connected to the goods it produces. So, *RCA* is defined as a matrix  $M_{cp}$  which is equal to 1 if a country  $c$  has *RCA* in product  $p$  and 0 otherwise.

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Nations COMTRADE database classified in accord to the Harmonized System at the 4- digit level (1241 goods, 103 countries).

<sup>15</sup> The North American Industry Classification System (NAICS) is the standard used by U.S. Federal statistical agencies for reporting data related to the U.S business economy. It classifies 318 products and 150 countries.

$$M_{cp} = 1 \text{ if } RCA_{cp} \geq 1$$

$$M_{cp} = 0 \text{ if } RCA_{cp} < 1$$

Then, the matrix  $M_{cp}$  allows to give a definition of *diversity* of a country, considered as the number of products that are exported by a country with comparative advantage, and the *ubiquity* of a product, which is the number of countries that export a product with comparative advantage:

$$Diversity = k_{c0} = \sum_p M_{cp}$$

$$Ubiquity = k_{p0} = \sum_c M_{cp}$$

Subsequently, we can define a matrix that links countries exporting similar products, weighted by the inverse of the *ubiquity* of a product (to discount common products), and normalized by the *diversity* of the country:

$$M_{cc'} = \frac{1}{k_{c,0}} \sum_p \frac{M_{cp} M_{c'p}}{k_{p,0}}$$

Finally, the Economic Complexity Index (ECI) of a country  $c$  is defined as:

$$ECI_c = \frac{K_c - \langle K \rangle}{std(K)}$$

where  $K_c$  is the eigenvector of  $M_{cc'}$  associated with the second largest eigenvalue (the vector associated with the largest eigenvalue is a vector of ones).

Moreover, the  $M_{cp}$  matrix, which represents the diversification of every country and the ubiquity of every product, permits to create a first initial diagram of four quadrants (Figure 3) in which are collocated the countries according to their empirically observed average measures of  $\langle K_{c,0} \rangle$  (generalized measure of diversification) and  $\langle K_{c,1} \rangle$  (generalized measures of ubiquity).

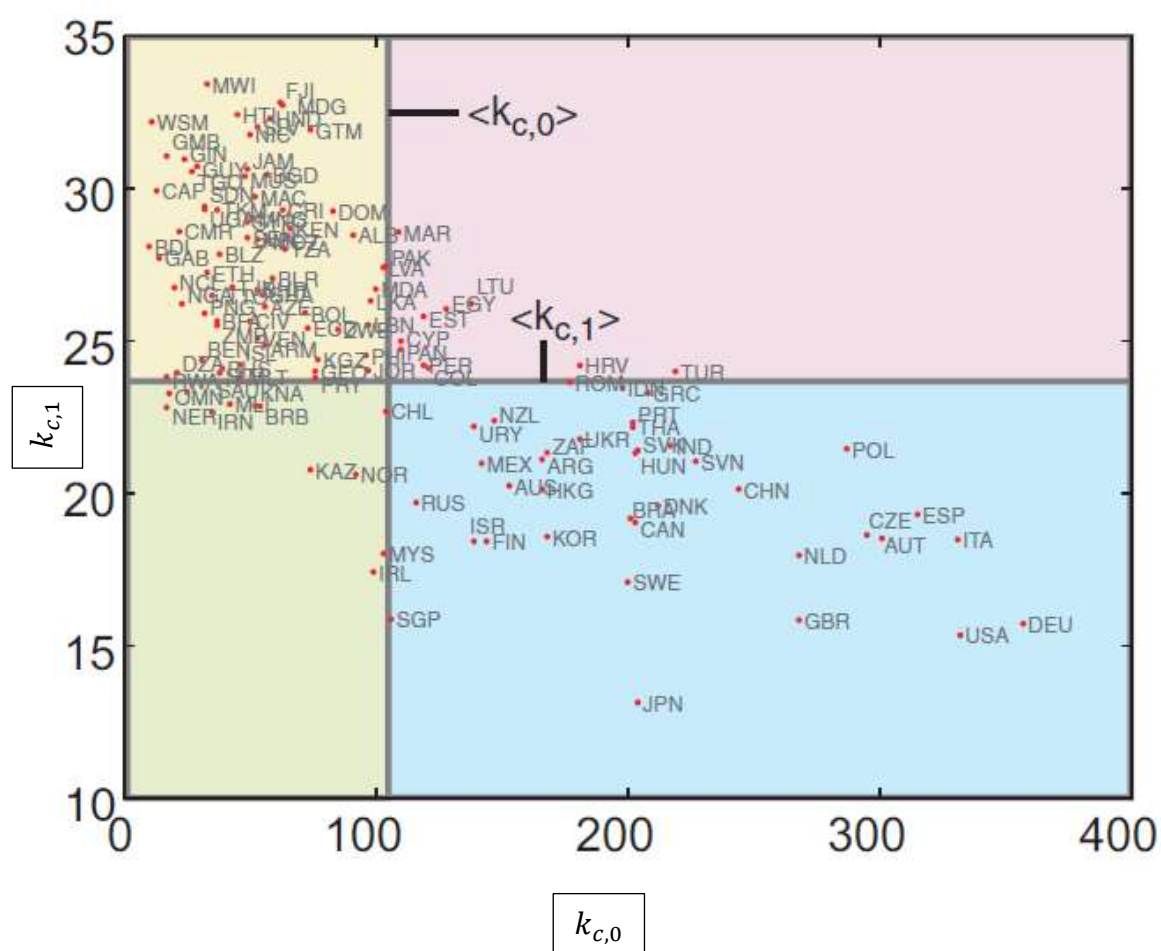
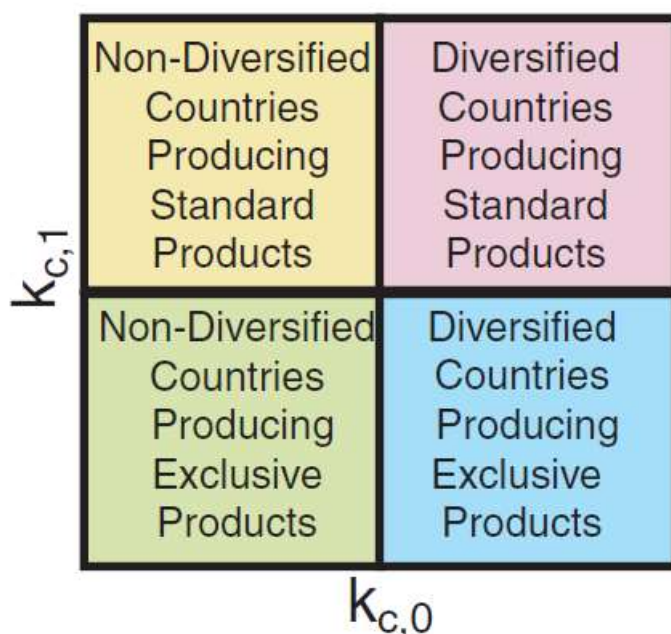


FIGURE 3: CLASSIFICATION OF COUNTRIES DEPENDING ON THEIR DIVERSIFICATION ( $k_{c,0}$ ) AND UBIQUITY ( $k_{c,1}$ ) OF THE PRODUCTS EXPORTED.  
 SOURCE: “THE BUILDING BLOCKS OF ECONOMIC COMPLEXITY” ARTICLE BY CÉSAR HIDALGO AND RICARDO HAUSMANN, 2009.

Taking the diagram in Figure 3, we can then subdivide and define countries depending on their current productive structure. We can create a new diagram to facilitate the visualization and the comparison with the previous one. In this new graph, each quadrant represents the status of the country related to the products it exports.



**FIGURE 4: SIMPLIFIED DEFINITION OF COUNTRIES BY THEIR PRODUCTIVE STRUCTURE.**  
**SOURCE: “THE BUILDING BLOCKS OF ECONOMIC COMPLEXITY” ARTICLE BY CÉSAR HIDALGO AND RICARDO HAUSMANN, 2009.**

As we can see from the comparison between Figure 3 and Figure 4, in the upper left section we meet all those countries that produce non-diversified and standard goods, that is the same to say with a high ubiquity and a very low diversification (yellow quadrant). They are states that don't produce high sophisticated goods and these goods are produced by a lot of other countries. Most of all the countries of this quadrant are under-developed countries with a weak productive structure. Opposite to the upper left part, in the bottom right section we can find the most developed countries and other nations that are following the road of the diversification of products which are not exported by many other countries. Nations in the light blue part are those whose productive structure is quite developed and strong. Lastly, there are two other parts colored in pink and in green in the diagram of figure 4. In these quadrants there are located very few countries located that are considered as economic exceptions. First of all, it is important to underline that they are located really close to those countries of the previous quadrants; this means that they do not differ significantly from the states in the yellow and light blue part and, so, they are in a sort of economic limbo. In the bottom left sector, the green one, there are those countries who do not make too much sophisticated goods but also at the same time these products are not exported by a lot of

other countries. On the other hand, the pink upper right quadrant includes those countries that produce quite sophisticated products (and so their level of diversification is quite high), which are not produced and exported by many other countries (therefore the ubiquity of the product has a high index).

Subsequently, after having computed the ECI for each country, it is possible to build a ranking of the countries of the world based on their level of ECI, that is their ability to make sophisticated products (with a relevant revealed comparative advantage) and to sell them all around the world. The ECI ranking, moreover, displays the level of economic complexity of each country since 1968, showing their dynamical changes of industrial structure during the last 50 years. It has been developed by the Observatory of Economic Complexity (OEC) and it is possible to find it online at their website page.

(<https://oec.world/en/rankings/country/eci/>).



FIGURE 5: ECI RANKING OF 2017 BY OEC (OBSERVATORY OF ECONOMIC COMPLEXITY)

In Figure 5 are visualized the first positions of ECI ranking of 2017 by OEC. Each country has its own level and is possible to see the trend of their rank during the years. This is an

efficient way to show the evolution of ECI for every single country and to look at their improvements or deteriorations in the last 50 years.

Being at the top of this ranking means that a country produces many and sophisticated goods which are not exported by much other countries. In other words, they have the best correlation between diversification and ubiquity, which allows them to export and to perform, consequently, an economic growth.

With the analogue computations of ECI and exchanging countries  $c$  with products  $p$ , it is possible to define the Product Complexity Index (PCI) as:

$$PCI = \frac{Q_p - \langle Q \rangle}{std \langle Q \rangle}$$

The Product Complexity Index is a useful tool to measure the knowledge intensity of a product, taking into consideration the knowledge intensity of the countries that export it. Differently, the ECI measure the knowledge intensity of an economy through the goods that it exports.

As for ECI, it is possible to build a rank of PCI that shows products ranked for their level of complexity. Products and their categories can be defined by using four different product classification: SITC, HS 92, HS 96, HS 02, HS 07<sup>16</sup>. Obviously, by using the Harmonized System classification (that is the most accurate classification system), the PCI index over the years starts from after the HS was published, while SITC system classifies goods since 1968. The following image (Figure 6) depicts the first positions of the Product Complexity Index by using HS 07 published in 2007 and for this reason, the year range starts in 2008.

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<sup>16</sup> As we discussed before for ECI, they are all systems of products' classification used for trade statistics and studies. SITC stays for Standard International Trade Classification. HS is for Harmonized System which stays for Harmonized Commodity Description and Coding System. HS is developed and managed by World Custom Organization (WCO). HS's codes are updated every five years since 1992 (so for this reason HS 92, HS 96, HS 02, HS 07) in order to cover also the new products introduced in the market<sup>6</sup> and traded.





FIGURE 6: PCI RANKING BY OEC (OBSERVATORY OF ECONOMIC COMPLEXITY)

#### 1.4. The Product Space

Another useful tool to study and visualize the productive structure of a country and its development over the time is the Product Space.

In the previous paragraph we introduced basilar concepts of *diversity* and *network* to study Complexity Economics by Hidalgo and Hausmann's point of view and to build the Economic Complexity Index. The evolution and the development of one country's productive structure are strictly related to the growth of the productive *diversification toward related varieties*<sup>17</sup>. A concentration of knowhow and knowledge in a certain product or sector lead to an evolution in the same field, enabling the production of similar and related goods embodied of a new level of *imagination*. In this way, it is possible to find out

<sup>17</sup> C. A. Hidalgo, "Why Information Grows: The Evolution of Order from Atoms to Economies", page 124, Ed. Basic Books, New York (2015)

those *nests* from which a productive ramification and development of the sector took place. The product space concept could be defined as “*a network connecting similar products*”<sup>18</sup>. So, the gradual growth of a country’s industrial sectors is not random but comes from a nest where a certain quantity of knowledge and knowhow is accumulated that it allows the improvements and the creation of new related products. Moreover, there is an important correlation and circular movement between the nest and the accumulation of knowledge and knowhow: the presence of a nest attracts more knowledge and develops knowhow and, at the same time, the accumulation of knowledge and knowhow by a nest allows the latter to grow and to evolve its productive structure. This means that the relatedness of the products does not only depend on technological intensities or on similarities in other broad factors (such as labor, capital and land which are substitutable), but it is more product-specific.

Thus, this model also explains that the human capital has a fundamental importance in the building of the product space of a country, because the human capital is a feature that cannot be substituted (or it can be substituted imperfectly), since it cannot be imported and exported as a normal economic factor. This leads to another relevant point, that is the quality of the links inside a nest: in order to reach a high developed accumulation center, it is important to have high quality networks. A productive nest is not just a nest displayed in a visualizing map or just a developed or under-developed productive structure of a country, but it also corresponds to a specific geographic area of that country, they are clusters. Most of the times, these nests are not spread across the country. They are usually concentrated in certain locations that fosters the links between firms from the same sector and can attract workers specialized in that field. This is the reason of the importance of the quality of the nests and, in other words, of the networks of people and firms which form these accumulation centers, or clusters, of knowledge and knowhow<sup>19</sup>.

We just talked about nests as accumulation centers that create strictly related products embodied of knowledge and knowhow; and as we saw for the ECI, diversification and ubiquity can be used to analyze a product with characteristics of exclusivity and diffusion around the world. The more the nest is developed, the more the products have potentially developed a high diversification and a low ubiquity. That means that more advanced accumulation centers of knowledge and knowhow produce many products with a revealed

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<sup>18</sup> C. A. Hidalgo, “*Why Information Grows: The Evolution of Order from Atoms to Economies*”, page 125, Ed. Basic Books, New York (2015).

<sup>19</sup> Silicon Valley, obviously, is the main example of this kind of case.

comparative advantage. In other words, most of the products they make are then exported worldwide because of their intrinsic features.

In conclusion, thanks to the product space it is possible to design the evolution map of productive structure of countries, showing that these countries moved to products close to those they were already specialized in and then upgraded their exports more quickly.

The strict connection between exports and production of RCA goods denotes the average level of the economic status of a country and, so, its wealth. The following image taken from the paper “*The Product Space Conditions the Development of Nations*”<sup>20</sup> by Hidalgo, Klinger and others (Figure 7) shows the different product spaces in 2006 of some regions of the world, subdivided for their productive structures and their ability to produce objects with a revealed comparative advantage.

Figure 7 is composed by the product spaces of four different regions of the world with different productive structures, giving a good visualization of the connection between products with a revealed comparative advantage, exports and the level of development of the economy. The black squares indicate the products with a relevant RCA which are exported by a region. The difference of number of black squares between developed countries and the rest of the world is very considerable.

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<sup>20</sup> C. A. Hidalgo, B. Klinger, A. L. Barabási, R. Hausmann, “*The Product Space Conditions the Development of Nations*”, Science, 2007.

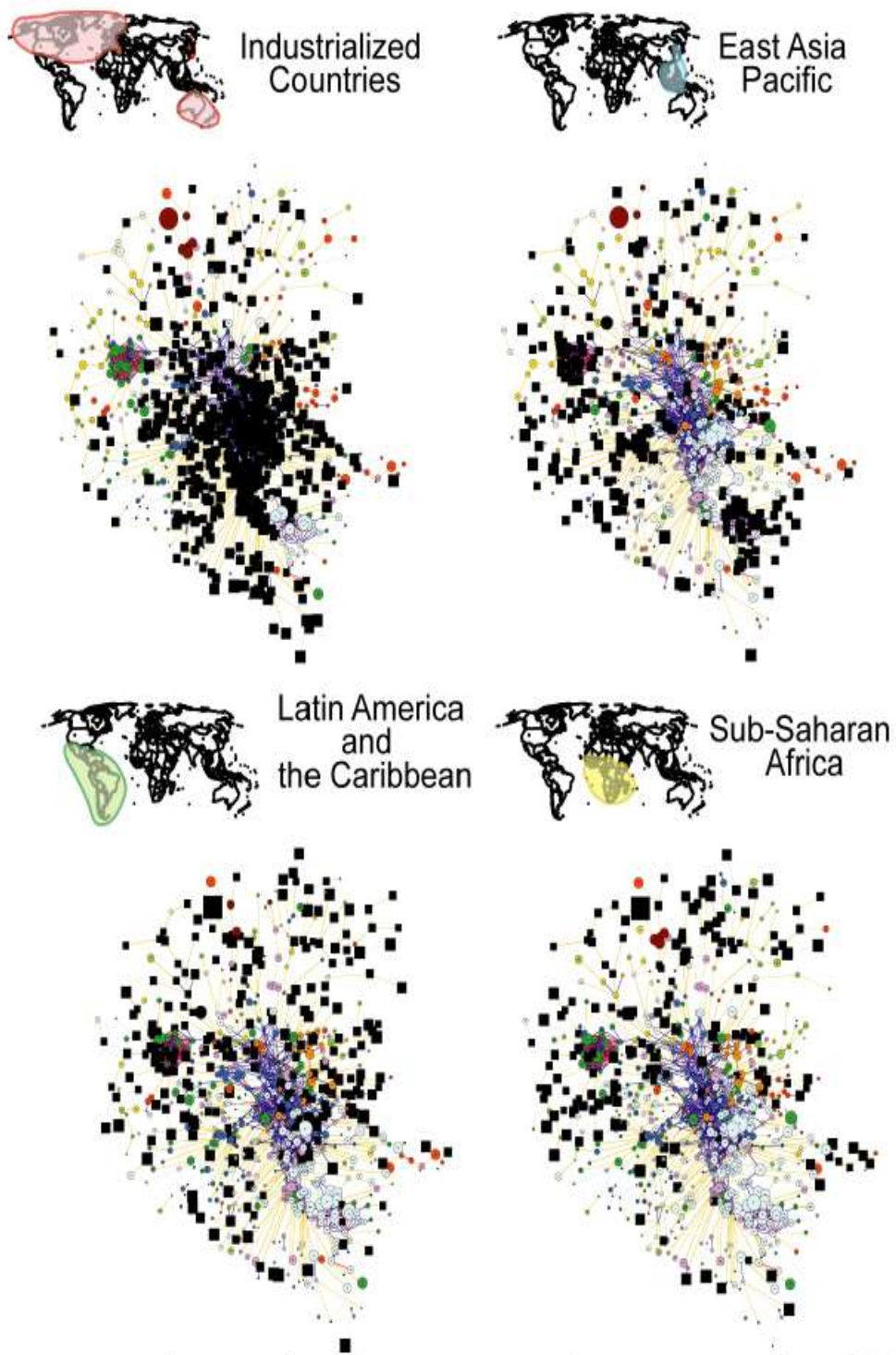


FIGURE 7: LOCALIZATION OF THE PRODUCTIVE STRUCTURE FOR DIFFERENT REGIONS OF THE WORLD. THE BLACK SQUARES DENOTE THE PRODUCTS FOR WHICH THE REGION HAS AN  $RCA > 1$ . SOURCE: C. A. HIDALGO, B. KLINGER, A. L. BARABÁSI, R. HAUSMANN, "THE PRODUCT SPACE CONDITIONS THE DEVELOPMENT OF NATIONS", SCIENCE, 2007.

Another point to take in account, properly highlighted by Figure 7, is the presence of one dense center and one peripheral area distinguished by others smaller centers. The product space has a core-periphery structure. The central area is composed mainly by metal products, chemicals and machinery, whereas the periphery is formed by other product's classes. Industrialized countries develop especially the core, because most of their products with RCA are from central sectors. Other regions have developed distinct clusters in the peripheral area. For example, East-Asian countries export products with an RCA related to sectors as garments, electronics and textile. Latin America and the Caribbean has developed even more peripheral clusters linked to mining activities, agriculture and garments. Finally, sub-Saharan Africa is the less developed region and it exports very few products in the far periphery. External areas indicate also a lack of connections, which explains the difficulties of some countries to create new products with a revealed comparative advantage and to evolve their productive structure.

This shows that each region of the world, and so, more specifically, each country, had a different and distinguishable path of specialization of the product space, i.e. it was the nature of the products created that determined the speed and the pattern of development.

### 1.5. ECI and Product Space as solid predictors of generation and distribution of the GDP of a country

#### *Generation of Gross Domestic Profit*

The ultimate step of the exploration of the economic complexity tools consists in discover what they are used for and how they are useful. As we discussed earlier, both the Economic Complexity Index and the Product Space are very helpful instruments to study how the patterns of a country's productive structure grew and developed in the past. But, focusing now on the future and no more in the past, ECI and Product Space can also be considered as consistent predictors for future economic scenarios of the country. Taking into consideration what we said in the previous paragraphs, we understand that they can be used as connectors between the productive structure of a country and its ability to generate and distribute income across the country itself.

As we said before, being a country with a high ECI means having a productive structure able to produce products with a high Revealed Comparative Advantage (RCA), which are then exported worldwide. Exporting goods with a high value, filled with imagination and so not easily replicable - and then for this reason with a high price value - means that you receive a considerable sum of money for producing it. The more you produce complex goods, the more you export them, the more you enrich your economy: this is the most simple and linear logic to explain that high ECI is strictly related to the growth of GDP. Looking at this economic concept with the perspective of the economics complexity, ECI really affects the generation and the growth of income in a country.

The mathematical proof of the correlation between ECI and the growth of income was demonstrated for the first time by César A. Hidalgo and Ricardo Hausmann in the article “*The building blocks of economic complexity*”<sup>21</sup> (they are in the Appendix). Here we just underline that deviations from the correlation between diversity of a country and income are good predictors of future increase of GDP: that is to say, countries tend to reach the level of income that correspond to their level of complexity measured by ECI.

In the following graphs (Figure 8) we can observe the growth in GDP per capita at *ppp* (purchasing power parity) of countries’ economies between 1985 and 2005 as a function of predicted average growth (1985-2005) measured in 1985 and controlling GDP per capita at *ppp* in 1985.

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<sup>21</sup> César A. Hidalgo and Ricardo Hausmann, “*The building blocks of economic complexity*”, PNAS June 30, 2009.



the sales. So, across those countries with complex productive structures income inequalities have a low ratio calculated by the Gini coefficient. In the other hand, studies have shown that poor economies with inefficient industrial sector are correlated to high income inequalities across the country.

In the article “*Linking Economic Complexity, Institutions and Income Inequality*”<sup>23</sup> written by Dominik Hartmann, Miguel R. Guevara, Cristian Jara-Figueroa, Manuel Aristarán and César A. Hidalgo, are developed the computations to prove the mathematical consistency of the relations between the economic complexity and the income inequality.

They also created the Product Gini Index (PGI) as a product-level estimator of income inequality that is expected from the states that export a given product. PGI is related to other measures regarding the sophistication level of the exports previously created and called PRODY (Hausmann et al., 2006)<sup>24</sup> and PCI (Hidalgo and Hausmann, 2009)<sup>25</sup>, which were used to show that the type of products a country exports determines its level of economic development. Differently, PGI is able to explore the and to define products with different levels of income inequality. So, to decompose income inequality at the product level, PGI is defined as the average level of income inequality of product’s exporters, weighted by the importance of each product in a country’s export basket.

Computations highlight that products with a high level of economic complexity (high value of PCI, Product Complexity Index) tend to have lower PGI measures. This means that sophisticated products tend to be produced in more egalitarian states than simpler or resource-exploiting products.

Another very interesting point to take in consideration consists in the fact that the combination of the PGI and the Product Space highlights that changes in a country’s productive structure are related to changes in a country’s level of income inequality. Indeed, low-PGI products (that means with a low level of inequality) are more likely located in the central and more dense area of the product space: this is the part of the product space where are located the more sophisticated and valuable goods. Otherwise, products with high levels of inequality tend to be located in the peripheral area of the product space, so in the area where there are less sophisticated goods. (Figure 9)

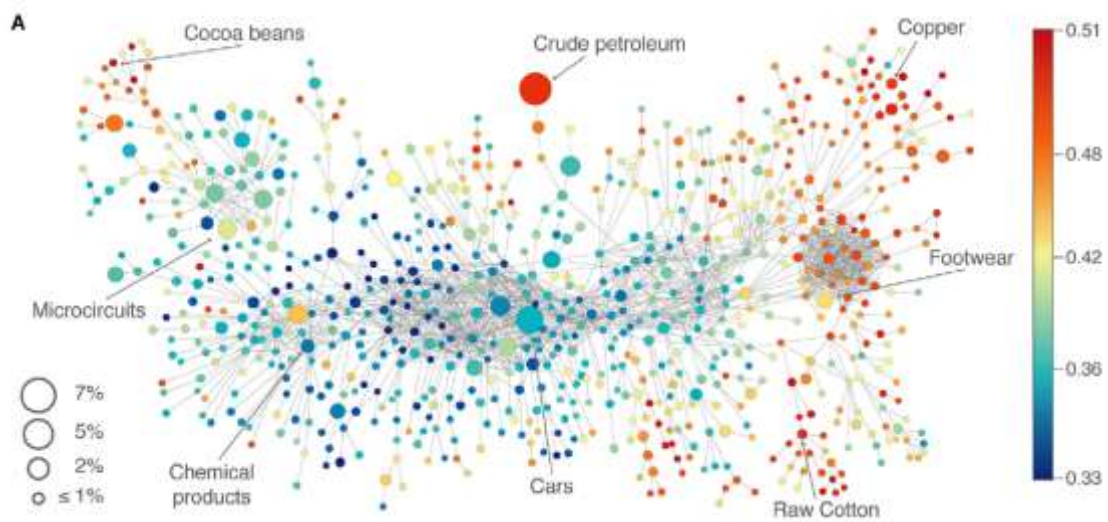
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<sup>23</sup> D. Hartmann, M. R. Guevara, C. Jara-Figueroa, M. Aristarán and C. A. Hidalgo, “*Linking Economic Complexity, Institutions and Income Inequality*”, Elsevier (2017).

<sup>24</sup> PRODY is an indicator used to measure product sophistication and the technology intensity used. It was introduced by R. Hausmann, J. Hwang and D. Rodrik in the article “*What your export matters*”, Journal of Economic Growth (2006).

<sup>25</sup> PCI was introduced by C. A. Hidalgo and R. Hausmann in the article “*The building blocks of economic complexity*”, PNAS (2009).





**FIGURE 9: THE PRODUCT SPACE AND INCOME INEQUALITY.**  
**SOURCE: D. HARTMANN, M. R. GUEVARA, C. JARA-FIGUEROA, M. ARISTARÁN AND C. A. HIDALGO,**  
**“LINKING ECONOMIC COMPLEXITY, INSTITUTIONS AND INCOME INEQUALITY”, ELSEVIER (2017).**

The Figure 9, taken from the paper “*Linking Economic Complexity, Institutions and Income Inequality*” written by D. Hartmann et al, Elsevier (2017), shows nodes of a product measured between 1995 and 2008 according to PGI. In this image it is possible to see that less complex products (low PGI) are situated in the periphery of the product space, whereas more sophisticated goods are in the core.

Moreover, this research that combined economic complexity with the capability of a country to generate and distribute income, has shown a strong correlation between the growth of GDP and the decrease of inequality in relation to the product mix that this country is able to make and then to export. In other simpler words, the research shows that the development of economic complexity of a country leads to an increase of income per capita and a decrease of income inequality in the country. So, those countries which produces more sophisticated products tend to be richer and more egalitarian, whereas those countries with a low ECI levels tend to be poorer and with high income inequalities throughout their population.

In conclusion, the strict relation in the past between ECI and product space with GDP and Gini coefficient indicates that these two tools are consistent and solid predictors for one country’s future economic growth and generation of inequality in the mid-range. So, they

can be used by institutions and policy makers as useful instruments to design and create projects and laws of economic development.

## 1.6. The central role of Human capital, social capital and ICT's for the economic development of a country

In the previous paragraphs of this first chapter we analyzed tools such as the Economic Complexity Index, the Product Space, the Product Complexity Index and the Product Gini Index, which are strongly correlated between them. We found out that at the base of their correlation there is the concept that exporting sophisticated products makes a country richer and more egalitarian. Hence, there are many features that characterize economies but, from the studies of these instruments, it is easy to understand how much is fundamental the level of human capital of a country.

The concept of *human capital* includes not only investments in education, from first school to university, but it consists also in all those investments of R&D directed to the developing of new products, with the aim to improve the productive structure of a country.

In fact, it is possible to add to the equation “high complexity of the economy = high level of GDP” the new term of Human Capital. So, we can tell that a high human capital level in one country means high complexity of its economy, that, in turn, means a high level of income for that country.

Starting from the Economic Complexity Index analysis, it is possible to find out the ability of a country to produce high complex products, which are not easy to create in many other parts of the world and it depends on the quality and the skills of that country's work force. The higher is the level of knowledge and knowhow of the people of a nation, the higher are the capabilities to produce goods embodied of imagination and creativity, which are called, according to Hidalgo, *Crystals of Imagination*. However, the accumulation of knowledge and knowhow at the population level is a long and not simple process which depends on multi and variable factors but, as we proved earlier, it is a guideline to lead the country to a solid productive structure. A country that invests in human capital prepares its workers to create sophisticated and diversified products, with a low ubiquity and, hence, to lay the foundations for a complex economic structure of the country. It is now clear the connection

between the improvements and investments at the human capital level with a future increase of the income per capita and a decrease of the income inequality.

For what concerns the Product Space, we already discussed that the creation of new sophisticated products is related to the concept of “*diversification toward related varieties*”. The ability to produce complex goods depends on, especially, the already present skill to create similar products, through a connection of products. This means that from one complex good or sector it is easier to create another complex product. This is possible thanks to the high level of knowledge and knowhow put in the product, but especially in the high level of knowledge and knowhow owned by the skilled workers.

High skilled labor is a fundamental component of economics, not only because high skilled workers are more capable to deal and work with complex goods or because it is a hard and long process to developed and put human capital in a generation, but also because it is a factor that cannot be substituted with unskilled labor, land, raw materials and capital.

If related to the product space, it makes clear the importance of the network and the links between products. They are favored by the quality of the level of human capital and they are possible thanks to the high standards of institutions and social networks relations. A high level of human capital leads to a lot of externalities, which can improve the society, its quality standards of living, the income per capita of the country and the income equality across it.

The high level of human capital does not only provide high educated workers, but also other externalities such as the increase of the social capital. A more egalitarian society enables better quality standards of living of the community such as better links and institutions. Human and social capital are, hence, strictly correlated and each one helps the development of the other and vice versa.

Last but not least, recent studies have demonstrated how in the last decades efficient ICT systems are strongly related in the creation of solid productive and social networks, thanks to the intensified and improved communications for firms and people. In this structure, thereby, the ICT development as well can be seen as another factor in the creations of high level of human and social capital. It could be considered as a catalyst which is able to give more speed at the development of an already fertile and prepared structure. Finally, ICTs too can be inserted among the factors and links that enhance the productive structure of a country.

To conclude, we can define human and social capital as a vortex accelerated by information and communication technologies. This leads to remark that good investments in the

development of human capital, social capital and ICTs are essentials for the development of the economy and productive structure of a country, and therefore, for the growth of GDP and the decrease of income inequality in a state.

## 2. South Korea: a remarkable case of rapid economic and human growth

In chapter 2 we are going to discover and analyze South Korea and all the economic, social and human changes that happened in this country. From a condition of extremely poverty in just 60 years, the Republic of Korea reached the wealth of developed countries and it doesn't seem to stop its growth.

### 2.1. Republic of Korea: an introductory overview of the country and its society

The Republic of Korea (ROK), the official name of South Korea, is located in the southern part of the Korean peninsula, a small part of land in the north east part of Asia between the Yellow Sea and the Sea of Japan, and upon East China Sea: a strategic natural place between China and Japan. The unique political border is the one that divides South Korea from North Korea at the level of the 38<sup>th</sup> parallel.

This portion of land, whose extension is 100,364 km<sup>2</sup>, is almost completely covered by hills and low mountains and the underground doesn't provide any specific or important natural resource. Its population in 2018 amounts to 51.6 million people<sup>26</sup>, with a high-density level of 530 people per sq. km of land area<sup>27</sup>. Almost half of the population lives in the Seoul Capital Area, indeed, ROK's capital city and surroundings form the second largest metropolitan area in the world where more than 25.6 million people<sup>28</sup> live. Nowadays, the life expectancy at birth is more than 82 years<sup>29</sup> and gradually the population is getting older like in the post-industrialized western societies.

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<sup>26</sup>[http://kosis.kr/eng/statisticsList/statisticsListIndex.do?menuId=M\\_01\\_01&vwcd=MT\\_ETITLE&parmTabId=M\\_01\\_01&statId=1962001&themaId=#SelectStatsBoxDiv](http://kosis.kr/eng/statisticsList/statisticsListIndex.do?menuId=M_01_01&vwcd=MT_ETITLE&parmTabId=M_01_01&statId=1962001&themaId=#SelectStatsBoxDiv)

<sup>27</sup><https://data.worldbank.org/indicator/EN.POP.DNST?locations=KR>

<sup>28</sup><http://worldpopulationreview.com/world-cities/seoul-population/>

<sup>29</sup>[http://kosis.kr/statHtml/statHtml.do?orgId=101&tblId=DT\\_1B41&vw\\_cd=MT\\_ETITLE&list\\_id=&scrId=&seqNo=&language=en&obj\\_var\\_id=&itm\\_id=&conn\\_path=A6&path=%252Feng%252F](http://kosis.kr/statHtml/statHtml.do?orgId=101&tblId=DT_1B41&vw_cd=MT_ETITLE&list_id=&scrId=&seqNo=&language=en&obj_var_id=&itm_id=&conn_path=A6&path=%252Feng%252F)

South Korea is a member of OECD<sup>30</sup> organization as one of the most developed economy in the world and, in fact, Korean GDP per capita (PPP based)<sup>31</sup> in current international \$ is 40,112 \$<sup>32</sup> (2018). As we will discuss later, Republic of Korea is the only country which has received OECD's financial aids first and then, in less than 50 years, it has joined the organization itself. For the moment, Korean economy is the 14<sup>th</sup> largest economy in the world: in 2018 Korean GDP amounted to 2.071.182 million dollars. The currency is the South Korean Won (KRW), whose change is set at 1,174 ₩ for 1 American Dollar.

Ethnically talking, this country is one of the most homogeneous countries in the world: 96% of the population is composed by Koreans. The remaining part is composed by immigrants, coming mainly from China (50%); moreover, there is a relevant number of Americans that came to work in Korea mostly as English teachers<sup>33</sup>. "*Hangul*" is the official language that, although it contains many Chinese words, is classified as an isolate language, even though it could be related also to the Altaic group and to Japanese. The 56% of Korean population has no religion, while the remaining part consists of Protestants (45%), Buddhists (35%) and Catholics (18%)<sup>34</sup>. Even if it is not a proper religion but a set of moral rules, Confucianism has still a great impact in the Korean society. Confucius' teachings code is based on three big central values: integrity, respect for mutual obligations and honesty in interacting with others. All these aspects are still intrinsic in the mentality of the people from the Republic of Korea.

## 2.2. Brief history of Korea

In order to understand Republic of Korea's amazing economic rise it is important to know its history, especially in the last decades. The Japanese domination and the dictatorships are strongly linked with the economic, cultural and social growth of the country. A brief

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<sup>30</sup> The Organization for Economic Cooperation and Development (OECD) is an international organization with the aim to promote economic development and international trade. It is composed by 36 countries members that are most of all developed countries with a high-income and very high Human Development Index (HDI).

<sup>31</sup> PPP stays for Purchasing Power Parity which means Gross Domestic product is converted to international dollars using purchasing power parity rates.

<sup>32</sup> <https://data.worldbank.org/indicator/NY.GDP.PCAP.PP.CD?locations=KR>

<sup>33</sup> <https://www.worldatlas.com/articles/ethnic-minorities-and-immigrants-in-south-korea.html>

<sup>34</sup> <http://www.korea.net/AboutKorea/Korean-Life/Religion>

overview of historical and political events which have influenced and created the roots of today's South Korea is summarized below.

### 2.2.1. From ancient period to 1960: from a united Korea to an independent South Korea

The Korean peninsula has a millennial history. Since Before Christ, there are proof of the *Gojoseon* kingdom, which broke apart in many small kingdoms. The most important where *Goguryeo*, *Silla* and *Baekje*. In the VII century, Silla unified Korea, Buddhism became the religion of the state and the first Confucian school was open. These spiritual and ethic ways of thinking and behavior started to merge, influence and inspire the Korean culture and people's mindset and are still part of the Korean background in today's Korean society. Until XX century, periods of independence in the Korean Peninsula were always interrupted by invasions, influences or monetary submissions by the Mongolian Empire before, Japan and China later. From this period, it is worth mentioning the King *Sejong The Great* (1418-1450), who promulgated Hangul, the Korean Alphabet still used to this day. It was only in the period between 1910-1945 that Korea fell under the direct control of a foreign country: the Empire of Japan. *Joseon* dynasty officially collapsed in 1910 and South Korea became a Japanese colony. This domination was very cruel and often imposed through violent repressions by the military forces and police. Men were used as forced workers for Japanese industries in Korea and more than 200,000 women were made sex slaves. Moreover, everyone had to take a Japanese name, to speak Japanese and to start praying Japanese divinities. Even though Japan started a sort of industrialization of the peninsula, built new infrastructures and improved agricultures techniques, only Japanese people or their Korean collaborators benefited from this first phase of economic growth. When the Japanese Empire was defeated in the WWII in 1945, Korea was finally liberated,

but these 35 years of domination left a long-lasting mark in the Korean society, affecting diplomatic and economic relations between the two countries in the following decades.

In 1945, Korea experienced a small period of freedom. In fact, United States and Soviet Union, the Allied victors, decided then to occupy and divide the peninsula in the vicinity of the 38th parallel without any consultation with Koreans people. The northern part was taken under control from the Soviet Union, whereas the Southern part was occupied by the United States. It should have been a temporary domination, with the aim to create a unit, independent and free Korea, but this never happened and the first foundations for the successive Cold War were laid: the two allied victors became instead enemies and each one put a different government in its part. In the South, the Americans backed Syngman Rhee<sup>35</sup>, whereas in the North Stalin helped the formation of a new regime led by Kim Il-sung<sup>36</sup>. In 1948 the Republic of Korea (ROK) was established in the southern part with President Rhee; in the North, the Democratic People's Republic of Korea (DPRK) was instituted, with Kim Il-sung as a prime minister. With the proclamation of these two independent states, Korea was officially divided in two completely different nations for the first time of its history.

This circumstance changed the geopolitical equilibrium of the last 70 years of that portion of the world, affecting the surrounding areas and the all world, too.

In fact, the 25<sup>th</sup> June 1950 North Korea invaded Republic of Korea, marking the beginning of Korean War which lasted until 1953 when, on July 27<sup>th</sup>, the armistice agreement between the two countries was signed, creating the famous DMZ (Demilitarized Zone) border to divide them at the level of the 38<sup>th</sup> parallel.

During the Korean War, a proper and cruel civil war, more than 3 million people died (2.5 million were Korean civilians), approximately 10% of all Koreans living in the peninsula (30 million at that moment). Moreover, this war had almost completely destroyed the

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<sup>35</sup> Syngman Rhee (1875 – 1965) was an American-educated and anti-Communist Korean who took part at the Provisional Government of the Republic of Korea in Shanghai. In 1948 he became the first president of south Korea before to start a dictatorship regime until 1960.

<sup>36</sup> Kim Il-sung (1912 – 1994) was a former communist independence fighter close to Soviet Union and China during the anti-Japanese guerrilla who was backed by Stalin in the formation of DPRK establishing a cruel dictatorship until his death.



infrastructures and around half of all houses. Therefore, South Korea started its history as a new and independent state in extreme poverty conditions and, during Rhee's corrupted government which began as a democratic state but quickly became a violent anti-communist regime, the economic growth was very slow. For the entire period that President Rhee maintained the power, South Korea was largely dependent on American economic aids, but Americans failed to create an industrial base in Korea because of the widespread corruption that enriched a small class of Koreans. Indeed, at the end of 1960, the annual GDP per capita was 158 dollars in current US\$<sup>37</sup> and life expectancy at birth was around 53 years<sup>38</sup>.

### 2.2.2. 1961 – 1988: From dictatorship to free democratic elections: Park's regime and the start of a slow democratization

In April 1960, in the aftermath of the April Revolution, Syngman Rhee was forced to abandon South Korea and to spend the rest of his life in exile in Hawaii, United States. After a one-year period of democracy, General Park Chung Hee took power with a coup in May 1961 and his govern lasted until 1979. He was obliged by the American administration to renounce to his military role and to participate at the presidential elections as a civilian leader. He won both in 1963 and in 1967, thanks also to his successful economic policies. When he tried to force the Constitution in order to govern for a consecutive third term - while constantly loosing popularity - in October 1972 he suspended the democratic constitution and parliament and took full powers, starting a proper dictatorship. Park Chung Hee's authoritarian regime ended with the kill of the dictator on the 26<sup>th</sup> October 1979. Despite the total lack of democracy and the diffused corruption in the public structures

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<sup>37</sup> World Bank national accounts data and OECD national account data files (<https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?end=2018&locations=KR&start=1960&view=chart>)

<sup>38</sup> "World Population Prospects: The 2019 Revision", United Nations Population Division. Life expectancy at birth for both sexes combined (years) (<http://data.un.org/Data.aspx?q=life+expectancy&d=PopDiv&f=variableID%3a68>)

during his dictatorship, his management allowed undoubtedly to lay the foundations to South Korean exceptional economic, social and cultural rise of the last sixty years.

In the following years, politically talking, the process of total democratization was very slow: in fact, South Korea had to wait until 1988 to have totally free and democratic elections, which were won by Roh Tae Won. Protests continued and the president liberalized the political system, adopted a series of measures to mitigate the authoritarian nature of the government, and started, for the first time in Korea's history, diplomatic relations with China and URSS after WWII. In this period and context, South Korea hosted the XXIV Olympics games in Seoul in 1988. The success of the organization of this event ratified the rise of Republic of Korea in the international panorama.

### 2.2.3. From 1990s to nowadays: the rise of South Korea in the international panorama

In 1991 South Korea became part of UN and in 1993 a civil president without any previous military role was elected for the first time: he was Kim Young Sam. In 1996 South Korea became part of OECD, the organization who gathers all the wealthiest and developed countries in the world. Unfortunately, these factors which helped the quick growth of South Korea became weak points (trade-dependent economy), when the following year a severe economic and financial crisis hit East Asia. In 1997, Kim Dae Jung was elected and he had to deal with crisis consequences that were very tough. He had to ask for help to IMF<sup>39</sup> and ROK obtained the biggest loan ever granted for a single country: 58.35 billion dollars. President Kim Dae Jung is also famous for having organized the first meeting with Kim Jong II, the north Korean leader and for this reason he received the Nobel Peace Prize. From 2003 to 2008, there was Roh Moo Hyun Government. Differently from the previous

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<sup>39</sup> International Monetary Fund (IMF) is the most important international organization with the aim to promote international economic cooperation, global trade and financial stability.

governments, he took long term view policies, which weren't appreciated by public opinion. In 2004, the national assembly voted the impeachment for corruption, but Roh was acquitted by the Constitutional Court. In 2009, he was charged again for corruption and bribery and, despite he declared himself innocent, he committed suicide after one month. The following elected president was Lee Myung Bak (2008-2013), who had to deal with massive protests and demonstrations by Korean people after he lift the ban on US Beef imports, which was declared for the mad cow disease. Lee's government made successfully regulatory and economic reforms in order to recover from the global recession and South Korea's economy started to grow again. His successor was Park Guen Hye: she was the first woman to be elected as President in Northeast Asia. Her government (2013-2017) was affected by a lot of corruption scandals and nationwide protests and, hence, the Constitutional Court confirmed her impeach forcing her to leave the presidency in 2017. That year the current President was elected, Mr. Moon Jae In, who met Kim Jong Un for three times at the inter-Korean summits held in 2018.

### 2.3. The Korean Miracle: the economic transformation of the country in the last sixty years

In this paragraph we are going to analyze those policies and strategies which helped South Korea to reach today's wealth and industrial power. We will divide Korean economic development in two parts: the first one refers to Park Chung Hee era, while the second one is about the period that followed when South Korea became, not without any difficulties, a democratic country developing exponentially its economic potentialities. The first part constitutes the fertile background on which the country rose later. Without that controlled and protected initial growth, despite high political, social and economic costs, we wouldn't have had the opportunity to study the Republic of Korea as a unique and exceptional case study in world's economic history.

As we discuss earlier, due to a widespread bribery, Rhee's government wasn't able to use US aids to build the basis for a strong industrial system as happened, for example, for many countries in Europe; but, at least, in that decade the national transportation infrastructure developed (that were completely destroyed after Korean War) and the education system was improved. Unfortunately, those provisions weren't enough to increase per capita wealth and the real economic growth started only after general Park Chung Hee obtained the leadership with a military coup. The dictator inaugurated a series of economic measures on a medium term, the so-called *Five-Year Plans*. Moreover, he created deep connections between his government and the rising big companies, called *chaebol*. A chaebol is a characteristic company's structure from South Korea that consists in an extremely large horizontal conglomerate, which is controlled and managed by a single owner or a single family. Later, we will reserve a paragraph to analyze this particular Korean industrial structure.

In the meantime, in the following paragraph the focus will move to those strategies that allowed South Korea to grow on the basis prepared in the previous period. In spite of continuous political scandals and changings, and despite the two financial crises (in 1998 and in 2008), South Korea's governments have always found original and winning plans to recover and to permit the economy to rise, especially in the last decade.

### 2.3.1. The Park Chung Hee era: the shift from an agricultural economy to an export-oriented industrial economy

The period that started with a coup in May 1961 is probably the one that changed South Korea the most in all its aspects. Although the massive costs for Korean society, politics and economy, Park's government transformed ROK from one of the poorest agricultural countries in the world into an industrial powerhouse in just one generation. The figure of Park Chung Hee is still nowadays very controversial for the Korean public opinion, for politicians and professors: after more than half century, the results of his policies are clear but it still has to be defined how high and heavy the social tradeoff to achieve those economic goals was and how much the dictator was personally responsible for that improvement.

## *Background*

In 1961, General Park and his govern began a whole set of measures to develop Korean economy. They gathered and organized those policies in midterm steps: the five-years plans. Thanks to this 5-years long orientation, South Korea was able to shift from an economy based on the first sector to an industrial economy.

Before the detailed analysis of the policies which characterized those 18-years long Park's dictatorship, it is important to understand the special context and background of South Korea. Indeed, there are some factors that distinguish this country, making it very particular in the global panorama.

The first condition consists in a deep-rooted Confucian moral and Chinese tradition in the Korean society. This explains the great importance that this country gives to teaching and learning, and why the population has very high skills and educational levels.

Related, again, to the Chinese tradition, the second factor distinguishing South Korea, is Koreans' incredible work ethic: the willingness and the ability to work hard was fundamental for the great economic success of the country. The long working week of that period could be taken as an example of their work ethic, but it must not be forgotten that the union power was very low or almost nonexistent. For this reason, it is difficult to demonstrate if all the time spent at work was due to ambition and willing to work or if it depended more to the weak powers of labor unions.

The third condition which contributed to the success of the country is represented by those traditional labor relations borrowed from the Chinese way of working. This is characterized by a greater employment stability and a greater flexibility is compared to U.S. and Europe. Furthermore, the close and permanent relations between the employer and his workers, the governmental and moral pressures of the employer to take care of his employees no matter who the state of the business is and the bonuses policies are all strictly linked to this background aspect.

It is interesting that all those factors above mentioned are manifested still nowadays, showing how they are really intrinsic in the cultural and social codes of South Korea and, also, in other east Asian countries like Japan, Taiwan and China, for example.

Another background aspect to take in account is the very low Gini coefficient<sup>40</sup> before the start of Park's regime. Data show that Gini's value in 1961 was 0.32<sup>41</sup>. This is an absolute demonstration of economic equality and egalitarian society, which is very different from the common situation that usually happens in other poor countries of the third world. There are some reasons at the base of this data. One is the land reform which took place after the Japanese domination. The Japanese introduced, in fact, new techniques and improved the food production and farm productivity in Korea. Then, after WWII, their properties were confiscated and redistributed with all the agricultural improvements. Moreover, also indigenous landlords were forced to sell many hectares at prices below market values.<sup>42</sup> Another reason is represented by the fact that Japanese domination and Korean war (1950-1953) had levelled almost all social and economic inequalities. In addition, another cause is the relevant amount of money received by U.S. They helped to rebuild the infrastructures destroyed by the war. Thanks to all those equalizing factors and influences, inequality of wealth was reduced before 1960 and South Korea had not an unequal distribution of income. So, for to all those factors, the Korean society became more egalitarian like in the more advanced industrial countries like France, Italy or United Kingdom.

### *The Chaebols under the Park Chung Hee era*

In Park's plans of industrialization of the economy of South Korea, the so-called *chaebols* represented the main characters. During Park's dictatorship, in fact, they had a crucial role in the Korean economic development and still nowadays they maintain their importance. As we mentioned above, *chaebol* is defined as a large family-controlled horizontal conglomerate of industries. It is usually composed by a family holding on top which controls many different branches of the company in many and diversified industrial and financial sectors. The term finds its origins from the Japanese concept of *zaibatsu*, vertical monopolies managed by a family which controlled the Japanese economy from the last decades of XIX century until the end of WWII. The term *chaebol*, instead, derives from the Korean word *jaebol* that literally means "wealth, property of a clan".

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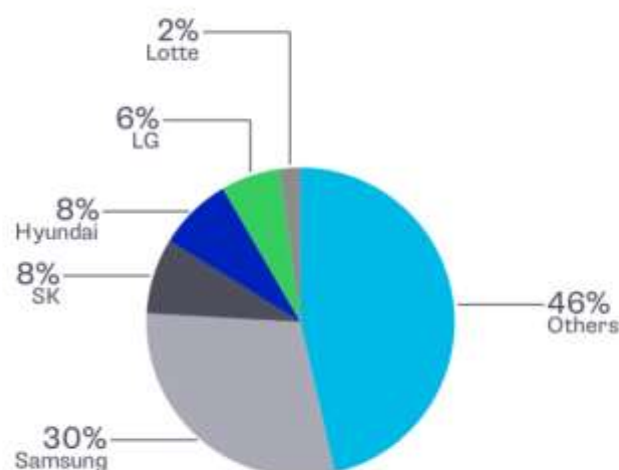
<sup>40</sup> Gini coefficient is a statistical measure of dispersion which the aim to represent the wealth or income distribution among a single country. It is usually used, therefore, to represent the economic inequality of a nation.

<sup>41</sup> [http://stats.areppim.com/listes/list\\_gini\\_1960x2012.htm](http://stats.areppim.com/listes/list_gini_1960x2012.htm)

<sup>42</sup> The land reform and its measures were taken under directives of US and under the strong influence of Wolf Ladejinsky, an American agricultural economist.

Most of them were founded in the 1940s and 1950s but only when Park took the power over the country they grew exponentially. Indeed, with the aim of making South Korea an industrial powerhouse, Park promoted a close relationship between the state and the *chaebols*. The dictator had personal and close connections with the families that owned those companies and he often suggested risky and strategic projects in which they had to invest and develop, in exchange of loans and political protection from the threat of business failures. Park's objective was to develop those risky industrial sectors which could have favored the growth of Korean economy. Park created an oligopolistic competition in the strategic industries, giving chances of development also to smaller *chaebols*, which could challenge with the front-tier and by doing so he was trying to stimulate positive effects and spillovers. Moreover, Park backed his allied *chaebols* with great financial and resource helps, but he was also prepared to let failing those that didn't have any chances to be rescued. This was a very costly but effective policy: it focused and kept the relation between the state and the *chaebols* towards the economic hypergrowth and avoided moral hazards by the companies.

They maintained their power in the economic panorama of South Korea also in the following decades after Park's regime. They are still nowadays the main actors of the Korean economy and the biggest five companies such as globally famous enterprises like Samsung, Hyundai, LG and less known chaebols as Lotte, SK, currently represent more than half of the Korean Stock Index. (Figure 10)



**FIGURE 10: THE WEIGHT OF CHAEBOLS IN KOREAN ECONOMY.**  
SOURCE: BLOOMBERG.COM

*Policies under Park Chung Hee: export-oriented policies for the “growth-first” strategy*

As we told before, South Korea had some social and cultural backgrounds tradition which were the fundamental basis for the economic development of the country in the last 70 years. We can quickly resume them in three points. The first one is constituted by Chinese traditions and Confucian philosophy, which give great importance to the learning, which reflected in the will to learn and the high both educational and skills level of Korean population. Second, coming from the Chinese tradition as well, is the ability and willingness to work hard, similar to the Protestant or Jewish work ethics. Indeed, in 1982 Korea had the world’s longest working week (ILO<sup>43</sup>,1983) and the length of the working week increase over the time. Finally, and again developed under Chinese influences, the labor relations between employers and bosses or firms: this is revealed by the high work and wage flexibility and by the great employment stability. These factors must be read as fundamental features of Korean culture.

After the coup, the regime started a long-term economic change. It all started with the shift from an agricultural economy to an industrial power. Until then, the poor economy of ROK was based on the first sector despite only 22% of the Korean land are arable and often it is not possible to double crop, due the unfavorable climate conditions. The industrialization that followed was accompanied by a great migration from rural to urban areas of unskilled workers.

Hence, during general Park dictatorship, South Korea pursued very forceful and aggressive economic policies and his government had great influence over economic strategies. As we already said, *chaebols* constituted the main productive structure of Korea and often they received indications by Korean authorities over the business and strategies to follow as private business and this was possible, as we told, thanks to frequent and personal contacts between firms (*chaebols*) and government officials. So, during Park’s regime, *chaebols* grew a lot thanks to these personal relations with institutes, in exchange of economic favors as credits and tax incentives.

The main strategy pursued by south Korea in the ’60 was the so-called “*export-led growth*”, when many export-promotion policies were introduced. In fact, in the immediate postwar during Syngman Rhee control, the policy of import substitution was adopted, which consisted in protecting the internal market with import restrictions and tax concessions, in

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<sup>43</sup> International Labor Organization.



order to encourage the domestic manufacture productive structure of goods previously imported. The aim of this kind of protectionism was to increase the self-sufficiency of the country and to decrease the dependence from the world trade. However, in general this policy is very expensive and hard to achieve especially because the products that a country imports are almost always those products for which that country has a comparative disadvantage.

For this reason, Park's regime chose to pursue the strategy to produce those goods in which Korean manufacture had an advantage for then exporting them. They consisted mainly in light industries like textiles, clothing and food processing that were very successful in expanding the export in the 60s and occupied unskilled employment. The first measure consisted on the cancellation of import duties and in starting a production finalized to the export. Moreover, indirect taxes on input of exports and on the exports themselves were remitted, and exemption from export earnings or corporate income tax for whose firms that were focused on export were established. In addition, Korean firms that were exporters had big fiscal benefits and advantages, such as tax concessions, export insurance, credits at special low rates or a favored terms and discount on electricity costs or on railways costs. Over the period 1965-1981, South Korea's exports rose at an average annual rate of 35%, valued in U.S. dollars (Tibor Scitovsky<sup>44</sup>, 1985). By the growth of more imports and exports, enormous trading companies grew drastically, the *chaebols*, with businesses spread in very disparate fields but always heavily involved in the manufacturing processes. So far, the export promotion and export expansion had a successful outcome: the value of gross exports had risen to a third of South Korea's Gross National Product. Subtracting the imported inputs from the gross exports, the value of net exports was approximately 20% of GNP.

The increase of GDP led to the increase of the production, due both to the growth of the labor force and to the growth of the productivity of labor. Employment grew with an annual rate of 3.4%, whereas labor productivity grew at average annual rate of 5.1% each year in the period from 1961 to 1980 (Tibor Scitovsky, 1985). Exports contributed to the economy and productivity grow, because the gain from trade allowed the country to obtain better imports with the labor used for producing exports. Hence, the increasing of exports stimulated the growth of labor productivity. First of all, because exports required great

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<sup>44</sup> Tibor Scitovsky (1910-2002) was a Hungarian economist naturalized American. He served as professor for prestigious American universities as Stanford, Berkeley, Yale and Harvard and for the London School of Economics (LSE). He worked for OECD from 1966 to 1968.

investments, they created economies of scale from which not only exports benefited, but also domestic consumers, increasing the domestic demand, too. Second, the new techniques and approaches developed by the export industries were transferred to other Korean industries. The high labor intensity used for exports implicated a very low rate of unemployment (around 3%-4%) during Park's regime.

The increase of domestic demand involved new investments for additional productivity capacities and employment, and they also led to new opportunities for the innovation and modernization and to the growth of labor productivity as well.

During the period that we are analyzing, Korea suffered from a chronic hyperinflation, more than any other industrial country. In fact, the average annual price inflation rate was 15% (T. Scitovsky, 1985).

Inflation, in cases like the Korean one, gave a positive contribution to the growth because it forced the public to reduce its real purchase and to release resources that could be used for the investments. The forced reduction of people's real purchase avoided also the so-called "forced savings". On the other hand, high inflation rates had bad effects too: primarily, the social injustice of inflationary financing reducing the real value of the debt for both creditor and debtor (it could be seen as an injustice with some advantages from the creditor's point of view). Another negative effect was that with high levels of inflation, the real rate of interest on savings deposits is very low, often negative. So, this reduced bank deposit's attractiveness for depositors and this is probably one of the reasons why Koreans do not have great saving habits still nowadays.

Outward-oriented economic strategy led to great and quick results in the economic growth, despite the great instability especially correlated to external issues from other countries which imported products. This happened with the oil crisis of the 1970's - the first one was in 1974 and the second one in 1979. In these two cases prices and inflation grew both almost of the 40%.

Due also to this international economic crisis, South Korea decided to shift its manufacturing productive structure from light industries (textile, clothing, food processing, plywood) to heavy industries. In fact, real wages were increasing and light industrial products became less competitive, starting to be less attractive than light product produced in those undeveloped countries in which unskilled labor was still cheaper. In addition, at the same time, more developed countries became more protectionists, erecting import barriers especially for textiles, shoes and clothing goods.

As always according to government decisions and strategies, South Korea's shifted its productive structure towards heavy and chemicals industries. In order to stimulate investments in those fields, firms benefited of incentives, credits and rates of taxes. At the end of the decade, the gradual change of the destination of investments towards more capital-intensive and more skill-intensive industries and products started. The main examples are chemicals, electronics, steel, construction, shipbuilding, footwear industries, and a shift within the textile sector to sports clothing and more high-quality goods. One of the reasons of this change of strategic investments, was to exploit South Korea's comparative advantage in skilled labor, in order to diversify exports with more value-added products by taking advantage of the decreasing of competitiveness left by Japan in certain sectors.

The new investment policies were successful: in the initial period between 1965 – 1971, the average annual growth of real GNP was very fast (10.2 percent) and in the second phase, from 1971 to 1977, the growth continued at the level of 10.1%. The exports that in 1965 counted for 53% of imports, in 1971 were the 63% and in 1977 they reach the same level. These results are very impressive considering that in those year there was a great increase and fluctuation of the price of oil which Korea had always to import due to the lack of first resources in the country. The high investment policies are confirmed by the rose of the share of investments in GNP from 29.4% to 36.9% in the years between 1975 and 1979 and, in the same period, the share in total investments of aggregate combined of chemicals, electronics, metals, machinery, intermediate products and transport equipment grew from 48.2% to 79%.

Obviously, as we mentioned before, the pressures and indications by Park's regime were enormous in order to shift the manufacturing productive structure of the country from light goods to heavy ones, chemicals and technological products, because any other firm could be pursued by a similar strategy. The pressures were followed by high incentives, favorable loans from national bank and state credit funds to the firms, especially chaebols, despite this kind of investment programs often led to troubles and problematic economic situations. But for Korea this didn't happen, and the increase of investments implicated to the rise both of wages and costs. This led to new highly competitive industries, thanks to the modern technologies combined with the relative low labor cost.

In conclusion, the Park Chung Hee era was the first fundamental step that allowed South Korea to start its economic development. In the next paragraph we will discuss the 5-year policies he initiated in order to bring South Korea from a situation of extreme poverty to

an economic power, with the aim of improving the economic and social conditions of Koreans. To resume, we can find 5 main economic points that characterized the period of the dictatorship which lasted from 1961 to 1979 and that were well expressed by Paul W. Kuznets<sup>45</sup>:

- High investments ratio;
- Small public sector;
- Competitive labor markets;
- Strong export expansion;
- Government intervention in the economy.

### 2.3.2. 5-years plans: an effective instrument for the export-led growth

When general Park took the power, he started to reform Korean industrial sectors in order to improve the Korean economy and the standards of living of Koreans. His government took the decision to take a long-term project of construction and renovation of the Korean productive structure, made by forced steps that brought a shift from an agricultural economy to an industrial one. These steps, called “five-years plans”, were medium-term plans with strategies and objectives to be reached in a period of five years each one, with the aim to grow and develop the Korean economy. These policies started in 1962 and they continued until 1996: 17 years after the murder of dictator Park Chung Hee.

#### *First five-year plan (1962-1966)*

The first five-year plan targeted investments of 15.1% of Gross Domestic Product. That was the first step to build a self-sufficient industrial structure which didn't depend on consumption and on oil. Investments in this period increased to an average of 16.4% exceeding all expectations, actually. The investments of this first economic plan focused on the expansion of the import-substitution and the consumer-goods industries, in order to

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<sup>45</sup> Paul W. Kuznets, professor at Indiana University (U.S.) and author of the paper “*An East Asian Model of Economic Development: Japan, Taiwan and South Korea*” edited by University of Chicago (1988).

supply products which represented basic needs for the population, such as cotton textiles, soap, rubber shoes. New facilities were built and other investments were made in key sectors like cement, iron, fertilizer, electric power and energy.

#### *Second five-year plan (1967-1971)*

The second economic development plan involved large increasing investments that counted for the 26.4% of GDP, but the average annual rate of investments was of 25.8% (increasing of investments of 57.3% over the previous period at 16.4%). This plan was oriented towards the modernization of the Korean industrial structure and on the building of import-substitution industries such as machinery, chemicals and steel. Investments were focused in those sectors and products that could be substituted for imports, like wool, plywood, synthetic spinning, sheet glass and newsprint; often, a substantial excess capacity was created. This “over-investments” happened because products weren’t already very competitive in world markets. Important investments took place in those industries that were export-oriented, especially those specialized in manufactured goods for developed countries.

#### *Third five-year plan (1972-1976)*

In this period, the investments percentage targeted was 27.8% of GDP and average rates nearly equal to this objective were realized. In this range of time, an export-oriented structure of heavy and chemicals industries (HCI’s) was quickly built, such as iron, steel, transport machinery (automobiles included), shipbuilding, petrochemicals and household electronics. The HCI sector required to supply new industries with raw materials and capital goods, reducing or eliminating the Korean’s dependency on foreign suppliers. Indeed, in 1973 the first steel mill was built, which supplied a special type of metal used for the production of shipyard, heavy industrial plant and ammunition. Moreover, in 1974 the first petrochemical center was built, followed by other twelve in the following years.

#### *Fourth five-year plan (1977-1981)*

The investments destined for this fourth economic development plan were 35.5% of GDP, but the average rate reached was of 31%, that is still very high and impressive especially considering that the murder of the dictator Park occurred in that period, followed by a great political and social instability. During the third and fourth five-year plans, South Korea invested almost one third of its gross domestic profit. In this period, moreover, the impressive investment in new strategic industries started, like electronics and machinery. This skilled labor and technological-intensive industries enabled the country to compete effectively in the world's markets. New goods were produced, which were exported worldwide thanks to the combination of high-quality and low production costs. With regard to machinery industries, investments were doubled in the production of integrated machinery, electric power tools, heavy construction equipment, integrated machinery and diesel engines.

#### *Fifth five-year plan (1982 – 1986)*

During this strategic plan, the first designed without the control of general Park and in a period of great instability, the investments ratio decreased at the average annual level of 28,5% of GDP. They mainly were oriented to new sectors as machinery and electronics, but still to heavy and chemical industries, too (HCIs).

#### *Sixth five-year plan (1987-1991)*

During the sixth five-year economic plan, ratio of investments reached the average of 34.9% of GDP. South Korea continued to pursue the shift from HCIs towards technology-intensive sectors such as electronics (televisions, videocassette recorders, semiconductors and related products), information systems and precision machinery. Moreover, this plan included the acceleration of science and technology, thanks to investments in research and development over 3% of the GDP.

### *Seventh five-year plan (1992- 1996)*

The seventh and last five-year economic plan reached an average annual investment rate of 36.7%. This final plan focused on the development of high technologic sectors, like microelectronics, bioengineering, optics, new materials, chemicals and aerospace. Moreover, new high-tech facilities were built by joint ventures between the state and chaebols: they were built in seven provincial cities, with the aim to give a better balance to the distribution of the industries across the country.

The financial crisis in 1997-1998 marked the end of the five-year policies. The investment ratio declined at the level of 25.9% in those years and remained sharply low during the following years. To conclude, the aggregate investment ratio from 1953 to 1998 (i.e. from the Korean war to the end of the financial crisis) grew at the annual speed of 3.8% and it was equal to an average 26.5% per annum. This path, focused on high investments in specific sectors, resulted as a key and successful strategy to allow the Korean economy to become an industrialized country, starting as a third world country.

### 2.3.3. Economic development from the 1980s to nowadays: the stabilization of an advanced country

We used the five-years economic and social development plans as a glue between the “*growth-first*” Park’s strategy and the “*consolidating growth on the basis of stability*”<sup>46</sup> strategy of the following policies. In fact, starting from the 1980s, the Korean economic development started a long period of adjustments and changes compared to the previous one, in order to balance its economic structure. In contrast to what used to happen before, when the government was deep involved and we can say that it was the main actor on Korean economic decisions, from the 80s it began to take a secondary role. Hence, private sector and markets gained an increasing freedom over the Korean economy, thanks to

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<sup>46</sup> Jong Dae Park “*Korea’s Path of Development in Retrospect*”, Palgrave Macmillan, Cham (2019).

private initiatives supports and market liberalizations, whereas the government started to focus more on social public policies as health, education and welfare.

First of all, the policies of trade liberalization started. From the beginning of the 80s, import liberalization measures were gradually applied and in 1986 South Korea registered a trade surplus for the first time, which increased in the following years thanks to always greater exports worldwide of even more sophisticated products. The trade performances and the economic status grew more and more and in 1990 South Korea moved into an upper category of the General Agreement on Tariff and Trade (GATT)<sup>47</sup>, without any trade restriction for the purpose of balance-of-payment. Between 1981 and 1995 the average tariff rate fell down from 34.4.% to 9.8% and the import liberalization from quantitative restrictions grew from 60.7% to 92%<sup>48</sup>.

In addition, the financial and markets were increasingly liberalized – although more slowly than trade liberalization policies - especially because many *chaebols* that were the owners of non-bank financial institutions demanded for deregulation. This marked the start of the development of the industry of service that was completely repressed during the Park's era. Also, the capital market was slowly liberalized because of the purpose to have a bigger control over the domestic money supply and the real exchange rate of movements. This opening was displayed by the government through more relaxed restrictions on FDI which until then were very few and controlled.

In the early '90s, South Korea had already reached the status and the economic growth started to decelerate slowly and, due to the increase of the knowledge-based economy and globalization that disadvantage low-skilled workers, the income inequality grew. Moreover, the productive gap between HCI's and light industries, manufacturing and services increased, and, also, between small and large companies. The government responded following two main challenges: the development of technological sectors and market opening.

The first target was pursued thanks to great both private and public investments in R&D activities (the Ministry of Commerce and Industry and the Ministry of Science and Technology, for example, supported technological development). These big investments were directed to development core technologies in the existing sectors and in new areas

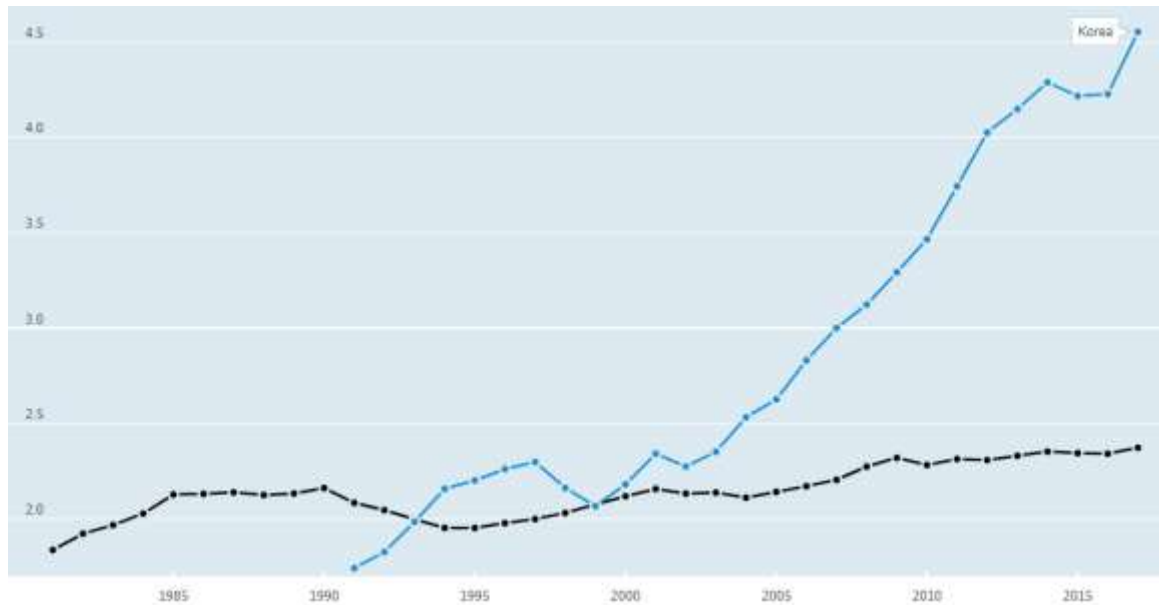
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<sup>47</sup> The General Agreement on Tariffs and Trade (GATT) is an agreement with aim to promote international trade thanks to the elimination or reduction of trade barriers like quotas or tariff. The first agreement was signed in 1947 by 23 nations in Geneva, Switzerland.

<sup>48</sup> Kwang Suk Kim, *Korea's Industrial and Trade Policies* (Seoul: Institute for Global Economics, 2001) p. 82.

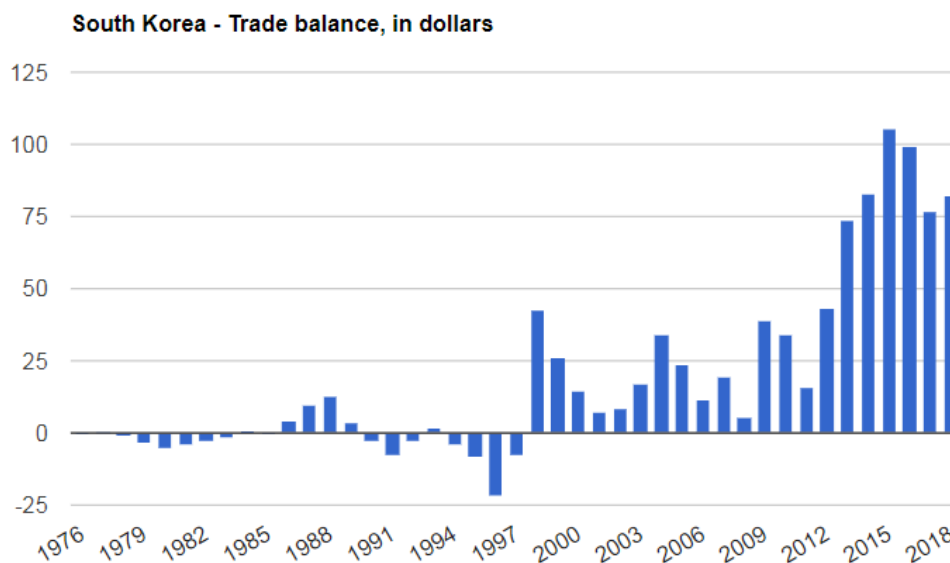


such as telecommunications and semiconductors. This led to the definitive rise of the Korean ICT industry, which became one of the fundamental key points of the Korean economy and society. (Figure 11)



**FIGURE 11: PERCENTAGE OF GROSS DOMESTIC SPENDING IN R&D. THE BLUE LINE IS THE RATE OF SOUTH KOREA WHEREAS THE BLACK LINE REFERS TO THE AVERAGE RATE OF OECD COUNTRIES. SOURCE: OECD DATA**

In the second place, a series of circumstances such as that South Korea took part to the World Trade Organization (WTO) in 1995, entered in the OECD in 1996 and faced the Asian financial crisis in 1997, pushed the country towards the full opening to the global markets even more, more than what happened in the previous decades. Indeed, in contrast with the early stages of economic development when manufacture firms were focusing only on exports and not towards the domestic market, in the second half of 1990s Korean industries adapted to global markets and international trends: they started to diversify partnerships, to establish new production facilities overseas and other measures to follow an industrial globalization. Indeed, from 1996 South Korea returned in a positive trade balance (Figure 12). In this way, combining the openness to the global markets with the huge investments in R&D, Korea increased enormously its competitiveness in many sectors especially in automobiles, shipbuilding, steel and electronics.



**FIGURE 12: TRADE BALANCE OF SOUTH KOREA (1976 -2018).**  
**SOURCE: WORLD BANK DATA**

In November 1997, South Korea was hit by a foreign exchange crisis due to its exposition to the international trade. The unforeseen crisis was a great shock for the Korean economy that forced the government to ask for the biggest loan ever made by the International Monetary Fund (IMF) to save a country: 58.35 billion dollars. The crisis led many chaebols to bankruptcy and the shortage of liquidity affected all businesses. The IMF’s aid saved South Korea in exchange of austere economic measures and structural reforms. All those businesses that didn’t perform were driven and left out of the market and a program of reconstruction of the industrial sector started. South Korea recovered the previous growth rate and trade surplus in only two years; about 3.5 million Koreans donated gold to help the government to repay the IMF’s loan.

South Korea came out from the crisis with a very different economy: it was more opened to international capital flows, the transparency of the corporate management was improved (especially in the *chaebols*), the functioning of the financial market was enhanced, some industries were restored and others, as we said before, such as ICT came out even more competitive.

With the start of the new millennium, the new strategy pursued by the Korean government was called “*new growth engines*”, with the aim of sustaining the economic growth and dynamism to secure the status of advanced economy. Because of WTO’s trade regulations

introduced in 1995, direct fiscal and monetary supports by the government as happened in the past were no longer allowed and only indirect supports in R&D were possible.

So, South Korea's industrial policy became a technical development policy, in which the government focused on technological development for the new growth industries. Indeed, in 2001, President Kim Dae-Jung promoted the "*five technological industries policy*", which was based on huge investments in the development of the five sectors of IT, biotechnology, nanotechnology, environmental technology and cultural technology. In 2003, the government of the following Korean president, mister Roh Mu-Hyun, designed ten industries on which to focus the R&D investments: robots, next-generation semiconductors, new generation mobile communication, future cars, display, software solutions/digital contents, next-generation batteries, intelligent home networks, new biomedicine and organs. In 2009, the new president Lee Myung-Bak introduced its new strategies, that concentrated the investments on green growth, high value-added service industry and high-tech fusion. These three policies, despite the high investment ratio, showed partial success (Kim, 2015)<sup>49</sup>: the average growth rate during Kim Dae-Jung administration (1998-2002) was 5.1%, during Roh Mu-Hyung govern (2003-2007) it was 4.5% and during Lee Myung-Bak administration (2008-2012) it was 3.2%.

The following government, the one of Park Geun-Hye, that lasted from 2013 to 2016, announced three economic goals that had to be reached with a three-years plan: a 4% economic growth rate, 40,000 dollars GDP per capita and an employment rate at 70%. This plan, however, wasn't very effective due also to the impeachment of President Park. By the way, reflecting the typical trend of developed economies, south Korea experienced a steady slip of GDP rate. After the 1997 financial crisis, as the previous cited GDPs show, the rate was lower at every administration, until Park government's GDP rate of 2.9%.

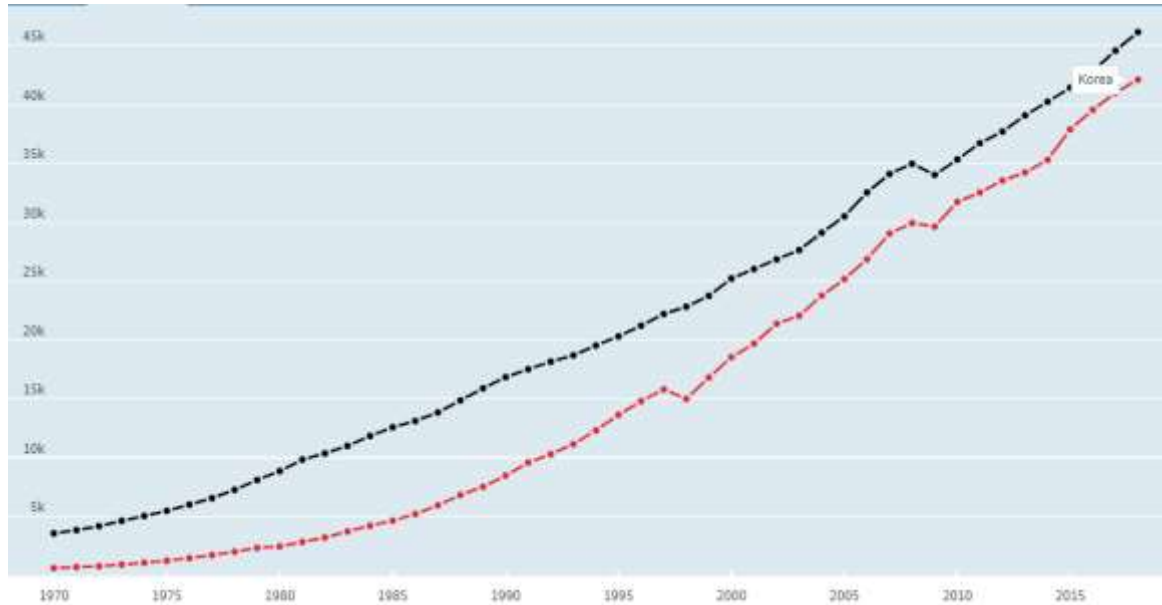
The current president Moon Jae-in's administration (2017-) has officially inaugurated the final phase of slow growth given by its industrial structure, income level and size of its economy: in 2019 the economy grew at the rate of 2.0%, the slowest since the crisis of 2008<sup>50</sup>.

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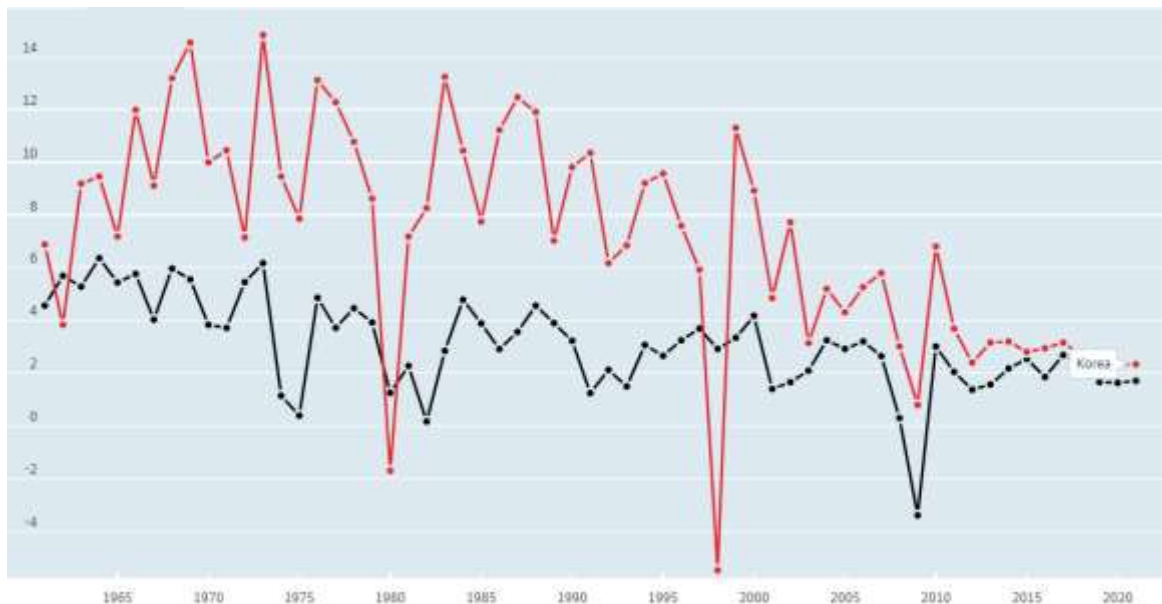
<sup>49</sup> Do Hoon Kim, "*In Search of Future Growth Engine: Tasks and Solutions*", Korea Economic Forum 8, no.2, Korea Economics Association (2015) p. 54.

<sup>50</sup> Source: <https://www.reuters.com/article/us-southkorea-economy-gdp/south-korea-posts-slowest-annual-gdp-growth-since-financial-crisis-idUSKBN1ZL00F>

The following figures (Figure 13, Figure 14) shows how South Korea is moving close to OECD GDP per capita reaching the level of \$42,136 per capita in 2018, but, also, its growth rate is decelerating and approaching the levels of OECD countries.



**FIGURE 13: GDP PER CAPITA GROWTH OF SOUTH KOREA (1970-2019). THE RED CHART REFERS TO KOREA WHEREAS THE BLACK CHART IS THE AVERAGE GROWTH OF GDP OF OECD COUNTRIES. SOURCE: OECD DATA**



**FIGURE 14: YEARLY GDP RATE (%) OF SOUTH KOREA (1960-2020). THE RED CHART REFERS TO SOUTH KOREA WHEREAS THE BLACK CHART IS THE AVERAGE RATE OF OECD COUNTRIES. SOURCE: OECD DATA**

## 2.4. The central role of Human Capital in Korean economic development

In the previous paragraph we analyzed the impressive economic growth of South Korea that had involve massive investments in the productive structure and in R&D. However, another main factor of the Korean economic expansion was the incredible growth and development of the human capital in the country. Economic growth and human capital are strictly connected and had interacted mutually reaching unthinkable goals. In fact, the educational and economic growth often develop and increase together, because usually the demand for education is positively related to the change of income.

Moreover, it is very interesting to note that in South Korea the growth of educations started already in the period between 1945 and 1961, before the Korean economic growth (unfortunately, there are no clear data of education level before 1945 during the Japanese domination). So, the human development in Korea cannot be explained only with the increase of income and prosperity: there were cultural, social and economic motivations at the basis of the high Korean demand for education. Firstly, as we previously discussed in paragraph 2.3.1, the Korean culture is still impregnated by Confucianism and by its teachings to learn and to respect the teachers. Then, after the Liberation from Japanese domination (1945) and the Korean war (1950-1953), the traditional system of social classes was completely destroyed and, taking in consideration that the Korean society is extremely homogenous in terms of ethnicity, culture and language, education was evaluated as the only key to reach higher social levels. Hence, the demand of education was closely related with the aim of social mobility and economic improvements. Education granted better occupations and rewards both economically and socially (the social status is still nowadays one of the main characteristics and ambitions in the Korean society).

As we said above, there are no sure data about education during Japanese control over Korea, but anyway Japanese contribution wasn't irrelevant. Indeed, the Japanese built many facilities (school) and trained many Japanese-educated Korean teachers. These components were prepared for the Japanese people living in Korea, but after the Liberation, obviously, they stayed there and became the basis for the new educational system. Another big contribution at the fundamentals of the Korean educative system was made by the U.S Army Military Government that financed about two-thirds of all Korean operating costs for

primary schools (McGinn & others, 1980)<sup>51</sup>. It should be taken in account that most of the Korean national expenditure were, and in part are still nowadays, concentrated in the defense and military sector due to the controversial relation with North Korea.

Starting from 1961, in the following decades, the export-oriented allowed the fast-human development and, vice versa. the increasing accumulation of human capital implemented the outward-looking economic strategy. As we analyzed earlier, from an initial economy that exported labor-intensive manufactured products, South Korea shifted the production to more skilled and capital-intensive goods. This shift of productive strategy and the great performances of even more skilled-intensive export industries, led to the increase of employment (unemployment rate has reached very low levels around 4-4.5% until 1990) and real salaries that, in turn, improved the demand for higher education in the Korean society.

We can analyze and explain an interesting feature about the strong correlation between economic strategies and human capital development. In fact, in a situation of a country with an inward-looking economy, there are very few motivations and incentives to have a higher education level needed for the job, because the productive structure and technologies improve and change slowly. On the other hand, a country with an export-oriented economy that competes in the global markets, changes its employment and industrial structure faster and, so, it needs to invest more in education. Indeed, better educated workers can move easily from declining sectors to others that are increasing and, also, they have the knowledge to move to new and more technological areas. Hence, the rewards are higher in export-oriented economy and societies. So, in relation to South Korea, the quick transformation of the economy from import-substitution strategy to an export-oriented had a great influence in the development of the education level of its population (Lee, 2007)<sup>52</sup>. Furthermore, talking about the labor market, closed economies tend to be more inflexible and distorted: there is no competitive pressures because of protectionist trade policies and because of the actions of the government and trade unions to maintain the wages set above market equilibrium. On the other hand, in open and export-oriented economies, the labor market needs to be more sensitive to market changes and evolutions, especially for what concerns the increasing new skills required. In South Korea during Park's regime, there

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<sup>51</sup> McGinn, Sondgrass, Kim, Kim, Kim, "*Education and Development in Korea*", Harvard University Press (1980).

<sup>52</sup> Jong Wha Lee, "Economic growth and human development un the Republic of Korea, 1945-1992" *Reconstruction*, 2007, pages 10-11.

were very few governments wage adjustments and labor unions were strongly controlled and almost ineffective. So, the change to an export economy of high-skilled products met an almost free labor markets with the abundance of well-educated workers ready for new technological productive sectors (Lee, 2007).

Therefore, because export-oriented economies compete at the global scale, governments and firms push for efficient educational and training system. That's what happened in South Korea: when Park's administration designed the progressive shift to an export productive structure, he understood the future demand for even better skilled workers. Indeed, since the 60s many Korean workers and managers went abroad to learn and accumulate knowledge and knowhow from the foreign technology. For example, the first 50 Korean workers went to a shipyard in Scotland (now South Korea is the world leader shipbuilder) and many managers were sent to U.S. to study. Moreover, in the 60s and 70s the industrialization level needed less skilled workers and the government established vocational training institutes and implemented technical secondary school. In 1967, the Vocational Training Law established the first 26 public vocational training schools that had positive effects on the workforce. Indeed, these institutes helped workers to develop different skills required for the changes of the industrialization. The productive structure of the 80's, instead, required more skilled workers for the more advanced technologies and the government responded with the creation of two-years junior technical colleges, colleges and universities.

To conclude this point, the Korean export-oriented development strategy had led Korean workers to accumulate more education and training to respond at the increasing demand coming by the changing industrial sectors. These was possible also because the labor market worked almost efficiently with the absence of unions and government interventions on the wages. So, the competition of labor market and of the markets worldwide pushed for higher education and for greater accumulation of human capital during the transformation of the Korean productive structure.

Another point to take in account, is how education and human development are strongly related to the equal income distribution. After the Liberation from Japanese and the Korean war, Korean social system was almost completely destroyed and this permitted that the economic growth led to an income equality throughout the population. Indeed, in 1961, the Gini coefficient for the country was only 0,32<sup>53</sup>. In South Korea, the growth of GDP per

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<sup>53</sup> [http://stats.areppim.com/listes/list\\_gini\\_1960x2012.htm](http://stats.areppim.com/listes/list_gini_1960x2012.htm)

capita and the equal income distribution permitted to Korean families to invest more in education in order to reach and to gain in wages and in social status. One characteristic of South Korea is that a consistent part of the expenditures of human accumulation is made by the families that sent their children to do many afternoon and evening courses with the aim to improve their ability and to gain better salaries in the future.

From the 1990s, South Korea started a second industrial shift to more advanced, innovative and technological products and sectors and, this time too, the abundance of knowledge in the workforce was fundamental for the economic development. The well-educated and high-skilled workers were ready to respond to the changes of demand coming from the global markets, especially in those sectors as ICTs and electronics.

In order to explain the fundamental role of human capital accumulation, it has been proved that without a human capital growth, the real income per capita of South Korea in 2014 would have been \$14,597 and not \$34,300 (Jeong, 2017)<sup>54</sup>.

In this paragraph we analyzed the central role of human development in the Korean economic growth and how the increase of one leads to the increase of the other and vice versa. These two concepts are strongly connected and, thanks to the long-term vision of governments, South Korea exploited its social and cultural characteristics to develop the fundamental of the following economic strategies of growth.

#### 2.4.1. ICTs in Korean education and society

As we discussed earlier, South Korea was a pioneer in the development of Information and Communication Technologies (ICTs) and from 2012 to 2017 it ranked in the top three of the Global Information and Communication Technology Development Index (IDI) created by the International Telecommunication Union (ITU)<sup>55</sup>. To understand how ICTs has a central role in the Korean policies and policymakers, in the current administration the Ministry of Science, ICT and Future Planning (MSIP) has been instituted. The government's policies for ICT development started in the 1990s, in conjunction with the

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<sup>54</sup> Hyeok Jeong “*Korea’s Growth Experience and Long-term Growth Model*” page 30, World Bank Group, 2017.

<sup>55</sup> The International Telecommunication Union (ITU) is an agency of United Nations specialized in those issues that concern information and communication technologies (ICTs).



Internet era. The government established the Korea Agency for Digital Opportunity & Promotion (KADO), which made many direct investments in R&D projects for ICTs. These great investments were directed to develop future pioneering and innovative projects such as Smart Cities and 5G.

The Korean government chose Busan Metropolitan City, the second largest city in South Korea after Seoul, to develop as a “Smart City of the future”, a place where the use of technology had a direct impact on the improving of its citizens lives. Thereby, Busan was the place where that first saw projects of community safety, energy conservation, traffic improvement and urban living, that can be monitored and directed in real-time thanks to open data. Another pioneering Korean ICTs project consists in the leadership of the diffusion of 5G across the country in order to create the infrastructure backbone for the 4th industrial revolution. It is expected to reach 30 billion wireless connections by 2020 that will be connected and will be supplied by 5G broadband.

As happened for Seoul Olympic games in 1988, South Korea had the opportunity to show its development and unrivaled ICT infrastructure during 2018 Winter Olympics in PyeongChang, too.

In the last decades, ICTs has been involved also in education promotion and its contribution was fundamental. According to the education report by OECD, South Korea is one of the top performers in education and ICTs. Since 1999, the Korean Ministry of Education has charged the Korean Education and Research Information Services (KERIS) to pursue policies to put the ICTs in education, in order to improve digital learning tools and to advance in technological infrastructure.

The Korean government designed the first ICT plans in 1996 with the main goal to provide schools of computers and to implement the “Edunet program”, a portal that allowed teachers to get digital support and to develop their ICT skills. The second policy, which took place from 2005 to 2010, concentrated more on the development of student’s abilities. Besides, it allowed the participation to virtual communities between teachers and students with the aim to improve teaching and learning activities. The following plan (2010-2014) focused on the use of ICTs in education, to improve creativity and efficiency in the future workforce. Nowadays, the main goal of the current plan is the “Digital Textbook project” with the ambition to introduce digital textbooks and interactive educational functions for all primary and secondary students.

As we can see, ICTs carried a fundamental role to the today’s development of Korean society and education structure. It is important to highlight that it happens thanks to the

long-term vision of policymakers that have been the first to develop a workforce able to create new innovative ICTs goods and services that then has been spread in the Korean society.

## 2.5. Analysis of the Economic Complexity Index of the Republic of Korea

In chapter 1 we discussed that an economy is considered complex if its productive structure is able to make complex products. The ability to produce and then to export sophisticated goods (with high level of diversity and low level of ubiquity) denotes the level of complexity of a country. This means that a country with a high accumulation of knowledge and knowhow and good links between its networks and institutions has the ability to improve its productive structure and to make and export innovative objects, with a clear revealed comparative advantage, worldwide. The high level of human and social capital, also, decreases the income inequality across the country, by developing, in turn, other economic, social and human improvements. To resume, the key factors to develop a country's complex economy are the volume of trade and exports, the quality of networks and institutions (social capital) and, above all, the level of human capital.

In this chapter 2 we looked at the case of Republic of Korea, better known as South Korea. This country was one of the poorest countries in the world after the civil Korean war that ended in 1953. It started a long-term project of economic development with medium range forced steps in order to find out better what was needed at that moment. Firstly, the economic growth was led by exports of low-skilled products but, then, the policy makers decided to shift the production into more sophisticated goods. The economic growth was accompanied by a parallel great development of the education. The growth of human capital conducted a fundamental role in the change of productive structure, because it built the well-educated workforce able to deal with more complex sectors and goods such as electronics, semiconductors, ICTs and so on. The rise of the information and communication technologies in which South Korea was a pioneer, moreover, helped the acceleration of the last thirty years when the country stabilized the status of advanced

economy. Lastly, the Korean social capital revealed the importance of the links and efficiency of social networks and institutions as a basic role in the economic development. Consequently, all the main features that characterize a country with high level of economic complexity are found in South Korea and, indeed, in 2017 this country was ranked as the 6th more complex economy by the Observatory of Economic Complexity (OEC) with an ECI of 1.78. The Economic Complexity Index (ECI) analyzes the complexity of the 126 principal economies in the world. In 2017, the last year in which data were collected by OEC, South Korea exported \$597 billion, positioning as the 5<sup>th</sup> largest exporters in the world among 221 countries. In the 5-years long period between 2012 and 2017, Korean exports has grown from \$561B to \$592B at the average annual rate of 1,2%.



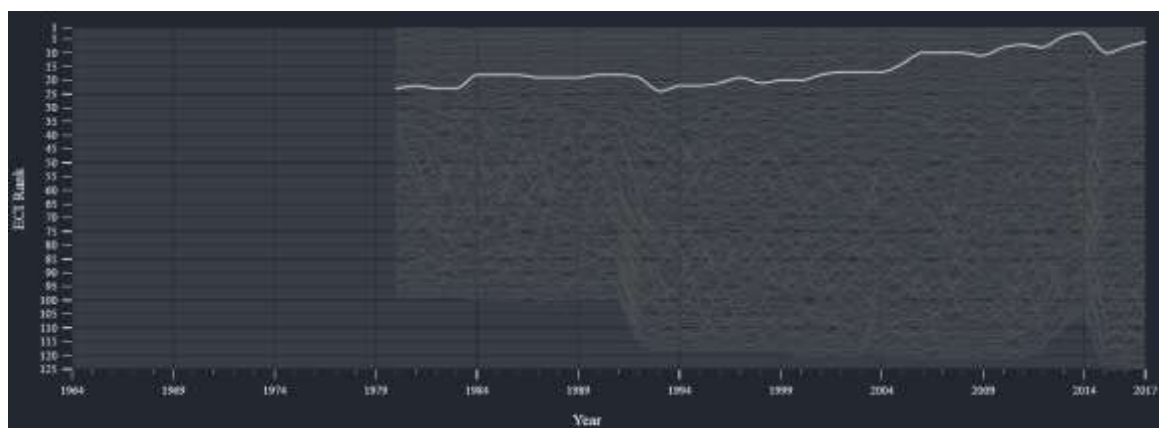
**FIGURE 15: TREEMAP OF SOUTH KOREA.**  
**SOURCE: OBSERVATORY OF ECONOMIC COMPLEXITY (OEC)**

Using the HS92 classification (1992 revision of the Harmonized System) and thanks to this tree map visualization (Figure 15), we can see that the most exported products by South Korea were integrated circuits (\$104B), cars (\$40.1B), refined petroleum (\$32,6B), passengers and cargo ships (\$24.4B) and vehicle parts (\$19.1B).

According to the Product Complexity Index (PCI), Integrated Circuits, better known as semiconductors or chips, are the 3<sup>rd</sup> most traded product and it ranked as the 248<sup>th</sup> most complex product of a total of over 1232 products classified (Product Complexity = 0,885). For what concerns cars and any kind of vehicles, they are the 2<sup>nd</sup> most traded product and the 277<sup>th</sup> most complex good with a Product Complexity (PC) = 0.833. Refined petroleum is the 4<sup>th</sup> most traded product in the world but with a PC of -0.889 it occupies only the 957<sup>th</sup> place of 1232 products as a complex good. Then, South Korea is the top exporter worldwide

of passenger and cargo ships, an industry born thanks to Park's long-term view: it produces almost the half of all the production related to these goods. This kind of product is the 59<sup>th</sup> most traded and the 742<sup>nd</sup> most complex product with a PC of -0.245. Regarding vehicle parts, it is the 6<sup>th</sup> most traded product in the world and the 173<sup>rd</sup> most complex product with a PC of 1.09. As we can see, almost all of the most exported products by South Korea correspond to the most traded products worldwide and, also, their level of complexity is quite high considering their concentration (ubiquity) among countries. They contribute incredibly to the enrichment of the country. The most imported products are most of all raw materials that are rare in South Korea and they have a very low PC level but, also, there are more complex products as Integrated Circuits and Photo Lab Equipment which are bought especially by ICTs firms to produce more complex goods.

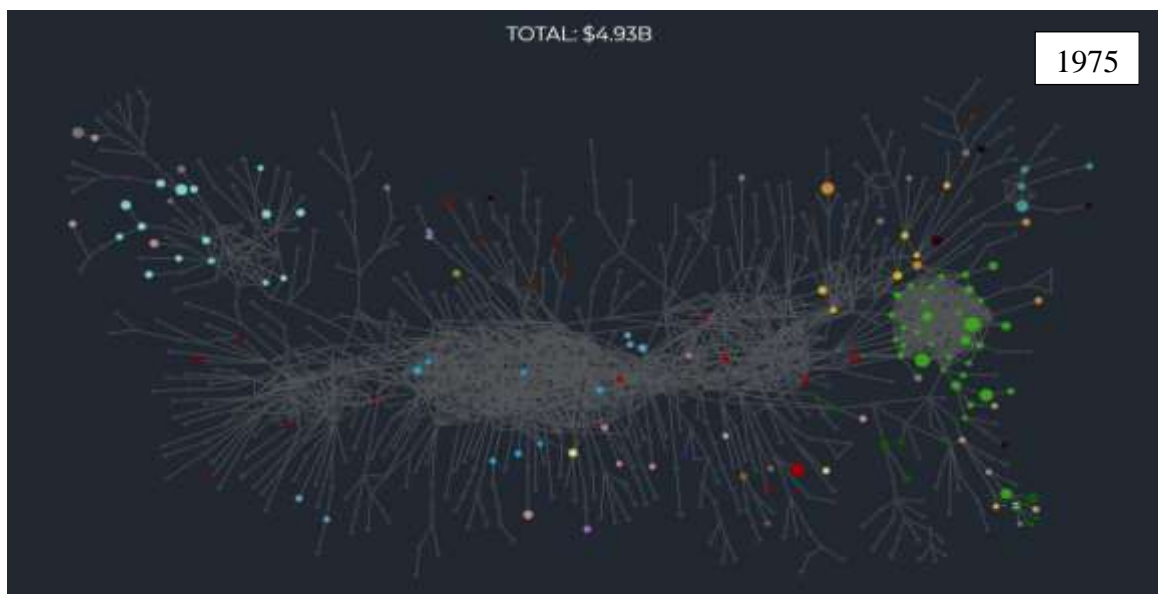
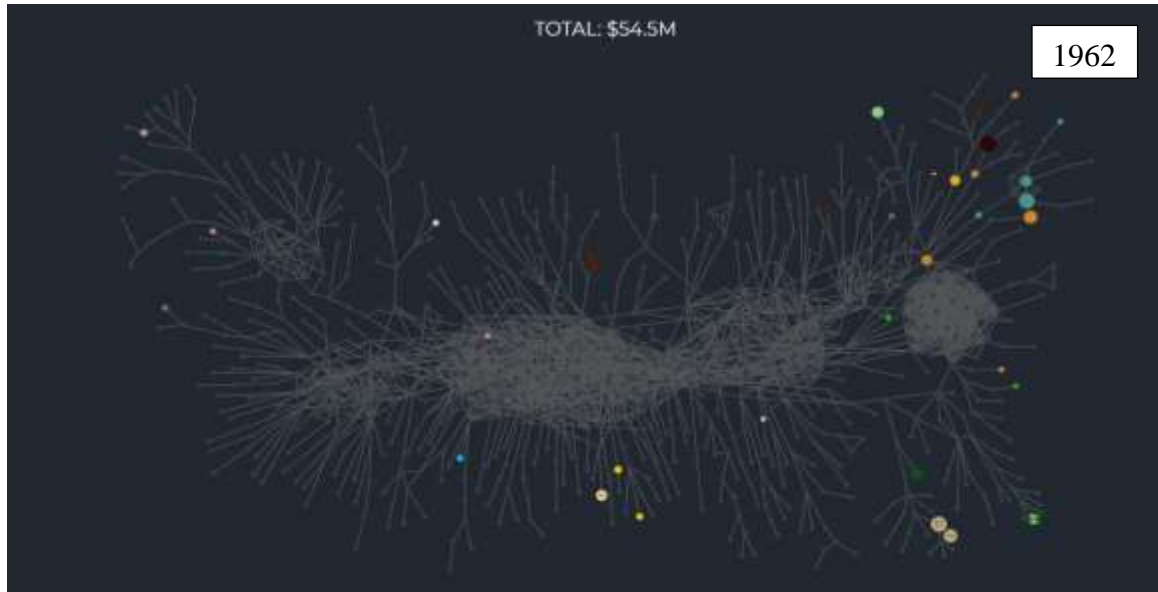
The figure 16 shows the Economic Complexity ranking highlighting the Korean complexity path in the time. The ranking starts in 1980, when Korea already occupied the 23<sup>rd</sup> position among 99 countries studied, that means that the country was focused on the export of quite sophisticated products already in the 80s. Since that year, the rank of South Korea slight improved over the time reaching the peak of the 3<sup>rd</sup> position in 2014. This indicates that the growth of the complexity was gradual and constant thanks to very effective policies.



**FIGURE 16: RANKING OF COUNTRIES BY ECI (SOUTH KOREA IS THE CHART HIGHLIGHTED).**  
**SOURCE: OBSERVATORY OF ECONOMIC COMPLEXITY (OEC)**

Lastly, we can analyze the product space of South Korea, in which those products who have a revealed comparative advantage - and that we already mentioned above - are colored. The colored points indicate those products that represents the main opportunities of export for South Korea. The figure at the following pages (Figure 17) represents the path of Korean product space from 1962 (second year of Park's regime) to nowadays. It is interesting to

notice how the economic development and industrial changes of the country in the last 60 years is properly described. Indeed, we can see that when Park took the power (1961), the economy of South Korea was very poor, and the exports were only \$54.5 million. The products with an RCA exported (the colored points) were related to, as we said before, the food processing (fish and swine), plywood and the archetypal forms of textile industry.



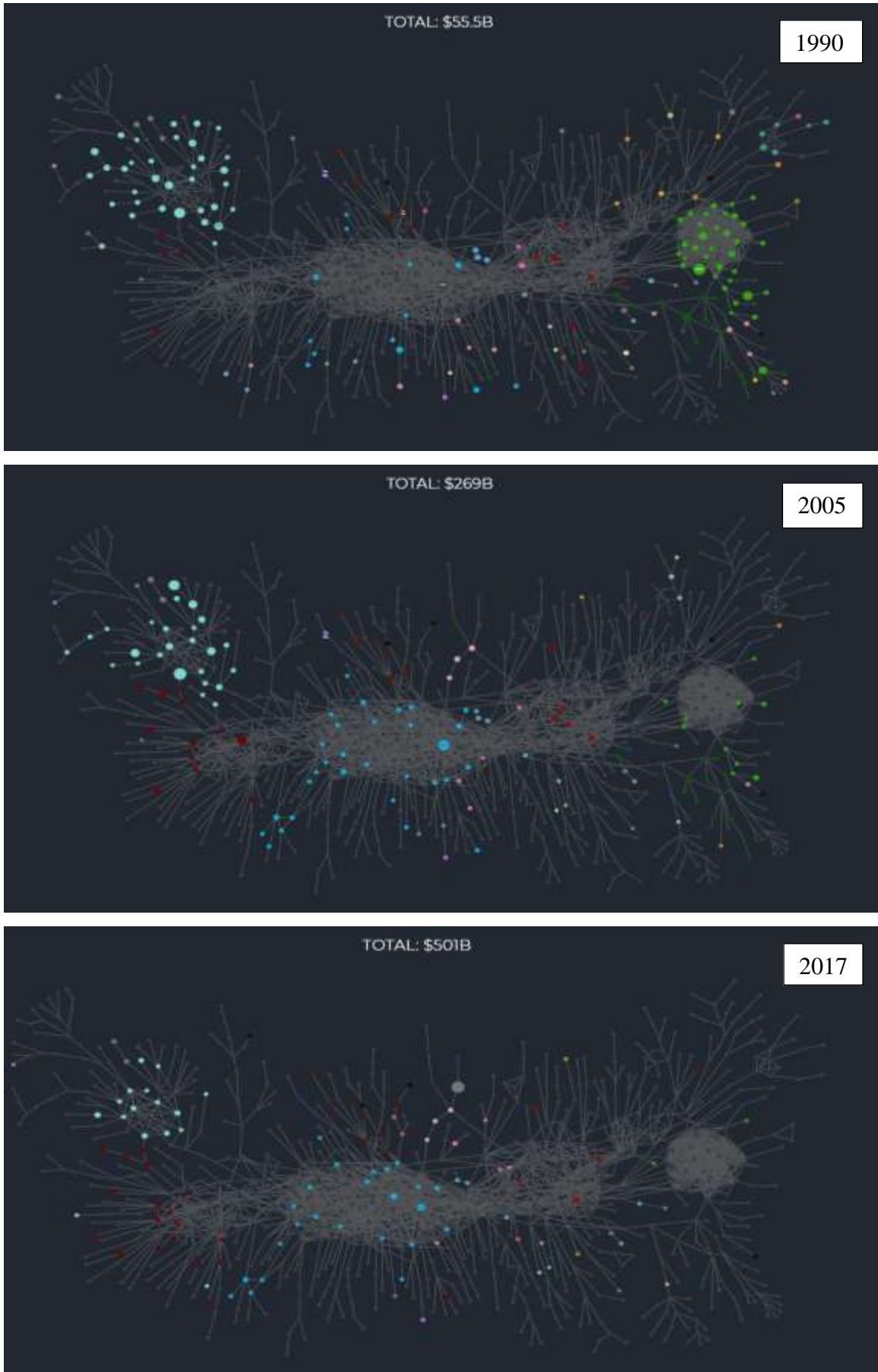


FIGURE 17: PRODUCT SPACES OF SOUTH KOREA OF THE YEARS 1962, 1975, 1990, 2005, 2017 BY OEC

In 1975, the policies of Park's administration already took place. The exports grew at \$4,93B, the textile sector increased enormously too (the green center on the right), but then other different industrial sectors, like the one of electronics, started to develop – pictured in the figure with the light blue center in the upper left side. In 1990, when the exports reached the level of \$55.5 billion, the product space certified the definitive growth of the sector of electronics and microcircuits, but also the exports in the textile industry still continued. The following product space that refers to the year 2005 with \$269B of export, shows the rise of the cars and vehicle sector (the central blue area) and the stability of the electronic one. Moreover, the chemicals industry started to develop (the red part on the left of the product space) and the exports of textiles and light industries definitely declined (the point on the right that in the previous years was colored in green). The last product space visualizes the composition of the Korean exports of 2017, with a total value of \$501B exported. The figure shows today's productive structure of South Korea: the most important sectors that export more goods with a revealed comparative advantage are electronics, integrated circuits, cars, chemicals, other chemicals (such as beauty care products), refined petroleum and shipbuilding.

### 3. The Italian case: a high developed country with a static economy

In the third chapter, we are going to study the Italian case starting from a panoramic overview of the country and then analyzing its productive structure using the Economic Complexity Index view. The first part will focus on the economic growth of the country after WWII and on all policies and investments in education, R&D and ICTs that characterize the Italian economy.

#### 3.1. Brief overview of Italy and its society

Italy, whose official name is Italian Republic, occupies the Italian peninsula in the middle of the Mediterranean Sea in the southern Europe. The country is delimited by the Alps, which represents also the political borders with France, Switzerland, Austria and Slovenia; its territory is composed by many islands, such as Sicily and Sardinia that are the biggest of the Mediterranean Sea. The nation covers an area of 301,340 Km<sup>2</sup> and, with the exception of Po Valley and few other small valleys, it is mostly covered by hills and mountains. The soil is scarce of mining and natural energetic resources.

In 2018 the population was 60.360 million people, with a density of 201.3 inhabitants/Km<sup>2</sup>. The Capital city is Rome, where all the political and administrative national functions are concentrated, whereas Milan is the most important economic center of the country. 68,6% of the population (ISTAT<sup>56</sup>, 2018) lives in urban areas spread in many main centers throughout the peninsula, especially in Po Valley.

Nowadays, in Italy the life expectancy is 83 years, one of the highest in the world. Italy is member of the OECD since its foundation in 1960, being among the most developed countries in the world: indeed in 2018 its GDP per capita (PPP based) was \$41,820<sup>57</sup>, whereas the total GDP (PPP) amounted at 2.084 billion<sup>58</sup>, the 12<sup>th</sup> economy in the world (World Bank, 2018). Italy, moreover, is one of the founding members of the European Coal

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<sup>56</sup> ISTAT data. ISTAT is the Italian National Statistics Institute which provide all the census about population and economy of Italy.



and Steel Community (ECSC, or in Italian CECA)<sup>59</sup> European Economic Community (EEC, or in Italian CEE)<sup>60</sup>. In 1993, with the Maastricht Treaty, EEC became EC and the Euro (€) was established as the new common currency and consequently it is the Italian Currency too. Nowadays 1 Dollar is exchanged for € 0,90. Italy is also member of the North Atlantic Treaty Organization (NATO)<sup>61</sup> since 1947, date of its foundation.

The official language is Italian; the population is composed for 91.5% by Italians and 8.5% by other foreign communities such as Romanians, Albanians and Moroccan (ISTAT, 2018). The religion of the majority of the population is Catholic (78%), whereas the irreligious are 17%. Despite irreligious are increasing, the entire system of values and ways of thinking in Italy is based on the Catholic and Roman culture.

### 3.2. The Economic and political history of Italy after WWII: from the economic *boom* to a static economy

In this paragraph we are going to look at the Italian economic growth since the postwar in 1945. First of all, after WWII the Italians chose, thanks to a referendum, to make Italy a Parliament Republic, which laid the foundations of the political form of the following years until today. However, economically and socially talking, the second World War left Italy almost completely destroyed on its infrastructures and productive and social systems. Successively, the population started to grow again and in combination with the growth of the economy, led to the beginning of the Italian economic miracle, also called *boom*.

The win of the moderate but conservative party of DC (Christian Democracy, in Italian Democrazia Cristiana) positioned the country in the so-called Western Bloc, as opposed to the communist bloc. It allowed Italy to access to the European Recovery Plan, also called Marshall plan. Thanks to this aid, Italy had the opportunity to restore the Italian economy.

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<sup>59</sup> The European Coal and Steel Community (ESCS) was an organization founded in 1951 by six European countries (Italy, France, Germany, Netherlands, Belgium, and Luxemburg) with the aim to regulate their industrial production under a centralized govern.

<sup>60</sup> The European Economic Community (EEC) was an organization founded in 1957 by the Treaty of Rome with the aim to develop economic integration among the member states. It was the first stage of the creation of European Union.

<sup>61</sup> The North Atlantic Treaty Organization (NATO) is an organization founded in 1949 by the North Atlantic Treaty with the aim to create a common defensive system between 29 North American and European countries.

Only in 1949 the before-war economic levels were recovered. Hence, the period that lasted from the 1950s to the 1970s was characterized by a speed growth of the GDP and the shift from an agricultural to an industrial economics. Moreover, the decisions to establish and participate to the European economic treaties - such as ESCS and EEC – have been crucial. Between 1951 and 1963 GDP increased with an annual average rate of 5.9%, that allowed Italy to open to the international trade and to surpass countries such as the Netherlands, Great Britain and France, which before were more industrially developed.

The impressive growth of the country during this period is demonstrated by the acceleration of all major economic indicators, such as the Gross National Income that doubled, the production grew of 95%, and real wages and public and private investments increased as well. In 1958, the number of workers employed in industrial sectors exceeded the number of workers in agriculture for the first time and Italy officially became a mainly industrial country.

In the 1970s, the population stabilized at around the level of 55 million but it was enough for the economic push. The main sectors of the industrial production were engineering and petrochemicals, which doubled also thanks to the entrance firstly in the ESCS, and secondly in the EEC. In those years, the production of domestic appliances made Italy the third biggest producer, behind U.S. and Japan. Many of these companies started from very small artisan firms which became important industries quickly, thanks to the entrepreneurial abilities and investments in R&D. In many areas of the north of the country, the power of unions was weak and that allowed the growth of many companies.

Another industrial key factor was the development of the automobile sector, led especially by FIAT<sup>62</sup>, and of the heavy metal sector (ILVA steel mills). This Turinese firm started to build and sell affordable cars to middle and low-class people, becoming the symbol of the Italian economic transformation and of the new level of wealth reached by the population, that changed from the traditional trend of saving. Many highways were built across the country, allowing the moving of people by private transport. Many public companies were also founded with the aim to decrease the unemployment and to build infrastructures such as ENI (energy) and IRI (infrastructures and joint ventures between public and private sectors). However, already since 1950s and 1960s a large economic inequality began, between the southern part of Italy and the northern one. In fact, the productive structure

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<sup>62</sup> Fabbrica Italiana Automobili Torino (Automobile Italian Factory Turin) or simply FIAT is the biggest Italian firm of automobiles founded in Turin in 1899 by Emanuele Cacherano di Bricherasio and Giovanni Agnelli. Nowadays it is part of the group Fiat Chrysler Automobiles (FCA).

developed only in the north of the country, whereas the south remained underdeveloped and very poor. This led not only to the phenomenon of urbanization, where people moved from the countryside to the cities, but especially to a huge emigration from the south of Italy to the developed north or even to other countries in Europe (Germany, France, Belgium) or in the United States of America.

Moreover, the purchasing power of the wages didn't increase and this brought to many protests and movements by labor unions and workers starting from the half of the 1960s: a situation that created a period of huge social tensions. In the 1970s, the basis of the following inadequate political reactions to the first economic problems were laid. In fact, despite of reacting to the petroleum shocks of 1974 and 1979 with investments in order to evolve the productive sector, policies such as "*politica del cambio*" were pursued (in English this means "exchange rate policy"), which consisted in continuous devaluations of the currency of the time, the Lira, in order to just increase the exports. In this manner, the inflation rate grew at the highest rate of the European countries (with peaks of over 20%) and also unemployment and public budget deficit hugely increased, too. In the 1980s, Italy lived a significant economic growth and technological development, especially thanks to the birth of Medium Enterprises (SMEs), which are still nowadays the main economic pattern in Italy<sup>63</sup>. Indeed, thanks to their specialization in niche markets which made the Italian economic panorama one of the most varied in the most advanced economies. The SMEs, especially in the north and in the center of the country, created in many cases different specialized industrial clusters that excelled in innovation and creation of sophisticated products. Indeed, the average number of workers per company in Italy is of 3.6 employees (8.7 employees in industrial and manufacturing firms), whereas the average numbers of workers in the Western European countries is 15.

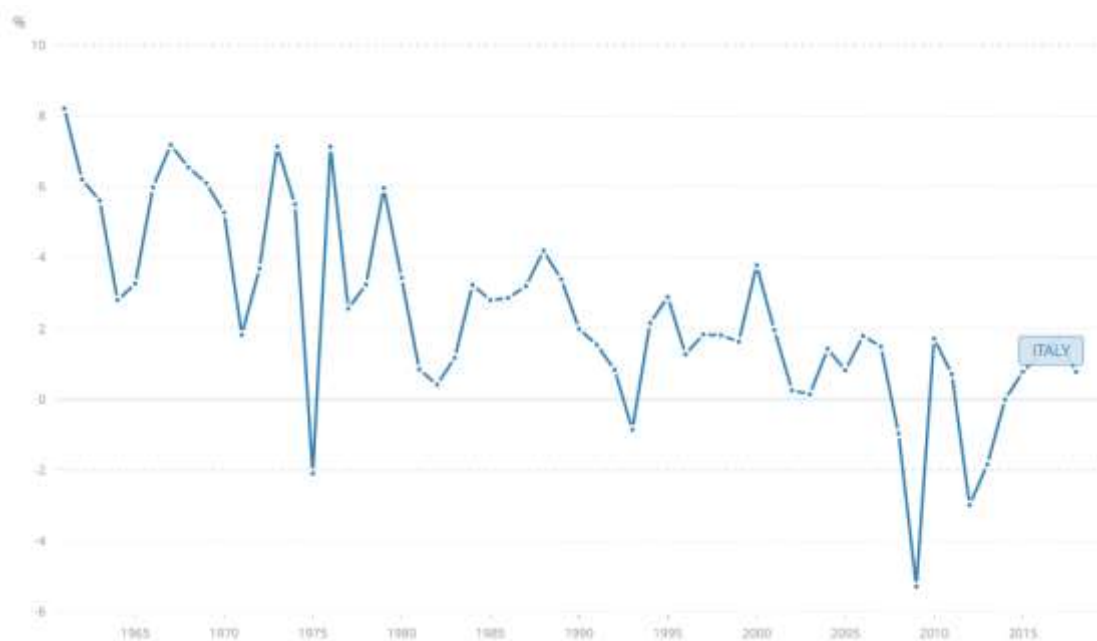
On the other hand, a black mark of this period was the particular increase of the corruption of politicians and organized crime such as the "Mafia" and the "Camorra", with huge consequences in the economic growth of the country and especially in the underdevelopment of the south of Italy. From the 1990s, the economic growth started to decelerate and to decline slowly. In 1991, Italy ranked as the 5<sup>th</sup> biggest economy in the world (World Bank Data), but in the same year the public debt exceeded the annual GDP of the country. Great devaluation policies had been pursued and many public businesses and public enterprises were privatized, in order to reduce the public spending and to pay

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<sup>63</sup> 92% of the Italian firms in Italy are SMEs and they produce the 57% of the national revenues.

the huge public debt by attracting foreign capitals; however, these policies weren't effective at all and the deceleration of the country already started.

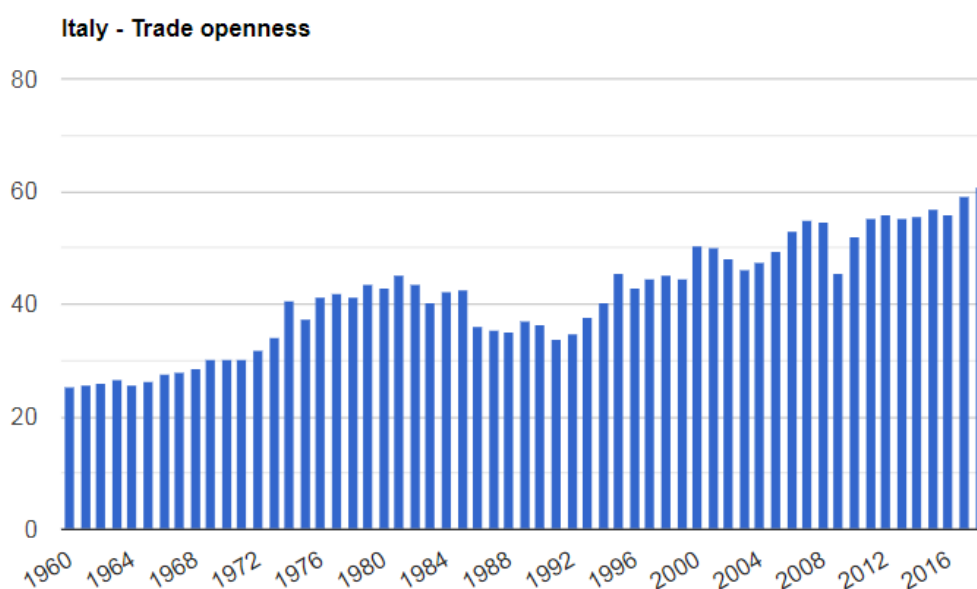
There were big changes in the political scenario, too: old political parties were replaced by new ones, but corruption problems and short-term political and economic strategies remained a constant. At the turn of the new millennium in Italy, too, the shift from an industrial to service economies started, due to the development and spread of ICTs. Contrary to what happened in many other developed countries, the changes to a service economy didn't reduce greatly the industrial sectors. In fact, Italy didn't attract enough innovative entrepreneurial start-ups. In the new millennium, Italy started this path in order to reduce the debt and to improve the financial system, but the global recession that started in 2007 - 2008 marked another big moment of ineffective political reactions to economic problems in Italy. Indeed, Italy was declassified by rating agencies and it was grouped in the PIIGS as the worst performing economy in Europe alongside Portugal, Ireland, Greece and Spain. Subsequently, a technocratic government led by Mario Monti was established in order to avoid the financial meltdown of Italy and to reduce the Italian debt thanks to a series of austerity measures. The following Prime Minister, Matteo Renzi, officially brought Italy out of the recession but the consequences in the deceleration of the Italian economy were clear. Nowadays, Italy is the 8<sup>th</sup> biggest economy in the world (World Bank, 2018), but the GDP (PPP) per capita is ranked as 29<sup>th</sup> in the world with a calculated value of \$41,830 according to World Bank in 2018.



**FIGURE 18: ANNUAL GROWTH RATE (%) OF GDP OF ITALY SINCE 1960.**  
**SOURCE: WORLD BANK, 2018**

### 3.3. Exports and Italy: a winning combination

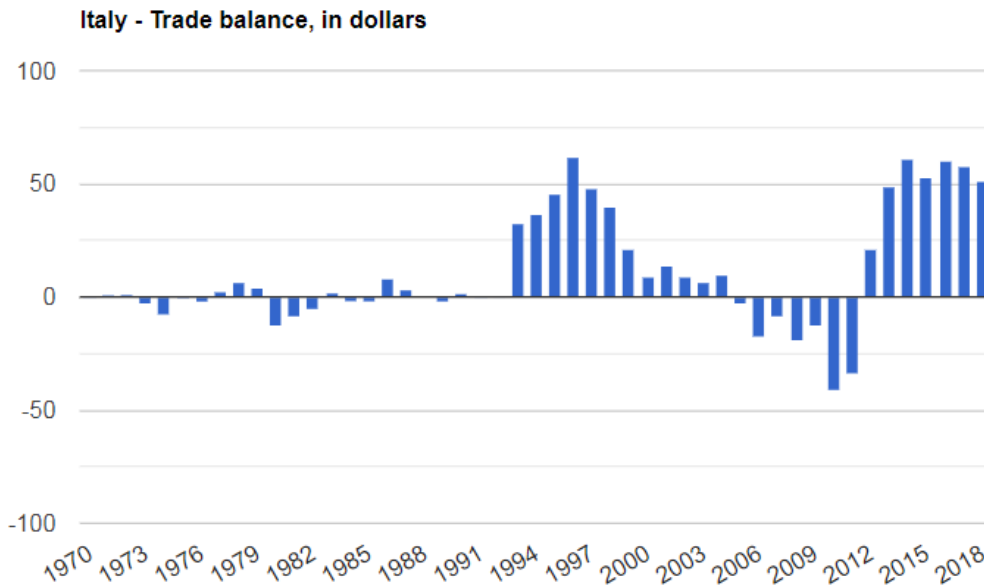
In 2018, Italy was the 9<sup>th</sup> biggest exporter in the world with a \$474.395B (World Bank, 2018). As we said in the previous paragraph, since the postwar the Italian Republic started a process of growth of its GDP and, also, of the exports. After the protectionist period between WWI and WWII, the opening to the international trade and markets helped the country to enhance its economy. The political choices taken to create an international economic organization with other European countries were very important to develop the industrial sectors, allowing easier movements of goods and services among them (ESCS and EEC before, EU later). Rapidly, Italy developed an incredible manufacturing industrial sector that were led by bigger firms at the beginning, and then by small and medium enterprises. Still nowadays, the economic pattern is almost completely composed by SMEs, which are often very export oriented. Indeed, the trade openness<sup>64</sup> of Italy grew from the value of 25.36% of GDP in 1960 to the value of 60.72% of GDP in 2018. Figure 19 visualizes the constant increase of Italian trade openness.



**FIGURE 19: TRADE OPENNESS OF ITALY IN % OF GDP.**  
SOURCE: WORLD BANK DATA

<sup>64</sup> Trade Openness is computed as the sum of exports and imports as a percent of GDP

Figure 20, on the other hand, shows the net trade balance<sup>65</sup> in dollars of Italy in the period from 1970 to 2018. Until 1993, the trade balance was almost always close to 0, which means that exports and imports had often similar values. Since 1993 and until 1998, Italy exported many more goods and services with a peak of \$62.16B in 1996. This was due to



**FIGURE 20: TRADE BALANCE OF ITALY IN U.S. \$.**  
**SOURCE: WORLD BANK DATA**

the devaluation of Lira started in 1992, that attracted many foreign capitals to buy many Italian government bonds. From 2006 to 2011, Italy experienced a negative trade balance due, especially, to the financial crisis of 2008 and its consequences. Since 2012, the trend returned positive and started to grow, thanks to the major outward look of the Italian firms, of the rising of the manufactured Italian excellences collected under the name of "Made in Italy" and thanks to the growth of tourism from the rest of the world. In the last years, since 2014, Italy is experiencing a positive trend with an average positive net trade balance of over 56 billion dollars. The products that are most exported by Italy are represented by precision machinery such as valves, air pumps, refrigerators but also cars, vehicle parts, packaged medicaments, refined petroleum, foodstuff and textiles.

<sup>65</sup> Net Trade Balance is computed by subtracting exports of goods and services and imports of goods and services in one country.

### 3.4. The development of human capital, ICTs and R&D in the last 70 years

As we discussed before, the Italian economic panorama changed a lot in the last 70 years: the first part was characterized by an incredible economic, industrial and social growth, whereas in the last 40 years the economic and industrial development has started to decelerate. By the way, the remarkable increase of the so-called *Italian boom* allowed the country to become a developed and wealth country that still nowadays has an important role in the economic scenario. Moreover, we understood that Italy has some exceptional particularity in its socioeconomic composition. The main are the different development between the more industrialized and technological northern-central area of the country and the less industrialized southern area; the second is related to the exceptional evolution of the Italian industrial structure that is mainly composed and sustained by Small and Medium Enterprises (SMEs).

The investments in R&D, science and new technologies is one of the key elements for the economic, social and cultural development of a country. At the first stages of the Italian Republic, during the *boom*, investments were made especially by the public sector with the double aim to employ more citizens and to develop an Italian industrial sector. For example, many big companies were created in that period, such as ENI and IRI and big firms as FIAT were supported. The IRI, especially, was used as a public hand to invest in many sectors of the Italian industry, in order not only to rebuild infrastructures after the WWII, but also to develop new industrial technologies and sectors.

In the last decades, however, public administration's trend was to cut the funds there were directed to the investments in R&D, whereas private investments consisted in the majority but not sufficient economic mean to develop innovative and new sectors. Moreover, the Italian economy is characterized by the prevalence of SMEs in sectors that often require few-intensity in R&D. In addition, the difficult access to credit and the small dimensions of risk capital market in Italy represent another obstacle for innovative start-ups. OECD's data shows that Italy invested a really little percentage of its GDP in R&D since the 1980s and, also, it was averaging 1 point less than the average percentage of GDP invested in R&D in other OECD countries (Figure 21). In 2018, Italy invested 1.352% of its GDP in R&D whereas the OECD countries invested 2.372%.



**FIGURE 21: PERCENTAGE OF GDP INVESTED IN R&D IN ITALY (RED CHART) AND THE AVERAGE INVESTED IN THE OECD COUNTRIES (LIGHT BLUE CHART).**  
**SOURCE: OECD DATA**

Another information from OECD Data is that in Italy the number of researchers per 1000 employed in 2017<sup>66</sup>. This highlighted another time how Italy doesn't invest like other developed countries: in fact, for both data we mentioned, Italy is the penultimate country among OECD countries.

Despite in Italy the 55,2% of the expenses on R&D are made by firms and private investments (ISTAT, 2017)<sup>67</sup>, we are going to do an overview over the governmental policies (GBARD)<sup>68</sup>, which are strictly related to the investments on human capital and ICTs. To summarize, as we already discussed, financial resources for the R&D in Italy are characterized by a level which is lower than the one of other western countries that are, basically, Italian competitors; a remarkable reduction of the public expenditures with a negative effect on the production of innovative and frontier can be noticed; there are no increases on expenditure in public universities and institutions, which are not able to attract private financings; the greatest unbalance is between the investments in the north and in the rest of the country, especially in the south and in the islands.

Human capital is the essential component of the knowledge society and the so-called knowledge triangle is composed by three elements that interact among them: education,

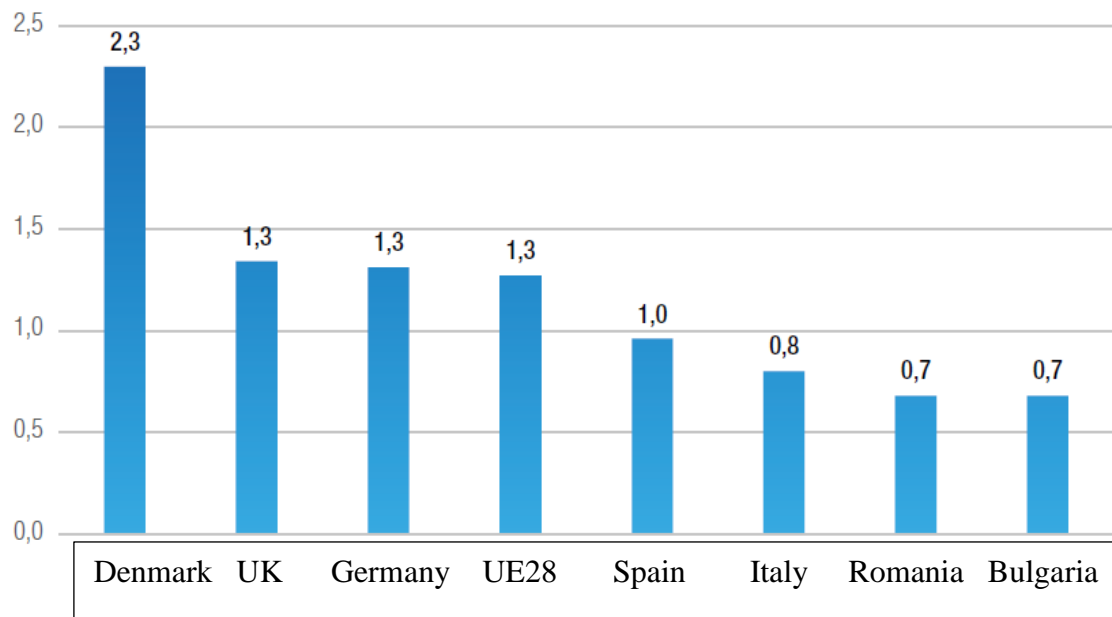
<sup>66</sup> Source OECD Data: <https://data.oecd.org/rd/researchers.htm#indicator-chart>

<sup>67</sup> ISTAT, "Ricerca e Sviluppo in Italia – anni 2017-2019" [https://www.istat.it/it/files/2019/09/REPORT\\_RicercaSviluppo\\_2017-2019.pdf](https://www.istat.it/it/files/2019/09/REPORT_RicercaSviluppo_2017-2019.pdf)

<sup>68</sup> Government Budget Allocations for R&D (GBARD).

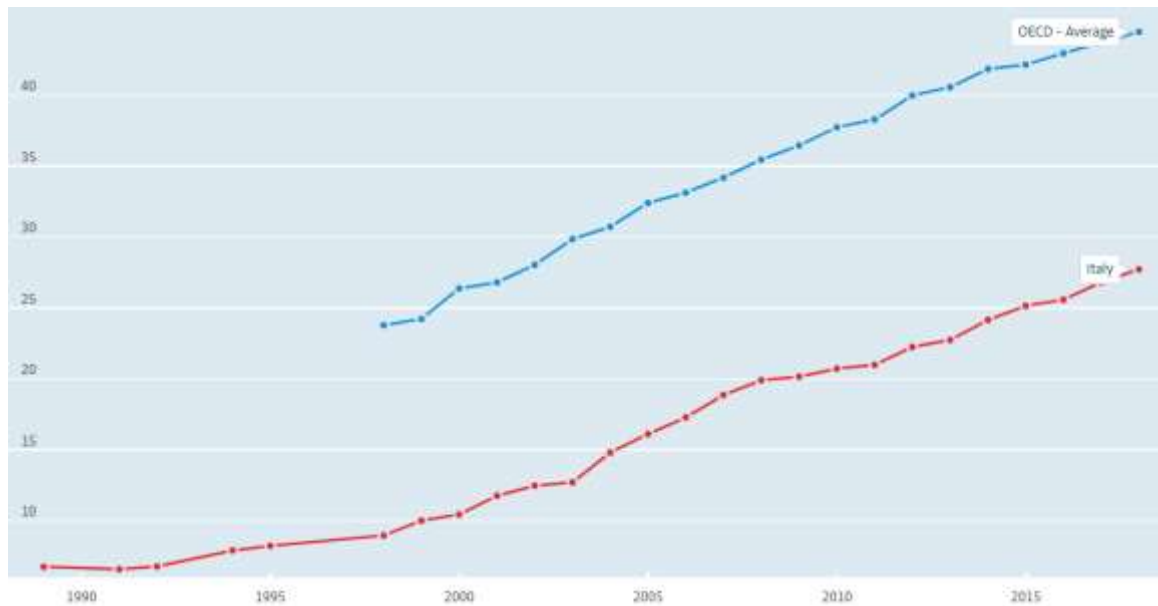


research and innovation. Hence, investments in R&D are fundamental and strictly connected to education, especially to the tertiary education, because the knowledge triangle couldn't be efficient without high skilled human resources. First of all, also for what concerns investments in *higher education*, public expenditures in tertiary education in Italy of the GDP is 0,8%, the worst percentage among the European western countries (EUROSTAT, 2017). (Figure 22)



**FIGURE 22: PERCENTAGE OF GDP IN PUBLIC EXPENDITURE ON TERTIARY EDUCATION IN 2014.**  
SOURCE: EUROSTAT, 2017

The insufficient investments in universities make Italy one of the European countries with the lowest percentage of graduated people: in the range of age between 25 and 34 years old, only 27% of the population are graduated, in contrast with the European average of 44.5% (OECD, 2018). (Figure 23)



**FIGURE 23: PERCENTAGE OF POPULATION 25-34 YEARS-OLD WITH TERTIARY EDUCATION IN ITALY (RED CHART) AND IN THE OECD COUNTRIES (BLUE CHART). SOURCE: OECD DATA**

Furthermore, the percentage of graduated people in the population falls to 12% in the range of age between 25 and 64, where the European countries show an average of 27%. The same happens for PhD, the higher level of the tertiary education and often with a key role for innovation: Italy occupies the last position of the rankings with other European western countries, with just 4 doctorates every 1000 inhabitants. The levels of school drop-out and of Not in Employment, Education, or Training (NEET)<sup>69</sup> are very high and differ between the North and the South of Italy and from the rest of EU. The public expenditure on education in Italy as a percentage of GDP, as we can see, is traditionally below the average of European and OECD countries. Indeed, in 2014, Italy spent 4% of its GDP on education, compared to an OECD average of 5.2% and a European average of 4.9%.

The reasons of this insufficiency of investments are various and, moreover, the lack of a long-term political vision, the huge public debt (134.8% of Italian GDP, source EUROSTAT 2018) are some of the factors that don't allow great investments.

One of the ways to analyze the level and the quality of the production of new knowledge of a country is the analysis of the scientific researches and publications. Indeed, publications represent a good proxy of the entire scientific production of a research system. Contrary to what we already said about the Italian educative system, Italy greatly improved

<sup>69</sup> Italy has one of the highest levels of NEET in OECD countries for population between 15 and 29 years-old with a level of 27,4%.

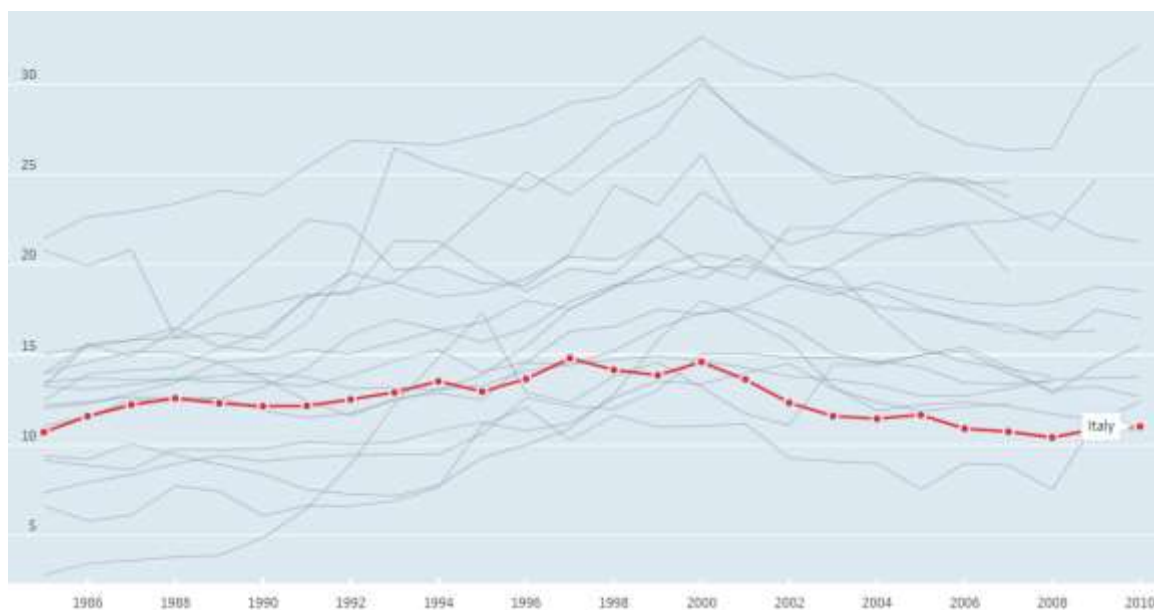
the number of publications. In fact, Italy rose from 3.3% of scientific publications in 2000 to 4.0% in 2016 with an average annual increase of 1.9%. From the third to last position among the country analyzed in 2000, in 2016 Italy has practically reached the United Kingdom that has always been at the top of this ranking. The disciplines in which Italy offers the greatest contribution on world advances in knowledge are Physics (7.3%) and Medicine (7.2%), a situation that has remained unchanged if compared to 2000. At the last places we find Chemistry (4.2%), and Psychology (4.2%), while in 2000 there were Economics and Statistics and again Psychology.

Another way to highlight the technological level and innovation activities of a country are patents. In terms of patents per capita, Italy confirms as a country with a low propensity to patenting. The sector in which Italy, together with Germany, has a strong specialization and that collect the major number of patents is the machinery industry, but at the same time Italy has no relevant position in patenting ICTs. However, on the other hand, Italy is the second country after Germany for what concerns the registration of industrial designs, so a kind of non-technological innovation. This is due especially to the typical manufacture Made in Italy sectors, that are characterized by a lower technological level than hi-tech sectors and that require industrial design protection instead of patents.

Information and Communication Technologies are part of the Key Enabling Technologies (KETs)<sup>70</sup> identified by the European Commission's Horizon 2020 Program, according to which their development is a key element to promote innovation and the competitiveness of a country. The social penetration of digital technologies and their use for work or training reasons, as well as the in-depth analysis of R&D investments by companies in the sector ICT, show a state of weakness of Italy compared to other European and non-European countries and it is particularly marked in the regions of the south. Figure 24 shows the percentage of the total investments made by a country in ICTs. As we can see, Italy allocate 11% of its total investments to research and to develop the ICTs sector, one of the lowest percentages among OECD countries showed by the others grey charts.

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<sup>70</sup> European Commission defines the Key Enabling Technologies (KETs) as the technology knowledge-intensive and associated with high intensity R&D, rapid cycles of innovation, high human capital and highly labor qualified. They enable innovation in processes, goods and services throughout the economy. They are multidisciplinary, transversal to any technological areas with a trend towards convergence and integration.



**FIGURE 24: PERCENTAGE OF THE TOTAL INVESTMENTS USED FOR ICTS INVESTMENTS.**  
**SOURCE: OECD DATA**

Italy lags significantly behind in terms of digital competitiveness, in particular for the implementation of broadband and “digital skills” of the population. Italy is still behind the average EU-28 on the use of internet among the population: 71% in Italy versus 84% in Europe. Data is very low especially for old people, with an age between 65 and 74 years: indeed, only 29% of them use internet, whereas in Europe the level is 51%. Concerning gen-Z and millennials, they are very close to the European level.

ICTs play an important role also in the relations between citizens and public institutions, in terms of simplification of management procedures of services, but, also, more generally in terms of the dialogue between State and citizens (e-government). Italy is the country with the lowest percentage of “active citizens” among the countries considered, that interact with public institutions by internet. In fact, only 24% of Italians communicate with public authorities on institutional sites, whereas in France is the 65% and the OECD average is above 50%. For what concerns the penetration of mobile and fixed broadband, Italy is in line with the European expectations and recommendations both for private citizens and for firms with a usage of 93%. As we see, Italy has a historical gap in expenditures on ICTs in % of GDP respect the other countries, but it is important to highlight that in absolute terms Italy is the 6<sup>th</sup> biggest contributors in the world to invest in ICTs.

However, after all we said in this paragraph, Italy maintained a secondary role in the development of ICTs and often it is very below to the levels of other developed countries.

This is certified by the ICT Development Index (IDI) by International Telecommunication Union (ITU), that ranks Italy at the 47<sup>th</sup> place in the world in comparison with ICTs performance within and across the countries and information societies.

In 2016, the Italian government tried to introduce some new policies in order to develop the investments on R&D and ICTs. The main are the “National Program for Research” (Programma Nazionale per la Ricerca, PNR) for the five-year period 2015-2020 and with the aim to allocate financial resources by EU and Italian government in order to develop research programs; “Industry 4.0 Strategy”, with the aim to incentive investments in the innovation of the manufacturer sector thanks to fiscal deduction, benefits for risky capitals, aid to the high technological infrastructures and to the universities to spread new developed technologies; new fiscal regime for those investments in R&D and to new patenting; the “Intelligent Specialization National Strategy” (Strategia Nazionale di Specializzazione Intelligente), made by the Ministry of Economic Development and the Ministry of Education, who have selected 5 main areas on which Italy should pursue a path of specialization: aerospace and defense; health, food and quality of life; intelligent and sustainable industry, energy and environment; tourism, cultural heritage and the creativity industry; digital Agenda, smart communities, infrastructure and intelligent mobility systems. Finally, the last policy consists in financing the universities and their research projects basing on their merit (FFO).

### 3.5. Analysis of the Economic Complexity Index of Italy

As we did for chapter 2, now we are going to do an analysis of the Italian productive structure by the point of view of the Complexity Economics. In chapter 1 we said that an economy is considered complex if its productive structure is able to produce complex goods. To produce and then export complex products means to create sophisticated goods with a revealed comparative advantage. For this reason, they cannot be reproduced easily by the competitors and give economic value to the economy of that country. The ability to make sophisticated products depends by many factors. The most important is the development of human capital that allows the formation of high skilled workers, able to create certain complex products and, as a positive spillover, allowing the growth of social

capital and positive networks too. Lastly, in this globalized world the key role is assumed by ICTs, that enable the speed of the development.

In this chapter 3 we analyzed the case of the Italian Republic, better known just as Italy. This country after WWII in a very short period of time developed an important productive structure, also thanks to the European policies but, as we said, it didn't pursue effective long-term strategies and policies to develop Italian industries in the world market. Indeed, what is called and export as Made in Italy are products with a small level of knowledge and with a small revealed comparative advantage. Moreover, Italy lacks in the educational system and in ICTs infrastructure, despite its status of developed countries.

After this introductory overview with the key factors, according to the Economic Complexity Index (ECI), in 2017 Italy ranked 12<sup>th</sup> among 126 economies in the world by the Observatory of Economic Complexity (OEC), with a value of 1.12. In 2017, the last year in which data was collected by OEC, Italy exported \$482 billion, positioning as the 7<sup>th</sup> largest exporters in the world among 221 countries.



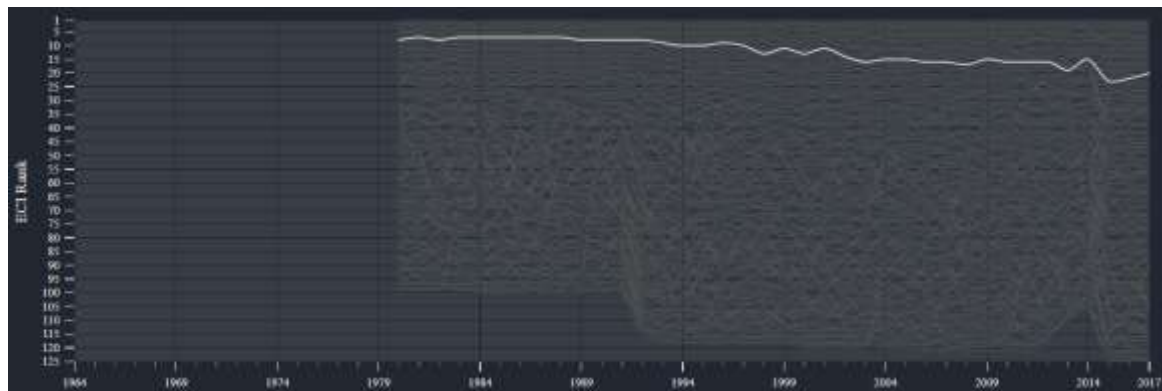
**FIGURE 25: TREEMAP OF EXPORTS OF ITALY.**  
**SOURCE: OBSERVATORY OF ECONOMIC COMPLEXITY (OEC)**

Using the HS92 classification (1992 revision of the Harmonized System) and thanks to this tree map visualization (Figure 25), we can see that the most exported products by Italy are packaged medicaments (\$21.7B), cars (\$18.5B), refined petroleum (\$13.7B), vehicle parts (\$13.2B) and valves (\$7.73B).

According to the Product Complexity Index (PCI), packaged medicaments are the 7<sup>th</sup> most traded product and it ranked as the 284<sup>th</sup> most complex product of a total of over 1232 products classified (Product Complexity = 0,822). For what concerns cars and any kind of vehicles, they are the 2<sup>nd</sup> most traded product and the 277<sup>th</sup> most complex good with a

Product Complexity (PC) = 0.833. Refined petroleum is the 4<sup>th</sup> most traded product in the world but with a PC of -0.889 it occupies only the 957<sup>th</sup> place of 1232 products as a complex good. Then, regarding vehicle parts, they are the 6<sup>th</sup> most traded product in the world and the 173<sup>rd</sup> most complex product with a PC of 1.09. Finally, the 5<sup>th</sup> most exported products by Italy are valves which are the 26<sup>th</sup> most traded product but they are the 64<sup>th</sup> most complex product with a value of 1.48 according to PCI. As we can see, all the most exported products by Italy are also those products that are most likely traded worldwide and also their level of complexity is quite high considering their concentration among countries. The most imported products are especially cars and crude petroleum that is scarce in Italy.

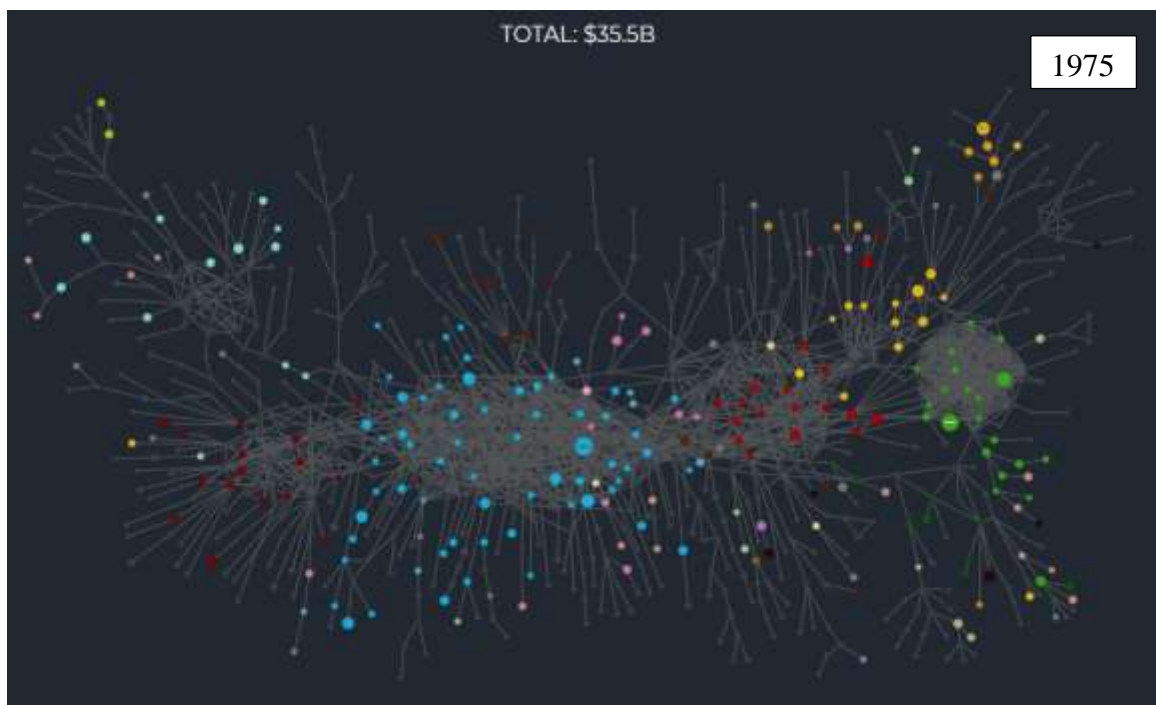
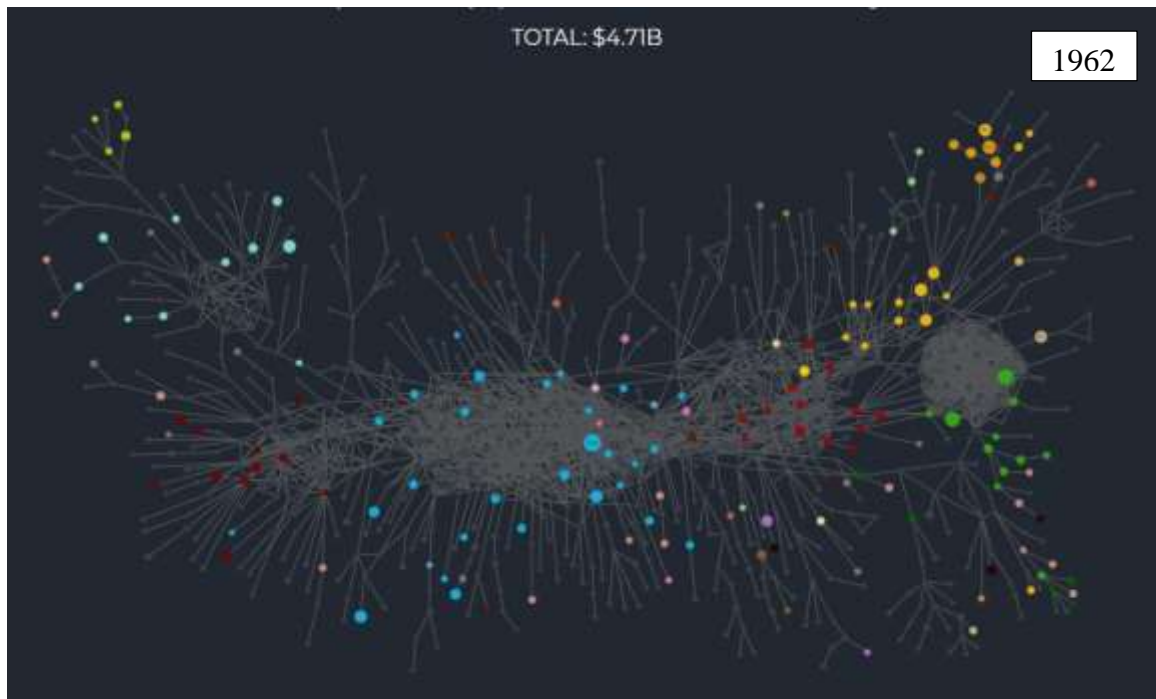
The figure 26 shows the Economic Complexity ranking highlighting the Korean complexity path in the time. The ranking starts in 1980, when Italy occupied the 8<sup>th</sup> position among 99 countries studied, that means that the country was very focused on the export of sophisticated products in the 80s. Since that year, the rank of Italy slight declined over the time until reaching the worst performance, ranking in the 23<sup>rd</sup> position in 2014. This indicates that the decrease of the complexity was gradual and constant because of those policies that weren't particularly effective.



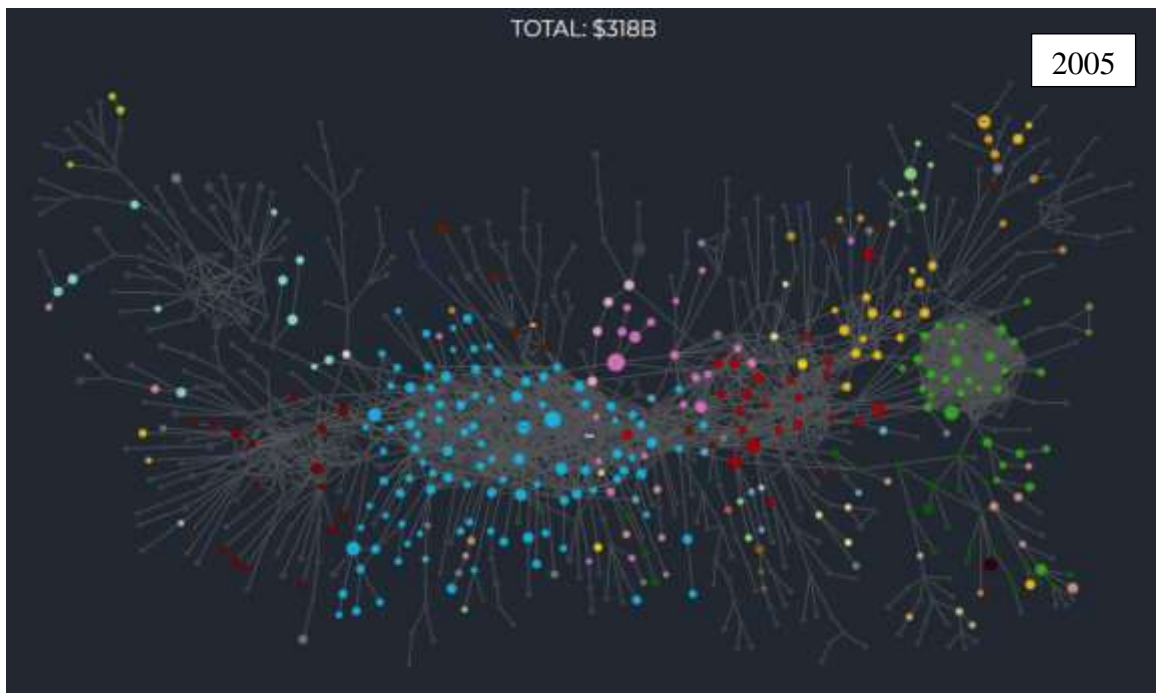
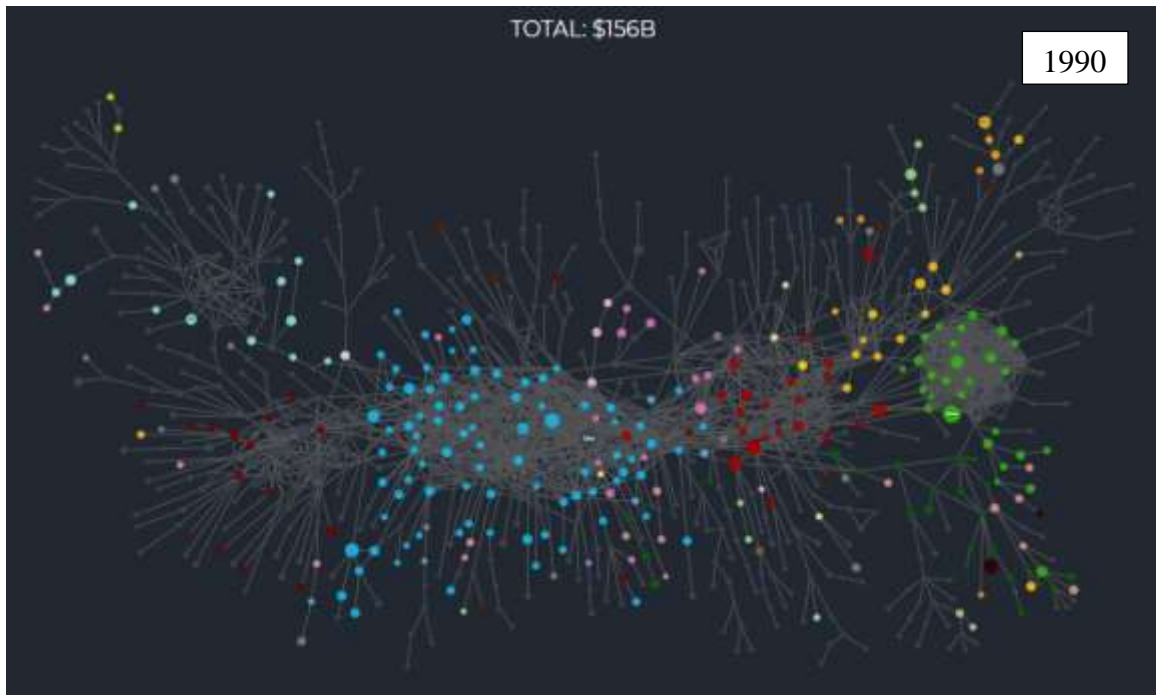
**FIGURE 26: RANKING OF COUNTRIES BY ECI (ITALY IS THE CHART HIGHLIGHTED).**  
**SOURCE: OBSERVATORY OF ECONOMIC COMPLEXITY (OEC)**

Lastly, we can analyze the product space of Italy, in which those products who have a revealed comparative advantage - and that we already mentioned above - are colored. The colored points indicate those products that represent the main opportunities of export for Italy. The figure at the following pages (Figure 27) represents the path of Italian product space from 1962 (in the middle of the economic boom) to nowadays. It is interesting to notice how the economic development and industrial changes of the country in the last 60 years is properly described. In fact, we can see that in 1962 the economy of Italy was

already developed for that time, and that the exports were already \$4.71 billion. The products with an RCA exported (the colored points) were related to, as we said before, the textile sector, cars and motorcycles (FIAT, Piaggio), agricultural products, calculating machines (Olivetti) and metal processed products (ILVA).







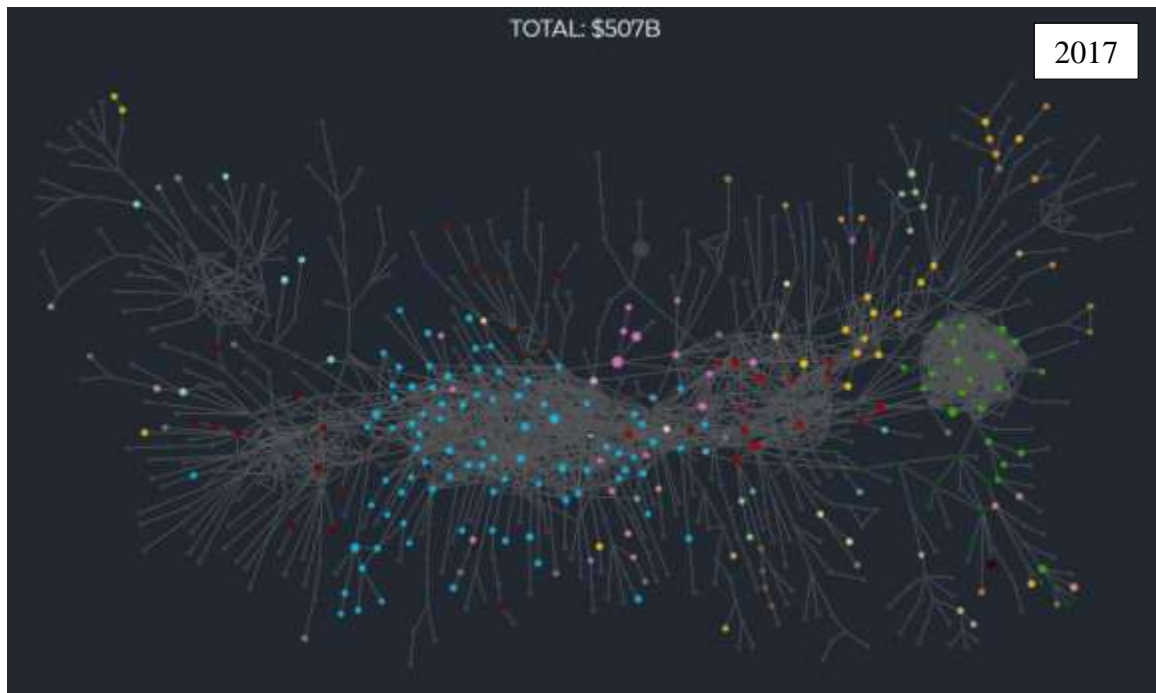


FIGURE 27: PRODUCT SPACE OF ITALY IN THE YEARS 1962, 1975, 1990, 2005, 2017 BY OEC.

In 1975, the economic boom was still effective and, indeed, the exports grew at \$35.5B. The machinery sector (cars and related) increased enormously, too (the light blue area on the center of the product space), and, also, the textile sector grew – pictured in the figure with the green center in the right side. In 1990, when the exports reached the level of \$156 billion, the product space certified the continuous growth of the sector of machinery and textiles, but also the exports of heavy processed metals grew considerably. The following product space that refers to the year 2005 with \$318B of export, shows the maximum expansion of the machinery, cars and vehicle parts sector (the central blue area) and the stability of the textile one. Moreover, the chemicals and medical industry grew a lot (the pink part on the middle of the product space) and the exports of electronic products definitely declined (the point on the upper left side that in the previous years was colored in light blue). The last product space visualizes the composition of the Italian exports of 2017, with a total value of \$507B exported. The figure shows today's productive structure of Italy: as we can see, compared to the 2005 product space, the value of products with RCA exported decrease, indicating an economic phase of involution. The main sectors remain the traditional of the previous years, which are machinery, medicals and chemicals and textile products.

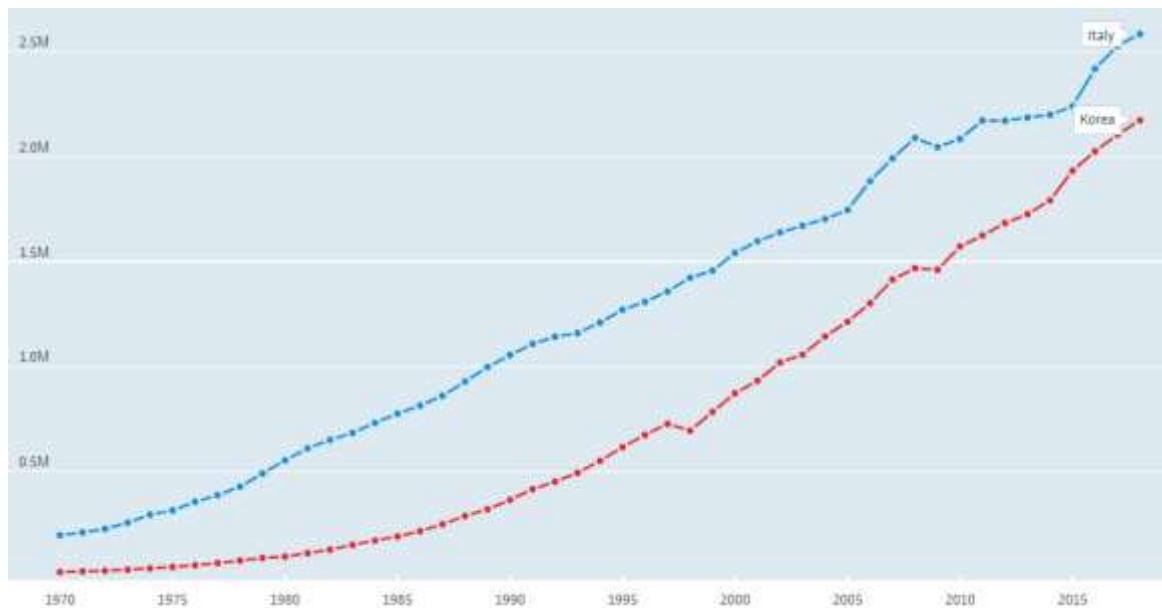
#### 4. Comparison between the Korean and the Italian case: few initial similarities but different paths

In this chapter, we are using some indexes in order to make a comparison between the two countries that have been analyzed in the previous chapters of this work. South Korea and Italy have some similarities but they differ a lot in most of the aspects. They are very similar for what concerns the fundamentals of manufacturing and the scarcity of natural resources, but they present a different economic path and an even more different industrial, social and economic development.

In the next pages we will use indexes that are strongly related to the evaluation of those aspects that represent the basis of the Economic Complexity. Firstly, we will study the evolution of the export flows of the two countries in the last 70 years, their trade openness and all those data related to the international trade. Secondly, we will look at the level of human capital inherent and developed by both South Korea and Italy, thanks to studies and indexes that investigated the quality of education in primary, secondary and tertiary levels and the quality of life. Subsequently, the analysis will move to the monitoring of the discrepancies in the development of ICTs, that are fundamental in today's globalized world and markets. In this way, we will check all the key factors that compose and improve the ECI: export, human capital and ICTs. Finally, the analysis will be conducted under the point of view of the Economic Complexity Index and we will observe the differences in today's productive structure, as well as future developments and predictions of the two countries.

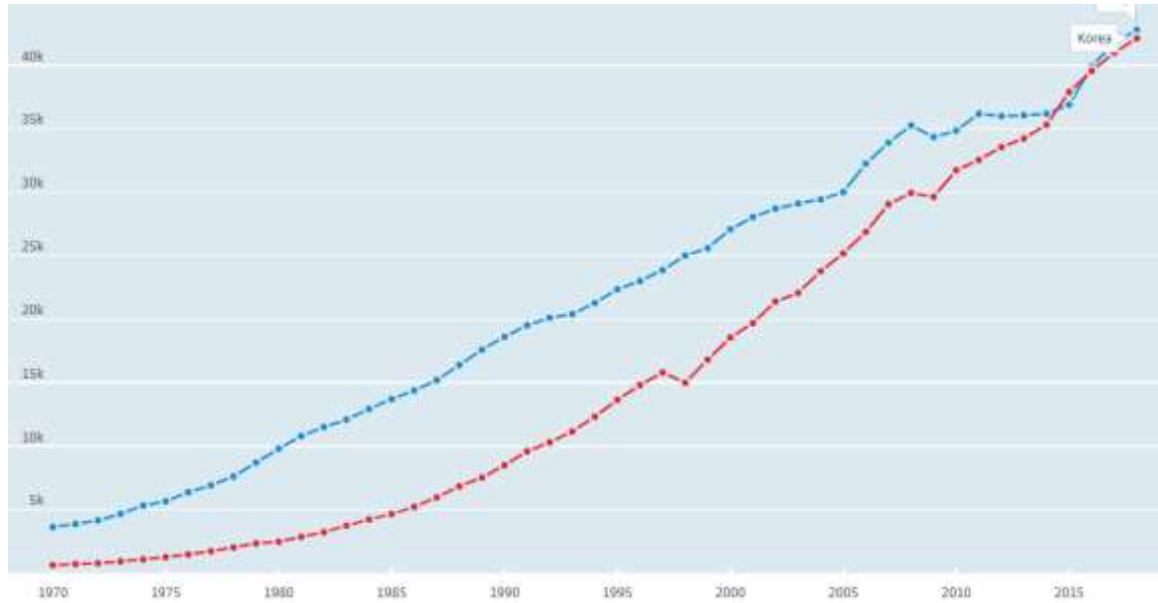
First of all, let's do a panoramic view over the two economies and their development in the last 70 years. As we said in chapter 2, South Korea had a very slow, almost non-existent, growth in the first 30 years, but this was essential to lay the foundations for the following economic acceleration, that started from the 1980s. In fact, the Korean GDP growth can be seen as an exponential growth, whereas the Italian one is more linear. For what concerns Italy, the increase of GDP has been almost stable, but the financial crisis of 2007 has levelled the growth. Just in the last 4 years, the Italian economy has started to grow again. Indeed, South Korea started from a total GDP of \$19,976 million in 1970 and reached the level of \$2,174,501 million in 2018. On the other hand, in the same period, Italy grew from a level of \$195,132 million to \$2,585,938 million (OECD Data). In 1970, the Italian GDP

was ten times bigger than the Korean one, in 1990 it was three times greater, while nowadays the two GDPs are closer. (Figure 28)



**FIGURE 28: TOTAL GDP IN \$ OF ITALY (BLUE CHART) AND SOUTH KOREA (RED CHART) IN THE PERIOD BETWEEN 1970 AND 2018.**  
SOURCE: OECD DATA

The expansion of South Korea is certified by the more impressive increase of Korean GDP per capita, if compared to the Italian case. In 1970, it was just \$620 – six times less than the Italian, that was \$3,626 – whereas nowadays they present almost the same value (\$42,136 for South Korea, \$42,798 for Italy). Figure 29 gives an accurate overview of the growth of the Korean GDP per capita, especially in the last two decades.



**FIGURE 29: GDP PER CAPITA IN \$ OF ITALY (BLUE CHART) AND SOUTH KOREA (RED CHART) IN THE PERIOD BETWEEN 1970 AND 2018.**

SOURCE: OECD DATA

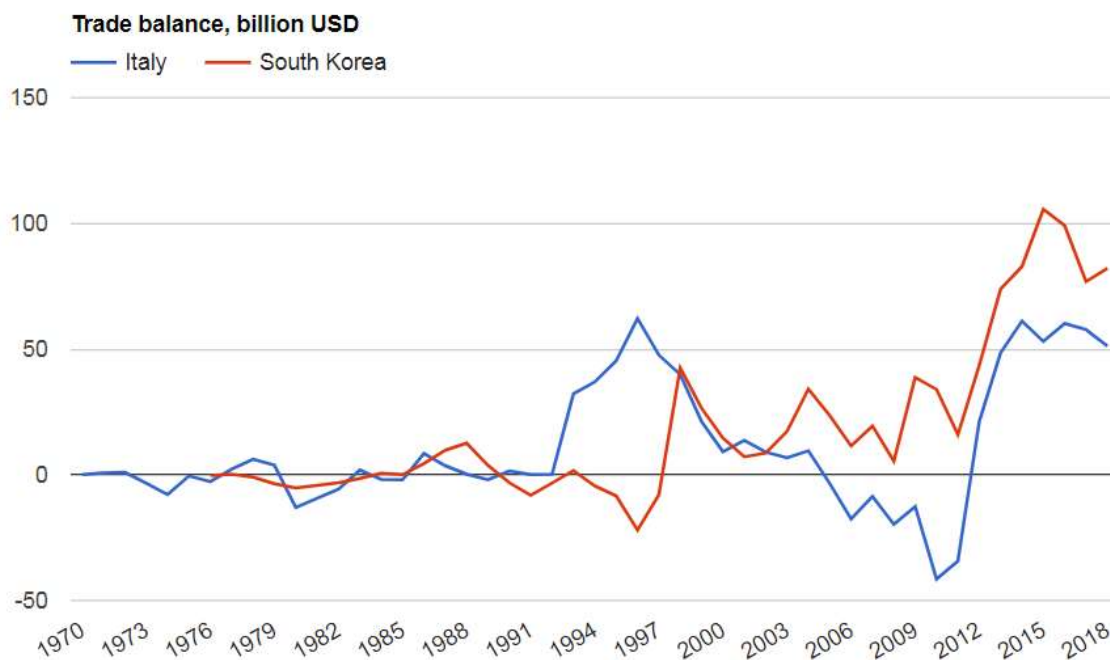
#### 4.1. Analysis of the export orientation of South Korea and Italy

Korean and Italian economies are very similar for their manufacturing structure, but especially for their outward-looking orientation. Since the 1950s, the two countries implemented various policies of export of their products, thanks to trade agreements with other European countries - in the case of Italy - or thanks to low-cost and low-skilled products in the case of South Korea. Indeed, the two countries occupy still nowadays in the top positions as exporters. In 2018, Italy ranked as the 9<sup>th</sup> biggest exporter, whereas South Korea classified 11<sup>th</sup> (WITS<sup>71</sup> - World Bank). Their propensions to the international trade were helped by the fact that both countries took part into international trade organizations. Indeed, it was fundamental for Italy to be among the funding members of ECSC and EEC before, and EU then. On the other side, South Korea got great improvements and benefits from the entrance in the WTO regime in 1995 and after the Asian financial crisis of 1997. Both countries present a very positive trade balance in the last years. The Italian trade balance was almost stable at 0 until the decade of the 1990s. Then, it became negative

<sup>71</sup> The World Integrated Trade Solution (WITS) is a joint agency by World Bank, United Nations Conference on Trade and Development (UNCTAD), United Nations Statistical Commission (UNSC), WTO and International Trade Center (ITC). The WITS software provides access to merchandise trade, tariff and non-tariff measures data.

during the period between 2005 and 2012, but in the last years it started to rise again. South Korea, instead, remained constant at 0 until 1998, when it finally became positive and this trend is continuing still nowadays. In 2018, the Asian country ranked as the 8<sup>th</sup> biggest positive trade balance with \$82,130 million, whereas the European one figured as 10<sup>th</sup>, with \$51,210 million.

Figure 30 shows the trend of the trade balances of the two countries between 1970 and 2018 (World Bank Data). Furthermore, their trade openness is quite high in relation to their economic dimensions. Indeed, the Korean openness to the trade is 83%, whereas the Italian one is 60.72%. Data refers to the year 2018.



**FIGURE 30: TRADE BALANCE IN \$ OF ITALY (BLUE LINE) AND SOUTH KOREA (RED CHART) IN THE PERIOD BETWEEN 1970 AND 2018.**  
**SOURCE: WORLD BANK**

Both South Korean and Italian economies, hence, as we checked, are opened to international markets and export oriented. This outward-looking strategy started with the first policies that tried to push exports of both countries, despite they started to have positive balances only since the 1990s. We will see further inequalities in their productive structures that will differentiate more their economic path, especially in the future.

## 4.2. Human Capital captured by PISA Report, Human Capital Index and Human Development Index

Human capital plays a central role in the development of a country, delivering effective economic benefits in the long term. However, the benefits of these investments often take time to materialize: the advantages that they bring to the society and to the economy of a country are not always visible, which usually leads to underinvestment in human capital. As we discussed in the previous chapters, long term strategies in education in South Korea and in Italy were very different. On the one hand, the Asian country invested a lot in education and research since the 60s in order to form high skilled workers for the future development of the productive structure. At the same time, the Mediterranean Sea didn't invest over the course of time in R&D, education and public expenditures, which on the contrary were often cut. So, these opposite policies and strategies are reflected the differences of the two countries according to the various indexes used to evaluate the development of human capital.

We will now analyze the scores of the two countries in the PISA tests, in order to check their level in primary and secondary education; later, we will look at the percentage of population owning a tertiary degree and, finally, we will compare South Korea and Italy under the perspective of the Human Capital Index (HCI) and Human Development Index (HDI).

### *PISA Report and tertiary education level*

PISA is the OECD's Program for International Student Assessment and it measures the abilities and knowledge of students in reading, mathematics and science at the age of 15 years old across the world; it is held every 3 years. Depending on the average scores of its students, each country is classified from level 1c (the lowest) to level 6 (the highest). In PISA tests of 2018, South Korea ranked 9<sup>th</sup> in the world in reading, with a score of 518 (level 3), whereas Italy scored 476 and it was put in level 2, occupying a very low position in the classification.

For what concerns mathematics, both countries belonged to level 3, but South Korea was among the top performing countries with a score of 526. Along with Japan that scored 527, they are the only two proper nations in the top ranking; in fact, the other countries on the

top are instead particular area or small city-state such as B-S-J-Z (China took part to this test only with the students of some high school of Beijing, Shanghai, Jiangsu and Zhejiang), Singapore, Macao (China), Hong Kong (China) and Chinese Taipei: those are all areas where it is easier to educate the students properly and homogeneously. Italy, on the other side, despite being part of level 3, is at the bottom of this group with a score of 487.

Comparing now countries' performance in science, Korea ranked 7<sup>th</sup> in the world (level 3 with a score of 519), whereas Italy appears in the 40<sup>th</sup> position, with a score of 468, under some other less developed countries such as Turkey, Ukraine and Belarus. By the way, both countries reached a mean performance above the OECD average. In relation to their socio-economic status, South Korea figures as the 8<sup>th</sup> best performers among countries (excluded B-S-J-Z, Singapore, Hong Kong, Macao and Chinese Taipei), while Italy occupies the 20<sup>th</sup> position, just a little above the OECD average. Figure 31 shows the mean performance by international decile of socio-economic status.

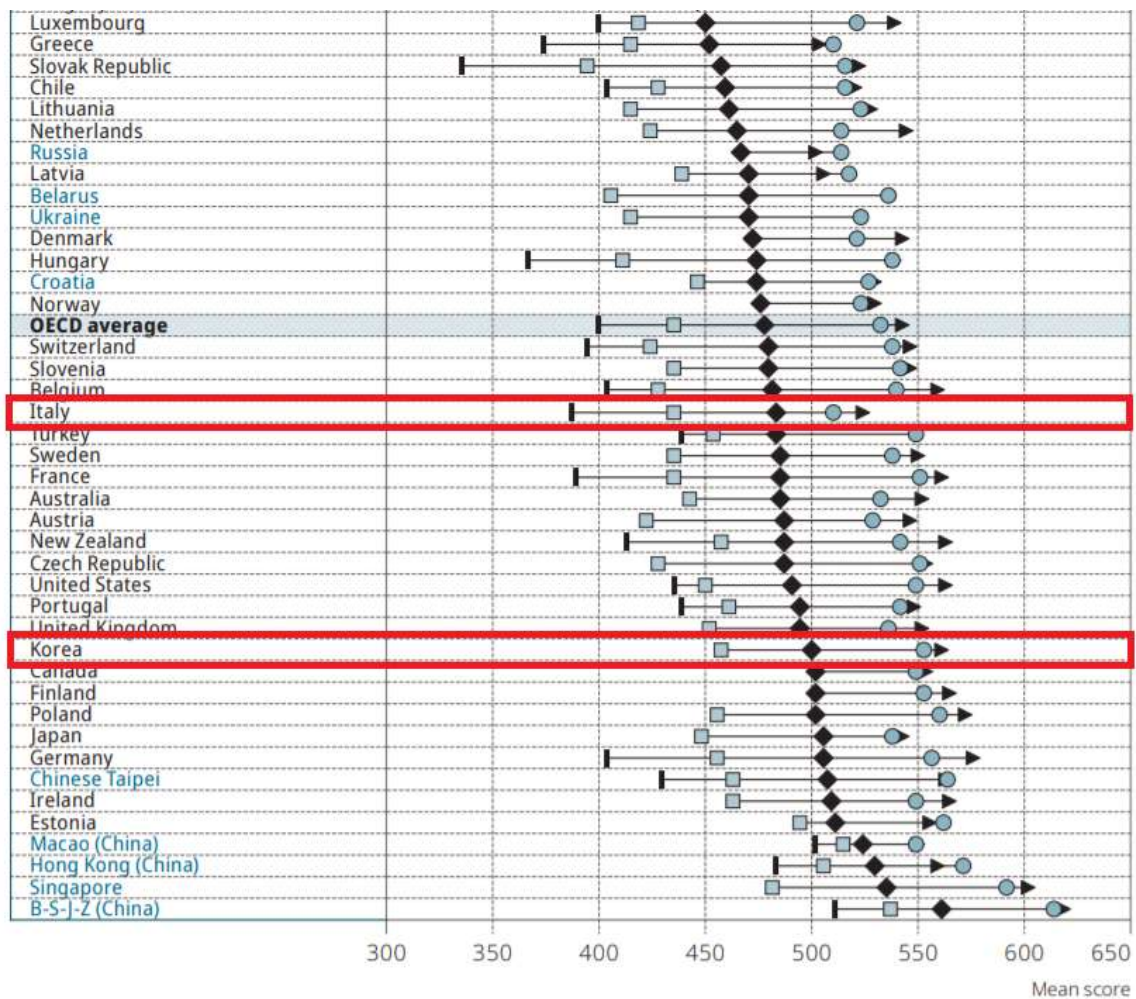
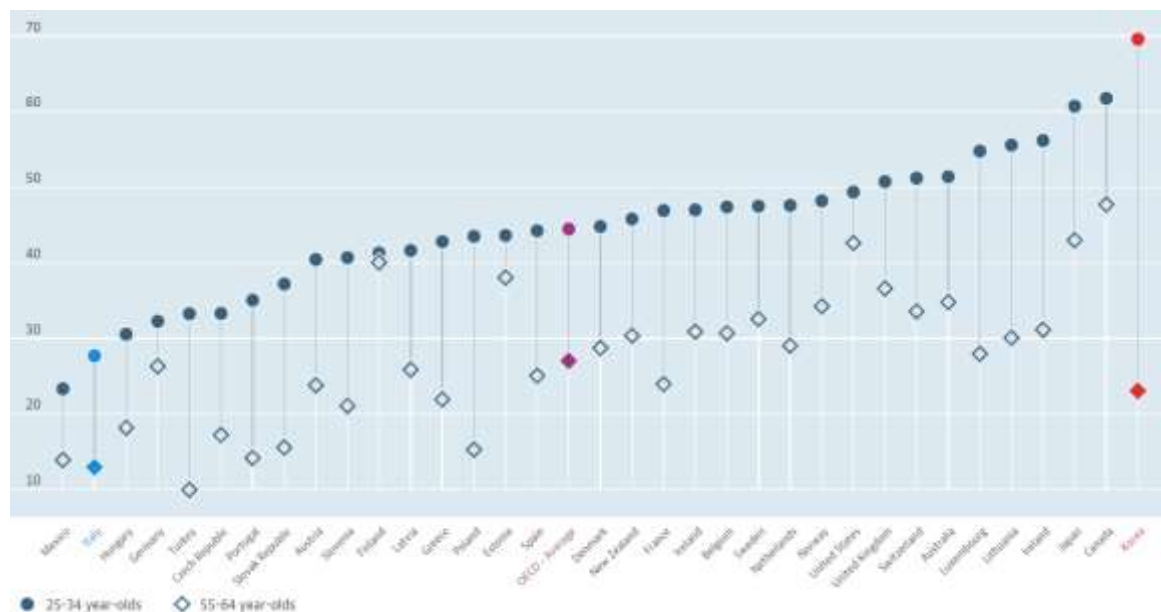


FIGURE 31: MEAN PERFORMANCE BY INTERNATIONAL DECILE OF SOCIO-ECONOMIC STATUS.  
SOURCE: PISA REPORT 2018



Another data that has to be highlighted and that demonstrates great gap between the two countries, is the percentage of population owning a tertiary degree in 2018. Thanks to OECD data represented in Figure 32, only the 27.7% of people with an age between 25 and 34 years old in Italy holds a university degree among the population with the same age range, and the percentage drops to 13% for that part of the population with an age between 55 and 64 years old. Both data brings Italy to position as the penultimate country in this rank among all OECD countries. On the other hand, in South Korea, people with a tertiary education within the 55-64 years old range are 23.1% and the percentage increases greatly for the population with an age included between 25 and 34 years old with a stunning level of 69.6%, the highest among OECD countries. In 2018, the average of OECD countries is 27% for the range 55-64 years old and 44.5% for the range 25-34. Therefore, Italy shows a very low level of tertiary education while, oppositely, South Korea is the top performer in the youngest university generation.



**FIGURE 32: PERCENTAGE OF POPULATION OWNING A TERTIARY DEGREE AMONG GENERATION 25-34 YEARS OLD AND GENERATION 55-64 YEARS OLD.**  
**SOURCE: OECD DATA**

PISA scores and tertiary degree percentage show big differences in the two countries' education level. The results clearly demonstrate the ineffective education policies led by Italy and a super-efficient tertiary strategy led by South Korea. These data lays at the basis of the construction of the Human Capital Index and Human Development Index.

### *The Human Capital Index*

The Human Capital Index (HCI) is provided by the World Bank and it quantifies the contribution of health and education to the productivity of the next generation of workers, giving a new definition of human capital. It is a statistical tool based on people's health, their level of education and their standard of living, measuring, in this way, a country's overall achievement in its social and economic dimensions. The HCI calculates the amount of human capital that a child born today can expect to attain by the age 18 in each country of the world. It is composed by six sources that, once summed, give the value of the HCI of that country; it is included between 1 and 0, where 1 is the maximum level of human capital. The six parts that contribute to create the total value of the index are:

- Probability of Survival to Age 5, that is calculated by subtracting the under-5 mortality rate from 1. Data is retrieved from the UN Interagency Group for Child Mortality Estimates supplemented with data provided by World Bank staff.
- Expected Years of School, that is calculated as the sum of age-specific enrollment rates between ages 4 and 17. Age-specific enrollment rates are approximated using school enrollment rates at different levels: pre-primary enrollment rates approximate the age-specific enrollment rates for 4 and 5 year-olds; the primary rate approximates for 6-11 years-old; the lower-secondary rate approximates for 12-14 year-olds; and the upper-secondary approximates for 15-17 year-olds. Enrollment rates are retrieved from the UNESCO Institute for Statistics supplemented with data provided by World Bank staff.
- Harmonized Test Scores, that are retrieved from Global Database on Education Quality. The database harmonizes scores across major international student achievement testing programs measured in TIMSS<sup>72</sup>-equivalent units, where 300 is the minimal attainment and 625 is the advanced attainment.
- Learning-Adjusted Years of School, which are calculated by multiplying the estimates of expected years of school by the ratio of most recent harmonized test scores to 625, where 625 corresponds to the advanced attainment in the TIMSS test.
- Fraction of Children Under 5 Not Stunted, that is calculated by subtracting stunting rates from 1. Stunting rates are retrieved from UNICEF-WHO-World Bank Joint Malnutrition Estimates, supplemented by data provided by World Bank staff.

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<sup>72</sup> Trends in International Mathematics and Science Study (TIMSS) is an assessment on large scale that provides an international perspective on teaching and learning in mathematics and science.

- Adult Survival Rate, that is calculated by subtracting the mortality rate for 15-60 years-old from 1. Mortality rates for 15-60 years-old are retrieved from the United Nations Population Division – World Population Prospects, supplemented with data provided by World Bank staff.

The sum of all these components gives the HCI as the contributions of education and health to worker productivity. The following figure (Figure 33) shows the ranking of the first positions by HCI.

| Rank | Country Name         | WB Code | Probability of Survival to Age 5 | Expected Years of School | Harmonized Test Scores | Learning-Adjusted Years of School | Fraction of Kids Under 5 Not Stunted | Adult Survival Rate | HUMAN CAPITAL INDEX |
|------|----------------------|---------|----------------------------------|--------------------------|------------------------|-----------------------------------|--------------------------------------|---------------------|---------------------|
| 1    | Singapore            | SGP     | 1,00                             | 13,9                     | 581                    | 12,9                              | ..                                   | 0,95                | 0,88                |
| 2    | Korea, Rep.          | KOR     | 1,00                             | 13,6                     | 563                    | 12,2                              | 0,98                                 | 0,94                | 0,84                |
| 3    | Japan                | JPN     | 1,00                             | 13,6                     | 563                    | 12,3                              | 0,93                                 | 0,94                | 0,84                |
| 4    | Hong Kong SAR, China | HKG     | 0,99                             | 13,4                     | 562                    | 12,1                              | ..                                   | 0,95                | 0,82                |
| 5    | Finland              | FIN     | 1,00                             | 13,7                     | 548                    | 12,0                              | ..                                   | 0,93                | 0,81                |
| 6    | Ireland              | IRL     | 1,00                             | 13,7                     | 538                    | 11,8                              | ..                                   | 0,95                | 0,81                |
| 7    | Australia            | AUS     | 1,00                             | 13,8                     | 524                    | 11,6                              | 0,98                                 | 0,95                | 0,80                |
| 8    | Sweden               | SWE     | 1,00                             | 13,9                     | 525                    | 11,7                              | ..                                   | 0,95                | 0,80                |
| 9    | Netherlands          | NLD     | 1,00                             | 13,8                     | 530                    | 11,7                              | ..                                   | 0,94                | 0,80                |
| 10   | Canada               | CAN     | 0,99                             | 13,7                     | 537                    | 11,7                              | ..                                   | 0,94                | 0,80                |
| 11   | Germany              | DEU     | 1,00                             | 13,9                     | 528                    | 11,7                              | ..                                   | 0,93                | 0,79                |
| 12   | Austria              | AUT     | 1,00                             | 13,9                     | 525                    | 11,7                              | ..                                   | 0,94                | 0,79                |
| 13   | Slovenia             | SVN     | 1,00                             | 13,6                     | 532                    | 11,6                              | ..                                   | 0,93                | 0,79                |
| 14   | Czech Republic       | CZE     | 1,00                             | 13,9                     | 522                    | 11,6                              | ..                                   | 0,92                | 0,78                |
| 15   | United Kingdom       | GBR     | 1,00                             | 13,9                     | 517                    | 11,5                              | ..                                   | 0,94                | 0,78                |
| 16   | Portugal             | PRT     | 1,00                             | 13,8                     | 520                    | 11,5                              | ..                                   | 0,93                | 0,78                |
| 17   | Denmark              | DNK     | 1,00                             | 13,4                     | 531                    | 11,4                              | ..                                   | 0,93                | 0,77                |
| 18   | Norway               | NOR     | 1,00                             | 13,7                     | 512                    | 11,2                              | ..                                   | 0,94                | 0,77                |
| 19   | Italy                | ITA     | 1,00                             | 13,6                     | 514                    | 11,2                              | ..                                   | 0,95                | 0,77                |
| 20   | Switzerland          | CHE     | 1,00                             | 13,3                     | 524                    | 11,1                              | ..                                   | 0,95                | 0,77                |
| 21   | New Zealand          | NZL     | 0,99                             | 13,6                     | 517                    | 11,3                              | ..                                   | 0,94                | 0,77                |
| 22   | France               | FRA     | 1,00                             | 14,0                     | 506                    | 11,3                              | ..                                   | 0,93                | 0,76                |
| 23   | Israel               | ISR     | 1,00                             | 13,8                     | 503                    | 11,1                              | ..                                   | 0,95                | 0,76                |
| 24   | United States        | USA     | 0,99                             | 13,3                     | 523                    | 11,1                              | 0,98                                 | 0,90                | 0,76                |

FIGURE 33: COMPOSITION OF HCI.  
SOURCE: WORLD BANK

Figure 33 represents the composition of the HCI by World Bank in 2018 for the top 24 countries among the 158 considered.

As we can see, South Korea (in red) occupies the 2<sup>nd</sup> place with a HCI of 0,84 shared with Japan, whereas Italy (in blue) has the 19<sup>th</sup> position with a HCI of 0,77. While the values of the probability of Survival at Age 5, the Expected Years of School and the Adult Survival Rate are equal or very similar, the biggest difference is embodied by the very different levels in Harmonized Test Scores and Learning-Adjusted Years of School. This fact highlights another time the better quality and high level of the Korean education compared

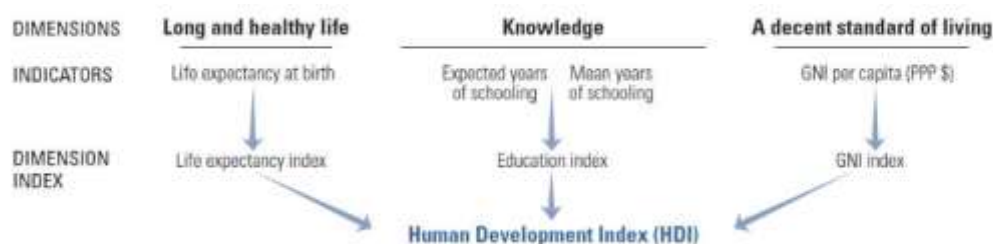
to the Italian one, while health indicators are almost equal. So, this ensure a greater productivity for the next generation of Korean workers.

### *The Human Development Index*

Lastly, we are going to look at the differences in human capital between South Korea and Italy using the Human Development Index (HDI) that is published every year in the Human Development Report by the United Nations Development Program. The aim of the HDI is to move the focus on people and their capabilities, as an ultimate criteria for assessing the entire development of a country and not just its economic growth. The Human Development Index is a sum of the average achievements in three key dimensions of human development:

- 1) A long and healthy life;
- 2) Knowledge;
- 3) A decent standard of living.

The health dimension is measured by life expectancy at birth; the education dimension (knowledge) is assessed by mean of the years of schooling for adults aged 25 and more, and expected years of schooling for children at the entering age of school; the decent standard of living dimension is calculated by Gross National Income (GNI) per capita (PPP \$). The scores of the three HDI dimension indices are then summed to define HDI using geometric means. (Figure 34)



**FIGURE 34: THE COMPOSITION OF HDI.**  
**SOURCE: UNITED NATIONS DEVELOPMENT PROGRAM**

Figure 35 shows the top ranked countries according to their HDI in the Human Development Report of 2018. As we can denote, South Korea occupies the 22<sup>nd</sup> position shared with Israel, thanks to the aggregate HDI of 0.906, whereas Italy is in the 29<sup>th</sup> place, with the total value of 0.803. The total amount of the countries analyzed is 189. The figure

depicts, also, the components of HDI: life expectancy at birth, expected years of schooling and the Gross National Income per capita are almost equal between the two countries. The only indicator that differs is the mean years of schooling, according to which South Korea shows an average of two years more than Italy; this indicates that, in the past decades, there were a substantial minor presence of Italians at school due to early drop outs or to the possibility to leave school at 14 years old.

| HDI rank                           | Human Development Index (HDI) | Life expectancy at birth | Expected years of schooling | Mean years of schooling | Gross national income (GNI) per capita |                      |
|------------------------------------|-------------------------------|--------------------------|-----------------------------|-------------------------|--|----------------------|
|                                    | Value                         | (years)                  | (years)                     | (years)                 | (2011 PPP \$)                          |                      |
|                                    | 2018                          | 2018                     | 2018 <sup>a</sup>           | 2018 <sup>a</sup>       | 2018                                   |                      |
| <b>VERY HIGH HUMAN DEVELOPMENT</b> |                               |                          |                             |                         |  |                      |
| 1                                  | Norway                        | 0.954                    | 82.3                        | 18.1 <sup>b</sup>       | 12.6                                   | 68,059               |
| 2                                  | Switzerland                   | 0.946                    | 83.6                        | 16.2                    | 13.4                                   | 59,375               |
| 3                                  | Ireland                       | 0.942                    | 82.1                        | 18.8 <sup>b</sup>       | 12.5 <sup>c</sup>                      | 55,660               |
| 4                                  | Germany                       | 0.939                    | 81.2                        | 17.1                    | 14.1                                   | 46,946               |
| 4                                  | Hong Kong, China (SAR)        | 0.939                    | 84.7                        | 16.5                    | 12.0                                   | 60,221               |
| 6                                  | Australia                     | 0.938                    | 83.3                        | 22.1 <sup>b</sup>       | 12.7 <sup>c</sup>                      | 44,097               |
| 6                                  | Iceland                       | 0.938                    | 82.9                        | 19.2 <sup>b</sup>       | 12.5 <sup>c</sup>                      | 47,566               |
| 8                                  | Sweden                        | 0.937                    | 82.7                        | 18.8 <sup>b</sup>       | 12.4                                   | 47,955               |
| 9                                  | Singapore                     | 0.935                    | 83.5                        | 16.3                    | 11.5                                   | 83,793 <sup>d</sup>  |
| 10                                 | Netherlands                   | 0.933                    | 82.1                        | 18.0 <sup>b</sup>       | 12.2                                   | 50,013               |
| 11                                 | Denmark                       | 0.930                    | 80.8                        | 19.1 <sup>b</sup>       | 12.6                                   | 48,836               |
| 12                                 | Finland                       | 0.925                    | 81.7                        | 19.3 <sup>b</sup>       | 12.4                                   | 41,779               |
| 13                                 | Canada                        | 0.922                    | 82.3                        | 16.1                    | 13.3 <sup>c</sup>                      | 43,602               |
| 14                                 | New Zealand                   | 0.921                    | 82.1                        | 18.8 <sup>b</sup>       | 12.7 <sup>c</sup>                      | 35,108               |
| 15                                 | United Kingdom                | 0.920                    | 81.2                        | 17.4                    | 13.0 <sup>e</sup>                      | 39,507               |
| 15                                 | United States                 | 0.920                    | 78.9                        | 16.3                    | 13.4                                   | 56,140               |
| 17                                 | Belgium                       | 0.919                    | 81.5                        | 19.7 <sup>b</sup>       | 11.8                                   | 43,821               |
| 18                                 | Liechtenstein                 | 0.917                    | 80.5 <sup>f</sup>           | 14.7                    | 12.5 <sup>g</sup>                      | 99,732 <sup>dh</sup> |
| 19                                 | Japan                         | 0.915                    | 84.5                        | 15.2                    | 12.8 <sup>i</sup>                      | 40,799               |
| 20                                 | Austria                       | 0.914                    | 81.4                        | 16.3                    | 12.6                                   | 46,231               |
| 21                                 | Luxembourg                    | 0.909                    | 82.1                        | 14.2                    | 12.2 <sup>e</sup>                      | 65,543               |
| 22                                 | Israel                        | 0.906                    | 82.8                        | 16.0                    | 13.0                                   | 33,650               |
| 22                                 | Korea (Republic of)           | 0.906                    | 82.8                        | 16.4                    | 12.2                                   | 36,757               |
| 24                                 | Slovenia                      | 0.902                    | 81.2                        | 17.4                    | 12.3                                   | 32,143               |
| 25                                 | Spain                         | 0.893                    | 83.4                        | 17.9                    | 9.8                                    | 35,041               |
| 26                                 | Czechia                       | 0.891                    | 79.2                        | 16.8                    | 12.7                                   | 31,597               |
| 26                                 | France                        | 0.891                    | 82.5                        | 15.5                    | 11.4                                   | 40,511               |
| 28                                 | Malta                         | 0.885                    | 82.4                        | 15.9                    | 11.3                                   | 34,795               |
| 29                                 | Italy                         | 0.883                    | 83.4                        | 16.2                    | 10.2 <sup>e</sup>                      | 36,141               |
| 30                                 | Estonia                       | 0.882                    | 78.6                        | 16.1                    | 13.0 <sup>c</sup>                      | 30,379               |
| 31                                 | Cyprus                        | 0.873                    | 80.8                        | 14.7                    | 12.1                                   | 33,100               |
| 32                                 | Greece                        | 0.872                    | 82.1                        | 17.3                    | 10.5                                   | 24,909               |

**FIGURE 35: HUMAN DEVELOPMENT INDEX.**  
**SOURCE: UNITED NATIONS DEVELOPMENT PROGRAM**

Furthermore, if we look at the trend of HDI of the two countries between 1990 and 2018, the position on the rank of South Korea and Italy does not change during this period of time, showing a certain stable situation in their human development.

With the HDI we completed the comparison over the two countries in the educational and social fields. We started from the basis of education to reach the, through the HCI, to the HDI and showing the advantage of the Korean education system, which then reflects in social and economic grater developments.

#### 4.3. The evaluation of the development of ICTs infrastructure and the orientation towards innovation

As the last point of this analysis we are going to highlight the inequalities between South Korea and Italy regarding the development of the ICTs. If we compare chapter 2 and 3, we can already distinguish two situations that are very different. The development of ICTs in South Korea started in the first years of 1990s thanks to the rising of the electronic and semiconductor industry, too. On the other hand, in Italy the initial will was to wait the development of ICTs at first and then to start to spread them throughout the country and among its industries.

In this field South Korea can be described as a pioneer or early adopter of information and communication technologies, whereas Italy waited to introduce them in its society. Still nowadays the differences are clear. We are pointing out the level of ICTs development and innovation of the two countries using three different indexes: the Networked Readiness Index (NRI), the ICTs Development Index (IDI) and the Global Innovation Index (GII).

##### *The Networked Readiness Index*

The Networked Readiness Index (NRI), also called Technology Readiness, measures the propensity and ability of the countries to exploit the opportunities created by ICTs. It is published by the World Economic Forum in collaboration with the INSEAD<sup>73</sup> and it is part of the Global Technology Report (GITR). This report is the most authoritative assessment of how Information and Communication Technologies impact the competitiveness and

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<sup>73</sup> The *Institut européen d'administration des affaires* (INSEAD) is a business school and research institute with headquarters in France and Singapore.

wealth of nations. In 2019 the NRI has been renewed by including new features, so the results of the last report are not entirely comparable to the rankings of the previous years. The 2019 index is the average of three different scores about Technology, People and Governance. Each pillar is composed of three sub-pillars:

- Technology is defined by access, content and future technologies;
- People includes individual usage, business usage and government usage;
- Governance is composed by trust, regulation and inclusion.

They all contribute to define the impacts on economy, on quality of life and on Sustainable Development Goals (SDGs) contribution. So, the new NRI ranks South Korea in the 17<sup>th</sup> position, whereas Italy occupies the position number 34 of over 121 nations. The scores in all three pillars is higher on South Korea than in Italy. If we consider the positions occupied in the previous NRI indexes - with all the due considerations of the changes between the new Networked Readiness Index and the previous one - we can see that the trend in the last years has always seen South Korea placed much better than Italy.

### *The ICT Development Index*

Using the ICT Development Index (IDI) the gap between the two countries is even bigger. IDI is an index that tries to measure the information society, the digital divide and the ICTs performance within and across countries. It is published by ITU, the United Nations International Telecommunication Union using information and communication technologies indicators that are grouped in three pillars:

- The Access sub-index that captures ICT readiness, that includes the following infrastructures and access indicators: fixed-telephone subscription/100 inhabitants; mobile-cellular telephone subscriptions/100 inhabitants; international Internet bandwidth (bit/s) per user; percentage of households with a computer; percentage of households with Internet access.
- The Use sub-index, that captures ICT intensity and includes the following three ICT intensity and usage indicators: percentage of individuals using the Internet; fixed (wired)-broadband subscriptions per 100 inhabitants; Wireless broadband subscriptions per 100 inhabitants (satellite, terrestrial fixed and active mobile with a minimum download of 256kbit/s included).
- The Skills sub-index, which captures ICT skills or capabilities as input indicators. It has less weight in the calculation of the total IDI compared to the other two pillars.

It is composed by three indicators: Adult literacy rate; Gross enrollment ratio secondary level; Gross enrollment ratio tertiary level.

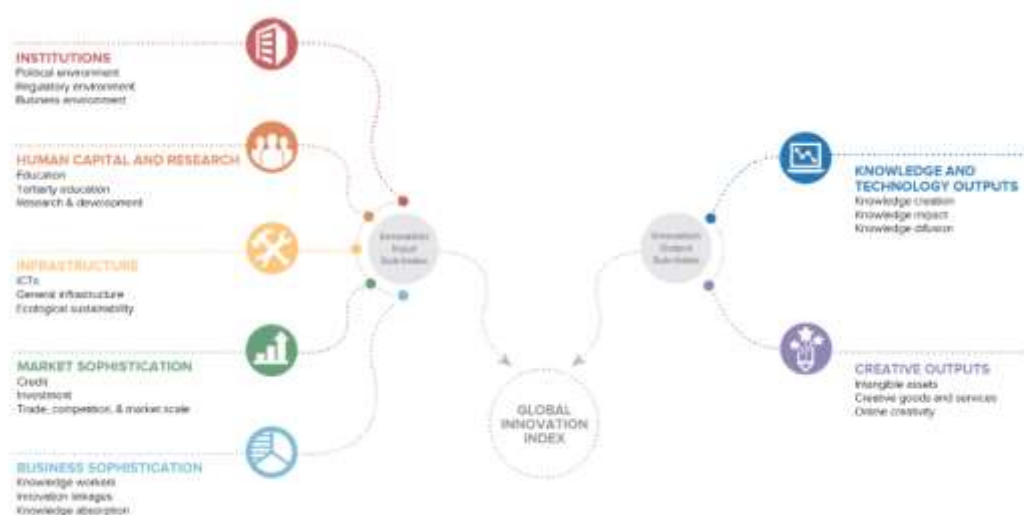
In the edition of 2017 of the IDI, South Korea reached the 2<sup>nd</sup> position in the IDI ranking, whereas Italy ranked only 47<sup>th</sup>. ICTs Development Index shows another time the insufficient level of development of ICTs in Italy, especially when compared to South Korea.

### *The Global Innovation Index*

Lastly, we are going to take in consideration the Global Innovation Index. The GII ranks countries depending on their ability and success in innovation and it is published by Cornell University, INSEAD and World Intellectual Property Organization. As Figure 36 shows, GII is composed by two sub-indexes:

- the Innovation Input sub-index, that captures those elements of the national economy that enable innovative activities thanks to those indicators: Institutions (political environment, regulatory environment, business environment), Human capital and research (education, tertiary education, research and development), Infrastructure (ICTs, general infrastructure, ecological sustainability), Market sophistication (credit, investments, trade, competitors and market scale) and Business sophistication (knowledge workers, innovation linkages and knowledge absorption).
- the Innovation Output sub-index captures the actual evidences of innovation outputs: Knowledge and Technology Outputs (knowledge creation, knowledge impact, knowledge diffusion) and Creative Outputs (intangible assets, creative goods and services, online creativity).





**FIGURE 36: COMPOSITION OF GII.**

**SOURCE: CORNELL UNIVERSITY, INSEAD AND WORLD INTELLECTUAL PROPERTY ORGANIZATION**

Then, the Global Innovation Index is computed as the average between innovation input sub-index and innovation output sub-index. For what concerns the Innovation Input sub-index, South Korea scores 65.95, taking the 10<sup>th</sup> position and Italy is in the 30<sup>th</sup> place with a score of 54.74. On the other hand, regarding the Innovation Output sub-index, the Asian country places 13<sup>th</sup> with a score of 47.15 while the European one occupies the 29<sup>th</sup> position with 37.87 points. GII 2019 total ranking places South Korea in position number 11 with a total score of 56.55 whereas Italy reaches the 30<sup>th</sup> position with a score of 46.30 among 129 countries. This index denotes the differences on the innovation field between the two countries and it marks, once again, a substantial different structure and orientation of the vision and investments between the two governments and societies of the Asian and the European country.

#### 4.4. Comparison between Korean and Italian ECIs and Product Spaces

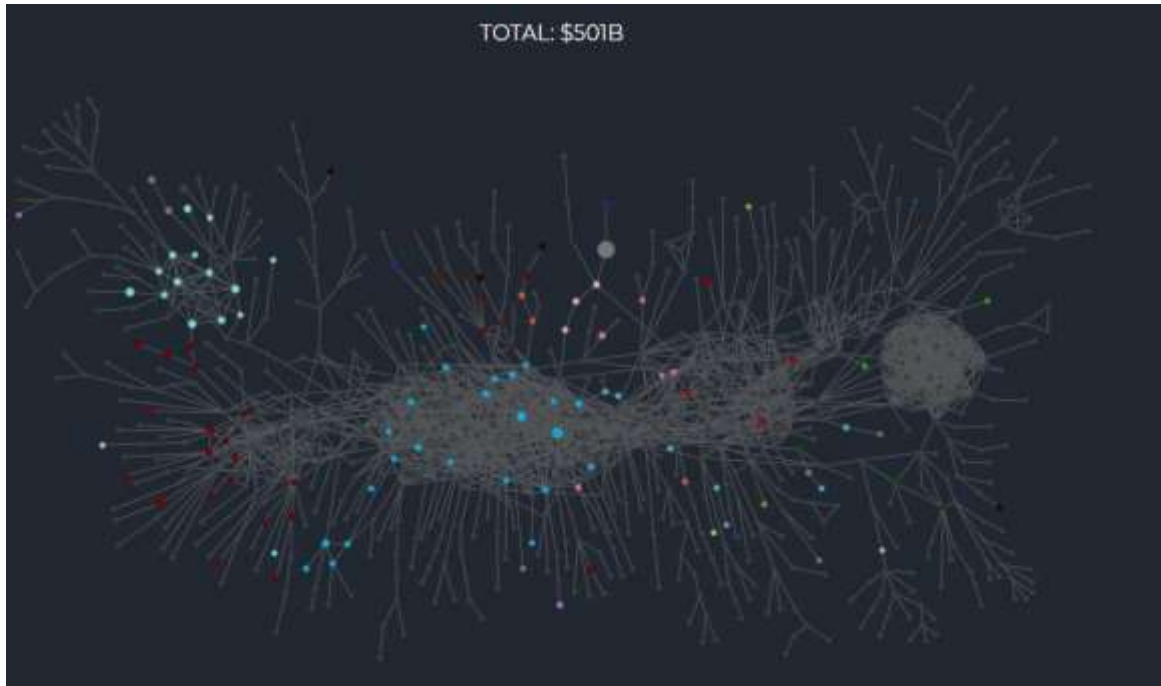
The last comparison between South Korea and Italy is made from the point of view of the Economic Complexity Index. As we previous discussed in chapter 1, the ECI is used to analyze the economic complexity of a country. To recap briefly, the complexity of the

economy of a country consists in the ability of its productive structure to produce sophisticated goods with a revealed comparative advantage and then to sell them worldwide. The export of this kind of products generates the economic, social and human development of the country. The basilar two features in economic complexity are *diversity* and *ubiquity*: diversity is when an economy has a varied production of many different kind of products whereas ubiquity means that a type of product is made by many other countries. So, when there is high diversity and low ubiquity we are facing complex economies and complex products that cannot be replicate by other countries. To create sophisticated goods a productive structure needs to accumulate high knowledge and knowhow in its workers, so it is fundamental the level of human capital. Hence, the diversification of incrementally more complex new products led to economic growth.

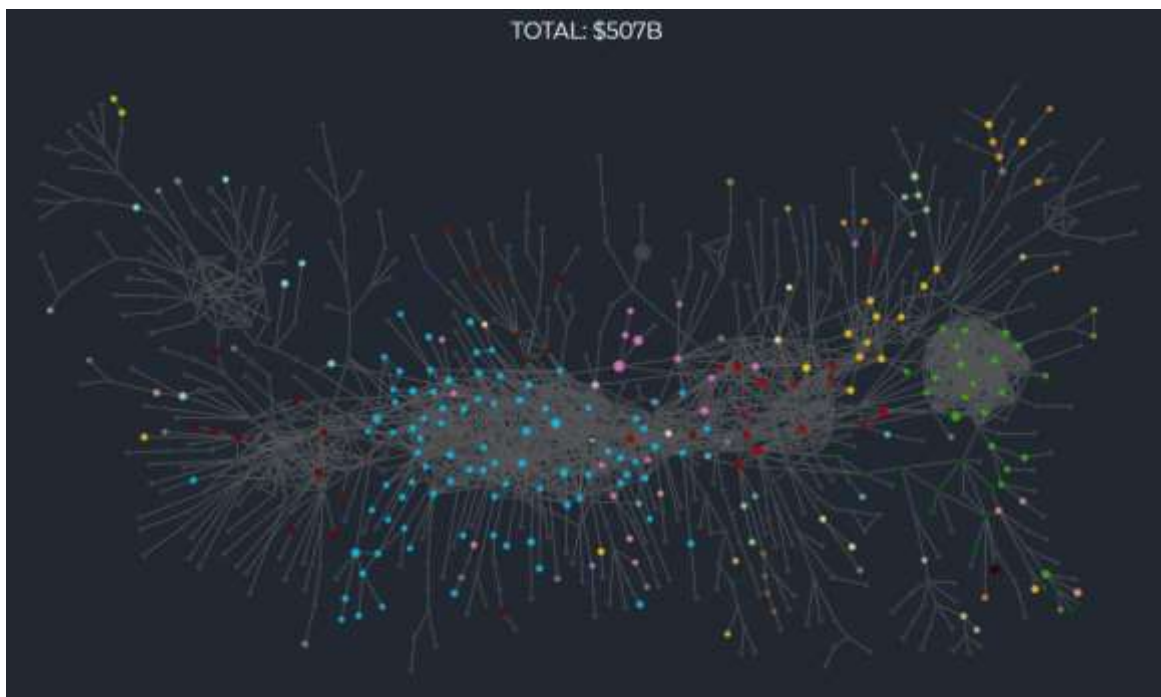
In the Economic Complexity Index ranking made by the Observatory of Economic Complexity in 2017, South Korea ranks 6<sup>th</sup> and Italy 12<sup>th</sup> as the most complex countries in the world. In the last decade, South Korea has improved its complexity despite the stagnant diversification of its exports but exploiting the many opportunities of its already existing knowhow in the productive structure. In the other hand, the improvement made by Italy was less marked, but it happened thanks to the many opportunities of diversification across Italian productive structure. Both countries have completed the process of transformation of the productive structure and, indeed, they already entered in all major and high-productivity sectors. According to the Diversity Rank of 2017 made by the Atlas of Economic Complexity<sup>74</sup>, South Korea occupies the 38<sup>th</sup> position whereas Italy the 2<sup>nd</sup> place. This feature is also well visualized by the comparison of the product spaces of the two countries (Figures 37 and 38). Italy has a much more diversified productive structure respect to the Korean one.

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<sup>74</sup> The Atlas of Economic Complexity (AEC) is the Harvard's version made by Ricardo Hausmann and César A. Hidalgo of the MIT's Observatory of Economic Complexity. The AEC uses a different methodology to clean data of international trade.



**FIGURE 37: PRODUCT SPACE OF SOUTH KOREA IN 2017.**  
 SOURCE: OBSERVATORY OF ECONOMIC COMPLEXITY



**FIGURE 38: PRODUCT SPACE OF ITALY IN 2017.**  
 SOURCE: OBSERVATORY OF ECONOMIC COMPLEXITY

But South Korea has a more complex structure because it is not only focused on high diversification but also in low ubiquity making very complex products. In fact, Italy exports 393 products with an  $RCA > 1$  but it is only 45<sup>th</sup> of 133 countries in the Complexity Outlook

Index (COI)<sup>75</sup>. Contrary, South Korea export less products with an RCA>1 (182) but it places 29<sup>th</sup> in the COI. This is certified by the fact that, since 2002, the Asian country added 23 new products that contributed \$511 in the income per capita and \$26.3B in the total value, the second highest performance in Eastern Asia, worst then China but better than Singapore and Japan. (Figure 39)

| COUNTRY     | NEW PRODUCTS | USD PER CAPITA | USD (TOTAL VALUE) |
|-------------|--------------|----------------|-------------------|
| China       | 54           | \$132          | \$183B            |
| South Korea | 23           | \$511          | \$26.3B           |
| Singapore   | 19           | \$2.56k        | \$14.4B           |
| Japan       | 8            | \$43           | \$5.50B           |

**FIGURE 39: CONTRIBUTION TO KOREAN ECONOMY BY COMPLEX GOODS.**  
SOURCE: ATLAS OF ECONOMIC COMPLEXITY

In the other hand, since 2002 Italy has introduced 15 new products and they contributed \$53 in income per capita and \$3.21B in total value, the highest performance in Europe, better than France, Germany and United Kingdom. (Figure 40)

| COUNTRY        | NEW PRODUCTS | USD PER CAPITA | USD (TOTAL VALUE) |
|----------------|--------------|----------------|-------------------|
| Italy          | 15           | \$53           | \$3.21B           |
| France         | 10           | \$28           | \$1.90B           |
| Germany        | 6            | \$2            | \$199M            |
| United Kingdom | 2            | \$2            | \$104M            |

**FIGURE 40: CONTRIBUTION TO ITALIAN ECONOMY BY COMPLEX GOODS.**  
SOURCE: ATLAS OF ECONOMIC COMPLEXITY

This determines that at the current economic and productive situation South Korea has a level of knowledge and knowhow that allow many opportunities to diversify into related products and its path towards diversification is classified as Technological Frontier

<sup>75</sup> The Complexity Outlook Index (COI) is a measure of how many complex products are near a country's current set of productive capabilities made by the Atlas of Economic Complexity. A high COI reflects an abundance of nearby, complex products that rely on capabilities similar to a country's existing production.

Approach because has exploited all major existing products and, so, growth can be reached by continuing to promote innovation and to create new products. In the other hand, because of its current level of knowledge and knowhow, Italy has moderate opportunities to diversify into related products. In diversifying its economy, Italy can be considered with a Light Touch Approach because it has good diversification, but it needs to be leveraged to create new more complex products. So, South Korea has many more opportunities to develop new complex products and to improve its productive structure and economy. Lastly, the ECI is a good tool to describe future economics dynamics studying the complexity of a country. The Growth Lab, by the 2027 Growth Projections, has predicted the future path of both economies. Korean productive structure is more complex that expected for its income level and, so, it is foreseen that Korean economy will grow moderately with an average growth rate of 3.1%. Differently, Italy is just slightly more complex that expected for its income level and so the forecasts says that its economy will grow slowly with an annually growth rate of 1.9%.

#### 4.5. Conclusions about the comparative analysis

In this chapter 4 we have analyzed and compared South Korea and Italy under many different aspects. Before we started to look at their economies by the point of view of exports, then we studied their development of human capital within each country and then we discussed of their level of innovation especially by the side of the ICTs. These three features were essential to understand, then, the results of the Economic Complexity Index and all its consequences.

We began certifying how these two economies are very similar for the manufacturing industrial structure and for the high export orientation, two of the most outward looking countries in the world in terms of good quantities and total value: their trade balances are positive and they do not give any impression to decrease. Moreover, the current GDP per capita of the two countries is very similar at the moment.

Then, we turned to the evaluation of the human capital. Here we started to note the first big differences among the two countries: South Korea, thanks to long term investments on education, has reach a higher level of human capital than Italy, one of the highest in all the

world. In all the indexes we used to compare the two countries (PISA Reports, tertiary education level, HCI, HDI), Italy has been always below the Korean standards marking a clear difference that is not easy to be repair in few years.

Finally, thanks to the NRI, ITU and GII, we checked their level of innovation and information and communication technologies. South Korea was a pioneer in the development of ICTs whereas Italy maintained an approach of initial wait. This different overture to the new technologies has led to a substantial gap between the two countries in favor of the Asian one, obviously.

This three aspects, export, human and social capital, and development of ICTs, work and increase together generating economic and social growth for the country. Moreover, they are, also, the pillars on which we can look at the economies by the point of view of complexity. A high accumulation of human capital in one society, improved by efficient ICTs, allow the creation of even more sophisticated products that, once they are exported, generates economic growth. This is, in extremely synthesis, how the Economic Complexity Index works and how it evaluates each country. Higher are the human capital, the level of ICTs and the export orientation of a country and higher will be the complexity of its economy.

Hence, the different ranking between South Korea and Italy is not unexpected and it is not so great how one could be imagine, actually, considering the big differences in human capital and ICTs. However, what is really worth of consideration are the prospects of the future: South Korea will probably continue to growth pushed by its high levels of education and ICTs whereas Italy, at the current stage, will be able to change its stagnant economic situation with difficulty without launching effective long term policies and not expecting immediate economic and social results.

## Conclusions

The Complexity Economics discipline determines the complexity of the productive structure of a country, which means, in other words, that it defines the ability of a country to generate an added value with its goods. To change a productive system is not easy and requires many investments and time. Economic Complexity is also able to predict the future economic trend for the following five-ten years of a country, just because when a country has a certain industrial structure it cannot be modified in few years. The Economic Complexity Index evaluates the levels of complexity of the economies of the countries and highlights that there are three main pillars that contribute to the development of an effective productive structure of a country: the orientation to the exports, the levels of ICTs and, above all, the accumulation of knowledge and knowhow – human capital – in the population. The ECI showed us that South Korea has a more complex economy than Italy and, also, that the forecasts of the near future predict that the Korean economy will grow more than the Italian one, which is in a period of static economic growth.

As we discussed in this work, both countries are great manufacture economies. Which allow them to export great quantities of goods and services. However, South Korea has developed more innovative and strategic industrial sectors that enable the production of more complex and profitable goods than Italy. On the other hand, Italy has developed a very different productive structure compared to South Korea. The so-called *Made in Italy*, that pulls the Italian exports, consists in manufactured products with a low level of sophistication and so, with a low added value. Italian high-tech exports, the most competitive products of today and for the future, have a very low incidence on the manufacturing export, strongly below the European average. In this situation, as in more than one circumstance found, weighs the imbalance existing in the Italian industrial fabric between the numerous small and medium enterprises belonging to traditional sectors (which in the past had been the strength of *Made in Italy*) and those few industries located in productive areas with a high research intensity, which should represent the tissue on which the country's competitive potential should be rebuilt.

So, what can Italy learn from South Korea?

Building a more complex productive structure is a long path. It needs medium and long-term investments without an immediate economic and social benefit and return. In today's

world, Italy is an anomaly: it is one of the main industrialized nations despite it invests minimally in research and development, both in absolute value and in relation to GDP. To count that this anomaly may last even longer is very risky, because of the increasing processes of economic globalization and the importance of the international collaboration on scientific-technological issues that requires the mobilization of strong investments. Hence, if Italy wants to change the route that lead to a static economy, it should start to invest more in the educational system and in R&D, to exploit its enormous potentialities. As witnessed in South Korea in the last decades, the accumulation of knowledge and knowhow in the population lead to the development of high skilled workers that can innovate and create competitive products to sell around the world. Moreover, as South Korea proved, the building of an efficient ICTs infrastructure can bring to a faster growth in hi-tech sectors.

To resume, to avoid the risks of a static or declining economy, Italy should launch long-term plans of investment in education and in research and development, in order to innovate and compete worldwide, although without expecting quick returns.

Gradually, investments in human capital will give back positive spillovers and benefits for the economy and for the society.

To conclude, in his masterpiece “Why Information Grows, The Evolution of Order, from Atoms to Economies”, César A. Hidalgo says “*Crystals of Imagination, [...], amplify the practical uses of the knowledge, knowhow, and imagination of our society, augmenting our capacities to create new forms of information [innovative objects]. Moreover, these objects allow us to form networks that embody an increasing amount of knowledge and knowhow, helping us increase our capacity to collectively process information [innovations].*”



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