



## Deliverable 1.1

# Catching Up among Firms, Industries and Countries

This project has received funding from the European Union's Horizon 2020 Marie Curie Research and Innovation Staff

Exchange under grant agreement No 778398



## A review of catch-up: evolutionary economics and the global value chain

***Abstract:** Catch-up is an important issue for developing countries in particular, which led to the level of interest displayed in the current literature. While one might argue that the dominant framework in the study of catch-up has been the evolutionary perspective, with the resource-based view often being used in conjunction, there has recently been a call to integrate the idea of the global value chain (GVC) in face of the increasing degree of globalization. Thus, this paper first reviews how the evolutionary perspective and the resource-based view has been used in the analysis of catch-up along with the issues in the empirical side, then explores the link GVC has with the evolutionary perspective in particular.*

### 1. Introduction

The issue of catch-up at the firm, industry, or country level has been of interest in many areas, especially in those concerned with developing countries, new firms or latecomers (Lee, 2013; Lee and Malerba, 2017; Perez and Soete, 1988; Mathews, 2002). Much of the interest in the subject was based on the rise of latecomer firms from Asian countries such as Japan or Korea in different points in time, in industries such as consumer electronics, memory, etc. (Shin, 2017; Giachetti and Marchi, 2017; Mathews, 2002). Mainstream economics seems to have had little interest on the topic, but for the evolutionary perspective the phenomenon was much more important, because it emphasizes the importance of adopting a dynamic perspective when analyzing firms or industries.

Catch-up is important for developing countries in particular, because whether and how effectively they can develop their economy is closely linked to whether their firms can catch up to the incumbent leaders, as is evident from cases such as South Korea. After all, any firm from a developing country is, almost by definition, a latecomer to many of the existing industries, so understanding the mechanisms behind catch-up is crucial. As is often acknowledged, however, the problem is that the occurrence of catch-up is quite rare, which makes it difficult to analyze the phenomenon. This is especially an issue in the empirical context, coupled with the difficulty in constructing the appropriate measures.

---

This project has received funding from the European Union's Horizon 2020 Marie Curie Research and Innovation Staff

Exchange under grant agreement No 778398



Despite this problem, there have been suggestions on how latecomers can catch up to the incumbents, in which the concept of the innovation system tends to play a significant role especially in the evolutionary perspective. The innovation system, which can be at the national, regional, or sectoral level, includes not only firms, but also other elements such as research institutions. An important part to consider, which has generally not been emphasized, is that no nation, region, or sector is completely independent from others, which means that researchers are required to consider not just the interactions within a system, but also those between systems.

As such, there have been calls to integrate this concept with the idea of the global value chain (GVC), especially since both perspectives explain in some ways how countries or firms can catch up to the leaders. Lundvall (2015), for example, claims that the integration of the two frameworks can provide valuable insight into the mechanisms behind catch-up, as the GVC perspective essentially combines two aspects of the innovation system idea. These are based on the contribution by Freeman (2004)<sup>1</sup> and Lundvall (1992). The former is focused on the country level, giving particular attention to trade, while the latter is focused on the firm level, especially user-producer relations. The link is that GVC addresses how countries' strategy on trade can affect their knowledge base, as in Freeman (2004), while also considering the nature of the relationships within markets, as in Lundvall (1992). This observation prompted studies such as Lee et al. (2017), which uses both the GVC and innovation system framework to explain catch-up.

In order to link the two frameworks in practice, it is necessary to first know what researchers have done to analyze catch-up. Even though several studies have pushed for or attempted their synthesis, the fact remains that this is still in its early stages. To this end, this review will first discuss the two related theoretical frameworks used in the catch-up literature, the evolutionary perspective and the resource-based view. The paper will then discuss some of the empirical approaches used in the literature, focused mostly on the problems related to measurement. How the concept of the GVC can be and has been used will be discussed next, followed by

---

<sup>1</sup> The original reference made in Lundvall (2015) was for the year 1982, when it was a working paper at the time, but this has since been published under the same title in 2004.



concluding remarks.

## **2. Major Theoretical Frameworks**

### **2.1. What is Catch-up?**

Catch-up is a term used to describe a phenomenon in which entrants or latecomer firms manage to achieve similar or superior performance, technological or otherwise, compared to the incumbent leaders of the industry. It is also a phenomenon generally best exemplified by the rise of countries such as South Korea and their firms, particularly in semiconductors or electronics industries since the late 20<sup>th</sup> century. Possibly because of this, much of the discussion on catch-up tends to be focused on the technological aspect, with one of the general assumptions being that technological catch-up leads to catch-up in terms of market shares, etc.

Much of the studies on catch-up are focused on the rise of Asian countries like Korea, Taiwan and China or the firms based in those countries, such as Samsung. Much of Lee (2013), for example, focuses on how technological factors contribute to catching up, giving particular attention to Korea, China, and India among others. This also shows how catch up occurred in some countries but not others due to the differences in the industries they chose to enter.

There is also a closely related concept of the ‘catch-up cycle’, which is used to describe a phenomenon in which industrial leadership changes successively (Lee and Malerba, 2017). This emphasizes the dynamics of industrial evolution making note of the fact that catch-up is not a phenomenon that just happens once. It is also where the role of windows of opportunity can be demonstrated more clearly, if only because the studies that introduce the concept place a great emphasis on it.

### **2.2. Major Perspectives on Catch-up**

One of the main questions regarding the phenomenon of catch-up is why it seems to occur more often in certain industries than others. In fact, much of the discussion centers around industries such as electronics (Lee et al., 2005; Lee and Lim, 2001). Thus, analysis of catch-up tends to gravitate towards identifying the heterogeneity among sectors and how certain

---

This project has received funding from the European Union's Horizon 2020 Marie Curie Research and Innovation Staff

Exchange under grant agreement No 778398



characteristics in that sector allow latecomer firms or other types of entrants to match or even surpass incumbent firms in terms of performance, whether technological or financial.

A key component in the analysis of catch-up is that there needs to be some kind of disruption if change in industrial leadership is to occur. This is referred to in many studies as a ‘window of opportunity’. Regardless of the disagreements on *why* catch-up occurs or *what* facilitates it, most studies imply that this is much less likely to occur in the status quo. This is supported by the history of industries such as that of D-RAMs, where latecomer firms such as Samsung managed to catch up to the industry leaders at the time because it had entered the industry during a time of transition.

### **2.2.1. Evolutionary Economics: Innovation Systems and Windows of Opportunity**

Evolutionary economics is a framework commonly credited to Nelson and Winter (1982). The motivation behind the framework is that some of the basic assumptions in classical economics need to be changed in order to analyze the behavior of firms. Examples of its departure from classical economics include the assumption that firms have bounded rationality, are heterogenous, and are profit-seeking rather than profit-maximizing. It also takes a different view on the role of the context at the industrial or national level, in that these are seen as having a much larger impact on firm behavior than was previously thought.

One of the ways in which the differences in the context was framed is the technological regime. This is essentially a description of the characteristics of the technologies in the relevant economic dimension. Malerba and Orsenigo (1997) develops the concept further by identifying four central elements that define the technological regime; appropriability, cumulateness, opportunity, and the knowledge base. This has allowed the framework to become more tractable and much of the discussion based on the framework also uses at least some of these elements.

The innovation system can be considered an extension of this concept, focusing not only on the firms but also other entities that can affect the technological aspect of an industry. The basic idea, as described in Acs et al. (2017) or Malerba (2002), is that there exists a systematic difference in economic performance between countries or sectors, and much of this can be



attributed to institutions and how they shape the interactions between the different elements in the system, economic or otherwise. An advantage of the concept is that it can be applied at different levels, ranging from the national (Lundvall, 1992; Nelson, 1993) to the sectoral (Malerba, 2002). Each level is not necessarily thought of as being completely separate, but at the same time two systems at the same level do not tend to be considered in conjunction. While there are efforts to address this issue based on works such as Adams et al. (2016), this is still a relatively recent development, which is even more significant given the increasing attention to the incorporation of the GVC idea discussed later.

Windows of opportunity also play a significant role in the evolutionary framework, although the concept is not exclusive to it. The idea of a window of opportunity, first conceived by Perez and Soete (1988), is that when a change occurs in the industry, technological or otherwise, some firms can turn this to their advantage, allowing them to gain on the incumbents in terms of performance. An example of a window of opportunity can be disruptive innovation, which changes the technological landscape to the extent that previous capabilities are no longer sufficient to allow firms to enjoy competitive advantage. For example, the case of the D-RAM industry, as described in Lee and Lim (2001), shows how Korean chaebols such as Samsung were able to become market leaders after they entered the industry during a period in which a technological transition was in progress.

### **2.2.2. Resource-Based View**

The resource-based view has its roots in Penrose (1959), but Wernerfelt (1984) is arguably one of the first studies to apply it. The basic premise is that a firm is essentially a bundle of resources that cannot be replicated easily by others, where resources can be financial, technological, etc. In other words, a firm's behavior, strategy, and performance can be affected by what resources the firm has. Many variations of the view can exist, such as the knowledge-based view of the firm, reflected in studies such as Grant (1996), where emphasis is put on knowledge as a resource.

The resource-based view often complements the perspective of evolutionary economics, because its core idea meshes very well with the notion that the context in which firms operate

in can have an effect. For example, as Mathews (2002) notes, latecomer firms tend to aim for specific industries because of the resources available to them, which can be categorized into their linkages, leverage, and learning capabilities. In fact, the study distinguishes latecomers from the usual brand of entrants based on these criteria, and then explain how their entry behavior and success differ. Lee and Lim (2001) also draw on the resource-based view, by noting that the catch-up of Korean firms in the D-RAM industry was fueled in large part due to their financial advantages that stemmed from their size.

The view can also be applied in relation to the window of opportunity idea. An example of how this is commonly done can be found in Lee (2013), where the study discusses how latecomer firms can develop the technological capabilities to take advantage of the window of opportunity once it opens. In fact, Lee and Lim (2001) notes that the financial advantage was important because it allowed the Korean firms to profit from the opening. In their case, the window was the fact that the D-RAM industry was in a phase where it was moving into a new technology.

### **3. Major Empirical Approaches**

One of the major issues when it comes to the empirical analysis of the phenomenon is the fact that measuring the technological aspects of the phenomenon is no simple feat, which is unfortunately the part that also tends to get more attention than others. While many methods have been proposed, the inherent uncertainty in innovation and technological development tends to hamper researchers' efforts to tease out the elements emphasized by the current theoretical framework, such as appropriability. Patent-based measures are often the most used but also the most criticized precisely because of this. The disadvantages of patent measures are well documented in studies such as Kleinknecht et al. (2002), but one of the most important issues is that patents are not representative of all technological developments. In fact, patents do not necessarily show the innovations of the firm, since not all inventions lead to innovations.

On the other hand, patent measures are also more easily obtainable and usable, especially since the numbers involved are practically astronomical. In addition, patents themselves have a large amount of information related to location and names of the inventors and assignees,



allowing great flexibility in its use. One particular aspect that has seen much use since Hall et al. (2001) is the citations data, which not only allows researchers to track each patent but also construct measures that reflect the qualitative nature of technology, such as the backward citation lag, self-citation ratio, and so on. This makes patent measures quite useful in representing the elements of the technology regime, and this is indeed done in several studies such as Park and Lee (2006).

Alternatives to patent measures tend to rely on surveys such as the Community Innovation Survey (CIS) or simply use R&D investments or changes in total factor productivity (TFP). These, however, tend to have their own issues. For example, the CIS suffers from the fact that it is only performed every two years. In addition, the CIS tends to change certain questions in its survey, resulting in situations where a question that was listed in one version disappears in the next, which greatly limits its usefulness. As for R&D investments and TFP, one of the major disadvantages is the fact that they merely show the input or output of the firm's innovative efforts without being able to show whether the technology regime, for example, has any impact on the likelihood of a firm catching up to the incumbent leaders.

These problems are even more pronounced when researchers try to consider the innovation system, whether national, regional, sectoral, or otherwise. By definition, incorporating the innovation system in the analysis requires not only data on the firms but also how they are linked to the government, academia, and any other entities that affects firms' innovations in one way or the other. More importantly, there is the question of which aspect of the interactions between the entities should be considered. One type of entities that tend to receive frequent attention are research institutions, public or private, as was the case in Mazzoleni and Nelson (2007) for example.

The next problem is the fact that defining catch-up in an empirical context is not as simple as it might first seem. Catch-up, almost by definition, is a rather long-term concept, which is perhaps why many of the important works on the subject tends to lean towards the theoretical side. In fact, the history-friendly model as used in Landini et al. (2017) is often used in the literature because it is arguably the best tool for analyzing how industries evolve, which includes the analysis of factors that facilitates the occurrence of catch-up.



Despite this problem, there have been attempts to analyze catch-up empirically. One such example is Park and Lee (2006), where the authors link the technology regime to catch-up in technology as the title suggests. In this study, catch-up is analyzed at the country level, and is measured using the number of patents in each patent class relative to that of the US. In other words, catch-up in this case is defined as firms in developing countries reaching a similar number of patents compared to those in developed countries. In some cases, such as in Lee and Lim (2001), similar criteria are used with respect to other measures such as exports, although this particular study simply examines the trend instead of relying on regressions.

Another approach is to simply look at how certain factors affect incumbent and latecomer firms differently. Lee (2013) is an example, where the effect of technological factors on firm profitability was found to be different depending on what country the firm was based in. The literature on disruptive or radical innovation, which is often cited in the catch-up literature, also focuses on how such technological developments can affect incumbents adversely or how they can counter such effects, as is the case in Tripsas (1997) or Hill and Rothaermel (2003).

#### **4. The Role of the Global Value Chain in the Catch-up Literature**

One major aspect of the evolutionary perspective when it comes to discussing catch-up is that it tends to focus on the national level, as noted by Lee et al. (2017). This is particularly noticeable in the concept of the innovation system, where the national level is usually the focus of analysis. While taking the nation as a unit is quite acceptable, it is also arguably insufficient in a time where many large firms tend to branch out internationally. GVC is a concept that attempts to take the global nature of today's economic activities into account.

Gereffi (2014) notes that two major perspectives tend to be of particular interest when it comes to research on the GVC. The first is the top down approach, which focuses on the governance structure of GVC. In other words, this pays particular attention to how corporate power, which can be exerted by lead firms or suppliers, can affect the distribution of profits and risks in an industry. The bottom up approach, on the other hand, focuses on economic upgrading, which involves the strategies of economics stakeholders to maintain or improve their position in the global economy.

The GVC also asks the question of how developing countries can catch up to the developed countries. At least until recently this question was dominated by how export-oriented and import-substituting industrialization differed in terms of their effectiveness when it comes to developing countries catching up to the developed countries (Gereffi, 2014). However, the GVC literature seems to have shifted somewhat since, focusing particularly on what conditions are needed for developing countries to upgrade their economy through the participation in GVC.

As Lundvall (2015) notes, much of the discussion regarding GVC is deeply related to two of the studies that first used the concept of the innovation system, Freeman (2004) and Lundvall (1992). The former focuses on the relationship between trade and innovation, while the latter is more focused on the production system, both of which can be identified in the GVC framework. Due to this link, Lundvall (2015) suggested that the GVC and innovation system concept should be combined in the globalization era, and a few studies have answered this call, of which Lee et al. (2017) is an example.

Despite this, however, the GVC does not quite play a major role in the catch-up literature. In addition, the theoretical combination is not, as of yet, entirely complete. Lee et al. (2017), for example, simply analyzes how latecomers behave in regard to the GVC, which essentially amounts to what the paper calls the “in-out-in-again” hypothesis. The hypothesis states that the foreign value-added of countries would increase in the low- and lower-middle income stages, decrease during the middle- and upper-middle income stages, then increase again in the high-income stages. This is based on the need to integrate external knowledge and to establish the local value chain.

## **5. Conclusion**

The incorporation of the GVC concept in catch-up is a relatively new trend, but this also shows promise of its usefulness, particularly in an era where globalization is the norm. This is the case regardless of whether catch-up is analyzed at the firm or country level, because as studies such as Gereffi (2014) point out, much of the competition in the modern economy is affected by what happens at the global level, even if local competition still plays a very significant role.

One of the more pressing concerns will be the theoretical aspect as suggested by Lundvall (2015). The challenge will be to determine how the GVC concept will expand the idea of the innovation system to the international level, and how this interacts with the national, regional, and sectoral level. While relying mostly on the GVC concept to explain catch-up is not entirely impossible, as Lee et al. (2017) shows, the same study also shows that the innovation system at the local level still plays a key role. In other words, the study demonstrates that the innovation system may be seen as a kind of component of the GVC, affecting how firms address the problem of establishing the local value chain.

At the same time, however, there is still much that needs to be done in terms of the empirical analysis of catch-up, especially if any theoretical breakthroughs are to be useful. This will be a challenge, since the phenomenon is a complex one that occurs over a long period of time. Combining the GVC framework into the current evolutionary perspective will most likely complicate the issue even further. This is especially the case given that the innovation system concept often used in the evolutionary perspective already demands a rather holistic approach.

In short, the key challenges will be the theoretical integration of GVC into the catch-up literature and the empirical issues in studying catch-up in the first place. The latter, in particular, is necessary if we are to take advantage of the theoretical integration when it occurs successfully, not to mention the fact that any policy decisions will need to be based on reliable empirical analyses.



## References

- Acs, Z., Audretsch, D., Lehmann, E., and Licht, G. (2017), “National systems of innovation”, *The Journal of Technology Transfer*, 42 (5), 997-1008.
- Adams, P., Fontana, R., and Malerba, F. (2016), “User-industry spinouts: Downstream industry knowledge as a source of new firm entry and survival”, *Organization Science*, 27 (1), 18-35.
- Freeman, C. (2004), “Technological infrastructure and international competitiveness”, *Industrial and Corporate Change*, 13 (3), 541-569.
- Gereffi, G. (2014), “Global value chains in a post-Washington Consensus world”, *Review of International Political Economy*, 21 (1), 9-37.
- Giachetti, C., and Marchi, G. (2017), “Successive changes in leadership in the worldwide mobile phone industry: The role of windows of opportunity and firms' competitive action”, *Research Policy*, 46, 352-364.
- Grant, R. (1996), “Towards a knowledge-based theory of the firm”, *Strategic Management Journal*, 17, 109-122.
- Hall, B., Jaffe, A., and Trajtenberg, M. (2001), “The NBER patent citations data file: Lessons, insights, and methodological tools”, *NBER Working Paper No. 8498*.
- Hill, C., and Rothaermel, F. (2003), “The performance of incumbent firms in the face of radical technological innovation”, *The Academy of Management Review*, 28 (2), 257-274.
- Kleinknecht, A., Van Montfort, K., and Brouwer, E. (2002), “The non-trivial choice between innovation indicators”, *Economics of Innovation and New Technology*, 11 (2), 109-121.
- Landini, F., Lee, K., and Malerba, F. (2017), “A history-friendly model of the successive changes in industrial leadership and the catch-up by latecomers”, *Research Policy*, 46, 431-446.
- Lee, K. (2013), *Schumpeterian analysis of economic catch-up: knowledge, path-creation and the middle-income trap*, Cambridge University Press.

- Lee, K., Lim, C., and Song, W. (2005), “Emerging digital technology as a window of opportunity and technological leapfrogging: Catch-up in digital TV by the Korean firms”, *International Journal of Technology Management*, 29, 40-63.
- Lee, K., and Lim, C. (2001), “Technological regimes, catching-up, and leapfrogging: Findings from the Korean industries”, *Research Policy*, 30, 459-483.
- Lee, K., and Malerba, F. (2017), “Catch-up cycles and changes in industrial leadership: Windows of opportunity and responses of firms and countries in the evolution of sectoral systems”, *Research Policy*, 46, 338-351.
- Lee, K., Szapiro, M., and Mao, Z. (2018), “From global value chains (GVC) to innovation systems for local value chains and knowledge creation”, *The European Journal of Development Research*, 30 (3), 424-441.
- Lundvall, B. (1992), *National systems of innovation: Towards a theory of innovation and interactive learning*, Pinter Publishers, London.
- Lundvall, B. (2015), “The origins of the national innovation system concept and its usefulness in the era of the globalizing economy”, Working Paper.
- Malerba, F. (2002), “Sectoral systems of innovation and production”, *Research Policy*, 31, 247-264.
- Malerba, F., and Orsenigo, L. (1997), “Technological regimes and sectoral patterns of innovative activities”, *Industrial and Corporate Change*, 6 (1), 83-118.
- Mathews, J. (2002), “Competitive advantages of the latecomer firm: A resource-based account of industrial catch-up strategies”, *Asia Pacific Journal of Management*, 19, 467-488.
- Mazzoleni, R., and Nelson, R. (2007), “Public research institutions and economic catch-up”, *Research Policy*, 36, 1512-1528.
- Nelson, R. (1993), *National systems of innovation: A comparative study*, Oxford University Press, Oxford.
- Nelson, R., and Winter, S. (1982), *An evolutionary theory of economic change*, Harvard University Press.

- Park, K., and Lee, K. (2006), “Linking the technological regime to the technological catch-up: analyzing Korea and Taiwan using the US patent data”, *Industrial and Corporate Change*, 15 (4), 715-753.
- Penrose, E. (1959), *The theory of the growth of the firm*, Oxford University Press, Oxford.
- Perez, C., and Soete, L. (1988), “Catching up in technology: Entry barriers and windows of opportunity”, In: Dosi, G., Freeman, C., Nelson, R., Silverberg, G., and Soete, L. (Eds.), *Technical Change and Economic Theory*, Pinter Publishers, London.
- Shin, J.S. (2017), “Dynamic catch-up strategy, capability expansion and changing windows of opportunity in the memory industry”, *Research Policy*, 46, 404-416.
- Tripsas, M. (1997), “Unraveling the process of creative destruction: Complementary assets and incumbent survival in the typesetter industry”, *Strategic Management Journal*, 18, 119-142.
- Wernerfelt, B. (1984), “A resource-based view of the firm”, *Strategic Management Journal*, 5 (2), 171-180.