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Does creativity foster economic growth?

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Emilie De Meyer

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Supervisor :
Prof. Dr. Erwin OOGHE

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Does creativity foster economic growth?

Emilie DE MEYER

r0724227

Thesis submitted to obtain the degree of

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Promoter: Prof. Dr. Erwin OOGHE

Co-promoter: Prof. Dr. Benoit GAILLY

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The concept of creativity and its impact on economic growth have been receiving an increased interest from both researchers and policy-makers. However, there remains a gap between this rising interest on the one hand, and the lack of empirical research on this topic in the economic literature on the other. *The purpose of this thesis is therefore to develop a better understanding of the relationship between creativity and economic growth.* I first establish a working definition of creativity. In a second step, via a literature review, I notice that the relationship between creativity and growth is neither empirically tested, nor theoretically developed. I then identify three potential intermediate variables via which creativity might influence economic growth: innovation, human capital, and entrepreneurship. After a theoretical exploration, I propose an empirical exercise to support this new model. *This thesis highlights a key gap in the economic literature, and develops an original model linking creativity and economic growth.*

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INTRODUCTION AND OUTLINE

The literature around creativity has increasingly developed in the past decades. There is a growing interest for this concept from both researchers and policy-makers. Individual creativity is considered as having a positive impact, often taken for granted, on team or organizational performance. By extension, an increasing level of creativity among the inhabitants of a region is expected to be positively correlated with the economic growth of that region.

However, there remains a gap between this sustained interest for creativity on the one hand, and the lack of empirical research on this topic in the economic literature on the other. Indeed, although creativity is assumed to be beneficial for economic growth, very few studies actually explore, theoretically or empirically, this relationship.

The purpose of this thesis is therefore to develop a better understanding of the relationship between individual creativity and economic growth.

To address this relationship, the first step is to agree on a definition of creativity and its various dimensions. Therefore, a working definition of creativity is constructed via a literature review.

In a second step, I examine the current state of literature, via a systematic review of the leading economic journals. I notice that the relationship is often merely observed, and neither theoretically developed nor empirically tested. Next to the feeble quantity of direct links established, I identify different intermediate variables through which creativity might foster economic growth – meaning variables that are enhanced by creativity, and that generate economic growth. The three main hypotheses found in the academic literature identify as intermediate variables innovation, human capital, and entrepreneurship.

In a third section, each of those three variables are theoretically developed, and their relationships with creativity and growth are explored.

The fourth section is an empirical exercise. I select indicators of the five variables analyzed – creativity, innovation, human capital, entrepreneurship, economic growth. Through graphic and multivariate analyses of these indicators for a selection of countries, the aim is to support the theoretical results obtained in the previous sections.

Lastly, I define the implications of these results for management and policy-making, the limits of the analysis, and suggestions for future research.

CHAPTER 1 – A WORKING DEFINITION OF CREATIVITY

In order to discuss the relationship between individual creativity and economic growth, the first step is to agree on a working definition of individual creativity¹.

Nearly all literature reviews around creativity begin by emphasizing the difficulty of reaching a consensus; there are nearly as many definitions as there are works on the topic (Dacey & Madaus, 1969; Treffingen, 1996). Although the consensus seems hardly reachable, some common elements can be used as starting points to explore this complex concept.

To conduct this literature review, I first searched for articles with the keywords “creativity” or “creativity definition” in their title, on various academic search engines such as JStor, Google Scholar, and Limo. Having summarized this first selection, I explored the sources of the articles selected to complement the information. Lastly, complementary researches with keywords such as “creativity 4P” or “creativity drivers” were used to dive deeper into some topics and enhance the analysis. As a result, a selection of about 70 articles, among which several literature reviews, was used to build this working definition. The list of these articles can be found in appendix 1.

1.1) A brief history of creativity research

Before attempting to define creativity, it is useful to have a look at how it has been approached and defined in past academic works.

Up to the twentieth century, creative inspiration was considered as a gift of divine origin, an innate aptitude reserved to an elite of creative geniuses. The creative human artist produced what was novel and original (Kristeller, 1990; Banaji et al., 2010). Creativity was only understood in terms of product, with an emphasis on the result (Pope, 2005; Surkova, 2012; Gaut, 2014).

In 1907 appeared the first study of creativity as a teachable human characteristic, for which one must develop abilities and skills (James, 1907; Surkova, 2012). Creativity as a separate field of knowledge gained popularity in the twentieth century, meeting the needs for a rapid evolution in science, technology and commerce. Research in creativity particularly developed in the 1950s, following Guilford’s Presidential Address (1950). He was the first to claim that creativity was accessible and claimable for every person.

Between the 1950s and the 1970s, creativity concerns focused on personality, cognition, and the stimulation of individual creativity. In the 1980s emerged an awareness of the

¹ We focus here on individual creativity as opposed to team creativity, which can be defined as “*the production of novel and useful ideas concerning products, services, processes and procedures by a team of employees working together*” (Shin & Zhou, 2007)

influence of environments and social contexts on individual creativity (Rhyammar & Brolin, 1999).

Nowadays, we observe a growing interest in creative industries and their impact on people's lives (Freedman, 2010). Martiniano (2016) describes our modern times as the "Creative Economy": a convergence of culture, capital, and civic spheres, as well as the rise of a creative professional class who works in them. Innovation is now a necessity to survive, and is widely democratized through the availability of technology, tools, knowledge, and creative spaces.

Creativity is now considered as an aspect of human intelligence that is inherent to all people; a competence which can be taught, enhanced, and nurtured (Sternberg & Lubart, 1998; Gaut, 2014). It is a learning process that anyone can accomplish (Kronfeldner, 2009; Freedman, 2010). Lastly, it is a multifaceted phenomenon, approached by different disciplines with different angles, and entering into almost every aspect of life; it therefore requires an interdisciplinary perspective (Sternberg & Lubart, 1998; Surkova, 2012).

1.2) The 4Ps framework

We now approach the definitions of creativity. There exist hundreds of them in the academic literature. Most of them can be classified, following Rhodes' (1961/1987) 4Ps framework, into four perspectives: Person, Process, Press, and Product.

1.2.1) Person

The "Person" definitions focus on determining personal characteristics that are common to creative persons. These are numerous: aesthetic qualities, high energy, autonomy (Barron & Harrington, 1981), openness to experience, self-confidence (Shallcross, 1981), motivation and effort (Nickerson, 1998; Sternberg, 1999), etc. The most recurring characteristics are motivation, imagination (cf. 1.5), openness, and curiosity. However, it is difficult to find a consensus for a "Person" definition of creativity, as even literature reviews provide extensive and varied lists of characteristics.

A particular stream of studies analyses the impact of the Big Five personality traits, or OCEAN model – Openness to experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism² – on individual creativity. All papers on this topic show that personality traits are systematically related to creativity; however, the findings

² Definitions by Zhao & Seibert (2006, pp.260-261):

- *"Openness to Experience is a personality dimension that characterizes someone who is intellectually curious and tends to seek new experiences and explore novel ideas"*
- *"Conscientiousness indicates an individual's degree of organization, persistence, hard work, and motivation in the pursuit of goal accomplishment"*
- *"Extraversion describes the extent to which people are assertive, dominant, energetic, active, talkative, and enthusiastic"*
- *"Agreeableness assesses one's interpersonal orientation. Individuals high on Agreeableness can be characterized as trusting, forgiving, caring, altruistic, and gullible"*
- *"Neuroticism represents individual differences in adjustment and emotional stability"*

regarding each trait separately are not always conclusive (Jirásek & Sudzina, 2020). There is overwhelming empirical evidence that Openness is directly and positively related to creativity (e.g. Sung & Choi, 2009; Kaspi-Baruch, 2017; Jirásek & Sudzina, 2020). A positive correlation between Extraversion and creativity has also been empirically established, though there is still debate on its significance. The other traits are still subject to discussions (Jirásek & Sudzina, 2020). Some authors advance moderators influencing these correlations, such as learning orientation (Kaspi-Baruch, 2017) or motivations (Sung & Choi, 2009).

1.2.2) Process

Process research puts the emphasis on the behavioral factors influencing creativity, such as modes of thinking and collaborative engagement (British Council, n.d.).

Guilford (1967) defines two types of thinking required for creativity. Divergent thinking is the ability to think of as many different solutions as possible to an open question or problem, using imagination and experimentation. Convergent thinking is choosing which idea or answer is most worth pursuing, using contextualized observations, logical thought and a systemized approach. The iteration of both types of thinking allows us to generate creative solutions (Runco & Chand, 1995; Kaufman & Glăveanu, 2019).

Many authors divide the creative process in several steps (Wallas, 1926; Boden 1992; Surkova, 2012). By comparing these, we can outline that this process comprises at least the following steps: (1) preparation or problem definition, (2) elaboration and adaptation of a hypothesis, and (3) evaluation of the idea by the creator and/or exterior persons – society, a group of experts, etc.

1.2.3) Press

Press describes the pressures on the creative process or on creative persons. It refers to “*the relationship of human beings and their environments*” (Rhodes, 1961/1987). There are indeed several “situational influences” that can encourage creativity, such as freedom, autonomy, appropriate organizational practices and resources, etc. (Amabile, 1988; Amabile & Grysiewicz, 1989; Witt & Beorkrem, 1989). On the other hand, some environmental factors can inhibit creativity: lack of respect, lack of resources, time pressure, etc. (Amabile & Grysiewicz, 1989; Witt & Beorkrem, 1989). However, this last affirmation has to be nuanced, as moderate levels of pressure – more particularly time pressure – can actually have a challenging effect, triggering higher levels of creativity (Baer & Oldham, 2006; Khedhaouria, 2017). Creativity tends indeed to be exacerbated by necessity in times of crises (war, pandemic, etc.). Press is the least explored aspect of creativity in the literature; therefore, we lack more detailed definitions of these factors.

1.2.4) Product

Lastly, Product focuses on the outcomes that result from the creative process, with the assumption that studies of these products are highly objective (Rhodes, 1961/1987). A

major consensus can be found in the literature around two main characteristics: creative products must be *novel* and *appropriate* (Boden, 2007; Mumford & Gustafson, 1988; Hokanson, 2016). However, the definitions of these characteristics vary and depend on cultural, social, and disciplinary contexts.

Novelty emphasizes the originality of the creative product in any given context. Novel means “*non-existent before, but which is in the phase of its becoming*” (Nikolko, 1990). Appropriateness means that the construction is considered fit for purpose and valued by a relevant community. It can be referred to as usefulness (Said-Metwaly et al., 2017), effectiveness (Cropley, 2003), validity (Kaufman, 1993), exemplarity (Kant, 1987; Martiniano, 2016), etc. The overarching idea is that a creative product must serve a purpose and have a value to a certain audience; creating something new for the sake of novelty is not sufficient. This also implies that a product becomes creative when people judge it to be creative, in a given socio-cultural context (Brem et al., 2016). Therefore, as we have seen in section 1.2.3, creativity is highly context-dependent. This appropriateness criterium can help to explain why many artists become famous for their work only long after they have passed. Lastly, some authors add a third component to the definition: spontaneousness (Kronfeldner, 2009), wholeness (Henriksen et al., 2016), surprise (Boden, 2007), etc.

1.2.5) Conclusions

This section gives us two major discoveries to build our working definition. Firstly, creativity is a process, meaning “*a series of actions that you take in order to achieve a result*” (Cambridge Dictionary, n.d.). Secondly, the result to be achieved through said process is a creative product that is novel and appropriate.

The Person and Press definitions, rather than concrete elements of definition, provide factors that influence creativity. Creativity is often modelled as an interaction between multiple elements, which must converge for a creative product or idea to emerge. Among these required elements, we find personal characteristics such as knowledge, intelligence, motivation, cognitive and practical abilities, etc. The surrounding environment is a second recurring element. Lastly, an evaluation, by oneself and/or by a “field of experts”, to validate the creative idea, is often required (Amabile, 1983/1996; Csikszentmihalyi, 1988; Feldman et al., 1994; Runco & Chand, 1995; Sternberg & Lubart, 1998).

1.3) Different types of creativity

Depending on the contexts and situations in which creativity may unfold, many authors distinguish between different types of creativity.

How “new” must an idea be in order to be considered creative? We can make a distinction between creativity arising out of nowhere and creativity that builds upon previously existing ideas. Indeed, many authors agree that creative persons depend on reproduction; they draw on ideas they have seen before, and elaborate on these existing ideas to produce something “new” (Foucault, 1977; Freedman, 2010; Spector, 2016).

Creativity is often associated with geniuses, having ideas that change the way we understand the world (Richards, 2019). This type of creativity, whether it builds upon previous knowledge or seems to “come out of nowhere”, produces entirely novel ideas that are appropriate to society. However, creativity can also be regarded as an essential skill, present in every individual. Through this “everyday creativity”, people build upon previously existing knowledge to produce ideas that are novel and appropriate to them, but not necessarily to the world, allowing them to develop their potential and express themselves (Loveless, 2006). Everyday creativity can be interpreted as the ability to think well beyond one’s prior knowledge and experience (Spector, 2016). Several authors operate this distinction between exceptional – historical, or Big-C – creativity and everyday – psychological, or little-c – creativity (Boden, 1992; Kaufman & Beghetto, 2009).

1.4) Motivations behind the creative process

From the literature, we can retrieve two major types of motivations to be creative: intrinsic and extrinsic. We can be intrinsically driven to be creative by a desire for growth, self-actualization, meaning, pleasure, the drive to understand our environment, etc. (Dewey, 1943; Gruber, 1988; Csikszentmihalyi, 1996; Adams, 2005; Perlovsky & Levine, 2012). Extrinsic motivations are also numerous: creativity can be required to pass an evaluation, impress an audience, etc. (Unsworth, 2001; Adams, 2005; Forgeard & Mecklenburg, 2013). The motivation(s) underlying a creative work will influence its outcome, as intrinsic motivations are more likely to foster creativity (Amabile, 1983). Some extrinsic motivations seen as “controlling” – e.g. passing a test – might even hinder it (Adams, 2005).

1.5) What creativity is not

Lastly, a useful way to clarify a concept definition is to compare it with similar concepts. In the public discourse, terms such as innovation, imagination, novelty, etc. are often employed as synonyms of creativity. In this section, I compare and differentiate between these close concepts.

Kaufman (1993) presents a logical structure of creativity concepts, through which he differentiates between originality, creativity, invention, and innovation (cf. appendix 2). According to him, a product is original if it is novel. It is the only condition, whereas for a product to be creative, it must be both novel and valid (appropriate). Therefore, creativity has to be distinguished from novelty and originality.

Imagination is “*the mental process of reproducing sensory and perceptual experiences stored in memory, or of recombining parts of formerly perceived experiences to create new arrangements apart from their actual occurrence in reality*” (Sadoski, 1992, p.1). Similarly, imagination also has to be distinguished from creativity; it can generate new ideas, but appropriateness is not required.

According to Kaufman (1993), an invention is novel, valid, but also incremental: it is an objective and real contribution to the existing knowledge. This is not always the case with creativity, as we have seen in section 1.3 that everyday creativity does not necessarily

produce something novel for society as a whole. Lastly, an innovation must be novel, valid, incremental, and realized: it entails putting the invention to use (Kaufman, 1993; Surkova, 2012). Creativity is an essential part of innovation, but the two concepts are not interchangeable. Innovation goes further, encouraging the processing of the creative idea, in order to exploit its potential value through development (O'Sullivan & Dooley, 2008).

1.6) Conclusion: a working definition of creativity

With all these elements in mind, a working definition of creativity can now be built. Although this prototype of definition is certainly not a universal answer, it provides us with a sufficient synthesis of existing literature, which will be a basis for the rest of this work.

Creativity is a process generating a result that is considered novel and appropriate to a certain audience in a given socio-cultural context.

To define it more in details: this process is inherent to all human beings and can be taught, enhanced, and nurtured. It can take the form of exceptional creativity, producing ideas that are novel and appropriate for society as a whole, or everyday creativity, producing novel and appropriate ideas for the individual. It is fueled by certain personality traits such as openness and curiosity, as well as environmental factors such as appropriate resources. Lastly, it can be powered by intrinsic or extrinsic motivations.

Now that we have a definition of creativity that will be employed for the rest of this thesis, the next step is to examine what has already been established in the literature regarding the link between individual creativity and economic growth.

CHAPTER 2 – CURRENT STATE OF RESEARCH AROUND CREATIVITY AND ECONOMIC GROWTH

In this section, I examine the economic literature that explores the links between creativity and economic growth. Economic growth can be defined as the transformation process through which a nation's - or a region's - wealth increases over time³ (Cornwall, 1998).

2.1) First research in the top five economic journals

As a first step, I focus on the articles published in the top five economic journals⁴: the American Economic Review, Econometrica, the Journal of Political Economy, the Quarterly Journal of Economics, and the Review of Economic Studies. The following research keywords and Boolean operators are tested: “creativity”, “creativity AND growth”, “creativity AND economy”. This first round of research generates the following amount of results:

	<i>“creativity”</i>	<i>“creativity AND growth”</i>	<i>“creativity AND economy”</i>
American Economic Review	3	0	0
Econometrica	1	0	0
Journal of Political Economy	275	189	270
Quarterly Journal of Economics	213	162	188
Review of Economic Studies	98	77	91

Table 1: Number of articles in leading economic journals, based on full-text search (on the 21st of January 2021)

The first two journals generated articles that mentioned creativity, but had no link with economic growth. For the others, I observe that the three different choices of keywords tend to generate the same list of articles. I also observe that beyond the first 30 articles, the rest of the list actually has no link with creativity and/or economic growth at all (the words are merely mentioned in the article); roughly, less than a quarter of all results generated are actually relevant. Therefore, I decide to make the research more focused, by only searching for the keywords in the title of the articles, not in the text. The following amount of results is obtained:

³ We make the choice here to focus on economic growth at a regional or national level, and not on personal enrichment.

⁴ This top five has been determined by IDEAS, the largest free bibliographic database dedicated to economics (IDEAS, 2020).

	“creativity”	“creativity AND growth”	“creativity AND economy”
American Economic Review	2	0	0
Econometrica	0	0	0
Journal of Political Economy	4	0	0
Quarterly Journal of Economics	4	0	0
Review of Economic Studies	1	0	0

Table 2: Number of articles in leading economic journals, based on title (on the 21st of January 2021)

These results are very few in number and confirm the gap we are exploring. Most of the articles generated do indeed cover the topic of creativity, but have no link with economic growth. For example, I obtain titles such as:

- Ceulemans, C., Ginsburgh, V. & Legros, P. (2011). Rock and Roll Bands, (In)complete Contracts, and Creativity. *American Economic Review*, 101(3), 217-221.
- Giorcelli, M. & Moser, P. (2020). Copyrights and Creativity : Evidence from Italian Opera in the Napoleonic Age. *Journal of Political Economy*, 128(11), 4163-4210.

On the basis of those findings, I conduct a wider search involving a larger number of publications as well as potential intermediate variables.

2.2) Wider literature research

In this second step, I widen the scope of the research by searching for articles with the keywords “creativity AND growth” in the title of papers recorded in academic databases such as Limo, Web of Science, and Google Scholar, for the time range 1950-2021. This method yielded 177 results in Limo, 65 in Web of Science, and 259 in Google Scholar (on the 21st of January 2021). The goal of this expanded research is to explore our main question through more than five journals, but also with the help of other disciplines (human sciences, management, etc.). I summarize the main findings below, considering on the one hand papers discussing a direct link between individual creativity and economic growth, and on the other hand potential intermediate variables.

2.2.1) A direct relationship?

The concept of creativity has been associated with business in the literature since at least 1971; it was considered to represent “*the group of conditions that lead to manufacturing products or to new ways that contribute to an enrichment of society*” (Kritikou et al., 2008). A series of business topics are related to it in publications since the late 1990s: technological discontinuities, innovation, behavior, strategy, market, competition, the impact of organizations, etc. (Castillo-Vergara et al., 2018).

A few authors identify a direct relationship between individual creativity and economic growth. For instance, Brosio (2016) establishes a parallel between the decline of creativity in Europe in the past decades and a decline in economic performance. Reid & Gatrell (2017) analyze the craft beer industry and the non-economic drivers of its growth, among which creativity can be found. Finally, Nakamura (2018) links the rise of investment in intangible capital such as creativity with the development of new economic forces.

However, in those papers, *the relationship between individual creativity and economic growth is neither empirically tested, nor explicated by a specific theoretical mechanism; it is merely observed*. Although creativity is believed to be beneficial to the economy, and therefore increasingly encouraged, we therefore find no conclusive empirical evidence of this hypothesis in the literature. Therein lies a gap in research that should be addressed. If, as suggested, creativity is a driver of economic growth, this phenomenon should be explained and empirically tested.

2.2.2) An indirect relationship?

To explore whether there might be empirical evidence of an indirect relationship between individual creativity and economic growth, the next proposition is to build a theoretical model introducing three intermediate variables: *innovation, human capital, and entrepreneurship*. Indeed, these variables are widely recognized in the literature as being linked to both individual creativity and economic growth (see for example Howitt, 1999; Storper & Scott, 2009; Faggian et al., 2017). This model is illustrated in Figure 1 below.

The selection of human capital and entrepreneurship as variables was guided by their multiple appearances, next to “creativity” and/or “growth”, in the article titles generated by the expanded research. Indeed, I observe that several authors identify them as drivers of economic growth. Some relevant examples of such titles can be found in appendix 3. Aside from those articles, I also noticed more where human capital and entrepreneurship are considered as potential drivers of economic growth, without being in the title. Their links with creativity, on the other hand, are rather intuitive, and developed further in chapter 3.

Similarly, regarding innovation, the search for “innovation AND growth” restricted to the title yielded 8.182 results in Limo and 8.980 results in Google Scholar (on the 1st of February 2021), confirming an extensive link. However, I found no articles with “creativity AND innovation AND growth” in the title, maybe due to the fact that, although “innovation” and “creativity” are two distinct concepts (cf. 1.5), they are often used as overlapping concepts.

I find that a handful of the articles obtained related to innovation and economic growth explore the topic of creative destruction. This theory, popularized by economist Joseph Schumpeter, states that the capitalist “engine” is kept in motion by the impulse from new goods, new methods of production or new markets. This process is continuously changing the economic structure from within. Even though innovation-driven change destroys some of the value of established companies, it is the disruptive force that sustains economic growth (Schumpeter, 1942). Creative destruction therefore establishes a link between the

creation of new products, markets, firms, etc. via innovation, and the creation of economic growth.

2.3) Conclusions

As a conclusion, we have found that the relationship between creativity and economic growth has been observed in the literature, but neither explicated nor empirically tested. Considering this gap in research, three recurring concepts were identified in sources tackling creativity and/or economic growth. Therefore, I explore them as potential intermediary variables through which creativity might influence economic growth.

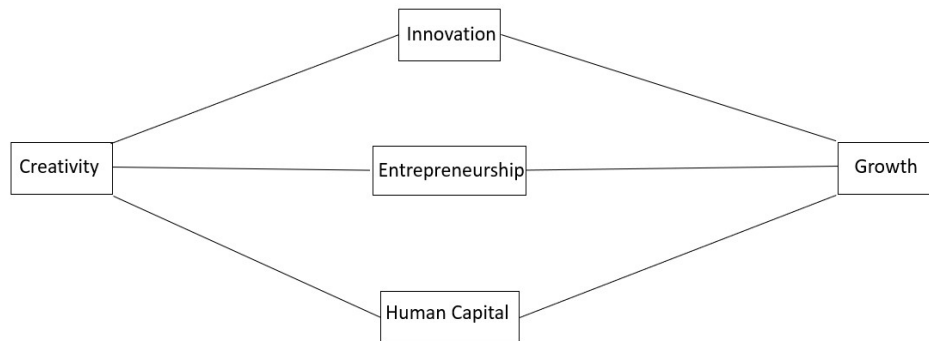


Figure 1: Creativity, economic growth, and intermediary variables

In the next chapter, I explore the literature around each of these variables, and the role they could play in the relationship between creativity and economic growth.

CHAPTER 3 – BUILDING A MODEL WITH INTERMEDIATE VARIABLES BETWEEN CREATIVITY AND GROWTH

In this section, I further explore each of the three intermediate variables proposed in chapter 2. More particularly, their definitions and their relationships with both creativity and economic growth are explored.

This chapter is based on several sources. Firstly, I use the articles obtained in the wider literature research of section 2.2. Next, I find complementary sources by searching the name of the variable AND growth (restricted to title) in academic databases for each of the three variables. Lastly, I complement with definitions of the various concepts.

3.1) Innovation

3.1.1) Definition and distinction from creativity

Innovation was defined in section 1.6 as a product or idea that is novel, valid, incremental, and realized (Kaufman, 1993; Surkova, 2012). In contrast, a creative product must only satisfy the novelty and validity conditions. Creativity is an essential part of innovation, but the two concepts have to be differentiated. That being said, they remain closely related, and many authors employ them as synonyms. Indeed, in a review of creativity research over the past 25 years, Williams et al. (2016) note that the terms “innovation” and “creativity” tend to be used interchangeably in some fields.

There is undeniably a confusion around these definitions. For the purpose of this thesis, I make the decision to distinguish clearly between the two concepts, in line with the previous literature review around creativity. I rely on a standard definition provided by the OECD: “An innovation is a new or improved product or process (or combination thereof) that differs significantly from the unit’s previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process).” (OECD, 2018b, p.20). Indeed, we find in this definition the conditions of incrementality - significant difference with previous products or processes - and realization - availability to potential users or brought into use - that distinguish innovation from creativity. For the purpose of this thesis, I focus on innovation as a process (rather than a product), through which creativity may or may not generate economic growth.

3.1.2) Relationship with growth

Joseph Schumpeter’s theory of creative destruction (cf. section 2.2.2) was among the first to link innovation and economic performance. Indeed, this theory states that innovation-driven change fosters growth and economic welfare in general, although it can also make some individuals worse-off – generating job losses, increased uncertainty, etc. (Schumpeter, 1942; Schubert, 2013).

Many authors have explored the positive effects of innovation on economic growth (Howitt, 1999; Aghion et al., 2001; Kogan et al., 2017; Castillo-Vergara et al., 2018). In these works, innovation is either measured via the proxy of R&D expenses, or via patent

activity. It is empirically and theoretically widely accepted that both the quantity and the quality of innovative activity are associated with economic growth (Hasan & Tucci, 2010; OECD, 2010c).

Through which mechanisms does innovation generate economic growth? The common answer is that innovation is the main force driving technological progress. Indeed, in the most basic sense, there are two ways of increasing the output of an economy: increasing the number of inputs, or finding new ways to get more output from the same amount of inputs (Rosenberg, 2004). Innovation and technological progress allow this second method to take place. Technological progress generates higher productivity levels, which drives long-run economic growth (Gaffard, 2009; Primo Braga et al., 2009).

In particular, Akcigit and Kerr (2018) differentiate between external and internal innovation. External innovations allow firms to create new products and capture new market shares, whereas internal innovations improve products that firms already own. They conclude that external innovations have more growth impact than internal innovations, showing the important role that small, innovative firms and new entrants can play in economic growth.

3.2) Human capital

3.2.1) Definition and link with creativity

At the individual level, human capital can be defined as “*the knowledge, skills, competencies and other attributes embodied in individuals that are employed in the creation of individual, social and economic well-being*” (OECD, 2001). Since it is a capital, it is an asset that yields income and other useful outputs in the long-term. At the unit level – where the unit can be a team, enterprise, country, etc. – human capital refers to the aggregate accumulation of its members’ human capitals, that can create value for this unit when they are combined in the right way (Wright & McMahan, 2011; OECD, n.d.).

As we have seen in our working definition (cf. chapter 1), creativity is a skill, an aspect of human intelligence. As such, it can be considered as an element of human capital. Besides, the “creativity premium” of human capital has to be taken into account. Sleuwaegen & Ramboer (2019) attempt to define five main elements that stimulate the development of high-growth firms – that is, firms that make a significant contribution to the economic performance of a region. The fourth one of these elements is human capital, which they measure by the availability of highly educated people in the region. However, not all aspects of human capital are equally important; human capital employed in creative occupations bears a significant premium. That is why the fifth element consists of people who are engaged in creative and innovative jobs. In short, they determine human capital, especially when employed in creative jobs, as a determinant factor of economic growth.

A recurring theory links creativity and human capital via the concept of the creative class. Florida (2002) posits that it is not only the education of individuals that matters in driving economic growth, but also their creativity. To measure it, the author establishes a set of professions that compose the “creative class”: artists, designers, writers, scientists, innovators, etc. This measure of human capital via the profession is argued to be better than

the conventional use of educational accomplishment, because it accounts for actually utilized skills rather than potential talent (Faggian et al., 2017). The author establishes the importance of a creative class for the innovation and growth of a region.

Related to this topic, the “creative city” is presented as a driver of economic growth. The idea is that cities attract a creative class of talented people and bring them close together (Gordon, 2013). These people are attracted by the presence of a rich variety of amenities, such as restaurants, expositions, concert venues, etc. (Piergiovanni et al., 2012) This class of creative workers fosters congruence between talent, technology, and tolerance (Jin & Munier, 2014). By bringing this creative class together, the individuals find new ways to combine resources, which generates economic growth (Gordon, 2013). Indeed, the density of creative workers has been empirically proven to facilitate innovation (Knudsen et al., 2008).

3.2.2) Relationship with growth

The role of human capital in economic growth has been a topic of interest for the past decades, and it has changed course at least three times. A first current of “new growth” literature considered human capital as a main generator of long-term sustained growth. Indeed, for a long time before the industrial revolution, production required human strength. Then, the neo-classical approach argued the opposite, that human capital is just an ordinary input unable to generate growth. At the time, machines were increasingly replacing humans in industries. Lastly, the revisionist view admits the role of human capital, but considers that it has been largely overstated in the past (Cohen & Soto, 2007).

Since the 1960s, there is an agreement on the generic importance of human capital for economic growth. Indeed, in the modern economy, the major source of growth is not physical capital anymore, but information. The sale or exchange of information requires people with the appropriate skills and knowledge to transform it into economic value (OECD, n.d.). Some authors argue that human capital, as a broad concept englobing creativity, is the most essential production factor in today’s knowledge societies (Meyer, 1999; Faggian et al., 2017).

At an individual level, people invest in themselves – usually through education – because it yields higher personal economic returns. Higher education usually yields a lower unemployment risk and a higher salary. These economic benefits have to be balanced against the cost of acquiring that capital – mainly school and university fees, as well as the opportunity cost of studying instead of working. However, this investment usually ends up paying for itself (OECD, n.d.). Empirical evidence has confirmed a simultaneous relationship between income and educational growth over time (Goetz & Hu, 1996; Bildirici et al., 2008).

As the accumulation of individual human capital produces individual economic (income) growth, the same holds at a national level. The recurring hypothesis is that a higher human capital benefits economic growth by yielding higher productivity. Indeed, a higher human capital tends to yield a higher salary. Higher earnings in turn tend to indicate a higher productivity – meaning a higher value of what is produced by the worker –, and this productivity tends to increase growth. The OECD has demonstrated that a one-year increase of the average time spent in education by a population increases economic output

per capita by 4 to 6% in the long term (OECD, n.d.). Besides, we can consider spillover effects, whereby an increase in the share of higher-education workers increases the salary of all categories of workers. This positive externality results in a social return of education that exceeds the private return (Moretti, 2004).

The growth of human capital is both a condition for and a consequence of economic growth. Human capital raises productivity, thereby raising physical capital and total output. Conversely, the growth of physical capital raises the marginal product of human capital. This phenomenon generates an increased demand for human capital relative to unskilled labor, resulting in an increased skill wage differential. The acquisition of human capital, or education, therefore becomes more profitable. Besides, the growth of human capital is also influenced by the growth of family incomes: higher incomes enable more people to finance human capital investments such as higher education (Mincer, 1981).

Lastly, it is of interest to note that the relationship between human capital and growth presents some non-linearities. Firstly, Ali et al. (2018) find that the positive relationship between human capital and growth requires the presence of better economic opportunities and high-quality legal institutions. Next, empirical analysis suggests that institutions and gender have an important influence on this relationship. In particular, female primary education has a direct effect on GDP growth, whereas male primary education has an indirect effect on GDP growth, which depends on the quality of institutions. This suggests that female primary education can have a very powerful effect in developing countries (Pelloni et al., 2019).

3.3) Entrepreneurship

3.3.1) Definition and link with creativity

By the OECD definition, entrepreneurship can be considered as the “*phenomenon associated with entrepreneurial activity*”, where entrepreneurial activity is “*the enterprising human action in pursuit of the generation of value, through the creation or expansion of economic activity, by identifying and exploiting new products, processes or markets*” (Ahmad & Seymour, 2008). That being said, a common definition of entrepreneurship has not yet been agreed upon in the literature.

Despite the lack of consensus on a definition, there seems to be a general agreement in the literature that entrepreneurship involves creating “something new”, be it a new organization, product, economic activity, etc. We can relate this to the novelty aspect of our creativity definition (cf. 1.2.4). In this context, entrepreneurship definitions can be classified in three categories, all three of them linking entrepreneurship either to novelty or to creativity:

- *What entrepreneurs do*: According to most definitions, entrepreneurs create “something new” and discover new opportunities.
- *Who entrepreneurs are*: They are often defined as creative and innovative persons.
- *What entrepreneurs produce*: They are thought to produce new organizations, products, activities, etc. (Gutterman, 2018)

As a reminder, *creativity is a process creating a result that is considered novel and appropriate to a certain audience in a given socio-cultural context* (cf. 1.6). Considering that entrepreneurship requires the creation of a result that is new or novel, we can see how

the two concepts are closely related. Indeed, to derive profits from the exploitation of a marketplace opportunity, an entrepreneur will have to be creative, in order to produce an idea/product/activity/... that is both new and relevant to a particular market.

Godley (2014) suggests that the buying and selling of ideas, which represent the outcome of creativity, create economic value in modern societies. Entrepreneurs market these ideas, the product of human creativity, using their experience and judgement to define how new ideas might meet human needs, and then convincing customers that these new products meet their needs.

3.3.2) Relationship with growth

Entrepreneurship is commonly considered as an engine for progress, competition, productivity, technological change, job creation, and welfare (Florida, 2003; Van Stel et al., 2005; Cabrita et al., 2014; Gutterman, 2018). Piergiovanni et al. (2012) state that economic welfare requires, among other factors, continuous flows of firm entries; therefore, startups and entrepreneurs are necessary for growth. They verify these claims empirically for 103 Italian provinces over the time period 2001-2006. In particular, growth is influenced by the share of firms in creative industries: art, fashion design, advertising, architecture, engineering, industrial design, software, etc. We find here the same “creative premium” idea as for human capital.

Entrepreneurs have been identified as playing at least five key roles in an economy (OECD, 2010a; Mazzarol & Reboud, 2019):

- *Disruptor*: Entrepreneurs are a key agent of innovation and creative destruction, disrupting market equilibrium through the introduction of new products and processes (Schumpeter, 1934).
- *Opportunity identification*: Entrepreneurs identify new market opportunities.
- *Risk taker*: Entrepreneurs take the risk of engaging in the commercialization of innovations, usually having a higher ability to deal with uncertainty and ambiguity (Knight, 1933).
- *Resource shifter*: Entrepreneurs move productivity forward by finding new ways to combine resources to achieve superior growth (Drucker, 1985).
- *Breakthrough innovator*: Finally, entrepreneurs who engage in market disruptive innovation can achieve a new breakthrough in technology, business or marketing approaches (Baumol, 1968).

Particularly, literature considers a sub-class of “high-growth” entrepreneurs, which are distinguished from the rest based on their aspirations. This “high-growth” entrepreneurship aims at creating and developing businesses that will drive productivity, create new job opportunities, increase innovation, promote internationalization, and achieve sustainable economic growth. The OECD defines high-growth firms as enterprises with an average growth greater than 20% per year over a 3-year period, and with more employees at the end of the observation period than at the beginning (OECD, 2010b). Considering these aspirations, high-growth entrepreneurship is particularly desirable (Gutterman, 2018).

However, it is interesting to note that entrepreneurship might not be a crucial element for growth in every economy. Porter (2002) defines 3 stages of economic development for countries: factor-driven, efficiency-driven, and innovation-driven. He states that, although institutions dominate in the first two stages, entrepreneurship and innovation play a crucial

role in economic growth in the third stage. Van Stel et al. (2005) find that the Total Entrepreneurial Activity rate, measuring the share of new businesses, has a negative effect for relatively poor countries, whereas it has a positive effect for relatively rich countries. This does not mean that entrepreneurship is bad per se for emerging economies; rather, this negative relationship might mean that there are not enough large companies present in these countries. Another explanation is that entrepreneurs in poor countries have lower human capital levels, and would be more productive as wage-earners in large companies. This finding suggests that, just like creativity can generate economic growth, a certain level of economic growth might be required for creativity to emerge and to be valued (cf. 5.3).

3.4) Entrepreneurship, human capital, innovation, and the broader context

In this section, I find it important to acknowledge the broader context around the three variables I have just analyzed. Indeed, although creativity is an important factor for each of them, there are many more drivers to consider. Although they go beyond the scope of this research, it is worthwhile to mention their existence. For instance, national factors such as the institutional environment, cultural traits, personality traits, economic development, income inequality, and levels of employment all have a significant influence on entrepreneurial activity, innovation and human capital (Simón-Moya et al., 2014).

Let us also acknowledge that our three intermediate variables can undoubtedly be linked to one another. For the sake of clarity and to remain within the scope of the research, I choose not to explore how these relationships could influence the link between creativity and economic growth. Nevertheless, it is worthwhile to acknowledge this overlap.

A certain degree of human capital is indeed necessary to successful entrepreneurship: it helps to discover and exploit entrepreneurial opportunities. It also helps in the accumulation of new knowledge and the creation of advantages for new firms (Marvel et al., 2014). Faggian et al. (2017) even go as far as to consider entrepreneurship as a part of a broadly defined concept of human capital. Unger et al. (2011) empirically find a small but statistically significant relationship between human capital and entrepreneurial success. This link is stronger when considering the outcomes of human capital investment – knowledge, skills, abilities – rather than the investments themselves – education and experience (Unger et al., 2011).

Similarly, entrepreneurship can be linked with innovation. Among the first economists to establish this relationship was Schumpeter, who stressed innovation and leadership as the main characteristics of entrepreneurship. According to him, the entrepreneur generates a wave of creative destruction by introducing innovations, making current technologies obsolete (Schumpeter, 1934). Similarly, Drucker (1985) suggests that successful entrepreneurs share a commitment to innovation. According to Timmons (1999), the entrepreneur is characterized by his/her ability to combine high levels of creativity and innovation with high levels of general management and business skills.

Lastly, Dakhli & De Clercq (2007) provide significant empirical support for the role of human capital as a driver of innovation. Indeed, human capital can be viewed as a factor of production, but it can also be considered as a source of technology. Human capital involves not only the transmission, but also the production of new knowledge, which is the source of innovation and technological change (Mincer, 1981).

3.5) Summary

Now that the relationships between the five variables have been discussed, I update Figure 1 with these findings and summarize them in Figure 2 below⁵. In this figure, full arrows indicate evidence of a causal relationship, whereas lines indicate arguments regarding a conceptual relationship.

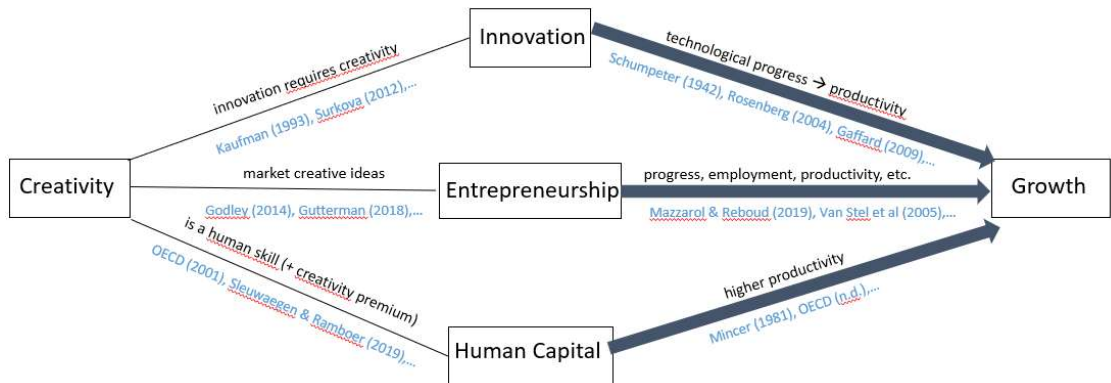


Figure 2: Exploring the indirect links between individual creativity and economic growth

Having defined and reviewed our model linking creativity and economic growth through three key intermediate variables, the next step of the analysis will be to look for empirical evidence supporting that model.

⁵ Except for relationships mentioned in section 3.4, which are outside the scope of this research.

CHAPTER 4 – PRELIMINARY EMPIRICAL OVERVIEW

In this chapter, I perform an empirical exploration of my theoretical findings. Using publicly available data, I select available indicators of the five variables to be analyzed – creativity, innovation, human capital, entrepreneurship, economic growth – and perform graphic and multivariate analyses of these indicators for a selection of countries⁶. I firstly test the direct correlation between creativity and economic growth. In a second step, I test the correlations between creativity and each of the intermediate variables (left-hand side of figure 2). Thirdly, I test the correlations between each of the intermediate variables and economic growth (right-hand side of figure 2)⁷.

This section is certainly not an attempt to “solve”, via data analysis, the question of creativity and its impact on economic growth. There is still a great lack of consensus in this area, even on the definitions of the concepts and on the aspects to be measured. Rather, it is a prototype of empirical analysis to find support for the theoretical results obtained. It is important to remind here that correlation is not causality; with this empirical analysis, I can only illustrate whether the variables are interdependent or not. However, the direction of causality remains an open question; for instance, creativity might influence economic growth, but economic growth might also have an impact on creativity levels.

4.1) Data selection and presentation

To perform this empirical exercise, we first need to agree on indicators for each of the five variables. In this section, I present the databases chosen and justify this selection.

4.1.1) Creativity

(a) *Choosing the indexes*

There are several methodological issues around the measurement of creativity. The main one is the absence of an agreed-upon instrument, resulting from the lack of consensus on a definition of creativity (Said-Metwaly et al, 2017b). Several options to assess creativity have been used in the literature. Said-Metwaly et al. (2017a) classify the most widely used instruments according to the 4Ps perspective, identifying instruments such as divergent thinking tests or self-report questionnaires⁸. However, these instruments are quite limited, and not self-sufficient to measure the multifaceted phenomenon that is creativity (Piiro, 2004; Surkova, 2012; Said-Metwaly et al., 2017a). The problem is that they often target a specific profession, region or context. In the literature, global measures of creativity for a large number of countries or regions are quite scarce.

⁶ The R code used for the statistical analyses can be found in appendix 5. I use the significance level $\alpha = 0.05$

⁷ It would have been interesting to build an empirical model regressing economic growth on the three variables at the same time. However, this was not possible here due to the important differences between the databases used.

⁸ Divergent thinking tests provide participants with open problems that require them to generate as many responses as possible. They are scored to capture fluency, originality, flexibility and elaboration. Self-report questionnaires enquire about personality traits related to creativity.

Correia & Costa (2014) provide a review of twelve selected indexes of creativity. These indexes are all composite measures; the authors start by identifying the ten dimensions commonly used to measure creativity. Let us notice that all twelve indicators include the dimensions “*human capital, creative class and education*” and “*technology and innovation*” – two of our intermediate variables – in their measure of creativity. Eleven out of twelve use the dimension “*openness, diversity and tolerance*”. However, our third variable of interest, “*entrepreneurship*”, is only used as a dimension of creativity by five of them. Other dimensions include “*cultural environment and tourism*”, “*regulations*”, etc.

Next, the authors identify the strengths and weaknesses of these twelve indexes. Based on these, I choose to use the Global Creativity Index (GCI)⁹ in this exercise. Indeed, I eliminated most indexes because they were specific to a (set of) region(s). I also eliminated those for which the data, methodology and metrics were not available. The three remaining indexes were all based on the same 3T model (which we detail later): Talent, Technology, and Tolerance. Out of these, I choose the GCI, because it provides the largest number of observations. The details of this selection can be found in appendix 4.

(b) First measure: the Global Creativity Index

The GCI is a composite measure of creativity at a national level, developed by Richard Florida and published by the Martin Prosperity Institute at the University of Toronto. The GCI is a measure for advanced economic growth and sustainable prosperity based on the 3T’s of economic development: Talent, Technology, and Tolerance (Florida, 2003).

Technology is a measure of the R&D effort and of innovation, based on patents. Talent measures the human capital, via educational and occupational measures of talent. Lastly, Tolerance establishes the broad context for technological innovation and talent attraction. As we can see, creativity is here once again connected to two of our three variables of interest: innovation (Technology) and human capital (Talent).

The GCI provides ratings for 139 countries on each of these dimensions and on their share of the creative class, aggregated for the time period 2010-2014. The main weakness of this index is that it only provides averaged measures for the period, which does not allow for panel data analysis. It also considers a rather limited number of dimensions, as compared to other creativity indexes (Correia & Costa, 2014).

(c) Second measure: the creative class share

The main methodological problem of the GCI is that it is a composite measure of creativity, taking human capital and innovation as components of it. Therefore, measuring the correlation of these two variables with creativity presents an endogeneity problem. This limitation seems difficult to avoid, as all the main creativity indexes presented by Correia & Costa (2014) use as components human capital and innovation.

To solve this endogeneity issue, I was unable to find a direct, non-composite measure of creativity that would fit my working definition. As a second-best solution, I decide to use

⁹ Correia & Costa (2014) analyzed the 2011 version of the GCI, which is not publicly available. I use the updated 2015 version, as it expands the previous one by adding more than 50 countries to the analysis, thereby providing a larger set of observations.

the creative class share, measured in the same GCI report. This measure is calculated as the share of a country's labor force that is engaged in creative occupations (Martin Prosperity Institute, 2015). Florida (2002) first established this concept, and defined a set of professions that compose this creative class: artists, designers, writers, people from the media industry, scientists, innovators, etc. (cf. 3.1.1). This definition is vague, as it does not establish conceptually what a creative occupation is. However, it is the only direct measure of creativity I was able to find at a national level. I use data on the creative class share of 93 countries, averaged over the time period 2010-2012.

4.1.2) Innovation – OECD data

The OECD plays a key role in the development of international standards on the measurement of innovation and the design of indicators. I already referred to the Oslo Manual to define innovation (OECD, 2018b). Therefore, I rely here on OECD data.

Firstly, I use the indicator “innovative firms as a percentage of total firms across countries”, provided on the OECD website (OECD, 2019a). An innovation-active firm “*is engaged at some time during the observation period in one or more activities to develop or implement new or improved products or business processes for an intended use*” (OECD, 2018b, p.34). The data is available as averages for the time period 2014-2016, for 34 countries.

Secondly, two types of proxies are used in the literature to measure innovation: R&D expenses and patenting activities (Hasan & Tucci, 2010). However, R&D expenses are by far the most frequently used proxy, as we have indeed observed in the literature research. Therefore, I use the gross domestic spending on R&D as a percentage of total GDP across countries as a second indicator. I consider R&D spending for 43 countries over the period 2010-2018 (OECD, 2019b). The main advantage of this database is that it allows for panel data analysis, and provides a large number of observations.

4.1.3) Human capital – Program for the International Assessment of Adult Competencies

The choice of a proxy to estimate the effects of human capital is no easy decision. Indeed, there is conceptually no clear-cut definition of how human capital should be represented: by years of schooling, education indexes, adult literacy rate, education investments, etc. (Cohen & Soto, 2007; Bildirici et al., 2008).

Different statistical approaches exist to measure human capital. The most common is the indirect approach: measure a person's skill set by his/her qualifications or educational attainment. This method is the most practical, but it presents major drawbacks. First, it only covers the skills developed in particular education programs, whose content changes over time. Also, this method only measures skills at a specific point in time. A second method is the direct assessment of skills, via specific test-based surveys. This method yields more comparable results and allows to evaluate a wider range of skills, but it is more costly. Lastly, self-reporting captures important aspects of skills demand, supply, mismatch and development, but this method suffers from a subjectivity bias (Eurostat, 2016).

For our exercise, I choose the direct assessment of skills method, which yields the most benefits. The most popular survey to use this method is the OECD's Program for the

International Assessment of Adult Competencies (PIAAC). This program assesses and analyses key adult cognitive and workplace skills in several countries/economies. These skills are assessed through the Survey of Adult Skills, which measures adults' proficiency in literacy, numeracy, and problem-solving skills (OECD, n.d.).

I use three indicators: the mean literacy and numeracy scores, as well as the percentage of people scoring at level 2 or 3 in problem-solving in technology-rich environments, for 16-65 year-olds in 38 countries. These scores are presented as an average of the three rounds of surveys, conducted in 2012, 2015, and 2018 (OECD, 2019c). This database allows us to have precise measures of several aspects of human capital. The main weakness is again that information is presented as averages, not allowing for panel data analysis.

4.1.4) Entrepreneurship – Global Entrepreneurship Monitor & OECD data

While there are countless theoretical studies around the definition of entrepreneurship, the measurement of entrepreneurial activity across countries is a very recent and under-developed area of study. There is still a great deal of conceptual and methodological confusion surrounding its measurement (Marcotte, 2013; Henrekson & Sanandaji, 2020).

For the purpose of this exercise, I rely on two databases: the Global Entrepreneurship Monitor's (GEM) annual surveys, and an OECD entrepreneurship indicator. These sources are both widely used references that provide a large range of observations. Furthermore, Marcotte (2013) establishes that these are the only two databases for entrepreneurship measurements whose conceptual foundations are complete and solid.

The Global Entrepreneurship Monitor carries out survey-based research on entrepreneurship across countries since 1999, collecting data directly from individual entrepreneurs (GEM Consortium, n.d.). The GEM's annual reports provide a lot of observations on many different indicators. However, an important weakness of this data is that the indicators presented and the countries analyzed tend to change a lot from year to year. For the sake of consistency, I choose to focus, for the time period 2010-2019 and for 47 countries, on the two most recurring and most central indicators:

- *Total Entrepreneurial Activity (TEA)*: Percentage of 18–64 years old population who are either a nascent entrepreneur¹⁰ or owner–manager of a new business¹¹.
- *Established business ownership rate (EBO)*: Percentage of 18–64 years old population who are currently owner–manager of an established business¹² (Marcotte, 2013).

Secondly, the OECD's "Entrepreneurship at a Glance" reports present panel data on several indicators measuring the activity, types of entrepreneurship, job creation, etc. for different countries and sectors. More particularly, I focus on panel data measuring new enterprise creations for 22 selected countries, for the time period 1990-2017.

¹⁰ A nascent entrepreneur is actively involved in setting up a business; this business has not paid salaries, wages, or any other payments to the owners for more than 3 months (Marcotte, 2013).

¹¹ A new business is a business that has paid salaries, wages or any other payments to the owners for more than 3 months, but less than 42 months (idem).

¹² An established business has paid salaries, wages or any other payments to the owners for more than 42 months (idem).

4.1.5) Economic growth – GDP per capita

In the literature, economic growth and economic performance of countries or regions are commonly measured via the Gross Domestic Product (GDP). The GDP is a “*standard measure of the value added created through the production of goods and services in a country during a certain period*” (OECD, 2020). For this empirical analysis, I use nominal GDP per capita measured in US dollars for 56 countries.

This database presents the advantage of providing data for many years, meaning that I can “adjust” it to other indicators depending on the years considered. The GDP is also a widely understood and accepted concept. The main weakness of this database is that for some countries, data is not available every year, resulting in missing observations.

4.2) Linking creativity and economic growth

I start by empirically testing the direct correlation between creativity and growth. As shown in 4.1.1, I use two different creativity indexes: the GCI and the creative class share.

Firstly, I regress GDP per capita on the GCI index and obtain the following regression:

$$\ln(GDP) = 10.83793 + 1.24235*\ln(GCI) + \varepsilon$$

Coefficients	Estimate	Standard error	t value	Pr(> t)	Significance level
Intercept	10.83793	0.07693	140.87	<2*10 ⁻¹⁶	>99.9%
ln(GCI)	1.24235	0.10145	12.25	<2*10 ⁻¹⁶	>99.9%

Table 3: regression of GDP per capita on the GCI index

This can be interpreted the following way: when a country’s GCI score increases with 1%, the GDP per capita of that country increases with 1.24%.

Next, I regress GDP per capita on the creative class share and obtain the following model:

$$\ln(GDP) = 8.595133 + 0.048856*CrClass + \varepsilon$$

Coefficients	Estimate	Standard error	t value	Pr(> t)	Significance level
Intercept	8.595133	0.164664	52.20	<2*10 ⁻¹⁶	>99.9%
CrClass	0.048856	0.004817	10.14	7.94*10 ⁻¹⁴	>99.9%

Table 4: regression of the GDP per capita on the creative class share

This result can be interpreted as follows: if the creative class share of a country increases with one percentage point, its GDP per capita increases with 4.8856%.

4.3) Linking creativity and the intermediate variables

In this next section, I empirically test the correlation between creativity and our three variables: innovation, human capital, and entrepreneurship. In our model, that means

testing the three left-side relationships. Again, I use two different creativity indexes: the Global Creativity Index (GCI) and the creative class share.

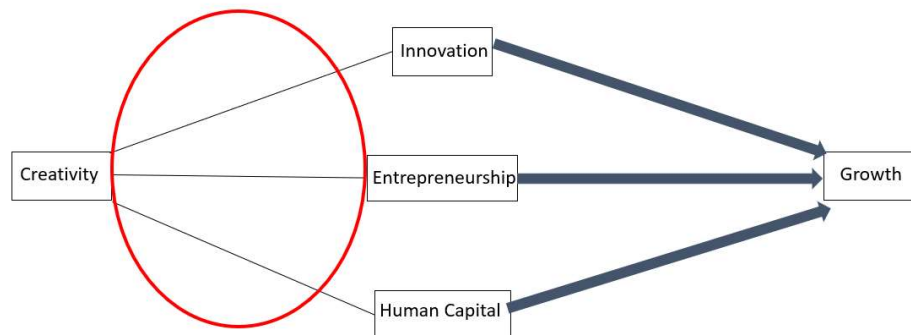


Figure 3: testing the correlation between creativity and the three intermediate variables

4.3.1) Global Creativity Index

I start by analyzing the first creativity indicator, the Global Creativity Index. The GCI measures creativity as a function of innovation (Technology), human capital (Talent), and openness (Tolerance).

I introduce this section with some graphical analyses based on GCI data. The following graphs illustrate the correlation between the GCI and two of our variables of interest, innovation and human capital.

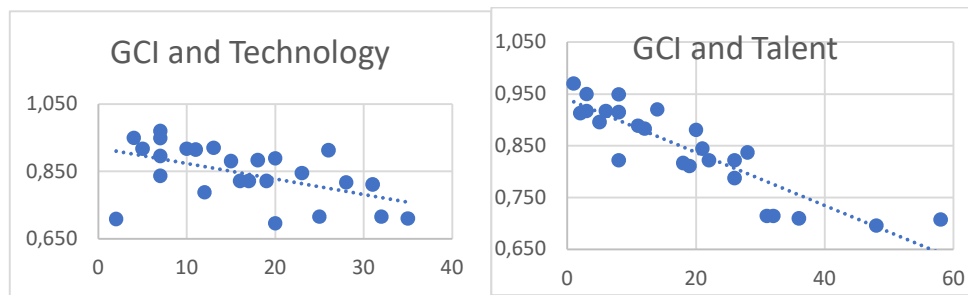


Figure 4: correlation between GCI and Technology/Talent

By construction of the indicators, a high score indicates a low level of Technology/Talent, whereas a high GCI indicates a high level of creativity. From the graphs, we can observe that a higher Technology or Talent index indicates a lower GCI. This indicates a positive relationship between human capital and creativity, and between innovation and creativity.

Secondly, I turn to entrepreneurship, which is not a component of the GCI. However, the GCI report claims a positive correlation between the GCI and entrepreneurship (0.83). A first reading of the GCI report therefore shows us a positive correlation between creativity and each of our intermediary variables.

4.3.2) Creative class share

In this section, I analyze our second creativity indicator, the creative class share. More particularly, I compute the correlations between this indicator and all of our other indicators for innovation, human capital, entrepreneurship, and economic growth¹³. I compute the correlation matrix:

	Creative class share	Innovation	RD	Literacy	Numeracy	Pbsolving	TEA
Creative class share	1.0000000	0.39380698	0.14609295	0.40562163	0.44249983	0.7308776	-0.17895136
Innovation	0.3938070	1.00000000	0.11846908	-0.08358628	-0.17244461	0.1289913	0.27003472
RD	0.1460929	0.11846908	1.00000000	0.67073582	0.59308697	0.5938505	-0.44639881
Literacy	0.4056216	-0.08358628	0.67073582	1.00000000	0.90530843	0.8819029	-0.55826170
Numeracy	0.4424998	-0.17244461	0.59308697	0.90530843	1.00000000	0.8750614	-0.67523339
Pbsolving	0.7308776	0.12899133	0.59385050	0.88190291	0.87506135	1.00000000	-0.51692443
TEA	-0.1789514	0.27003472	-0.44639881	-0.55826170	-0.67523339	-0.5169244	1.00000000
EBO	-0.1898431	0.24391746	-0.05115318	-0.07395903	-0.40128430	-0.1773348	0.45762958
EntrCreations	-0.2555200	-0.49377296	0.14944428	-0.20230779	-0.02522092	-0.2626575	-0.14874898
GDP	0.5824849	0.60690795	0.37783611	0.57963139	0.49562868	0.7133963	-0.06752038
	EBO	EntrCreations	GDP				
Creative class share	-0.18984308	-0.25551997	0.58248495				
Innovation	0.24391746	-0.49377296	0.60690795				
RD	-0.05115318	0.14944428	0.37783611				
Literacy	-0.07395903	-0.20230779	0.57963139				
Numeracy	-0.40128430	-0.02522092	0.49562868				
Pbsolving	-0.17733479	-0.26265747	0.71339629				
TEA	0.45762958	-0.14874898	-0.06752038				
EBO	1.00000000	-0.22175429	-0.03957878				
EntrCreations	-0.22175429	1.00000000	-0.67513655				
GDP	-0.03957878	-0.67513655	1.00000000				

Figure 5: correlation matrix between the creative share and all other indicators

From this correlation matrix, we can see that the creative class share is positively related with our indicators for innovation and human capital, and also with economic growth (these correlations are statistically significant). Surprisingly though, our measures of entrepreneurship are all negatively correlated with the creative class share. However, the correlation between the creative class share and the indicators EBO and EntrCreations are not statistically significant.

4.3.3) Interpretations

In this first section, we have found that creativity, as measured by both the GCI and the creative class share, is indeed positively correlated with innovation and human capital. In fact, these variables are even used to form many composite measures of creativity. Although this generates an endogeneity problem, we can also consider this observation as an argument in favor of our intermediary variables: the use of these two variables as components of many creativity indexes shows that they have an important relationship with creativity.

However, our results regarding entrepreneurship are not entirely satisfying. The GCI, on the one hand, claims a positive correlation between creativity and entrepreneurship. The creative class share, on the other hand, is negatively correlated with the Total Entrepreneurial Activity indicator.

¹³ For this exercise, in order to ensure coherence with the creative class data, we use aggregates of our indicators for the time period 2010-2012. However, these were not available for two indicators: the share of innovative firms (2014-2016) and the PIAAC scores (2012-2018). These results should therefore be interpreted with care.

These observations are discussed further in section 4.5. Before that, the next section explores the relationships between our three variables and economic growth.

4.4) Linking the intermediate variables and economic growth

We now turn to the relationships between the intermediate variables and growth. Although we presented them as causal relationships in the theoretical model (cf. Figure 2), we have to be careful about the fact that our empirical results do not allow for a causal interpretation. Indeed, simple regressions, fixed effects and random effects models allow to determine a correlation – namely, to what extent changes in one of the variables correlate with changes in GDP –, but this relationship can go both ways: it can also be that changes in GDP per capita affect innovation, human capital, and entrepreneurship.

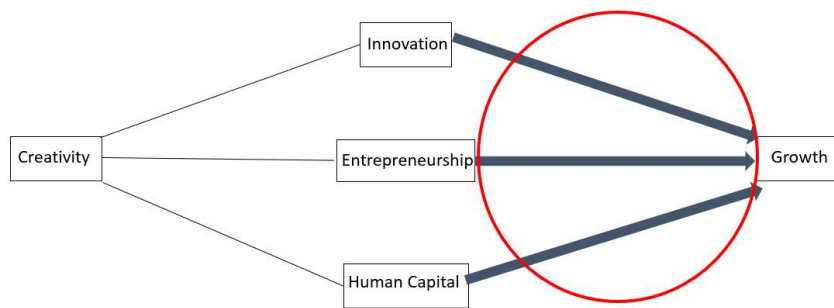


Figure 6: testing the correlation between the three intermediate variables and economic growth

4.4.1) The GCI components

I explore the relationships between the components of the GCI and economic growth. To do so, I combine GCI data with OECD data on the GDP per capita in 56 OECD countries, averaged over the time period 2010-2014. The following correlation matrix is obtained:

	Rank	Technology	Talent	Tolerance	GCI	GDP
Rank	1.0000000	0.8161578	0.8816606	0.8082974	-0.9729577	-0.6543127
Technology	0.8161578	1.0000000	0.6612556	0.5282078	-0.8414401	-0.6171181
Talent	0.8816606	0.6612556	1.0000000	0.5739803	-0.8652311	-0.6303024
Tolerance	0.8082974	0.5282078	0.5739803	1.0000000	-0.8425243	-0.5321474
GCI	-0.9729577	-0.8414401	-0.8652311	-0.8425243	1.0000000	0.6940223
GDP	-0.6543127	-0.6171181	-0.6303024	-0.5321474	0.6940223	1.0000000

Figure 7: correlation matrix between GCI components and GDP per capita

We observe a correlation coefficient of 0.694 between GCI and GDP/capita. The correlation matrix also confirms the strong correlations between GCI and innovation, and between GCI and human capital. The correlations are all statistically significant.

Lastly, to explore the effects of each of the 3T's on economic growth, I test a multiple regression and obtain the following:

$$\ln(GDP) = 11.080065 - 0.006259*Technology - 0.014408*Talent + \varepsilon$$

Coefficients	Estimate	Standard error	t value	Pr(> t)	Significance level
Intercept	11.080065	0.100820	109.899	<2*10 ⁻¹⁶	>99.9%
Technology	-0.006259	0.002814	-2.224	0.0305	>95%
Tolerance	-0.002523	0.001716	-1.470	0.1476	<90%
Talent	-0.014408	0.002513	-5.732	5.08*10 ⁻⁷	>99.9%

Table 5: regression of GDP per capita on the GCI components

The effect of Tolerance is not statistically significant, therefore I leave it out of the regression. The result can be interpreted as follows: an increase in the Talent score of a country with 1 point (meaning that human capital decreases) is associated with a decrease of 1.47% in the GDP per capita of that country. An increase in the Technology score of a country with 1 point (meaning that innovation decreases) is associated with a decrease of 0.62% in the GDP per capita of that country.

4.4.2) Innovation

I look at our first innovation indicator: innovation-active firms as a percentage of total firms across countries. I correlate this measure with GDP per capita, for the time period 2014-2016, and obtain the following correlation matrix:

	Innovation	GDP	2014	2015	2016
Innovation	1.0000000	0.6249912	0.6765184	0.3500497	0.6343288
GDP	0.6249912	1.0000000	0.6592065	0.8413096	0.6743711
2014	0.6765184	0.6592065	1.0000000	0.1561393	0.9588169
2015	0.3500497	0.8413096	0.1561393	1.0000000	0.1752195
2016	0.6343288	0.6743711	0.9588169	0.1752195	1.0000000

Figure 8: Correlation matrix for innovation-active firms and GDP per capita

I obtain a positive correlation of 0.6295 between innovation and GDP per capita (statistically significant), which is coherent with the 0.617 coefficient found in section 4.2.1 with the GCI index.

Next, I test a simple regression and obtain the following:

$$\ln(GDP) = 9.718167 + 0.017045*Innovation + \varepsilon$$

Coefficients	Estimate	Standard error	t value	Pr(> t)	Significance level
Intercept	9.718167	0.179949	54.005	<2*10 ⁻¹⁶	>99.9%
Innovation	0.017045	0.003441	4.953	2.28*10 ⁻⁵	>99.9%

Table 6: regression of the GDP per capita on the share of innovation-active firms

This regression can be interpreted as such: an increase by 1 percentage point in the share of innovation-active firms of a country is associated with an increase of 1.7% in the GDP per capita of that country.

I now turn to the second indicator: gross domestic spending on R&D for the years 2010 to 2018. Considering that we have panel data, I use fixed and random effects to estimate the regression and obtain the following:

$$\text{Fixed effects: } \ln(\text{GDP}) = 0.064404 * \text{RD} + \varepsilon$$

Coefficients	Estimate	Standard error	t value	Pr(> t)	Significance level
RD	0.064404	0.038620	1.6676	0.09636	>90%

Table 7: regression of the GDP per capita on R&D spending (fixed effects)

$$\text{Random effects: } \ln(\text{GDP}) = 10.243232 + 0.115855 * \text{RD} + \varepsilon$$

Coefficients	Estimate	Standard error	z value	Pr(> z)	Significance level
Intercept	10.243232	0.085292	120.0956	<2.2*10 ⁻¹⁶	>99.9%
RD	0.115855	0.032919	3.5194	0.0004325	>99.9%

Table 8: regression of the GDP per capita on R&D spending (random effects)

In this case, the Hausman test shows that it is preferable to trust the fixed effects model (since the null hypothesis of exogeneity is rejected). It can be interpreted as follows: an increase of one percentage point in the R&D spending of a country is associated with a 6.44% increase in the GDP per capita.

4.4.3) Human Capital

In this section, I regress the three components of the PIAAC survey – proficiency in literacy, numeracy, and problem-solving skills – against GDP per capita.

	Literacy	Numeracy	Problem-solving	GDP
Literacy	1.0000000	0.9471749	0.7875354	0.2311711
Numeracy	0.9471749	1.0000000	0.7673155	0.2220910
Problem-solving	0.7875354	0.7673155	1.0000000	0.4969220
GDP	0.2311711	0.2220910	0.4969220	1.0000000

Figure 9: Correlation matrix for the PIAAC components and GDP per capita

Surprisingly, the PIAAC components seem to only have a weak correlation with GDP per capita. Out of the three components, problem-solving skills seem to be the most important feature; besides, it is the only one whose correlation with GDP is statistically significant.

I then proceed to regress GDP per capita on the three components, and obtain the following:

$$\ln(GDP) = 11.164415 + 0,028223*Problem-solving + \varepsilon$$

Coefficients	Estimate	Standard error	t value	Pr(> t)	Significance level
Intercept	11.164415	1.140184	9.792	3.28*10 ⁻¹⁰	>99.9%
Literacy	-0.002721	0.010013	-0.272	0.78800	<90%
Numeracy	-0.002608	0.008513	-0.306	0.76180	<90%
Pbsolving	0.028223	0.008927	3.162	0.00396	>99%

Table 9: regression of the GDP per capita on PIAAC components

The effects of literacy and numeracy are not statistically significant, so I leave them out of the regression. According to this model, an increase of one percentage point in the number of people scoring at level 2 or 3 for problem-solving skills corresponds to an increase of 2.82% in the GDP per capita.

4.4.4) Entrepreneurship

To analyze entrepreneurship and economic growth, I first look at two indicators out of the Global Entrepreneurship Monitor – the Total Entrepreneurial Activity (TEA) rate and the Established Business Ownership (EBO) rate. Considering that we have panel data, I use fixed and random effects to estimate the regression and obtain the following:

$$\text{Fixed effects: } \ln(GDP) = 0.0177557*TEA + \varepsilon$$

Coefficients	Estimate	Standard error	t value	Pr(> t)	Significance level
TEA	0.0177557	0.0032067	5.5370	6.74*10 ⁻⁸	>99.9%
EBO	-0.0062134	0.0043953	-1.4136	0.1585	<90%

Table 10: regression of the GDP per capita on GEM indicators (fixed effects)

$$\text{Random effects: } \ln(GDP) = 10.1171999 + 0.0163634*TEA - 0.0091154*EBO + \varepsilon$$

Coefficients	Estimate	Standard error	z value	Pr(> z)	Significance level
Intercept	10.1171999	0.0911407	111.0063	<2.2*10 ⁻¹⁶	>99.9%
TEA	0.0163634	0.0033443	4.8930	9.932*10 ⁻⁷	>99.9%
EBO	-0.0091154	0.0045657	-1.9965	0.04588	>95%

Table 11: regression of the GDP per capita on GEM indicators (random effects)

In this case, according to the Hausman test, I prefer again to trust the fixed effects model. The results can be interpreted as follows: an increase of 1 percentage point in the Total Entrepreneurial Activity rate of a country results corresponds to a 1.775% increase in that country's GDP per capita.

Lastly, I turn to the OECD's "Entrepreneurship at a Glance" 2018 report, and focus on the indicator for new enterprises creation. I obtain the following regression:

$$\text{Fixed effects: } \ln(\text{GDP}) = 0.516057 * \ln(\text{Creations}) + \varepsilon$$

Coefficients	Estimate	Standard error	t value	Pr(> t)	Significance level
ln(Creations)	0.516057	0.059259	8.7085	<2.2*10 ⁻¹⁶	>99.9%

Table 12: regression of the GDP per capita on the share of new enterprises creation (fixed effects)

$$\text{Random effects: } \ln(\text{GDP}) = 8.203369 + 0.491824 * \ln(\text{Creations}) + \varepsilon$$

Coefficients	Estimate	Standard error	z value	Pr(> z)	Significance level
Intercept	8.203369	0.278365	29.47	<2.2*10 ⁻¹⁶	>99.9%
ln(Creations)	0.491824	0.059471	8.27	<2.2*10 ⁻¹⁶	>99.9%

Table 13: regression of the GDP per capita on the share of new enterprises creation (random effects)

Similarly, we prefer to trust here the fixed effects model. The results can be interpreted as follows: an increase of 1% in the share of new enterprises creation of a country is associated to a 0.52% increase of its GDP per capita.

Now that I have performed empirical analyses on all the indicators, let us turn to the interpretation of these results in the next section.

4.5) Results discussion

In this section, I analyze and attempt to interpret the numerical results obtained. For each of the three intermediate variables, I discuss first their positive correlation with creativity (left-hand side of Figure 2), then their positive correlation with economic growth (right-hand side of Figure 1).

4.5.1) Innovation

Firstly, analyzing the GCI and the creative class share, I have found that both of them are positively correlated with innovation. This supports the theoretical relationship between creativity and innovation.

Looking at the percentage of innovation-active firms confirms the theoretical finding that innovation seems to be positively related to economic growth. Regarding the effects of R&D spending, as a proxy to measure innovation, this exercise does not allow us to draw a conclusion. Let us however note that the sign of the correlation is, as expected, positive.

A large empirical literature has attempted to estimate the R&D rate of return. Most of these works find evidence for the presence of R&D spillovers, and for a beneficial impact of R&D spending on economic growth (Griffith, 2000; Hartmann, 2003; Nkwoma Inekwe, 2014). For instance, Coccia (2012) finds a high concentration of R&D expenditure in leading countries – such as the U.S., China, and Japan –, and shows the strategic role of R&D intensity in supporting labor productivity and long-term economic growth. Therefore,

although our simple empirical analysis does not allow us to draw conclusions, literature can give us confidence in the beneficial impact of R&D spending on economic growth.

4.5.2) Human capital

Similarly as for innovation, the correlation between creativity and human capital is supported by our empirical exercise. Regarding its correlation with economic growth, problem-solving skills are the only component of the PIAAC that seems to have a significant effect.

The measurement of problem-solving skills, as defined by the PIAAC, focuses on “*the abilities to solve problems for personal, work and civic purposes by setting up appropriate goals and plans, and accessing and making use of information through computers and computer networks*” (OECD, 2012[7]). We can therefore relate problem-solving skills with the concept of “little c”, or everyday creativity, developed in section 1.3. Whereas literacy and numeracy skills are not directly related to creative skills, the ability to solve problems by setting up appropriate goals and plans requires to use everyday creativity. This everyday creativity is the ability to think well beyond one’s prior knowledge and experience to produce ideas that are novel and appropriate to the individual – not necessarily to society (Boden, 1992; Kaufman & Beghetto, 2009; Spector, 2016). Besides, as shown in Figure 5, creativity is more strongly correlated with problem-solving (0.73) than with literacy and numeracy (respectively 0.40 and 0.44).

We can also relate these results to the creativity premium of human capital (cf. 3.2.1). Indeed, Sleuwaegen & Ramboer (2019) define human capital as one of the main elements to stimulate the development of high-growth firms. However, they specify that human capital engaged in creative occupations bears a significant premium. The results obtained for human capital suggest empirical evidence of this creativity premium, by suggesting that human capital influences economic growth mostly via creativity-related skills.

4.5.3) Entrepreneurship

The results on entrepreneurship are less satisfying than for the two other variables. Indeed, while the GCI claims a positive correlation between the index and entrepreneurship, the creative class share is negatively correlated with all our measures of entrepreneurship.

I have found no echo for this surprising result in the literature, which only establishes a positive correlation between creativity and entrepreneurship. A hypothesis might be that these empirical results are due to the definitions employed. Indeed, the TEA and EBO consider entrepreneurs as persons “setting up a business”. Professions such as writers, artists, scientists, people from the media industry, etc. that constitute the creative class might not fit this traditional and narrow definition of entrepreneurship, which would explain the negative correlation.

Regarding economic growth, analyses of both our entrepreneurship indexes seem to indicate that the share of new and nascent businesses in an economy has a positive impact. Indeed, the TEA rate measures the share of the population involved in setting up a business or managing a new business (cf 4.1.4). On the other hand, the EBO rate, focusing on businesses that are older than 42 months, appears to negatively affect economic growth.

Entrepreneurial activity has been defined previously as “*the enterprising human action in pursuit of the generation of value, through the creation or expansion of economic activity, by identifying and exploiting new products, processes or markets*” (Ahmad & Seymour, 2008). While I have found empirical evidence of impact for the *creation* of economic activity, I was unable to display the *expansion* aspect. The issue is that the established business ownership rate does not tell us anything about the businesses’ growth; an established business could be expanding, but it could also be in difficulty and not generate enough economic value. To explore this expansion aspect, a more precise measure of established businesses and their economic growth would be needed.

4.6) Conclusions

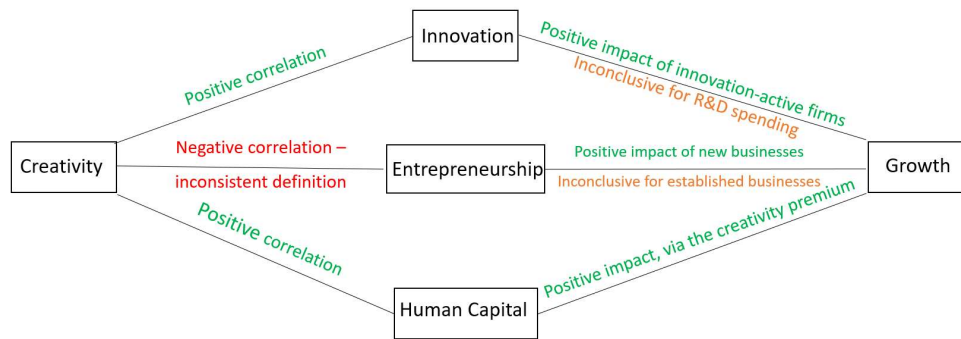


Figure 10: Overview of empirical evidence

In this chapter, I began by analyzing two creativity indexes: the GCI and the creative class share. These indexes showed a positive correlation with GDP per capita, supporting the idea that creativity has a positive impact on economic growth. They are also positively correlated with innovation and human capital, confirming the relevance of these two concepts as intermediary variables. However, I obtained a negative correlation between the creative class share and entrepreneurship; I suggest this might be due to an inconsistency in the definitions.

The empirical results showed a positive correlation between the percentage of innovation-active firms and economic growth. Analysis of the effect of R&D spending, however, was inconclusive. Regarding human capital, I suggest that the results can be viewed as evidence of the creativity premium: human capital influences growth mostly through the channel of creativity-related skills. Lastly, analysis of the entrepreneurship indexes showed a positive correlation between the creation of new businesses and economic growth. However, our results were inconclusive about the effects of the expansion of established businesses.

In conclusion, while the available data provides some evidence of the validity of our model, it also confirms the need to further explore and test the relations between the various dimensions identified, and to better conceptually define how they are both distinct and interrelated. For instance, the correlation between creativity and entrepreneurship obtained is not entirely conclusive, and would require further exploration. Let us recall that in the composite creativity indexes reviewed by Correia & Costa (2014), less than 50% of them considered entrepreneurship as a component of creativity.

CHAPTER 5 – GENERAL CONCLUSIONS

Throughout this thesis, I have aimed at developing a better understanding of the relationship between creativity and economic growth. Indeed, although the economic benefits of creativity have been gaining an increased interest from researchers and policy-makers, their relationship remains an underdeveloped area of study.

I began by establishing a working definition of creativity. I found that, despite the lack of agreement on a common definition, some recurring elements could be retrieved from the literature. Creativity was defined as a process generating a result that is considered novel and appropriate to a certain audience in a given socio-cultural context.

In a second chapter, I analyzed the current state of research around creativity and economic growth through a literature review. I found very few works exploring the direct relationship between creativity and economic growth, and none explicating the mechanisms behind it or empirically testing it. Next, this section allowed me to identify three intermediate variables via which creativity might have an impact economic growth: innovation, human capital, and entrepreneurship.

Those three variables were analyzed and developed in chapter 3. For each of them, I provided a definition and explored their conceptual relationships with creativity on the one hand, and their causal relationships with economic growth on the other.

Lastly, I performed a preliminary empirical exploration of this theoretical model. Using publicly available databases and simple statistical tools, I found empirical support for most of my hypotheses regarding creativity, growth, and the three intermediate variables.

5.1) Implications for management and policy-making

This research has several potential implications for policy-makers, by exploring the link between two concepts – creativity and economic growth – that are often combined, but without a clear understanding of their interdependence. More particularly, this model could provide guidance for policies aimed at supporting growth initiatives through individual creativity (for example ideation competition or innovation prizes), through a better understanding of how and to what extent creativity might foster economic growth. For instance, this work highlights the importance of the creativity premium in the development of human capital. It also provides arguments supporting the promotion of innovation, in education as well as businesses. Lastly, it confirms the indirect role of creativity in economic growth, through the creation of new businesses.

Similarly, this thesis can provide guidance to managers, by showing the importance of fostering creativity in businesses and the most efficient mechanisms to do so. For instance, it confirms the role that new businesses and start-ups can play in generating economic growth. It also provides evidence supporting the promotion of innovation in businesses.

5.2) Limits of the analysis

In order to appreciate the results provided by this thesis, we must be aware of its limitations. I summarize here the most important ones.

Firstly, the literature reviews relied on specific choices regarding the concept definitions. Indeed, I defined the concepts of this model by relying on recurring elements in the literature. However, we have to keep in mind that for most of these concepts, there is no consensus definition in the academic field. Therefore, our theoretical results depend on the decisions made regarding the elements to incorporate or not in definitions. Furthermore, our model did not include contextual variables (such as public policies), which could play a key role (see for example Autio et al. 2014; Correia & Costa, 2014).

Next, the empirical analysis was performed using only publicly available data. Also, the fairly simple statistical tools used for this analysis raise the question of robustness. Let us however remember that the goal was not to prove a relationship, as there is still ongoing debate in the academic field; rather, it served as a first prototype of empirical support to our proposition of theoretical model. Next, as already exposed, I faced a methodological difficulty in finding creativity measures. I used the GCI and creative class share as second-best solutions, but was unable to find a direct, non-composite measure of creativity that would fit the working definition. Besides, time effects have to be considered in the relationship between creativity and growth: a creative idea generated today might take years to be economically beneficial. Lastly, it would be interesting to build an empirical model regressing economic growth on the three variables at the same time. However, this was not possible here due to the important differences between the databases used.

5.3) Suggestions for future research

One important reveal generated by this research is the lack of direct measures of creativity at a national level. The development of such a measure would allow further empirical research on the impact of creativity on economic growth.

The first chapter attempted to define creativity. However, by its very nature, creativity is actually an ever-changing, evolutive concept. Can we define something that has not been invented yet, and the process leading to it? Although this is more of an avenue for reflection, I believe the very idea of defining creativity would benefit from further research.

Next, future research might explore other relevant variables than the three that compose this model. In particular, we can notice that context often appears in the composite measures of creativity. Diving into the influence of the context (social, political, educational, familial, etc.) on creativity, and by extension, on economic growth, can be an interesting topic of future research.

Lastly, the question of creativity and its impact on economic growth can be examined differently. Indeed, although creativity undoubtedly has a positive impact, one also has to weigh its benefits against those of stability, refining and perfecting products/ideas/techniques instead of constantly looking for newness. Furthermore, the converse relationship can be a topic of examination: creativity generates economic growth, but to what extent does a certain level of economic growth generate/facilitate creativity?

APPENDICES

Appendix 1: List of articles used for the literature review on creativity

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Appendix 2: Kaufman’s logical structure of creativity concepts. Source: Surkova, I. (2012). Towards a creativity framework. Society and Economy, 34(1), 115-138.

Concept	Creativity concepts			
	Novelty	Validity	Increment	Realization
Originality	+			
Creativity	+	+		
Invention	+	+	+	
Innovation	+	+	+	+

Source: Kaufmann (1993).

Appendix 3: Some relevant examples of articles generated by the wider literature research.

Source reference	Brief description
Storper, M. & Scott, A.J. (2009). Rethinking human capital, creativity and urban growth. <i>Journal of Economic Geography</i> , 9(2), 147-167.	The authors deal with the role of creativity and skilled labor in individual migration patterns and urban growth.
Faggian, A., Partridge, M. & Malecki, E.J. (2017). Creating an Environment for Economic Growth: Creativity, Entrepreneurship or Human Capital? <i>International journal of urban and regional research</i> , 41(6), 997-1009	They find that human capital - measured by educational attainment - and entrepreneurship - measured by the share of small and medium businesses – are both significantly conducive to a region’s economic growth.
Florida, R. (2003). Entrepreneurship, Creativity, and Regional Economic Growth. In Hart, D. (Ed), <i>The Emergence of Entrepreneurship</i>	The author defines entrepreneurship as a driving force of wealth and growth. He empirically explores the relationship between

<i>Policy: Governance, Start-Ups, and Growth in the U.S. Knowledge Economy</i> (pp.39-59). Cambridge, UK: Cambridge University Press.	entrepreneurship and various forms of creativity.
Meyer, D. (1999). Creativity, human capital , and economic growth . <i>Society and Economy in Central and Eastern Europe</i> , 21(4), 117-129.	The author defines human capital, fueled by creativity, as the most important modern factor of production and development.

Appendix 4: Presentation of the main creativity indexes and their weaknesses for this empirical exercise. Source: Correia, C.M. & Costa, J.d.S. (2014). Measuring Creativity in the EU Member States. Investigaciones Regionales, 30, 7-26.

Creativity Index	Presentation	Reason for rejection
Florida Creativity Index (FCI)	Developed by R. Florida (2002), measures the share of the creative class based on the 3T model.	Same reasoning as the GCI, less observations
Creative Community Index (SV-CCI)	Four categories of indicators – outcomes, participation, assets, levers – to measure creativity in the Silicon Valley.	Specific to the Silicon Valley
Florida’s European Creativity Index (F-ECI)	Florida, with I. Tinagli, revisits his model to fit European reality.	Same reasoning as the GCI, less observations
Hong Kong Creativity Index (HKCI)	Comprises 88 indicators, measures creativity in Hong Kong.	Specific to Hong Kong
Czech Creative Index (CZCI)	Based on Florida’s 3T model, to analyze Czech regions.	Specific to Czech Republic
Composite Index of the Creative Economy (CICE)	Developed to measure the creative capacity of the Flanders District of Creativity regions.	Specific to Flanders
Creative City Index (J-CCI)	Uses 78 indicators, separated into “fundamental” and “flow” factors.	Does not provide methodology and metrics
European Creativity Index (ECI)	Study for the European Commission.	Data not available
Baltimore Creativity Index (BCI)	Adapts Florida’s model to assess the potential of transforming Baltimore into a creative region.	Specific to Baltimore

Landry's Creative City Index (L-CCI)	Identifies 10 dimensions that characterize a creative place.	Does not provide the methodology and metrics
Creative City Index (CCI-CCI)	Constructed for Beijing, 72 indicators grouped in 8 dimensions.	Specific to six cities

Appendix 5: R code for data analyses of chapter 4.

```
#packages
library(ggplot2)
library(car)
library(corrplot)
library(readxl)
library(sjPlot)
library(gmodels)
library(stargazer)
library(plm)
library(lmtest)
library(orcutt)
library(car)
library(Hmisc)
library(data.table)
library(AER)
library(aTSA)
library(pcse)
library(lme4)
library(parameters)
library(fastDummies)
library(clubSandwich)

####4.2 Creativity and growth#####

##GCI
#data presentation
dataGCI=read_xlsx("data GCI.xlsx")
head(dataGCI)
attach(dataGCI)
str(dataGCI)
summary(dataGCI)

#simple regression model
modl=lm(log(GDP)~log(GCI),data=dataGCI)
summary(modl)
#positive significant effect of 1.24%
```

```
##Creative class share
#data presentation
data_crclass=read_xlsx("data creative class.xlsx")
head(data_crclass)
attach(data_crclass)
str(data_crclass)
summary(data_crclass)
```

```
#simple regression model
modl=lm(log(GDP)~CrClass,data=data_crclass)
summary(modl)
```

#####4.3 Creativity and intermediate variables#####

```
##Creative class share
#data presentation
data_crclass=read_xlsx("data creative class.xlsx")
head(data_crclass)
attach(data_crclass)
str(data_crclass)
summary(data_crclass)
```

```
#correlation matrix
data_crclass_new<-data_crclass[complete.cases(data_crclass),]
datanum=subset(data_crclass_new,select=-Country)
cormatrix=cor(datanum)
cormatrix
cor.test(CrClass,Innovation)
cor.test(CrClass,RD)
cor.test(CrClass,Literacy)
cor.test(CrClass,Numeracy)
cor.test(CrClass,Pbsolving)
cor.test(CrClass,TEA)
cor.test(CrClass,EBO) #not significant
cor.test(CrClass,EntrCreations) #not significant
cor.test(CrClass,GDP)
```

#####4.4 Intermediate variables and growth#####

```
###GCI
#data presentation
dataGCI=read_xlsx("data GCI.xlsx")
head(dataGCI)
attach(dataGCI)
str(dataGCI)
summary(dataGCI)
```

```

#correlation matrix
dataGCI_new<-dataGCI[complete.cases(dataGCI),]
datanum=subset(dataGCI_new,select=-Country)
cormatrix=cor(datanum)
cormatrix
cor.test(GCI,Technology)
cor.test(GCI,Talent)
cor.test(GCI,Tolerance)
cor.test(GCI,GDP)

#multiple regression model
modl2=lm(log(GDP)~Technology+Tolerance+Talent,data=dataGCI)
summary(modl2)
#most significant effect is Talent, or human capital

###Innovation

##innovation-active firms
#data presentation
datainnov=read_xlsx("data innov.xlsx")
head(datainnov)
attach(datainnov)
str(datainnov)
summary(datainnov)

#correlation matrix
datainnov_new<-datainnov[complete.cases(datainnov),]
datanum=subset(datainnov_new,select=-Country)
cormatrix=cor(datanum)
cormatrix
cor.test(Innovation,GDP)

#simple regression model
modl=lm(log(GDP)~Innovation,data=datainnov)
summary(modl)

##R&D spending
#data
dataHC=read_xlsx("RD spending.xlsx")
attach(dataHC)
panel<-pdata.frame(dataHC,index=c("Country","T"),row.names=TRUE)

#pooled model
plm_pld=plm(log(GDP)~RD,data=panel,model="pooling")
summary(plm_pld)

```

```

#fixed effects
plm_fixed<-plm(log(GDP)~RD,data=panel,model="within")
summary(plm_fixed)

#test for individual effects
pFtest(plm_fixed,plm_pld)
#reject pooled model

#random effects
plm_random<-plm(log(GDP)~RD,data=panel,model="random")
summary(plm_random)

#Hausman test
phtest(plm_fixed,plm_random)
#reject random effects, use fixed effects model

###Human capital

#data
dataHC=read_xlsx("data PIAAC.xlsx")
head(dataHC)
attach(dataHC)
str(dataHC)
summary(dataHC)

#correlation matrix
dataHC_new<-dataHC[complete.cases(dataHC),]
datanum=subset(dataHC_new,select=-Countries)
cormatrix=cor(datanum)
cormatrix
cor.test(Literacy,GDP) #not significant
cor.test(Numeracy,GDP) #not significant
cor.test(Pbsolving,GDP)

#regression model
modl=lm(log(GDP)~Literacy+Numeracy+Pbsolving,data=dataHC)
summary(modl)

###Entrepreneurship

##GEM
#data
dataGEM=read_xlsx("data GEM.xlsx")
attach(dataGEM)
panel<-pdata.frame(dataGEM,index=c("Country","T"),row.names=TRUE)

```

```

#pooled model
plm_pld=plm(log(GDP)~TEA+EBO,data=panel,model="pooling")
summary(plm_pld)

#fixed effects
plm_fixed<-plm(log(GDP)~TEA+EBO,data=panel,model="within")
summary(plm_fixed)

#test for individual effects
pFtest(plm_fixed,plm_pld)
#reject pooled model

#random effects
plm_random<-plm(log(GDP)~TEA+EBO,data=panel,model="random")
summary(plm_random)

#Hausman test
phtest(plm_fixed,plm_random)
#reject random effects, use fixed effects model

##OECD data
#data
data_entr=read_xlsx("data OECD entrep.xlsx")
attach (data_entr)
panel<-pdata.frame(data_entr,index=c("Country","Year"),row.names=TRUE)

#pooled model
plm_pld=plm(log(GDP)~log(Creations),data=panel,model="pooling")
summary(plm_pld)

#fixed effects
plm_fixed<-plm(log(GDP)~log(Creations),data=panel,model="within")
summary(plm_fixed)

#test for individual effects
pFtest(plm_fixed,plm_pld)
#reject pooled model

#random effects
plm_random<-plm(log(GDP)~log(Creations),data=panel,model="random")
summary(plm_random)

#Hausman test
phtest(plm_fixed,plm_random)
#reject random effects, use fixed effects model

```

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FACULTY OF BUSINESS AND ECONOMICS

Naamsestraat 69 bus 3500
3000 LEUVEN, België
tel. + 32 16 32 66 12
fax + 32 16 32 67 91
feb.leuven@kuleuven.be



LID VAN **ASSOCIATIE
KU LEUVEN**

