School of Economics

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Patience - Rate of Time Preference and Public Spending on Education

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Declaration

I hereby declare that this dissertation is entirely my own work and that it has not been submitted as an exercise for a degree at this or any other university.

Signed: _____ Date: 27/05/2022

Abstract

This inquiry presents the causal relationship between the Rate of Time Preference and Public Expenditure on Education, in order to explain the canal through which patience, education and growth are strongly correlated. This correlation is well established in past literature. Research findings confirm the theoretical model, according to which Patience is correlated to education and Growth through a causal link to Public Expenditure on Education. In the empirical analysis, endogeneity issues are taken into consideration and there is strong proof that results are unbiased and robust. In the final part, I describe and analyze some useful conclusions about my findings.

Key-words: Culture, Patience, Rate of Time Preference, Public Expenditure on Education, Human Capital Accumulation, Endogenous Growth

Acknowledgement

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Contents

1 Introduction

Modern Economists try to explain the heterogeneity of economic outcomes as a result of cultural elements. Culture often leads to structural problems that often tackle economic growth, however culture is a concept extremely difficult to understand. The study of economics has recently shown great effort to incorporate historical, psychological and sociological components to interpret comparative development. Important economic parameters that define growth are often shaped by culture.

One of them is the Rate of time preference, which plays a crucial role in reflecting society's patience. Even though there have been many approaches on how to measure the rate of time preference, the most recent one uses behavioural methodology for creating a national index of Patience. In this thesis, I am going to utilize the Patience- index by Falk et al. (2018), which is the latest measure of the rate of time preference at a country level, to show a causal relationship between the rate of time preference and public expenditure on education. The significance of society's patience on economic growth is well established in theoretical economic models, but there is a huge gap in empirical research on showing causality. In the past, economic science had not developed statistical methods for showing causal link between culture and economics, because it arouses endogeneity issues. Recent statistical tools allow researchers to embody cultural indexes on economics and causally link them to relative outcomes. On the other hand, Public expenditure on education is known to positively affect economic growth by mechanisms of human capital accumulation. Little is shown, however, about what drives societies choosing how much they choose to invest in education.

This thesis tries to fill these two gaps in the bibliography, by presenting a causal link of patience as a cultural dimension to public expenditure on education. Chapter two is a literature review of both Patience and Public Expenditure on Education. In the third chapter, the data set used for the empirical research is described, followed by an empirical analysis. The last chapter is a summary of my work and findings.

2 Theoretical Framework

2.1 Culture, Patience and Rate of time preference

"... the invention of the mechanical clock in medieval Europe. This was one of the great inventions in this history of mankind – not in a class with fire and the wheel, but comparable to movable type in its revolutionary implications for cultural values, technological change, social and political organization, and personality."
David S. Landes, Revolution in Time: Clocks and the Making of the Modern World

2.1.1 Introduction - What is culture?

It is extremely hard to define what culture is because the meaning is very broad. The profound definition for this paper would be the one from Hofstede (1980b) who was the pioneer in combining the economic environment with cultural elements. According to Hofstede, culture is the collective programming of the mind which distinguishes the members of one group or category of people from another. However, for the purpose of this paper, a broader definition of culture will be used. More specifically, according to Marrien Webster dictionary, culture is the integrated pattern of human knowledge, belief and behaviour that depends upon the capacity for learning and transmitting knowledge to succeeding generations and the customary beliefs, social forms and material traits of a racial, religious or social group; the shared attitudes, values, goals and practises that characterizes an institution or organization.

The main reason for considering the second definition more suitable is that it unveils a plethora of possible causal factors that affect economic outcomes. In greater detail, geography, historic origins and many other similar reasons are responsible for shaping the modern homo economicus, mainly through the diachronic interaction of the individuals with environmental factors. Individuals of every generation inherit common beliefs, values and predispositions that determine their economic behaviour. However, it is important to note that the aforementioned procedure is dynamic, which means that cultural dimensions evolve and change over time along with their economic environment. The collective appearance of specific characteristics that are associated with certain types of socioeconomic structures

and institutions have been in the spotlight of early social thinkers, with the most famous example being Weber and Kalberg weber2013protestant, who highlighted the importance of protestant ethics in the evolution of capitalism. Nevertheless, economists used to avoid incorporating cultural elements into Economics, since there was no space for unquantified factors and without the necessary mathematical and statistical tools, they could not prove causal links between cultural dimensions and economic outcomes(Guiso et al., 2006). Even though economists acknowledge its importance, culture was considered abstract for the strictly established economic science. However, in the last decades there has been an increase in publications, trying to explain different economic outcomes between and within countries as a result of cultural heterogeneity. Last but not least, culture is widely accepted among economists as an important factor in economic development, but there is a debate around whether culture should be considered an exogenous or endogenous factor. In line with Guiso et al. (2006) cultural dimensions that change rapidly should be considered endogenous as the fast-moving components of culture, while inherited slow-moving components should be considered exogenous. A further explanation could be that beliefs and values that are transmitted from parents to children (Arrondel, 2013 ;Cipriani et al., 2007) are long-lasting and harder to change as a result of socioeconomic factors, while there are other cultural dimensions sensitive to social interaction, which can rapidly change through peer group effects (Manski, 2000).

Culture is easy to explain, hard to define and even harder to handle as an economic variable. Especially after the use of instrumental variables and natural economic experiments, economists focused their research on causal relationships between cultural dimensions and economic outcomes mainly between countries. But what is the causal channel from culture to economics?

2.1.2 Culture and Economics

Culture is here to stay but to establish causal links between culture and economics, a certain procedure is essential. Culture affects economics through different channels, but the most important ones are preferences and expectations. Primarily economists should show the impact of culture on the latter and then empirically demonstrate how this cultural heterogeneity that shapes preferences and expectations, affects economic outcomes. The different economic outcomes between countries could be regarded as a game of multiple equilibria that reflect the returns of the different strategies selected by the players due to the heterogeneity in their preferences that derives from culture (Fernández, 2011).

Past literature confirms the heterogeneity of preferences among and within countries, as well as the endogenous relationship of cultural variables with economic variables. Economists create cultural indexes by using behavioural questionnaires and scientific scales or by

conducting natural experiments to isolate the effect of culture outside of the economic environment. More specifically, using experimental data preferences seem to be affected by culture due to biographic or cultural factors, such as the language structure and the fertility of the soil on which the ancestors of the participants immigrated years ago (Falk et al., 2018). On the other hand, some economists tried to link these factors directly to economic outcomes. For example, Alesina et al. (2002) refer to how different beliefs for fairness lead to different distributional policies between countries (or between cultures). From a historical perspective,Tabellini (2010) suggests that culture shaped values, which contributed to the differences in economic development among European regions. It is impressive tough, that not only social stimuli but also biological factors affects cultural dimensions and particularly cognitive ability (Dohmen et al., 2010).

In conclusion, the analysis of culture and economics highlights the reverse causal link between cultural dimensions and economic variables through the lens of modern bibliography. The following section will focus on how individuals perceive time and their time preferences since it is the primary cultural dimension of this research.

2.1.3 Rate of time preference - Patience: A Dimension of Culture

The concept of preference concerning present and future rewards is a core element of our everyday behaviour. As such, it could not be omitted by the effort of the Economic Science to interpret that kind of behaviour. Every time an individual assesses whether to eat a dessert after lunch or not, the underlining procedure is a cognitive cost-benefit analysis. Taking it a step further, it is whether someone is patient enough to postpone the current pleasure (eating the desert) for a future reward (health). Therefore, at the centre of our analysis lies the cultural term of patience. Patience-Rate of time preference has been studied and measured extensively and the variety of outcomes emphasizes its complexity. This paper will utilize the index of Patience (Falk et al.,2018), as it accords with certain theoretical assumptions that will be discussed later. Table 1 shows the variety of different measurements on the rate of time preference. In Economics Patience index should be regarded as Long-Term Orientation, discount rate or as it is widely known, the rate of time preference.

TABLE 1 (*Cont.*)

Study	Time Range	Annual Discount Rate(s)	Annual Discount Factor(s)
Maital & Maital 1978	1 year	70%	0.59
Hausman 1979	undefined	5% to 89%	0.95 to 0.53
Gateley 1980	undefined	45% to 300%	0.69 to 0.25
Thaler 1981	3 mos. to 10 yrs.	7% to 345%	0.93 to 0.22
Ainslie & Haendel 1983	undefined	96000% to ∞	0.00
Houston 1983	1 yr. to 20 yrs.	23%	0.81
Loewenstein 1987	immediately to 10 yrs.	–6% to 212%	1.06 to 0.32
Moore and Viscusi 1988	undefined	10% to 12%	0.91 to 0.89
Benzion et al. 1989	6 mos. to 4 yrs.	9% to 60%	0.92 to 0.63
Viscusi & Moore 1989	undefined	11%	0.90
Moore & Viscusi 1990a	undefined	2%	0.98
Moore & Viscusi 1990b	undefined	1% to 14%	0.99 to 0.88
Shelley 1993	6 mos. to 4 yrs.	8% to 27%	0.93 to 0.79
Redelmeier & Heller 1993	1 day to 10 yrs.	0%	1.00
Cairns 1994	5 yrs. to 20 yrs.	14% to 25%	0.88 to 0.80
Shelley 1994	6 mos. to 2 yrs.	4% to 22%	0.96 to 0.82
Chapman & Elstein 1995	6 mos. to 12 yrs.	11% to 263%	0.90 to 0.28
Dolan & Gudex 1995	1 month to 10 yrs.	0%	1.00
Dreyfus and Viscusi 1995	undefined	11% to 17%	0.90 to 0.85
Kirby & Marakovic 1995	3 days to 29 days	3678% to ∞	0.03 to 0.00
Chapman 1996	1 yr. to 12 yrs.	negative to 300%	1.01 to 0.25
Kirby & Marakovic 1996	6 hours to 70 days	500% to 1500%	0.17 to 0.06
Pender 1996	7 mos. to 2 yrs.	26% to 69%	0.79 to 0.59
Wahlund & Gunnarson 1996	1 month to 1 yr.	18% to 158%	0.85 to 0.39
Cairns & van der Pol 1997	2 yrs. to 19 yrs.	13% to 31%	0.88 to 0.76
Green, Myerson & McFadden 1997	3 mos. to 20 yrs.	6% to 111%	0.94 to 0.47
Johanneson & Johansson 1997	6 yrs. to 57 yrs.	0% to 3%	0.97
Kirby 1997	1 day to 1 month	159% to 5747%	0.39 to 0.02
Madden et al. 1997	1 week to 25 yrs.	8% to ∞	0.93 to 0.00
Chapman & Winquist 1998	3 months	426% to 2189%	0.19 to 0.04
Holden, Shiferaw & Wik 1998	1 yr.	28% to 147%	0.78 to 0.40
Cairns & van der Pol 1999	4 yrs. to 16 yrs.	6%	0.94
Chapman, Nelson & Hier 1999	1 month to 6 mos.	13% to 19000%	0.88 to 0.01
Coller & Williams 1999	1 month to 3 mos.	15% to 25%	0.87 to 0.80
Kirby, Petry & Bickel 1999	7 days to 186 days	50% to 55700%	0.67 to 0.00
van der Pol & Cairns 1999	5 yrs. to 13 yrs.	7%	0.93
Chesson & Viscusi 2000	1 year to 25 yrs.	11%	0.90
Ganiats et al. 2000	6 mos. to 20 yrs.	negative to 116%	1.01 to 0.46
Hesketh 2000	6 mos. to 4 yrs.	4% to 36%	0.96 to 0.74
van der Pol & Cairns 2001	2 yrs. to 15 yrs.	6% to 9%	0.94 to 0.92
Warner & Pleeter 2001	immediately to 22 yrs.	0% to 71%	0 to 0.58
Harrison, Lau & Williams 2002	1 month to 37 mos.	28%	0.78

Both psychologists and Economists accept that individuals seem to change their preferences over time. Thaler (1981) showed that individuals are more impatient when the reward is in further future. That time inconsistency reflects a present bias for a variety of economic behaviours including the inter-temporal choice of earning a fixed amount now rather than a greater one in the future (Ariely & Wertenbroch, 2002). Another term for present bias is Short-run impulsiveness and long-run impatience. In detail, the rate of time preference had a long way through the bibliography. According to Frederick et al. (2002), there should be a distinction between time discounting and time preference. Economists should on the one hand use the term time discounting broadly to encompass any reason for caring less about a future consequence, including factors that diminish the expected utility generated by a future consequence, such as uncertainty or changing tastes. On the other hand they should use the term time preference to refer, more specifically, to the preference for immediate utility over delayed utility. The first scientists to mention the psychological causes beneath inter-temporal choices were Rae and Mixter (2021) in their book "The sociological theory of capital". He detected an important factor of wealth accumulation, the ability to restraint-ourselves. Particularly important according to them was that individuals tend to feel pleasure by present consumption and discomfort by self-restraint. In this sense, someone will substitute current for future rewards only if the future rewards compensate for the individuals' harm from self-restraint at present. Furthermore, Economist Bohm-Bawerk tried to create the first theoretical model of inter-temporal choice, but his effort was unfruitful. His greatest contribution lies in the classification of possible factors that affect time preferences, to objective ones like income etc and to personal or cultural. The establishment of time preference comes with a publication from Samuelson (1937). His work was immediately accepted despite his doubts, which were grounded on the model's ability to describe accurately the behavioural reality of inter-temporal choice. The great thing about that model was that a single parameter incorporated all the individuals' motivations that could possibly guide inter-temporal decisions. That parameter was the rate of time preference. Even though it was not empirically tested, the academic community embraced the model mainly because it was easy to use and resembled the interest rate. In detail, Samuelson argued that the inter-temporal utility could be expressed as the sum of each year's utility function.

$$U^t(c_t, ..c_T) = \sum_{k=0}^{T-t} D(k)u(c_t + k)$$

where

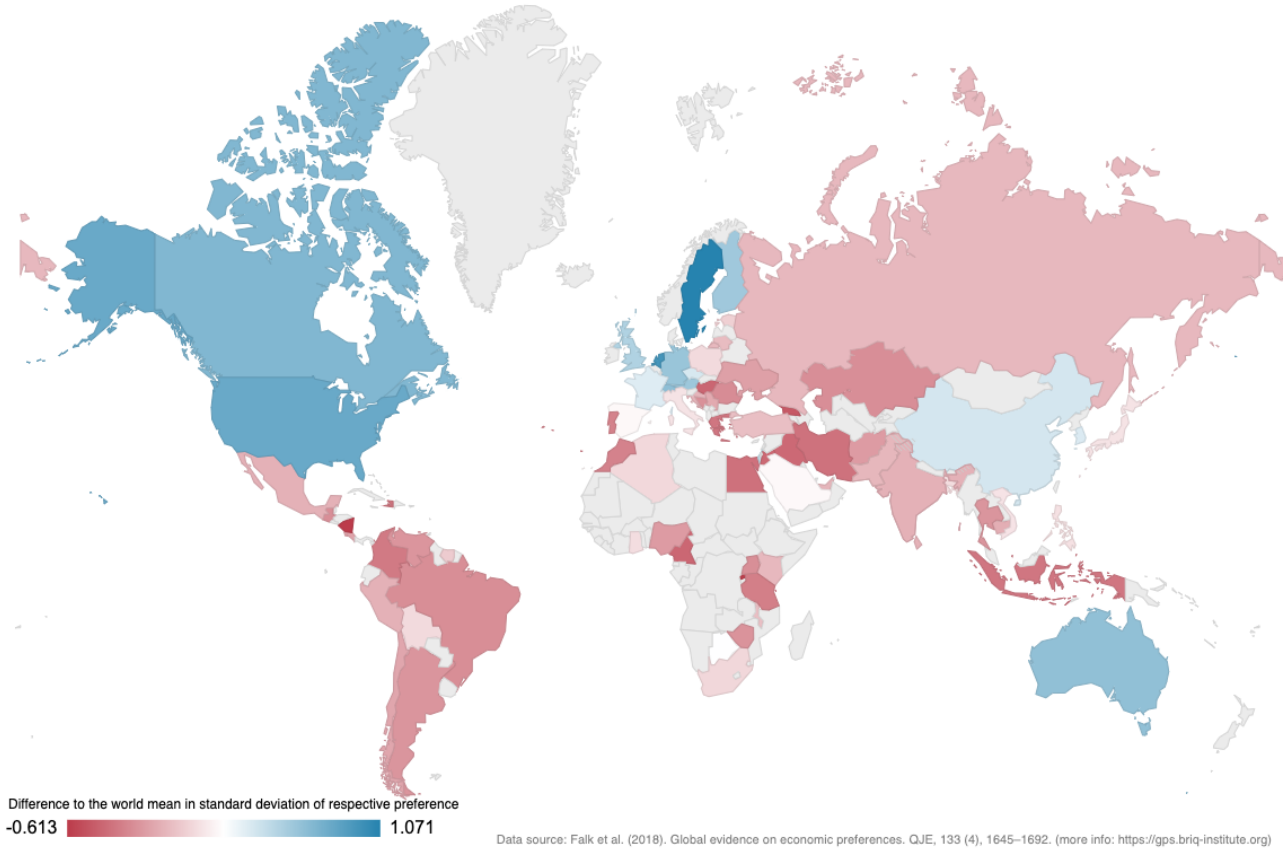
$$D(k) = \left(\frac{1}{1+\rho}\right)^k$$

In this formulation, $u(c_t + k)$ is often interpreted as the person's cardinal instantaneous utility function—her well-being in period $t + k$ — and $D(k)$ is often interpreted as the person's discount function—the relative weight he/she attaches, in period t, to his/her well-being in period $t + k$. ρ represents the individual's pure rate of time preference (discount rate), which is meant to reflect the collective effects of the "psychological" motives. Koopmans (1960) added some axioms under which the discount rate was always positive, which contributed even more to the establishment of the model. However, the model nowadays is regarded as inadequate since it is unable to describe some behavioural phenomena. For example, empirical research shows that discount rates decline over time, a pattern referred to as hyperbolic discounting. Additionally, the Samuelson model is unable to explain why gains are discounted more than losses and small amounts more than large amounts. Second, when functions fit to data, a hyperbolic functional form, which imposes declining discount rates, fits the data better than an exponential functional form, which imposes constant discount rates (Kirby, 1997; Kirby & Maraković, 1995; Myerson & Green, 1995). For these reasons economists created hyperbolic models, taking into account the latter parameters and H. R. Stroz was the first to build the theoretical framework for Phelps and Polak (1968) to complete his work by publishing the first equations. Many models have been published in the last decades, trying to include as many behavioural elements as possible that are also in line with the empirical research. In this paper, the Patience index (Falk et al., 2018) will be used since it fits almost perfectly with the theoretical assumptions. More specifically, patience as an index of the rate of time preference seems to behave more like a hyperbolic discount rate rather than an exponential, because as a cultural dimension it changes diachronically due to its interaction with social factors. Moreover, it is in agreement with the findings of both Falk et al. (2019), who argue that the older the individual gets, his/her patience diminishes (as a hyperbolic discount rate) and Loewenstein and Prelec (1991), who argues that the discount rate could be a positive as well as negative (Patience index takes positive and negative values).

In summary, the rate of time preference has been a matter of great importance for the economic research of inter-temporal choice. The two models that dominate the bibliography are the Samuelson's model, which assumes the rate of time preference to be constant and the model of the hyperbolic discounting. In the preceding sections, the reasons why the Patience index should be regarded as a hyperbolic discount rate were analysed. In the following section, the paper aims to empirically demonstrate how Patience interacts with cultural and economic variables in simple words what defines patience and how patience affects the economy.

2.1.4 What affects the rate of time preference - Patience

Different socioeconomic and cultural stimuli between countries shaped the heterogeneity in time preferences (Wang et al., 2010). Therefore, patience as the rate of time preference could be no exception (Table 2). Before analysing possible factors that have a causal impact on patience, we observe in Table 2 the heterogeneity of time preferences, depicted on a map. We notice that groups of countries with similar cultural origins, like the countries of the west, present similar levels of patience. An analysis will follow indicating some of the possible factors responsible for that heterogeneity.



There are a plethora of factors that have a significant impact on the rate of time preference, ranging from biological and environmental to social and historical. Since patience is regarded as a dimension of culture it is impossible to present all possible variables that affect patience, thus this analysis will focus on the primary ones. One of the most important factors is biological. In greater detail, research by Rosati et al. (2007) showed, that humans have a genetic predisposition that defines their time preference, which has its roots even before humans separated from apes. However, genetics is not meant to be a panacea for explaining any economic behaviour related to time preference, since many other social stimuli shaped patience over time. Historically, agriculture has played a significant role in human survival mainly through the harvest of crop yields, which subsequently had an impact

on patience as well. Galor and Özak (2016) showed that crop yields that needed more time to be cultivated had a positive impact on patience and shaped future-oriented behaviours. In their paper, Howden and Kampe (2016), argue that the quality of political and juristic institutions is positively correlated with the discount rate,they do not, however, test their argument through empirical research. Another possible factor that may affect patience is the transmittance of thrift as a value from generation to generation. More specifically, by learning thrift as an important value, individuals train their self-restraint by postponing current consumption as well as its utility. As a result, they develop future oriented behaviours since the postponement seems less and less unfavourable over time (Anderson & Nevitte, 2006). Additionally, someone's beliefs, financial conditions or native language are important elements that influence individuals' time preferences. Individuals who were born and raised in poverty are expected to be less patient because they are not willing to sacrifice current consumption as they feel uncertain over their future financial capacity(Bartoš et al., 2021), while languages that do not differentiate present from future tenses shape future-oriented behaviours (Chen, 2013). Hofstede highlighted the importance of Confucianism as a cultural and religious component that explains the heterogeneity of patience rates/long term orientation between countries (Hofstede, 1980a).

To sum up there are many factors related to the shape of patience over time. Shaping time preference is a cultural phenomenon, which evolves and changes, following a dynamic progression. The latter assumption is confirmed by many bibliographic sources. The variables that affect patience are endless, however, a full-scale analysis is beyond the scope of this paper. The aforementioned factors indicated by academic research, are just a sample to pinpoint how diverse the factors that define patience are and their dynamic correlation with the formation of time preference.

2.2 Economic Policy - Public Expenditure on Education

2.2.1 Introduction

The second part of the bibliographic summary will focus on how economic policy and particularly Public Expenditure on Education is affected by the rate of time preference-Patience, leading to heterogeneity between countries regarding not only the quality of human capital but also their economic development. In the previous section, Patience's effect on several economic outcomes was thoroughly presented.The inter-temporal choice will be of crucial importance in this analysis. Combining the findings mainly by Dohmen et al. (2018), who presented a really strong correlation between Education, LnGDP and Patience, with the theoretical model presented, will set all the foundations needed for a

convincing theory for the importance of Patience in Economic Policy and Economic Outcomes.

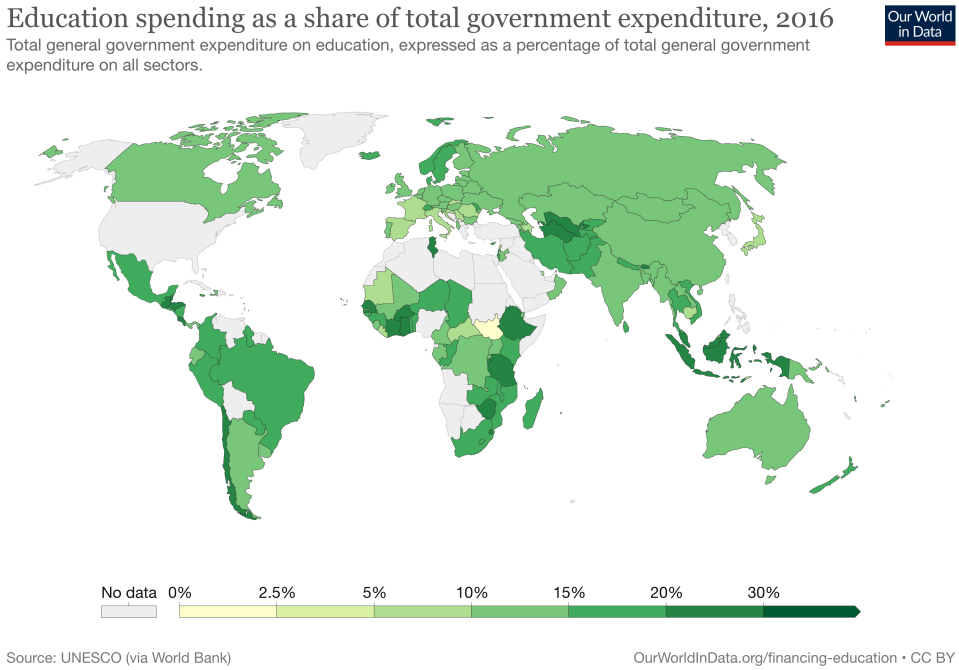
According to the following theory, an endogenous Growth model, in which the human capital accumulation, depends on the societal time preferences ,fits the best to our theoretical framework . The social dilemma is whether to invest productive labour in producing consumer goods or in accumulating human capital through a better educational system. However, before presenting the model, an overview of Public Expenditure on Education and Human Capital will be discussed, focused on the needs of this paper.

In conclusion, completing the literature review before proceeding with the empirical analysis should be concerned as an attempt to connect the dots between Rate of Time Preference, Public Spending on Education and Human Capital Accumulation, through both the Bibliography and the theoretical model based on previous research on Patience.

2.2.2 Public Expenditure on Education

Public Spending on Education has been a matter of great debate among economists since the establishment of Endogenous Growth Models. The intuitive social acumen of Economists has always accepted the importance of Human Capital, while even Governments seem to be in line with it. Therefore, there is a lot of research about it, trying to understand what drives the Public Spending on Education

Economists try to answer the aforementioned query all over the world, but especially in developing countries. From Kenya (Imana, 2017), to India (Chaterji et al., 2015) or Indonesia (Bischoff & Prasetyia, 2019) researchers try to understand what exactly shapes Public Spending on Education and its' composition from both a microeconomic and macroeconomic point of view. The most impressive, though, is the fact that findings are so different that economists could conclude that there are not certain common factors among these countries, that shape Public Expenditure on Education. In Europe, there are findings, that indicate factors, mainly derived from Political Economy (Dragomirescu-Gaina, 2015)(the closest thing to culture), but the pattern does not repeat itself in Latin America for example (Martin-Mayroal & Sastre, 2017).



As we see in the map, which depicts the Education Spending as a share of total government expenditure, there is great heterogeneity among countries regarding their economic policy. Even among countries of the same developing classification, Public Expenditure on Education differs substantially. For example,in 2016, the Democratic Republic of Congo spent 14.64% of its' government expenditure on education, while neighbouring countries like Tanzania and Uganda spent 24.4% and 11.38% respectively. The case is the same among high-income countries, since Germany for example spent 10.93%, while Switzerland 15.51%.

Despite the great research done to identify the differences in Public Spending on Education between countries, little is known about what shapes societies' preferences and what leads Policy Makers to the amount they invest in education as a share of total government expenditure.

2.2.3 Public Expenditure on Education and Human Capital Accumulation

"Whenever I am asked what policies and initiatives could do the most to spur economic growth and raise living standards, improving education is at the top of my list."

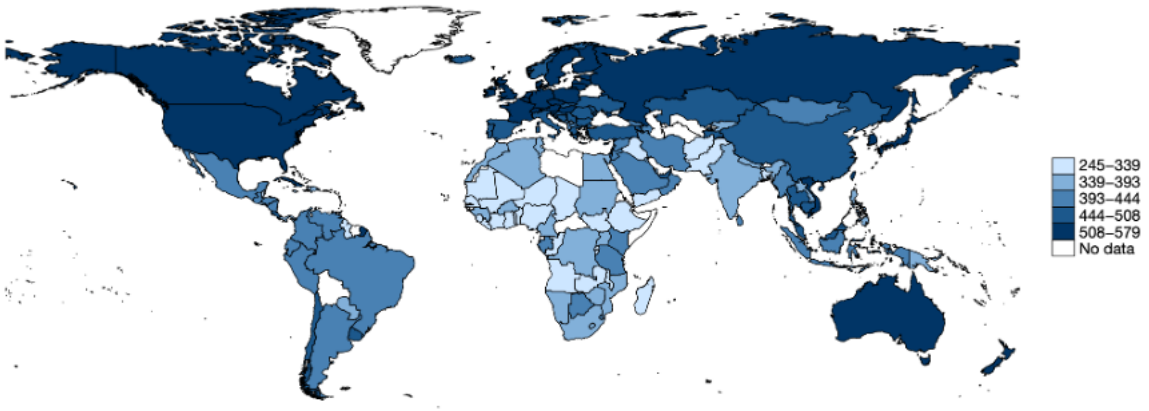
—Janet Yellen | Chair of the Federal Reserve

Many Economists, if not all, have long now accepted the importance of improving human capital while aiming at economic development. By the time Lucas (1988) and Romer (1986) published the first macroeconomic models of endogenous growth, education started to play a more and more significant role for low-income countries to reach higher economic growth rates. Thus, the strategy and policy of public finance was conducted conscientiously in these

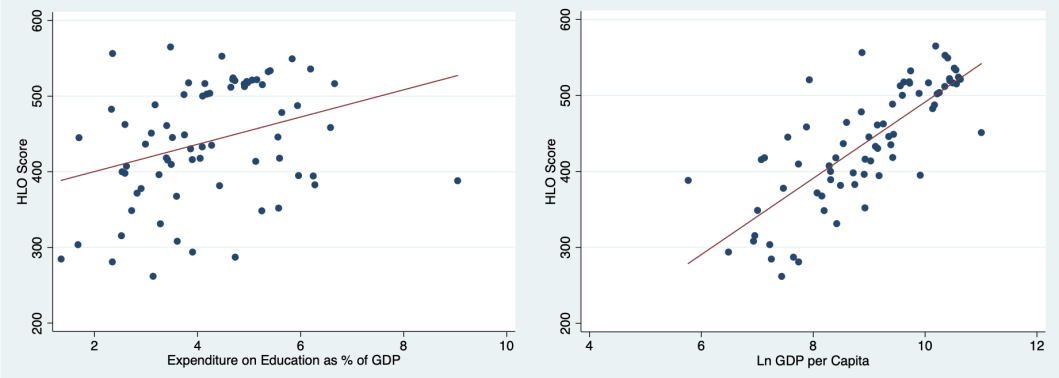
countes (Dissou et al., 2016), since the right implementation of Public Expenditure on Education, in the long run, could upgrade human capital, which as a result would lead to greater growth (Baah-Boateng, 2009).

Education is beneficial to human capital accumulation by increasing its productivity. Recent studies in the US showed that increased human capital accumulation could explain one-fifth of the productivity increase from 1950 to 2007. In addition, educational attainment has been growing at about one year per decade, which has contributed about 0.6 percentage points to productivity growth per year (Wolla, 2016).

The following map is a geographical depiction of the HLO index, the most reliable index measuring the quality of human capital (Angrist et al., 2021). The scores are based on adjusted maths, reading and science exams and cover the period from 2000 to 2007.



On a first analysis richer countries seem to score greater HLO scores, which means they have a greater human capital. Even if the correlation between human capital accumulation through education and development is very well established (Bils & Klenow, 2000), a correlation graph that indicates the relationship between the former and the latter will follow. However, it is suitable for our forthcoming analysis to present a second correlation graph as well, that shows the positive relationship between Public Expenditure on Education and Human Capital.



It is important to mention at this point that these data are presented not as a proof of

causality but to strengthen our following theory, which seems to be absolutely in line with previous research. The expenditure on education was measured as the average expenditure from the Classification Of the Functions Of Government(COFOG) data set of the IMF. The graphs show a positive relationship between Public Expenditure on Education and greater human capital. However, the variation is much greater in the first graph, probably because of the efficiency of the educational system. In many countries investing in education may bring lesser human capital accumulation than expected because of institutional reasons like corruption etc. Concerning the second graph, the positive relationship between human capital and comparative development is even clearer, which is also in accordance with the endogenous growth model.

In conclusion, there is an obvious positive correlation between both Growth and Expenditure on Education with human capital. The theoretical model which explains our theory regarding the channel through which the cultural aspect of the rate of time preference (Patience) determines both human capital accumulation and growth, through Spending on Education will be presented in the following section.

2.2.4 Rate of Time Preference (Patience), Public Expenditure on Education and Endogenous Growth

Because of the heterogeneity between countries regarding their Preferences on how much to invest in education and the fact that relative bibliography cannot find certain common factors that shape these preferences across the globe, I draw the conclusion that the main factors are unobserved characteristics that are difficult to be quantified. Intuitively, culture could be one of them and specifically the rate of time preference. The strong correlations that Dohmen et al. (2018) found between Patience and education or Patience and GDP may not prove any causal relationships, however, they were really important, because they shed light on possible channels through which the rate of time preference was correlated to the other two variables(Education and LnGDP).

In greater detail, if patience is treated as exogenous since for every period it is a slow-moving component of culture that is difficult to change, it defines the inter-temporal choice of the society in investing in productive or unproductive expenditures. To keep our analysis simple we will focus only on the expenditure on education as a form of productive expenditure (Kneller et al., 1999). A patient society would prefer to invest in education in order to boost its productivity and future growth through an improvement in human capital, but an impatient society may prefer not to sacrifice current consumption for future greater returns.

For the purpose of this paper, a very simple model of endogenous growth published by Williamson (2018) will be presented, slightly modified, regarding the interpretation of the parameters, to fit our analysis.

Consider a representative consumer who begins the current period with H^s units of human capital. In every period he allocates his productivity either for consumption or education to accumulate more human capital. To keep things simple we assume that he does not have any time for leisure or saving. The representative consumer who is also the social planner has the following consumption function:

$$C = wuH^s \tag{1}$$

w is his salary, while u is a parameter that represents his/her productivity share devoted to consumption and it is a negative function of his/her Patience. That means that uH^s represents the productive labor supplied by the consumer. Even though the consumer cannot save, there is an inter-temporal choice for him/her between current and future consumption through the accumulation of human capital. The technology function of human accumulation is given by:

$$H^{s\prime} = b(1-u)H^s \tag{2}$$

That means the future human capital depends on the productivity invested in education. To sum up, a patient society would invest in productive expenditure (education) shrinking u, while an impatient one would have a higher u by investing in unproductive expenditure aiming at a higher current consumption. Additionally, function (2) also adds the information that the greater the share of productivity someone devotes to education and human capital accumulation the easier it is for the accumulation of further human capital.

Consider now a representative producer with a production function that is characterised by constant returns to scale:

$$Y = zuH^d \tag{3}$$

Where Y denotes current production and $z > 0$ is the marginal product of the productive units of labour. H^d is the demand for efficiency units of labor by the representative firm.

The firm maximisation equation is:

$$\pi = Y - wuH^d \tag{4}$$

which is the quantity of output produced minus the wages paid to workers.

Substituting for Y from Equation (3), we get

$$\pi = zuH^d - wuH^d = (z - w)uH^d \tag{5}$$

If $z = w$, then the firm's profits are zero for any quantity of workers hired, so that the firm is indifferent about the quantity of efficiency units of labor hired. We conclude that the firm's demand curve for efficiency units of labor is infinitely elastic at $w = z$. Thus, no matter what the supply curve for efficiency units of labor, the intersection between demand and supply always occurs at a real wage of $w = z$. In other words, the equilibrium real wage per efficiency unit of labor is always $w = z$.

Competitive equilibrium: There is only one market and we know that this market clears at a real wage of $w = z$. Market clearing gives $uH^s = uH^d$ and so $H^{s\prime} = H^d = H$. Therefore, substituting in Equations (1) and (2) for w and H^s , we get

$$C = zuH \tag{6}$$

and

$$H' = b(1 - u)H^s \tag{7}$$

The growth rate of human capital is

$$\frac{H'}{H} - 1 = b(1 - u) - 1 \tag{8}$$

This means that the growth rate is constant. What is important here is that the growth rate of human capital increases if u decreases. The model predicts that countries with better education systems should experience higher rates of growth in human capital (Williamson, 2018).

We can determine the growth rate of consumption, which is

$$\frac{C'}{C} - 1 = \frac{zuH}{zuH} - 1 = \frac{H'}{H} - 1 = b(1 - u) - 1 \tag{9}$$

And at the equilibrium point $Y = C$, and the growth rate for consumption, product output and human capital.
This economy model grows in an endogenous way, and its growth rate depends on patience which as a dimension of culture defines the parameter u.

Theoretical analysis of the model:

Both u and b are defined for every given time period by patience. There is not an optimal solution. The rate of time preference shapes u which depicts the preferences of the society. U would possibly change either current or future consumption, therefore there are not any optimal solutions and everything depends on society's culture- preferences.
If we graph the natural log of consumption against time, this is a straight line. The slope of the graph of consumption increases as u decreases and the growth rate of consumption increases and the vertical intercept of the graph decreases as u decreases, as this reduces consumption in the very first period. There is, therefore, a trade-off for the representative consumer when u decreases: Consumption is sacrificed early on, but consumption grows at a higher rate, so that consumption ultimately is higher than it was with a higher level of u. The growth rate of consumption, even though consumption is higher in the long run. There is a cost to higher growth, which is that consumption in the near term must be forgone. Which consumption path the consumer prefers depends on how patient he or she is. Preferences could be such that the consumer is very impatient, in which case he or she would tend to prefer the initial consumption path with a low growth rate of consumption. Alternatively, the consumer might be very patient, tending to prefer the new consumption path with a high growth rate of consumption.

In conclusion, if we make the assumption that u is causally connected to patience as a cultural dimension, then recent papers that show that growth and education are strongly correlated with the rate of time preference are definitely in line with the theoretical model. The idea is that patience positively affects public expenditure on education because patient societies value the sacrifice of current consumption in the name of a gradual increase in their productivity more, since they expect to achieve higher growth rates and returns in the future. Our model seems to explain not only the correlation of patience to education but also the correlation to growth. Our only assumption is that patience directly affects positively public expenditure on education, which is something that may seem logical when explained but has not been tested so far empirically. Our next two parts of this paper will focus on the empirical analysis of the causal relationship between patience and Public Expenditure on Education, in order to provide enough evidence for our previous theoretical assumption. Impatient societies are more in favour of less investment in education, in order to allocate resources towards unproductive expenditure that boosts current consumption.

3 Data Description

This section will present the data used for the empirical analysis. It introduces global measures of the rate of time preference at a national level in order to examine its effect on Public Policy and particularly on Public Expenditure on Education. Additionally, there will be a short description of the control variables.

3.1 Dependent Variable

The empirical analysis uses the average Public Expenditure on Education as a percentage of total Gross Domestic Product as the dependent variable of the model. The variable covers a period from 1960 to 2020 and it was extracted from UNESCO's Institute for statistics and more specifically from the dataset used for the Sustainable Development Goals. UNESCO collects these data from national statistical services. The dataset was enriched by adding the relevant statistics for some countries whose values were missing. However, the contribution to the sample size was minor, since the number of observations in our empirical analysis was only increased by one (USA). The mean value in the sample is 4.2% with a standard deviation of 1.4%. Considering that the minimum value is 1.3% and the maximum value is 9.05%, the standard deviation indicates the existence of great variance (close to 2%) that highlights the heterogeneity between countries on how much they spend on Education.

3.2 Main Independent Variable

In line with the latest literature, the empirical analysis uses Patience as an index of the rate of time preference. Patience was extracted from the Institute on Behaviour and Inequality and is part of the Global Preference Survey (GPS), an experimentally validated survey data set of time preference, risk preference, positive and negative reciprocity, altruism, and trust from 80,000 people in 76 countries (Falk et al., 2018). There are many reasons why Patience is the best index for the rate of time preference. First, the preference measures were elicited in a comparable way using a standardized protocol across countries. Second, the data cover representative population samples in each country, which allows for inference

about between-country differences in preferences. The median sample size was N=1,000 per country, for a total of 80,000 respondents worldwide. Respondents were selected through probability sampling and interviewed face-to-face or via telephone by professional interviewers. A third feature of index is geographical representativeness in terms of the countries being covered.

The sample of 76 countries is not restricted to Western industrialized nations, but covers all continents and various levels of development.

Fourth, the preference measures are based on experimentally validated survey items for eliciting preferences. To ensure the behavioral relevance of the measure of patience, the underlying survey items were designed, tested, and selected for the purpose of the GPS through a rigorous ex-ante experimental validation procedure (for details see Falk et al. (2018)). In this validation step, subjects participated in choice experiments that measured preferences using real money. They also answered large batteries of survey questions designed to elicit preferences. The survey items, that were jointly the best predictors were, were selected to form the survey module. In order to make these items cross-culturally applicable, all items were translated back and forth by professionals, monetary values used in the survey were adjusted based on the median household income for each country and pretests were conducted in 22 countries of various cultural heritage to ensure comparability. See Falk et al. (2018) for a description of the data set and the data collection procedure. Patience is derived from the combination of responses to two survey measures, one with a quantitative and the other with a qualitative format. The quantitative survey measure consists of a series of five interdependent hypothetical binary choices between immediate and delayed financial rewards, a format commonly referred to as the "staircase" (or unfolding brackets) procedure. In each of the five questions, participants had to decide between receiving a payment today or a larger payment in twelve months:
Suppose you were given the choice between receiving a payment today or a payment in 12 months. We will now present to you five situations. The payment today is the same in each of these situations. The payment in 12 months is different in every situation. For each of these situations we would like to know which one you would choose. Please assume there is no inflation, i.e., future prices are the same as today's prices.
Please consider the following:
"Would you rather receive amount x today or y in 12 months?"
The immediate payment x remained constant in all four subsequent questions, but the delayed payment y was increased or decreased depending on previous choices. In essence, by adjusting the delayed payment according to previous choices, the questions "zoom in" on the respondent's point of indifference between the smaller immediate and the larger delayed payment, which makes efficient use of limited and costly survey time. The sequence of questions has 32 possible ordered outcomes that partition the real line from 100 Euros to

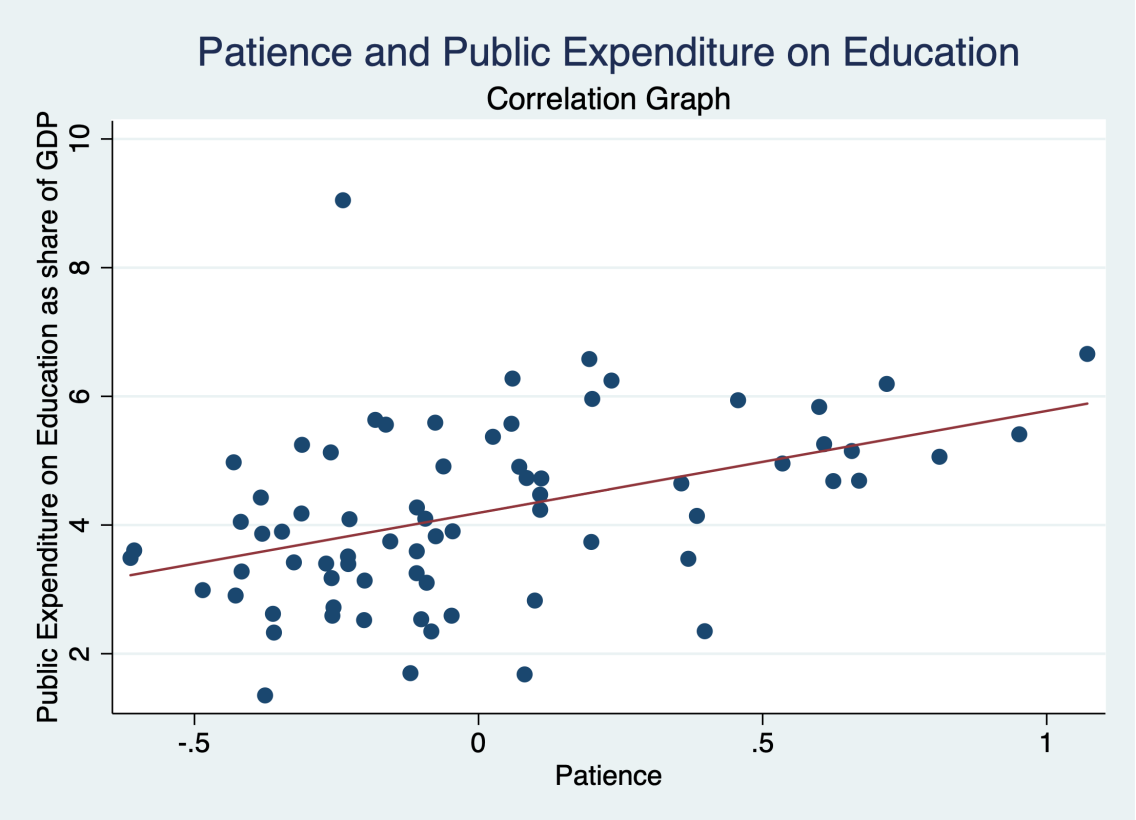
218 Euros into roughly evenly spaced intervals. In the international survey, the monetary amounts x and y were expressed in the respective local currency, scaled relative to the median monthly household income in the given country.
The qualitative measure of patience is given by the respondents' self-assessment of their their willingness to wait on an 11-point Likert scale:
We now ask for your willingness to act in a certain way. Please indicate your answer on a scale from 0 to 10, where 0 means you are "completely unwilling to do so" and a 10 means you are "very willing to do so". How willing are you to give up something that is beneficial for you today in order to benefit more from that in the future?
Our patience measure is a linear combination of the quantitative and qualitative survey items, using the weights obtained from the experimental validation procedure.2 As described in detail in Falk et al.(2018), the survey items are strongly and significantly correlated with preference measures obtained from standard incentivized inter-temporal choice experiments.The ex-ante validation of the survey items constitutes a methodological advance compared to the often ad-hoc selection of questions for surveys. A clear advantage of the quantitative staircase measure relative to the qualitative one is that it closely resembles standard experimental procedures of eliciting time preferences and corresponds to how economists typically think about immediate versus delayed rewards. The measure is context neutral and precisely defined, making it less prone to culture-dependent interpretations. In recent work Bauer et al. (2020) show that quantitative (staircase-type) survey questions reliably measure preferences also outside the Western world, while this is not necessarily the case for more qualitative questions like subjective self-assessments.

3.3 Control Variables

Regarding the control variables, my empirical analysis is based on relevant literature (Falk et al., 2019; Galor and Özak, 2016). The variables depicting the geographical characteristics (Temperature, Terrain Roughness, Latitude, Longitude etc) were directly taken from Galor and Özak's (2016) dataset, who found the relevant information by the CIA's World Factbook, the G-ECON project (Nordhaus, 2006), previous publications (Özak et al., 2012; Ramakutty et al., 2002), Climate Research Unit and the World Bank. Furthermore, control variables regarding transfers, savings (Indicators | Data, 2022) and inequality (Gross-GINI) were used from the Worlds Bank Development indicators except for the Gini coefficient which was extracted from the World Inequality Dataset (WID). Finally, a variety of institutional and demographic variables were used, such as Religion Dummies (La Porta et al., 1999), Democracy index (Polity IV Project), the Neolithic transition timing (Putterman, 2008), Life expectancy, Age dependency (World Bank), Employment in agriculture (World Bank), Stability of malaria transmission (World Health Organisation) and Colonial Duration (Galor & Özak, 2016).

4 Empirical analysis

This section focuses on how the Patience-Rate of time preference affects Public Expenditure on Education. We assumed in our theoretical model that because of a causal relationship between Patience and Public Expenditure on Education we could explain not only the strong correlations between Patience and GDP growth but also the strong correlation between Patience and Education. Patience causally affects Public Expenditure on Education, reflecting the inter-temporal choice of the society between human capital accumulation and current consumption. In greater detail, patient societies are expected to invest more in human capital since they also expect greater rewards in the long run and sacrifice current consumption. On the contrary, impatient societies are expected to allocate their funds toward consumption expenditure and invest less in education. We expect to find a positive relationship between Patience and Public Expenditure on Education, which is confirmed by the following graph as well:



In table 1, model 1 the regression shows a strong correlation between Patience and Public Expenditure on Education. However, the former could only explain around 18% of the latter's variance. In model 2, the main independent variable remains statistically significant after controlling for world regions and GDP. This simple regression by itself could explain around 40% of the variation in Public Expenditure on Education. At this point, in line with publications that used this index to explain economic outcomes (Dohmen et al., 2018), we will address the endogeneity issue. According to recent publications, the patience variable might not only measure patience but may reflect additional features of the external environment such as institutions, inflation, or interest rates and the OLS correlations could be driven by measurement errors or reverse causality (Dohmen et al., 2018). For example, the survey required respondents to think through abstract choice problems, which might be unfamiliar and cognitively challenging for some participants. This could induce people to decide based on heuristics. Furthermore, there is a great possibility for the existence of reverse causality. Greater Patience leads to greater public investments in education, but also more efficient educational systems may shape future-oriented societies. To overcome endogeneity concerns, it is safer to use the instrumental variable technique and our regressions will use the most common instrumental variable estimator, which is the Two Stage Least Squares. The instrumental variable used for the regression is a spatial IV in line with Gründler and Köllner (2020).

Our full regression model is :

Public Expenditure on Education = β_0 + β_1 Patience + β_2 Geographical Characteristics + β_3 Economic/Fiscal Policy + β_4 Institutions and culture + ε_i

In our full regression model, we control for a series of variable categories. To indicate the robustness of our results, at first, model 3 will include only a vector of variables that we expext to affect Public Expenditure on Education, then model 4 is enriched by a geographical set of control variables that may affect the dependent variable and finally we regress our full model by adding variables that have to do with institution and culture and may affect Patience and the dependent variable.

Table 4.1: Patience-Rate of time Preference and Public Expenditure on Education

Dependent Variable: Public Expenditure on Education as Share of GDP					
	Model 1 OLS	Model 2 OLS	Model 3 IV	Model 4 IV	Model 5 IV
Variables					
Patience	1.584***	1.299***	2.010***	2.367***	2.326***
	(0.28)	(0.44)	(0.78)	(0.67)	(0.79)
Ln[GPD per capita]		0.21	-0.560*	-1.144***	-1.007***
		(0.25)	(0.34)	(0.32)	(0.32)
Transfers			0.062***	0.080***	0.01
			(0.02)	(0.03)	(0.03)
Savings			-0.02	0.00	0.01
			(0.02)	(0.02)	(0.01)
Gini			2.89	6.43	-3.70
			(3.36)	(4.99)	(4.77)
Employment in agriculture as a % of GDP			-0.020*	-0.041***	-0.02
			(0.01)	(0.02)	(0.02)
Age Dependency Ratio			-0.046***	-0.050**	-0.02
			(0.01)	(0.02)	(0.03)
Life Expectancy at Birth			-0.03	-0.08	-0.03
			(0.04)	(0.07)	(0.07)
Observations	72	72	59	47	46
R^2	0.186	0.376	0.598	0.728	0.814
Adj. R^2			0.493	0.519	0.536
Country FE	NO	YES	YES	YES	YES
Geographical Set of Controls[1]	NO	NO	NO	YES	YES
Culture/Institutions Set of Controls[2]	NO	NO	NO	NO	YES
Religion FE	NO	NO	NO	NO	YES

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

The spatial instrumental variable that we use in the two Two-Stage Least Squares regression is constructed in accordance with Gründler and Köllner (2020). Since collective values are shared by social groups which often do not correspond directly to the national population (Hofstede, 1980b). Patience as a dimension of culture may goes back beyond a country's frontiers, since cultural dimensions are often much older than national borders. We can use this feature to construct an instrumental variable for Patience by assuming that, conditional on covariance, Patience in neighbouring countries should be uncorrelated with a country's national level of Public Expenditure on Education. In case it does it is through culture that a neighbouring country could affect Public Policy. To construct our spatial instrument, we split each continent into four disjoint regions (16 regions in total). $Let = [1, ...,]R$ denote our set of regions, where each country i belongs to exactly one region r. Let N_{rt} be the number of countries in region r at period t and C_{ikt} denote Patience in country-year i,t.Then the instrumental variable C^r_{ikt} r is calculated separately for Patience - C.

$C^r_{ikt} = \frac{1}{N_{rt}-1} \sum_{(j \neq i | r=r', r' \in R)} C_{jkt}$.

[1]Geographical Set of Controls includes the following variables:Terrain Roughness, Temperature, Precipitation, Distance to Coast or River, Longitude, Latitude, Soil Fertility, Total Land Area, Pre-Industrial Distance to Trade routs

[2]Culture/Institution Set of Controls includes: Democracy, Colonial Duration, Stability of Malaria Transmission, Neolithic Transition Timing

Models 3,4 and 5 are regressions, that use the instrumental variable technique. In all of them, we run the Sanderson-Windmeijer test for underidentification and the null hypothesis is rejected. We also run a test for the weakness of our variable and we reject the null hypothesis that the IV is weak for every chosen bias level, since the SW F-statistic is greater than any maximal IV size (Stock and Yogo F-test critical values). Therefore, there is strong evidence that our estimators are not biased and our instrumental variable is strong.

The results reveal a significant positive relationship between patience and public expenditure on education. We assume that patience causally affects public expenditure on education which confirms our initial theoretical model. Our findings are robust since in all the IV models (3,4,5) patience remains statistically significant at all levels even after adding the different categories of control variables. However, controlling for so many variables leads to a much smaller sample because of many missing values in the data-set. Last but not least, the full model explains 82% of the variance of the dependent variable which is more than sufficient in a cross-country analysis to assume that the relationship is robust.

5 Conclusion

Culture has always been an important factor that shaped economic outcomes, but only recently have economists been able to empirically show how cultural dimensions interact with economic variables. While there are plenty of publications about what affects the rate of time preference, there are very few on how preferences, regarding inter-temporal choices, affect economic outcomes, especially between countries. Even though there are theoretical economic models explaining the relationship between the rate of time preference and economic outcomes, most of them have not been tested empirically.

The evolution of measuring cultural variables and particularly the rate of time preference has a significant impact on explaining the heterogeneity of macroeconomic outcomes (Dohmen et al., 2018). Recent publications (Dohmen et al.,2018; Falk et al., 2018) tried to shed light on how patience ,which represents the rate of time preference, is correlated with education and growth, however they do not present sufficient proof of causality. This thesis tries to fill that gap in the literature by causally linking education, patience and economic outcomes.
In detail, it is assumed that patience causally affects society's choice of Public Investment in Education. How great Public Expenditure on Education is, reflects how much individuals value human capital accumulation over current consumption. Given an endogenous growth model, patient societies are expected to be willing to sacrifice current consumption over a greater reward in the future as a result of human capital accumulation. Human capital accumulation takes years because any educational contribution to individuals is a long process. Therefore, by investing in education society seems to prefer future greater consumption over a lesser current consumption in the short-run. We find a strong causal positive relationship between the rate of time preference and Public Expenditure on Education, confirming our theoretical model and binding modern literature and endogenous growth. Causally binding cultural variables with economic outcomes may arise endogeneity issues. Therefore the use of a two-stage least squares estimator is essential to our analysis. Our findings and statistical tests confirm the strength of the instrumental variable used, therefore I am confident that the results are unbiased and robust. Nevertheless, working towards an even greater improvement of statistical techniques that could allow economists

to embed culture in their analysis, is essential.
Culture and its various dimensions have always been in the centre of Social Sciences trying to explain behavioral phenomena. Economic Science is responsible for taking this a step further by indicating possible causal relationships of societal variables and questioning their historical establishment in the form of plain correlations.

6 Appendix

Table 6.1: Summary Statistics

Table 1: Descriptive Statistics					
	N	Mean	Std. Dev.	min	max
Latitude	200.00	25.35	17.05	1.00	72.00
Terrain Roughness	183.00	0.21	0.19	0.00	1.24
Temperature	183.00	18.70	8.71	(19.46)	28.64
Precipitation	183.00	96.06	67.34	2.91	379.33
Life Expectancy	191.00	67.79	10.46	41.47	81.98
Age Dependency	185.00	62.08	17.89	23.79	108.10
Neolithic Transition Timing	168.00	4,847.58	2,510.06	362.00	10,500.00
Savings(%)	176.00	18.55	19.37	(50.02)	83.68
Distance from water	164.00	334.69	467.52	7.95	2,385.58
Transfers	141.00	9.00	8.04	0.56	36.50
Longitude	221.00	759,294.85	4,116,397.55	(9,870,340.00)	9,917,110.00
Precolonial Trade routes	142.00	0.71	1.36	-	8.83
Colonial Duration	197.00	1.37	1.67	-	11.45
Employability in Agriculture(%)	146.00	24.00	23.45	0.20	85.10
Malaria Transmission	129.00	4.36	7.18	-	31.64
Gini	73.00	0.56	0.09	0.38	0.75
Arable Area (%)	200.00	0.65	1.82	-	16.38
Soil Suitability	162.00	0.58	0.21	-	0.98
Patience	75	-0.0016305	0.3718198	-0.61252	1.07145
Public Expenditure on Education(% of GDP)	72	4.190998	1.389217	1.35177	9.047444

Table 6.2: Multiple Correlations

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Patience(1)	1																				
Public Expendit. On Education (2)	0.386**	1																			
Terrain roughness (3)	-0.163	-0.355*	1																		
Temperature (4)	-0.411**	-0.279	0.138	1																	
Precipitation (5)	-0.0171	-0.429**	0.215	0.319*	1																
Distance from water (6)	-0.206	-0.0750	-0.165	-0.175	-0.258	1															
Longitude (7)	-0.153	-0.378**	0.0122	0.334*	0.488***	0.218	1														
Latitude (8)	0.456**	0.305*	-0.173	-0.926***	-0.401**	-0.0150	-0.403**	1													
Soil suitability (9)	-0.00761	-0.0884	0.251	-0.280	0.242	-0.192	-0.126	0.229	1												
Arable Area (10)	-0.0168	-0.0514	-0.141	-0.242	-0.135	0.693***	0.410**	0.100	-0.119	1											
Pre-industrial Trade routs (11)	0.133	0.180	-0.148	0.291*	0.0541	0.115	0.440**	-0.321*	-0.162	0.328*	1										
Transfers (12)	0.612***	0.428**	-0.172	-0.665***	-0.239	-0.262	-0.485***	0.718***	0.295*	-0.103	-0.162	1									
Savings (13)	0.176	-0.0829	-0.0984	-0.0742	-0.0788	0.324*	0.109	0.106	-0.259	0.278	0.0267	0.0344	1								
Gini (14)	-0.483***	-0.105	0.0286	0.669***	0.0486	0.260	0.309*	-0.724***	-0.357*	0.0558	0.257	-0.784***	-0.0572	1							
Neolithic Transition Timing (15)	-0.110	-0.361*	0.391**	-0.135	-0.205	-0.164	-0.149	0.237	0.215	-0.180	-0.626***	0.143	-0.114	-0.217	1						
Democracy (16)	0.739***	0.266	0.0631	-0.487***	0.0365	-0.271	-0.0848	0.503***	0.288	-0.00396	0.103	0.552***	0.0339	-0.473***	-0.0158	1					
Colonial Duration (17)	-0.150	-0.226	-0.000361	0.474***	0.360*	-0.0228	0.386**	-0.477***	0.0182	0.0912	0.125	-0.352*	0.0934	0.283	-0.0620	-0.0294	1				
Employment in Agriculture (18)	-0.496***	-0.265	-0.0455	0.525***	0.380**	0.209	0.323*	-0.656***	0.0228	-0.0293	0.0369	-0.611***	-0.284	0.501***	-0.152	-0.490***	0.413**	1			
Age Dependency (19)	-0.204	0.0106	0.0761	0.430**	0.152	0.160	-0.00388	-0.587***	-0.194	-0.137	0.173	-0.366*	-0.388**	0.447**	-0.243	-0.273	0.178	0.565***	1		
Life Expectancy (20)	0.460**	-0.111	0.247	-0.403**	-0.0477	-0.396**	-0.0719	0.562***	0.146	-0.0774	-0.228	0.523***	0.199	-0.683***	0.450**	0.451**	-0.261	-0.739***	-0.664***	1	
Malaria Transmission (21)	-0.295*	-0.160	-0.105	0.508***	0.411**	0.126	0.107	-0.645***	-0.223	-0.0876	0.200	-0.446**	-0.108	0.520***	-0.419**	-0.383**	0.0839	0.635***	0.635***	-0.678***	1

(* p<0.05, ** p<0.01, *** p<0.001)

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