The effect of culture on student performance, human capital and economic growth.

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Bachelor Thesis International Economics and Business

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Abstract

Every Economics or Business student will be familiar with the Hofstede framework when graduated. However, far less is known about the effects of the 6 Hofstede cultural dimensions on human capital. The effect on human capital and consequently economic growth will be scrutinized by examining the relationship between PISA scores and each of the cultural dimensions. Utilizing average PISA scores in the period 1960-2000. The paper finds significant effects for only 2 of the 6 dimensions (Indulgence and Long-Term orientation). However, the effect of Indulgence and Long-Term orientation on student performance is at best very modest.

Keywords: Culture, Education quality and Human Capital

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1. Introduction

In the modern era, everything revolves around economic growth. Rapid acceleration of technological development and capitalist thinking hugely increased the importance of economic development. Each country needs to keep up with world pace. Piling pressure upon governments to design policies which spur economic growth. Often true happiness is measured in terms of GDP per capita and purchasing power parity. Rather than incorporating other aspects of life which influence well-being too. This forces policy-makers to desperately pursuit methods to improve economic performance. The question arising then; which factors influence economic growth, and how can a government shape these forces to obtain maximum growth and development.

Human capital development is often mentioned as a key determinant of economic growth. Mincer (1984) for example, views human capital as one of the vital factors of the production functions. Together with physical capital. Moreover, the Solow growth model by Solow (1956) emphasizes the importance of Human Capital in the form of productivity of Labor. In the Solow model, labour productivity or factor productivity is key for of economic development. If every worker can produce more output. The economy can produce more, hence, economic growth. The Solow model is tested by Mankiw et al (1992). They verify that both human and physical capital play a role in cross-country differences in economic growth. The importance of human capital is also stressed by Hanushek (2008). Hanushek claims that human capital or cognitive skills are key in the development of economic growth. Since it is so important for a country, how could you increase productivity of a worker? The Solow model states that the key component of higher productivity is TFP or total factor productivity. Where technological progress is regarded as the most important driver of productivity. More advanced technologies lead to more efficient production according to Carlow and Lipsy (2003). This increases output and consequently, growth. However, skill level of a population also matters according to Hanushek and Woesmann, which they claim in their paper written in 2008. De Vries et al (2014) in addition argue that high skilled Labour adds more value and intelligent people can more efficiently perform tasks. This increases output per worker and each worker adds more value, both putting upward pressure on economic growth numbers.

The major determinant of skill level is education. Massing and Schneider (2017) believe that someone who has had a longer and more thorough education will have a higher level of ability. Accordingly, Hanson (2010) visualizes education as a major determinants of economic growth. In his paper Hanson shows that both educational attainment and quality of education are vital determinants for development. In his paper he identifies education system difficulties in Mexico as one of the major factors behind the lack of economic development compared with China. China used to have lower GDP/capita and economic growth than Mexico. However, China now has become the 2nd economy of the world, experiencing enormous economic growth. Since Hanushek defined cognitive skills as truly important to economic growth

through Human Capital development, it is clear that the determinants of cognitive skills are relevant for policy-makers to increase economic development.

Hanushek himself uses scores of PISA tests and other standard tests as a proxy for the cognitive level of a country. The major component, the PISA test, is held every 3 years. Pisa tests 15 and 16-year old high-school students around the world on their knowledge and abilities in the field of Mathemathics, Science and Reading. Hanushek and Woesmann from these tests define a cognitive skill index. Which is a proxy for the level of development of a country. Which also serves as an indicator for Human Capital levels and Economic growth. Then remains to be discovered what exactly influences these tests performance or cognitive skills levels of a population. Apart from renown influences such as living standards, government spending and educational attainment, the thought of cultural influences possibly affecting Human Capital immediately arose. Stories of Chinese high school students spending the whole day (8 am-11 pm) at school either having class or preparing homework. Whereas in western countries, as part of a more indulgent lifestyle according to the Hofstede dimensions, students have much more free time. With more emphasis on total human development rather than a purely academic focus. This is confirmed by Yao Zhang (appendix figure 11), a PHD student at Columbia university and co-founder of Minds abroad.

One of the key papers on the consequences of culture for education is written by Hofstede himself, who investigated the impact of his cultural dimensions on teacher interaction and problem solving abilities. Kastanakis and Vover(2014) confirm Hofstede's theoretical outline in their analysis of the influence of culture in the classroom. However, neither of them nor any other research has examined the quantitative effect of culture. Each of the papers only theoretically substantiate the possible effects of culture. And never analyse data on whether culture affects student performance. They acknowledge the effect culture has on learning styles and knowledge accumulation, yet they do not investigate the possible reaction of performance on the cultural differences. The question how the differences in cultural traits influence human capital development and economic growth through their effect on student performance serve as the foundation of this research. The paper extends the current literature by adding data analysis. To investigate whether the effects of culture on learning styles and student teacher interactions found by previous research have significant effect on student performance. Which would affect human capital levels. With the knowledge whether certain learning styles enhance or hamper performance and consequently Human Capital. Policy could shape teacher and student interactions such that they facilitate optimal student performance. Benefiting economic growth.

The paper in accordance to expectations finds that each dimension has an extremely small influence. Moreover, only for 2 out of 6 dimensions; Long-Term Orientation and Indulgence, significant effects are found. Indulgence has a small negative effect on student performance. Long-Term orientation has a minor positive impact on student performance. For the other dimensions, Uncertainty avoidance has a negative

insignificant influence on Student test scores. Whereas Individualism and Power Distance have a positive but insignificant effect. The final cultural dimension, Masculinity was examined for its influence on the share of top performers in a country. It exerts positive but insignificant influence on the occurance of top performers in a country.
The next section in the paper will incorporate the current paradigm in literature on two areas which are important to consider before the data analysis.

2. Literature review

In this section I will review the existing literature on two dimensions. Firstly, all the previous findings on how culture impacts student performance will be collected, and secondly, the major determinants of student performance will be outlined. The literature review will provide sufficient control variables to incorporate into the data analysis, to prevent omitted variable bias influencing the results, ensuring the effects found in the regression analysis could be used for making certain conclusions. Following the data analysis, the results will be discussed and put into perspective given the limitations of the data and research.

The regression equation will use PISA scores as a determinant of education, since (Hanushek,2008/2012.) argues that educational quality and "cognitive skills" are extremely important for the level of human capital, which in turn is important for economic growth according to Didenko(2007). Therefore, the performance of students on this test serves as a suitable indicator of the cognitive level of a society, as it tests student on a broad and comprehensive range of academical skill sets, namely science, maths and reading/language aptitude. Other factors than culture which influence PISA scores should be controlled for in the regression analysis. Providing a less biased and more precise estimate of the influence of culture on education. If conducted properly, a clear overview of the necessary variables to control for in the regression equation can be listed. However, I will also omit parts of the explored variables within this section, either due to data constraints or insignificance of the impact. After thoroughly examining the literature, hypotheses on expected outcomes of the models can be constructed.

Influence culture on education

Evidence that culture influences education is abundant. Hanushek, in his paper" is location fate" emphasizes the discrepancy between US states regarding achievement in education. He believes this is predominantly caused by the fact that education is provided locally. Within each state differences arise on how education is provided. Secondly, he believes racial concentration affects educational performance, which adds relevance to the location debate. Serving as another confirmation that race and culture play a role in education, considering he concludes with black and Hispanic students performing worse than their white counterparts. Such that regions where there is a large concentration of immigrants might be outperformed by regions where the share of immigrants is less. So, location certainly plays a role in determining

educational performance of students, and thus should therefore be handled with in my regression.

An additional paper which fuels interest in this topic is the work of Kastanakis and Vover (2014), in their paper they argue that culture affects education through differences in student/teacher interactions, different methods of teaching and diversity in set up of homework and assignments.
For example, with individualism, individual freedom and intrinsic motivation are high. Hagger et al (2014) show that intrinsic motivation is higher in collectivist societies when work is assigned. Whereas in individualistic societies intrinsic motivation is higher in personal choice situations. In classroom situations most tests are not chosen but are mandatory. So, in collectivist societies intrinsic motivation might be higher for tests. Intrinsic motivation is more valuable according to Harpine (2015), as she claims that higher levels of intrinsic motivation lead to more time spent on tasks. Connected to that is the study of the OECD in 2014, since they state the importance of hours invested in homework account for within country differences in test scores. So, it is assumed that individualism negatively influence cognitive performance. Quite differently channelled is the effect of Power Distance, as investigated by Yoo(2014). Yoo claims that when there exists a lower degree of power distance, there will be more interaction between student and teacher. Consequently, students are expected to take more initiative. Adding to self-reliant and independent skills of individuals, better enabling students to apply the knowledge to new or different situations. Such that higher Power distance is negatively affecting student performance expectedly. Also, if you are more afraid to make mistakes, it is less likely that you will push yourself to the edge, since that is the area where you make mistakes (Kristi John Smith). Furthermore, fear of failure can cause all sorts of troubles during exams, each of them negatively affecting performance at tests, as outlined by Korthagen et al (2015)

Hofstede (2001) himself also investigated the effect of different positions in his cultural dimensional framework on eduction. For instance, when scrutinizing long term orientation, his theory is that people will invest more in education. Because in short term oriented societies, the focus lies on how to optimally live your life in the short term. Less emphasis is put on future earnings. This is also one of the main theories in Labour economics. Boeri and van Ours for instance in their book on the economics of Labour markets: explain the decision to pursue a degree as a mere cost benefit analysis. One with a high discount rate on future earnings will less value these future earnings. He will rather have earnings in the present. Leading to lower investment in education either in the form of not obtaining extra degrees or even drop out.
The dimension Masculinity has a completely different effect compared to the previously mentioned components of the Hofstede model. Hofstede argues that in highly masculine societies, the focus is on excelling students. They get praised often and are set as benchmarks for the others to catch up to. This is similar to what Manikutty found in 2007. In feminine societies, a greater focus is placed on below average students. Trying to encourage them to perform better and pick up the pace of

the better performing students. In masculine societies greater inequality possibly arise due to concentrating on the high skilled people. This makes high skilled relatively higher skilled and demoralizes low skilled people. However, average performance is not expected to be affected by differences in this dimension. Because both ends of the spectrum with own techniques try to improve the same measure. Which is average performance. However, more effect could be expected when looking at the share of top performers within a country.

For indulgence it is best to have a look at China. Where high school students, under pressure of parents and teachers participate in after class study sessions which finish at 10 or 11 in the night. In other words, the students almost spend 80 hours at school per week. This could possibly be a factor which plays a role in the assembly of human capital and the development of all skills and abilities. Positively in a sense that Dukes (2006) shows that more hours spent on studying results in better test scores. However, also negatively, since there are more skills in life than academic skills. Human capital comprises of comprehensive sets of skills/knowledge and abilities which include academic skills, but also knowledge of life outside of the books and ability to interact with other people. Some of the most brilliant specialists in certain areas might be horrible teachers or instructors for example. Purely because they lack the skill to properly interact with people and properly design teaching strategies.

Alternative measure culture

Undoubtedly, the Hofstede dimensions framework is not the only way of measuring culture possible and used. One comprehensive overview of different measures of culture is provided by Mohr and Rawlings (2012), who identify 4 main techniques or models for measuring culture. However their work is scarcely used.

Another part of the literature which constructs several forms of measurement of culture is work of Connerly and Pedersen(2005), who outline 3 additional frameworks aside to the Hofstede framework, firstly he mentions the first framework for measuring culture, which is developed by Kluckhohn and Strodtbeck (1961), their work is the basis for Hofstede's cultural dimensions and comprises of 5 core topics, Basic nature of human beings, Relationships among people, Activity orientation, Relation to nature and Time orientation.
Secondly Connerly and Pedersen highlight the quality of the work of Hampden-Turner and Trompenaar(1998) who invent 7 cultural dimensions and their effect on business and management: Universalism vs Particularism, Individualism vs Communitarianism, Neutral vs Affective, Specific vs Diffuse, Achievement vs Ascription, Attitude towards time and Internal vs External control. All these frameworks overlap on several areas. The Globe framework too for example, which divides culture into 9 dimensions, 4 of which are the same as Hofstede and the other 5 being: Assertiveness, Future orientation: which could be regarded as similar to long vs short-term orientation of Hofstede, performance orientation, humane orientation and gender differentation. Where Hofstede and globe framework are widely used in

all sorts of settings, the other 2 frameworks tend to be less utilized, the Trompenaar framework is more focused on business and management instead of education. These alternative measures could serve as a robustness check for my model, however, these frameworks are seldom used with regards to education, more for life in general and for management principles. Focus on Hofstede in this paper since it is more common and familiar. Which is convenient for comparing the results to the theoretical foundation in the literature. Moreover, Brewer and Venaik in 2008 found that in fact there is quite some difference between the two dimensions in terms of outcome, partly also because of the different time periods. Such that adding them together in a database does not benefit the outcome of the model. Therefore, neglecting GLOBE data, and entirely focusing on Hofstede's dimension is deemed as the most appropriate method.

Hypotheses

1. Indulgence vs Restraint and Human Capital

The level of indulgence of a country negatively effects the performance of students on mathematics and science, however, since reading requires more know how rather than subject specific knowledge, a milder effect is expected for scores on the reading dimensions. Potentially, since Minkov argues that indulgent countries induce happiness, which potentially dampens the effects on education performance, as people who are happier and experience less stress usually perform better at school (Leblanc 2009)

2. Power distance and Human Capital

Power distance will especially influence the teacher-student relation and interaction. In societies with higher power distance, the teacher speaks and what the teacher speaks is deemed true. With lower levels of power distance, there is more interaction between students and teacher. Leaving more possibility for students to share their own opinions and thoughts. Giving more room to discussions and interaction. Active learning methods require more thinking and to a greater extent prepare to perform outside of the regular setting(Prince), which tests are similar to. Therefore, expected that Power distance will have a slight negative effect on performance at tests. Especially in areas where:"know-how" rather than "know-that" is important, inferring that a greater effect could be expected in the reading dimension of the PISA score.

3. Long term orientation vs Short term orientation and Human Capital

In a relatively long term oriented country education is shaped by culture in the sense that future earnings are more important compared to the current situation. In short term oriented countries students will tend to focus less on education and prefer to work. Whereas in long term oriented countries, education which will be accompanied by short term losses. Students will be more likely to invest more into their education. Logically then, student performance will be higher in a long term oriented country, since education and performing at school is considered as more important. Therefore, based on theory and reasoning I assume that a Long-term orientation has a positive impact on the performance of students on the PISA test.

4. Uncertainty avoidance and Human Capital

´Regardless of your current performance level, you will never improve at an activity unless you are willing to push yourself to the point of making a mistake´. This quote from Kristi John Smith is the perfect argument why higher levels of Uncertainty avoidance can be associated with lower levels of performance. Which in turn implies lower levels of Human Capital. Moreover, as Sharma (2015) shows for mathematics class, risk taking behavior positively influences performance of students. Furthermore, higher levels of uncertainty avoidance are accompanied by higher levels of fear of failure, which as this Dutch study by Korthagen shows, has negative influences on performance.

5. Masculinity vs Femininity and Human Capital

When considering the role of a high level of masculinity or femininity in education, it is ambiguous which effect dominates. Because PISA scores are averaged. Both Masculinity and Femininity improve the average performance. Which one is better remains unclear. According to Hofstede and also Kastanakis and Vover(2014), education in masculine societies puts emphasis on good students performing even better. Whereas for feminine societies the weaker students are more in the centre of attention, trying to enable weaker students to pick up to the level of the rest. PISA scores are average so one would expect no clear influence on the average scores, it would influence the peak performances on both sides of the spectrum, as in a masculine society presumably there will be some students very good and some students very bad. Contrary to that, in feminine societies one would expect less fluctuation or less margins between skilled and less-skilled students. Therefore, on beforehand it is impossible to forecast whether either masculinity or femininity could be regarded as a better form of education.

6. Individualism vs Collectivism and Human Capital

Regarding the influence the level of individualism within a society will exert, I expect a positive influence. Because in classroom situations for collectivist societies, intrinsic motivation is higher according to Hagger et al (2014). Higher levels of intrinsic motivation ensure people invest more time and effort in tasks (Harpine 2015). More time and effort in school work leads to better results (OECD 2014, appendix figure 12), a negative effect for the degree of individualism will be a likely outcome.

However, culture is not the only factor affecting student performance. So other important variables determining educational quality need to be incorporated into the model. This will be discussed in the upcoming section.

Determinants educational quality

I will measure human capital by a proxy for cognitive skill level constructed by Hanushek. Which is an average score over time of PISA and other international standard tests for student performance for countries. This gives a comprehensive overview of quality of education through the capability levels of the students. Furthermore, I will control for some of the variables considered to influence education performance and quality, such as income, since better living standards increase the likelihood of opportunity for education and better health standards improve the performance at school. Also, Bernstein (1967) and Douglas (1964), show that lower class people tend to a lesser extent intellectually challenge their children. Therefore, their cognitive starting level is lower, potentially biasing the results as they will have lower performance levels on average. This makes it necessary to include income into the regression analysis. Additionally, Sherpa (2012) and Hanson (2010) emphasize the importance of educational attainment for quality of education.

One of the most comprehensive and thorough investigations on determinants of student performance is done by Scheerens, J 2011, in his research, that overlaps with the study of Fuchs and Woesmann (2004). As both examine the effect of institutions and student backgrounds. Scheerens constructs a framework on educational quality, which serves as a great overview of all the indicators believed to be having an impact on the quality of education. In the paper the indicators are categorized into 3 groups: System level/governmental level inputs, similar to the institutions variable constructed by (Fuchs and Woesmann). System inputs are inputs such as expenditures of the government on education or whether private or public investments are made into education. Secondly mentioned is school level input. Finally, he just like Fuchs and Woesmann highlights the importance of student characteristics and backgrounds Using this distinction between forces of educational performance Fuchs and Woesmann found that 25 percent of international differences are caused by institutional variation. Which is a very large fraction. these institutional differences are often overlooked or underestimated. Perhaps for future policy-makers this knowledge could prove useful. The second level, School level input, mainly regards to teacher quality and quality of school facilities. The third category of inputs comprises of student characteristics, of which culture is a major part. These 2 papers provide an excellent overview of which forces determine the quality of education, and thus a selection of the variables that could be excellent control variables. This to prevent the omitted variable bias from interfering with the regression results. Adding explanatory power to the model. However, data on these specific indicators is rare and exclusive. Such that it is extremely difficult to incorporate into this analysis.

Connected to the previously discussed papers is another great piece of research on the the determinants of education quality by Pootrakul (2014). Pootrakul investigates secondary high schools in Bangkok to find out what the key factors behind education quality are. He concludes that only teacher quality and facilities of the school have a significant effect on education quality. Which basically emphasizes the importance of the school level inputs mentioned before by both Woesmann/Fuchs and Scheerens.. It

also indirectly affiliates with spending levels since better facilitated schools are partly caused by higher budget provided by the government. Since data on teacher and facility quality seldom appeared in the several big databases consulted. Spending on education together with the GDP of a country serve as a makeshift control variable. Partly controlling for education standards

The pioneer however, on the importance of educational quality and factors behind this is Hanushek, he specializes his entire research on educational quality.. One of the things Hanushek in his work in the early 90's found was that performance based contracts for teachers positively influence the quality of teaching, and seemingly positively influences the performance of students. This is indirectly confirmed by Santos who stresses the importance of commitment of teachers to their task as an influence on education quality, Better teaching means better preparation and more efficient learning better teaching will lead to better performance of students. Adding to the importance of teacher quality is the degree of autonomy a teacher possesses. Santos (2007) based on her research on Argentinian education performance concludes that the more autonomy a teacher exerts the better influence on quality of education and subsequently performance of students.

Adding to the extensive research of Hanushek, Fuchs and Wossmann(2006) who specifically examine reasons for differences in PISA scores and student performance between countries. They claim their model explains 85 percent of variations in student performances. Key takeaway from their paper is the significant impact of autonomy for schools on the performance of their students, mentioning concepts such as autonomy on the topic of textbook choice and recruitment of teachers. Contradictory, Fertig (2003) finds no support for this claim in his econometric analysis of German PISA scores. Rather stresses the fact that schools have a tendency to " impact of schools aiming at a more homogeneous body of students in terms of their educational achievement. Which in other words means that through transfers of students to other schools and entry examinations. The level of students within a school is tried to be evenly matched. This according to Fertig, enhances individual educational achievements. Fertig his results oppose popular believes regarding the effect of regulation of schools and non-citizen participation. Immigrant participation could bias results, since they might have possible language problems. Making learning more difficult.

Reading vs science and mathematics

Fertig in his paper also nicely addresses the differences of knowledge required for each of the 3 dimensions of the PISA test. As he claims that reading requires far more know-how and general knowledge. Because reading texts can be about any topic. Which adds to the required comprehensiveness of the knowledge, whereas Maths and Science tests are far more specifically in testing knowledge and skill. This suggests that culture also differently affects each of the distinct dimensions of the PISA score. For instance, indulgence in the form of more hours spent on studying could especially

improve specific knowledge appropriate for performing well in science and maths, but to a lesser degree impact know-how, which according to Fertig is more crucial for performance in the reading component of the PISA test. The differences in effect of culture on student performance is not only theoretically based, but also statistically scutinized. Fuchs and Woesmann(2004) in their paper investigate the determinants of student performance and have somewhat surprising findings. In absolute values the effect of student characteristics and backgrounds, which incorporates cultural values, for each of the 3 PISA dimensions is approximately equal. Which means that within the different models used for each of the 3 PISA dimensions, the absolute effect of culture is equally high. However, relative to other factors, student background and characteristics play a significantly larger role in reading test scores compared to the influence student characteristics has in Mathematics and Science performance.

Lynn S Fuchs her findings contrary, are not in compliance with Fertig's reasoning of different forms of knowledge between Maths/Science and reading. And slightly in accordance with the in absolute terms equally large effects of student characteristics and background on performance in each of the 3 categories of the test. They moderate the differences between maths/science and reading scores on knowledge because Mathematical and scientific problems also often have texts accompanying the problem or the case which needs to be solved. Such that it would suggest that a reading comprehension also is important for performing in other areas of tests. They find a relationship between reading comprehension and mathematical test scores, even after they control for technical reading factors. Subsequently, they argue that both reading and mathematical exercises require a certain amount of reasoning abilities in a student.
However, due to especially the statistical evidence of Fuch and Woesmann, the paper will additionally to the regular regressions investigate whether the effects of each of the culture dimensions will differ depending on the particular test dimension (Reading, Science or Mathematics).

A different factor possibly affecting educational performance as mentioned by Wolter and Vellacott (2002) could be the existence of siblings and the order of birth of these siblings, for instance younger children having the motivation to outperform their older brothers and sisters, however they find a rather small and heterogeneous effect such that I deem it invaluable and unnecessary to control for this feature.

Furthermore, they reignite interest from previous literature of primarily Hanushek, who based on economic theory define institutions as the key influence of educational quality, as they shape the educational system and give or fail to give incentives to everyone operating within the system, for example teachers. Fuchs (2006) provides empirical evidence for the importance of institutions in determining cognitive performance, estimating that 25 percent of changes in quality are ignited by institutional disparities among countries. They provide a list of examples of institutions they obtain from the literature which they deem relevant. For example （e.g., Epple and Romano 1998; Nechyba 1999, 2000; Chen and West 2000) all three papers examine the impact of either private or public funding on the quality of

education. They find out that private funding benefits the higher quality segment of students, similar effects as that of masculine attitude in societies. Fuchs and Wossmann in their paper commence by highlighting the importance of institutions by referring to significant earlier investigations such as the testing of data of TIMSS and IAEP scores which is performed by (Bishop 1997; Wößmann 2003a). Or alternatively the usage of TIMSS-Repeat by (Wößmann 2003b).
Each of the 3 papers agree on the significance of institutions for quality of education. Combining these two features nicely outlines focus areas for research into this area. Additionally, Woesmann and Fuchs in their research stress the importance of culture in education performance at the Pisa test by mentioning the influence of background of students, next to individual characteristics of students, teachers, institutions and resources. Fuchs and Wossmann with their work try to reignite policy interest in institutions and their impact since it is overlooked on a frequent basis by policy makers specialized in improving quality and level of education. Policy makers often are focusing too much purely on resources, and not on how they are used, Fuchs conclusion adds nicely to a pivotal claim of Hanushek, who argues that only increased spending on education does not necessarily improves the quality of the education provided, also with decreasing returns to scale in his opinion.
Another element influencing educational quality, as mentioned before is outlined by Hanushek in 2014, which specifically investigates the role of location, since location plays such a significant role, especially in combination with culture and living standards, controlling for location is a must, such that comparing countries with similarities in ethnicity and similarities in immigration policies but who differ in cultural settings might be suitable to include in the sample.

To summarize: due to data constraints as well as insignificance of some factors found in the literature, when running the regression analysis, I will try to control for income, location, education spending, education attainment and institutional differences. Which should prevent the omitted variable bias from arising, ensuring that conclusions from regression results can be safely made. However, as earlier described, data on institutions concerning education was extremely hard to obtain. Country level data for all the years for private versus public spending on education and all other aspects mentioned by Fuchs. Leaving out institutions was regarded as the best option. This decision is justified by the fact that Pootrakul(2014) identifies teachers quality and especially the quality of facilities is important. By controlling for government investments and the income of a country, indirectly institutional differences to a slight degree is covered by these 2 variables.

Having extensively scrutinized the related literature, the objective of the present research folds out to be the empirical addressing of how culture influences education, building upon the existing literature, which recognizes the potential effect of culture on education. However, empirical contribution on this specific topic is scarce. Whereas the bulk of literature on cultural influences discuss the issue from a theoretical perspective, without trying to quantify these separate effects. They do not try to distinguish if one cultural value is better for education or not. The emphasis is

on how to handle differences in culture. Rather than which of these different forms of culture would be optimal for student performance. This is partly due to culture being difficult to change. However, I believe to some extent it could help improve policy decisions even without rigorously changing mindsets.

The second regression part will examine whether culture plays a similar role for each of the 3 dimensions of PISA test. Reading, Science and Mathematics. For the distinct dimension scores, the same signs are expected. However ,the size of the coefficients might vary. Fuchs and Woessmann acknowledge the bigger influence of student characteristics and background on reading performance compared to science and mathematics. However, for indulgence the effect is expected to be less, since solving mathematical and scientific problems are more based on practice and repetition compared to reading exercises.
Additionally, for Masculinity dimension there will not be any expected effect since data constraints do not allow for checking the distribution of reading scores within a country, and the cognitive proxy alike, there is no reason to believe that masculine or feminine values will exert significant influence on average scores.

For each of the regressions I expect small influences, some bigger than others, and differently for each of the dimension of PISA score, as the literature has shown, there is an astonishing quantity of factors, circumstances and influences that affect the PISA score.

Overview expectations

Cultural dimension	**Cognitive Skills**	**Reading**	**Science**	**Mathematics**
Indulgence	Negative effect	Negative effect	Negative effect	Negative effect
Power Distance	Negative effect	Negative effect	Negative effect	Negative effect
Long Term orientation	Positive effect	Positive effect	Positive effect	Positive effect
Uncertainty avoidance	Negative effect	Negative effect	Negative effect	Negative effect
Individualism	Negative effect	Negative effect	Negative effect	Negative effect
	Share top performers	**Reading**	**Science**	**Mathematics**
Masculinity	Positive effect	Ambiguous	Ambiguous	Ambiguous

3. Data and Method

Just as (Hanushek and Woessmann), PiSA scores are used as a measure of educational quality. Using their database on PISA scores gives a great dataset on

cognitive levels of countries over time. Since they use an average of PISA scores between the period 1960-2000. They standardize the results of several of international tests in existence (PISA, TIMSS, PIRLS) on the scale of PISA scores. Then Hanushek and Woessmann use the results achieved in mathematics and science for the entire time-period a country participated in the PISA test. To average the scores over this longer time-frame. This provides a comprehensive and robust dataset on purely cognitive skills of the students. This is exactly the reason why this database is used for the basic model on cognitive skills and culture.
However, since Hanushek and Woessmann only incorporate mathematics and science scores into their variable of cognitive skills, reading abilities are neglected. As mentioned before, Fertig argued that reading abilities and the capacity to solve scientific and mathematical problems are driven by different forces. The widely known saying "Practice makes perfect" truly applies to solving mathematics and science related problems, however, doing well on reading tests requires more know-how. Therefore, additional models for investigating the effects of Hofstede his 6 dimensions on reading scores of students is required. The data of test scores on separate dimensions is obtained from the world bank database, where data on mean test scores for each dimension of the PISA test for almost any country in the sample is available. Just a few observations had to be removed. Due to problems with collecting data from the OECD website, the time-frame for looking at differences between reading scores and mathematics/science scores is quite limited, being only from 2000 onwards.
Thirdly GDP data is collected from the CLIO project conducted by (Jutta Bolt), where GDP data per capita in international dollars for the time-period between 1960-2000 is available. An average GDP per capita over this period is constructed, similarly he education data such that they measure the same time-period. Unfortunately, due to unavailability of data for Iceland, Indonesia and Luxembourg, these 3 countries have been removed from the database. GDP data per capita for the 3 previously mentioned countries only was available from 1990 onwards. The GDP per capita data time-frame is aligned to the time-frame of dimension test scores data. Such that for the entire analysis, the period between 2000 and 2015 will be used. Furthermore, the GDP measure used will rather than the other dataset, utilize constant 2011 international dollars. This to ensure that for each analysis the right GDP measure will be employed.

Furthermore, for the other control variables, the Barro and Lee database in combination with the world bank was consulted, Barro and Lee database provided the average years of primary and secondary schooling for each student in the included countries in the analysis, providing as a measure of educational attainment. World Bank data was used to quantify education spending of governments, since it is expected that governments who spend more on education are likely to have a higher quality standard of education.

Having collected all the data and compiled everything into a sufficient database, regression analysis can be started, using a linear regression for each of the regression models. To be sure that neither Heteroskedasticity nor multicollinearity bias the data, tests will be run to detect whether these two forces play a role. For Heteroskedasticity,

a Breusch-Pagan test will be performed. As for multicollinearity both a correlation for each of the independent variables and a VIF test will be used to ensure multicollinearity does not influence the data used in the regression analysis. Additionally, although not entirely necessary, normality tests will be utilized to show whether any of the variables used in the regression are non-normally distributed. Which could be solved by using the Log measures of these variables.

Due to data limitations: reading shares of top performers were impossible to calculate, such that for masculinity the effect of a masculine society on the share of top performers in reading tests cannot be investigated. Throughout the empirical analysis, two separate databases will be used. One database on cognitive skills measurement of Hanushek between 1960-2000 and corresponding control variable data. The second database comprises of reading/mathematics and science score averages between 2000-2015 and once more the corresponding control variable data input for the specific time-frame. This leads to the following groups of regression equations: The first group is all with the Hanushek and Woesmann cognitive index as dependent variable and as independent variables, one of the Hofstede dimensions, ln of GDP/Capita, Educational attainment of Primary and Secondary school in average years and Educational spending as a percentage of GDP. Then there is one regression analysis on the influence of masculine societies on the share of top performing students within this society. As written down in equation 2.

Regression equations

Equation 1: Cognitive Skills=$\beta 0+\beta 1Hofstede+\beta 2GDP+\beta 3Primary+\beta 4Secondary+\beta 5spending+\varepsilon$

Equation 2: Top share performers=$\beta 0+\beta 1masculinity+\beta 2GDP+\beta 3Primary+\beta 4Secondary+\beta 5spending+\varepsilon$

After the analysis goes more in depth on specific dimensions of the PISA test to examine whether differences in influence among the 3 scales is significant. Which looks as follows and is then applied to all the dimensions apart from Masculinity since for that dimension there is no expected effect.

Equation 3: Average Reading score = $\beta 0+\beta 1Hofstede+\beta 2GDP+\beta 3Primary+\beta 4Secondary+\beta 5spending+\varepsilon$

Equation 4: Average Math score= $\beta 0+\beta 1Hofstede+\beta 2GDP+\beta 3Primary+\beta 4Secondary+\beta 5spending+\varepsilon$

Equation 5: Average Science score = $\beta 0+\beta 1Hofstede+\beta 2GDP+\beta 3Primary+\beta 4Secondary+\beta 5spending+\varepsilon$

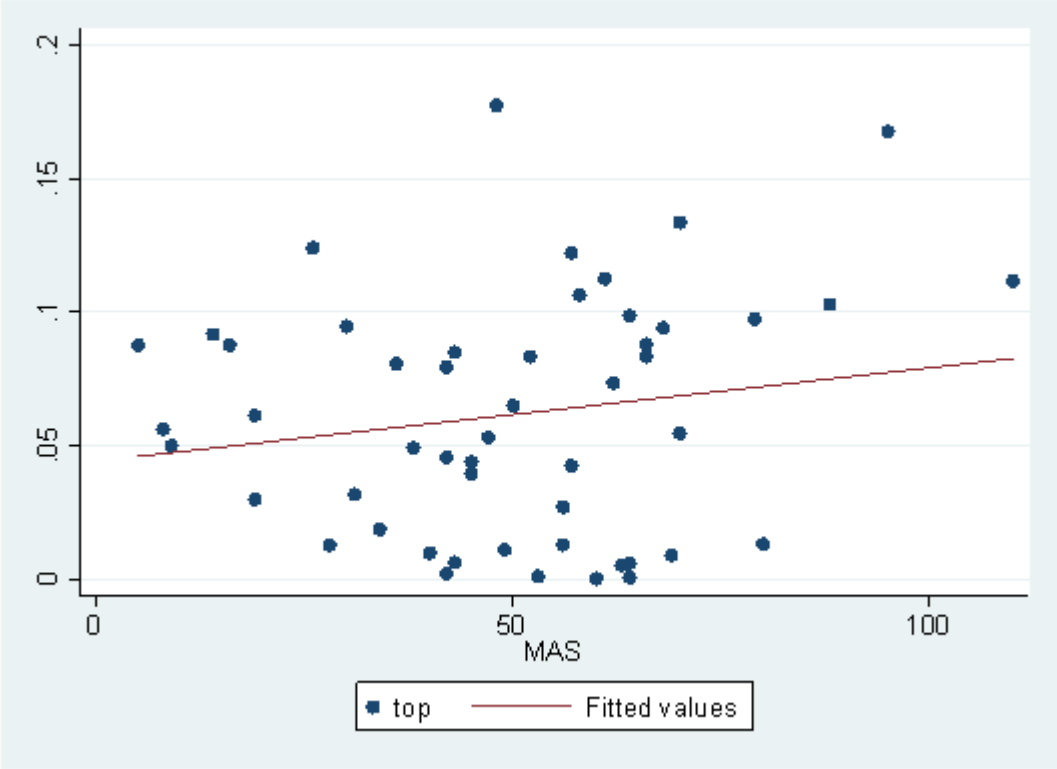
Multicollinearity did not feature in any of the samples used in the analysis. For some of the variables however, heteroskedasticity and/or non-normality occurred. The Heteroskedasticity issue was solved by using robust standard errors in the specific

regression models which were biased by Heteroskedasticity. As for non-normality log data were used, trying to minimize the effect of non-normality. Having discussed the methodology, the following passage will be an outline of the results obtained.

4. Results

In this section a detailed overview of the obtained results will be provided. The graph below exemplifies the small effects which were found in each regression. All the other graphs of each analysis show a similar pattern.

Figure 1:



The above figure is made from the correlation between the values for Masculinity and the values of the cognitive variable as constructed by Hanushek and Woesmann.

The mild effects of each of the dimensions is clearly visible in the regression output as well. In Table 1 below, a brief overview of the regression output is provided, with for each dimension tested the coefficients/observations and R-Squared of each distinct model. Firstly, concerning significance, 2 out of 6 dimensions possess coefficients statistically significant different from 0. The Long-Term Orientation dimension has a coefficient of 0.0112 which is significant at 0.01 level. Highly significant but nevertheless a rather small number. The sign of the coefficient is in line with the hypothesis that higher Long-Term orientation corresponds to more value placed on education and more effort and time invested. Which leads to a higher test score. The R squared of this regression analysis is reasonably high, standing at 0.632, which means 63 percent of the variation in cognitive skills is explained by the variables included in the model.

The other significant dimension is Indulgence, which also behaves as assumed beforehand. Yet again the coefficient is rather small, being -0.00725, and significant at 0.05 level. As assumed, the coefficient is negative. Strengthening the reasoning that lower levels of indulgence, which means less emphasis on free time, lead to lower performance levels. Since less time is devoted to academic results, and more time is invested in personal development and leisure activities. The explanatory power of the Indulgence model is lower than that of Long-Term Orientation. Being 0.535, it is not very high, yet not very low.

The first surprising result is the fact that Power Distance is not significant and contrary to forecasted, has a positive coefficient. Possible explanations why power distance has a positive coefficient might be more related to active learning being not such an advantage for a standardized knowledge test. And might exert more influence with non-standardized aptitude test.
However, to put the analysis in perspective, 0.00135 is a very tiny number. Being almost equal to 0. Moreover, since the coefficient is statistically insignificant, the coefficient being positive instead of negative might just be purely coincidental.
Another surprising result is the positive coefficient of individualism, which could infer that maybe more tasks are of personal choice. Or that these assignments within boundaries possess personal freedom.
For Uncertainty Avoidance the hypotheses seem to be justifiable in this analysis. However, as mentioned before, it is difficult to draw conclusions since the insignificance of each coefficient.
The final dimension Masculinity did not involve cognitive skill levels but the share of top performers within a society. As expected, the coefficient is positive: 0.000332 . Which suggests that it might be true that in more masculine societies, the emphasis put on top performers positively influences the number of top performers within that society.

	Long Term Orientation	Power Distance	Uncertainty Avoidance	Indulgence	Individualism (Ln)	Masculinity
Coefficient (Standard deviation)	0.0112*** (a0.00261)	0.00135 (0.00446)	-0.00145 (0.00363)	-0.00725** (0.00277)	0.00379 (0.178)	0.000332 (0.000228)!!!
Observations	51	51	51	51	51	51
R-Squared	0.632	0.483	0.484	0.535	0.482	0.497

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

!!!: coefficient of masculinity refers to share of top performers rather than cognitive skill proxy.

As expected, GDP per capita or in this case the log value in each of the regressions is statistically significant and plays a role in the determination of education performance. Which way causality runs in this example is unclear nevertheless, either rich countries have better schools because the facilities are better, or they are rich because their education is at a high level.

One of the surprising outcomes of the regression is the insignificance of government spending. The general view is that countries with higher proportions of government spending on education will have a qualitatively higher education system. However, as the regression results show, spending on education in none of the models has significant influence on cognitive skill level of countries.

Two possible explanations come to mind. Firstly, the nature of the measure of education spending being in the form of percentage of GDP does not say anything on the absolute amounts of spending, furthermore, it is taken as percentage of GDP and not of GDP per capita. Secondly, as Hanushek mentions not only the level of spending matters but also the quality of the spending. In their paper on quality and quantity of spending the main argument is that more effective spending will require less spending in total, such that percentage of GDP dedicated to education investments will thus not necessarily affect education quality of countries. Other measures of education spending are not useful due to data constraints. This as will later be again acknowledged in the discussion part is a major limitation of the model, since an effective measure of government spending has not been found. Some other interesting patterns include the slightly high negative coefficient for Power distance when looking at each of the dimensions specifically, as well as the high coefficient in general for the dimension specific regression analysis, compared to the model for cognitive skills.

For the second analysis, each of the dimensions of PISA (Reading, Mathematics, Science) were scrutinized independently of each-other. The results are summarized in Table 2 down below.
Similar as with cognitive skills, Long-Term Orientation and Indulgence remain statistically significant. Both again behaving as expected. With a negative significant coefficient for Indulgence and a positive significant coefficient for Long-Term Orientation. Comparing the coefficients between the two models does not make sense due to the different data sources. However, vital for this model is the distinction between Mathematics, Reading and Science. Where as predicted, Indulgence and Long-Term Orientation have a stronger effect on performance in Science and Maths than reading. This is perfectly in line with the hypothesis that Mathematics and Science tests require more “know-that” than “know-how”. For Uncertainty avoidance and Power distance the coefficients are the same as what was expected upfront. For Uncertainty avoidance this was also the case in the first regression model. However, for Power Distance the sign changed from positive in the cognitive skills model to negative in the Dimensions Model. Meaning that for the different dimensions it might be the case that

the difference in student-teacher interactions with different levels of Power-Distance have an influence on Student performance.
The coefficients for Individualism remain different from predicted. This might imply personal freedom in assignments, which would infer higher intrinsic motivation in individualistic societies exists.

Table 2: Summary results regression distinct PISA dimensions.

	Long Term Orientation	Indulgence	Power Distance	Uncertainty Avoidance	Individualism
Reading	0.398*(0.209)	-0.405*(0.211)	-0.309(0.249)	-0.239(0.191)	4.628(9.668)
Mathematics	0.891***(0.229)	-0.684***(0.251)	-0.0541(0.316)	-0.362(0.235)	1.992(12.06)
Science	0.713***(0.220)	-0.607**(0.232)	-0.168(0.288)	-0.268(0.218)	4.674 (11.03)

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5. Conclusion

In both compartments of the regression Indulgence and Long-Term orientation have a statistically significant effect in accordance with the Hypotheses. A lower score on Indulgence signals a lower value for free time and more emphasis on work and study related activities. Such that a higher performance in any of the areas is expected, also in line with expectations is the smaller effect indulgence has on reading scores compared to science and mathematics in the other model. However, since different data sources are used, comparability issues might arise. This will be discussed in detail in the discussion section.
The results also suggest that purely practicing until you know everything there is to know(know-how) is less important for reading. For Long Term orientation the statistically significant coefficient follows the hypothesis. People who are more Long Term oriented in their action will value school more as they see the chances and possibilities of future earnings and rather have higher future earnings than high earnings now. Such that they will put more effort into their schoolwork.
So what does this imply for possible policy implications? Long-Term orientation remains significant throughout the analysis. This suggests that there might be some value for policy makers to try to shift children their mindset from short-term to long-term. Benefiting the economy. Also, a less indulgent school population might possess

positive benefits for levels of Human Capital. For the other 4 dimensions it remains unclear if policy in this area will affect Human Capital levels.

6. Discussion and Limitations

Of course, this research is not perfect. The following section will be concerned with the acknowledgement of the limitations of the methodology used, as well as further implications for future research on this topic. Providing a starting point for more elaborate research on this area.
First and foremost, from this paper point of view, neglecting institutional variation in the model is a huge limitation. As Woessmann and Fuchs found that institutional variation could explain up to 25 percent of performance diversity. In an ideal world this paper would include proxies for institutional variation, however, due to data availability it was decided to leave institutions out of the analysis. Partly controlling for them through income and spending, yet of course this does not fully account for the expected variation.

Secondly, a drawback of this research is the low number of observations possible, first and foremost because not that many countries participate in PISA tests, and with the nature of the variables used, it is not very fruitful to incorporate patterns over time into the analysis. Robustness checks for GLOBE or alike measures of culture would not be very useful either since other papers found there are quite some differences in dimensions which seemed similar initially.
Additionally, issues regarding comparing the two models within the paper arise since different data sources and measures are used. Such that it lessens the strength of the conclusions drawn from the analysis.

As stated previously, the ultimate and most important limitation of my conclusions is that culture free education is practically impossible to construct. For instance, (…) argue that culture has such deep roots in each society. Consequently, it is difficult to change the values and beliefs of the people within a certain society. So even though implementing some cultural traits or values might increase student performance, the process of every student/teacher and organisation to adapt to these changes will be extraordinary complex. Such that the small increase in student performance accompanying the change in learning style might not be worth the investment required for this change. The small influence found in this report nicely links back to the conclusion of (Wursten & Jacobs), that the most effective study method depends on the cultural setting. What works for a Korean student will not work as effectively for an American student.

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8. Appendices

Regression table 3: Relationship of each of the Hofstede dimensions on the vertical side with the cognitive index on the horizontal side.

Table 1 VARIABLES	(1) Cognitive index	(2) Cognitive index	(3) Cognitive index	(4) Cognitive index	(5) Cognitive index	(6) Share of top performers
Long Term orientation	**0.0112*** **					
	(a0.00261)					
GDP/Capita(ln)	0.282**	0.286	0.274*	0.338**	0.267	0.0223**
	(0.115)	(0.189)	(0.158)	(0.163)	(0.185)	(0.0103)
Government spending	0.00869	0.0172	0.00235	0.00810	0.0115	0.000185
	(0.0464)	(0.0692)	(0.0728)	(0.0608)	(0.0702)	(0.00418)
Primary years	0.0709	0.119***	0.122***	0.0959***	0.121***	0.00939**
	(0.0430)	(0.0388)	(0.0351)	(0.0356)	(0.0357)	(0.00385)
Secondary years	0.0830	0.106	0.0893	0.120	0.0973	0.00515
	(0.0826)	(0.0972)	(0.0998)	(0.0896)	(0.0914)	(0.00734)
Power Distance		**0.00135**				
		(0.00446)				
Uncertainty Avoidance			**-0.00145**			
			(0.00363)			
Indulgence				**-0.00725****		
				(0.00277)		
Individualism(ln)					**0.00379**	
					(0.178)	
Masculinity						**0.000332**
						(0.000228)
Constant	1.047	1.123	1.492	1.216	1.394	-0.207**
	(0.843)	(1.750)	(1.199)	(1.243)	(1.188)	(0.0781)
Observations	51	51	51	51	51	51
R-squared	0.632	0.483	0.484	0.535	0.482	0.497

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4: 2nd dimension (Long Term Orientation) influence on PISA performance

VARIABLES	(1) AVGREADING	(2) AVGMATH	(3) AVGSCIENCE
LTO	**0.398***	**0.891*****	**0.713*****
	(0.209)	**(0.229)**	**(0.220)**
loggdp2015	61.51***	66.34***	60.33***
	(11.91)	(13.03)	(12.53)
SPENDING2015	0.362	0.268	-0.675
	(4.450)	(4.869)	(4.681)
PRIMARY	-0.0773	1.446	1.696
	(3.282)	(3.592)	(3.453)
SECONDARY	3.795	3.762	3.959
	(5.212)	(5.703)	(5.483)
Constant	-182.0*	-262.5**	-183.6*
	(99.81)	(109.2)	(105.0)
Observations	42	42	42
R-squared	0.699	0.742	0.711

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: Indulgence dimension interacting with PISA components

VARIABLES	(1) AVGREADING	(2) AVGMATH	(3) AVGSCIENCE
IND	**-0.405***	**-0.684*****	**-0.607****
	(0.211)	**(0.251)**	**(0.232)**
loggdp2015	66.70***	76.95***	69.08***
	(11.80)	(14.04)	(12.95)
SPENDING2015	0.0969	-1.451	-1.751
	(4.409)	(5.245)	(4.836)
PRIMARY	-0.712	0.776	0.960
	(3.334)	(3.966)	(3.657)
SECONDARY	5.847	7.623	7.243
	(5.241)	(6.234)	(5.749)
Constant	-195.8*	-291.0**	-207.1*
	(99.63)	(118.5)	(109.3)
Observations	42	42	42
R-squared	0.699	0.695	0.686

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6 interaction Power distance and each of the separate PISA dimensions

VARIABLES	(1) AVGREADING	(2) AVGMATH	(3) AVGSCIENCE
PD	**-0.309**	**-0.0541**	**-0.168**
	(0.249)	**(0.316)**	**(0.288)**
loggdp2015	62.72***	73.50***	65.19***
	(12.22)	(15.52)	(14.16)
SPENDING2015	-4.212	-5.267	-6.020
	(4.771)	(6.058)	(5.528)
PRIMARY	0.848	3.102	3.101
	(3.354)	(4.258)	(3.886)
SECONDARY	1.715	4.881	3.728
	(5.797)	(7.361)	(6.716)
Constant	-136.2	-273.9*	-170.5
	(111.7)	(141.8)	(129.4)
Observations	42	42	42
R-squared	0.682	0.633	0.630

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: interaction Individualism with each of the separate dimensions of the PISA test.

VARIABLES	(1) AVGREADING	(2) AVGMATH	(3) AVGSCIENCE
logidv	**4.628**	**1.992**	**4.674**
	(9.668)	**(12.06)**	**(11.03)**
loggdp2015	63.58***	73.32***	65.05***
	(12.61)	(15.73)	(14.38)
SPENDING2015	-2.043	-4.916	-4.897
	(4.487)	(5.597)	(5.118)
PRIMARY	0.591	3.043	2.936
	(3.412)	(4.256)	(3.892)
SECONDARY	3.629	4.991	4.354
	(5.741)	(7.161)	(6.548)
Constant	-193.0*	-284.3**	-202.1*
	(104.3)	(130.1)	(119.0)
Observations	42	42	42
R-squared	0.671	0.633	0.628

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 8: interaction Uncertainty Avoidance with each of the separate dimensions of the PISA test.

VARIABLES	(1) AVGREADING	(2) AVGMATH	(3) AVGSCIENCE
UAI	**-0.239**	**-0.362**	**-0.268**
	(0.191)	**(0.235)**	**(0.218)**
loggdp2015	64.98***	74.04***	66.48***
	(12.09)	(14.89)	(13.80)
SPENDING2015	-3.515	-7.269	-6.562
	(4.580)	(5.638)	(5.224)
PRIMARY	0.634	3.049	2.979
	(3.349)	(4.122)	(3.820)
SECONDARY	2.900	2.930	3.436
	(5.493)	(6.762)	(6.266)
Constant	-165.0	-243.6*	-170.9
	(104.5)	(128.7)	(119.2)
Observations	42	42	42
R-squared	0.682	0.655	0.641

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Figure 2: The relationship is here slightly more apparent. Hence also the significant positive coefficient for Long Term orientation.

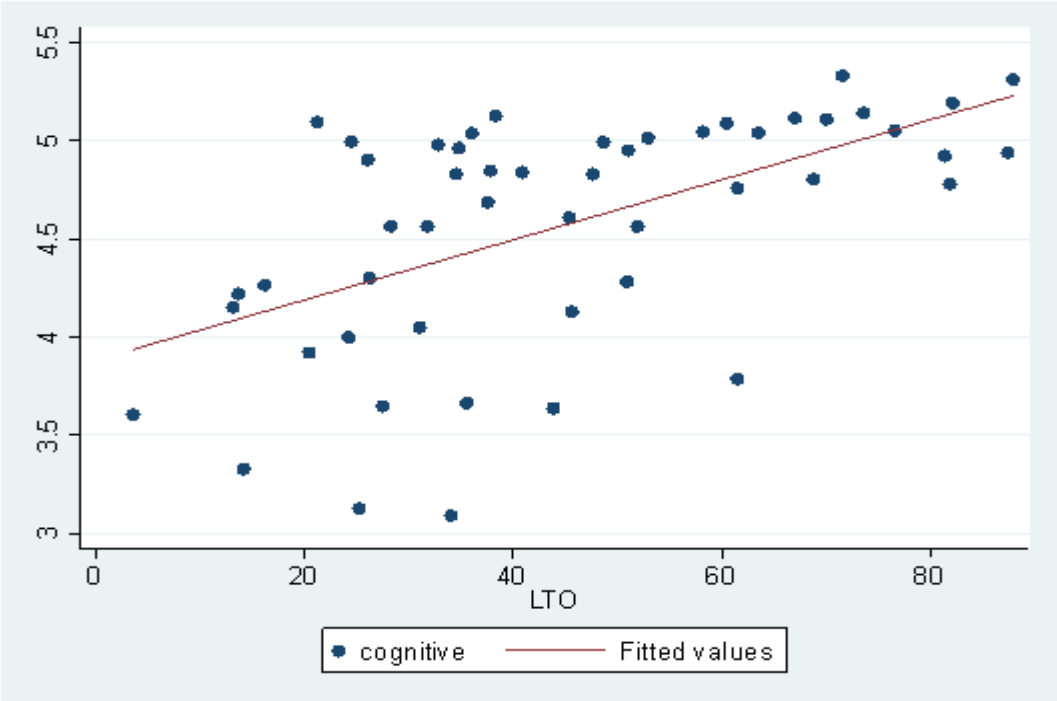


Figure 3: even though Indulgence has a significant effect on test performance, the effect as can be clearly seen below is very tiny.

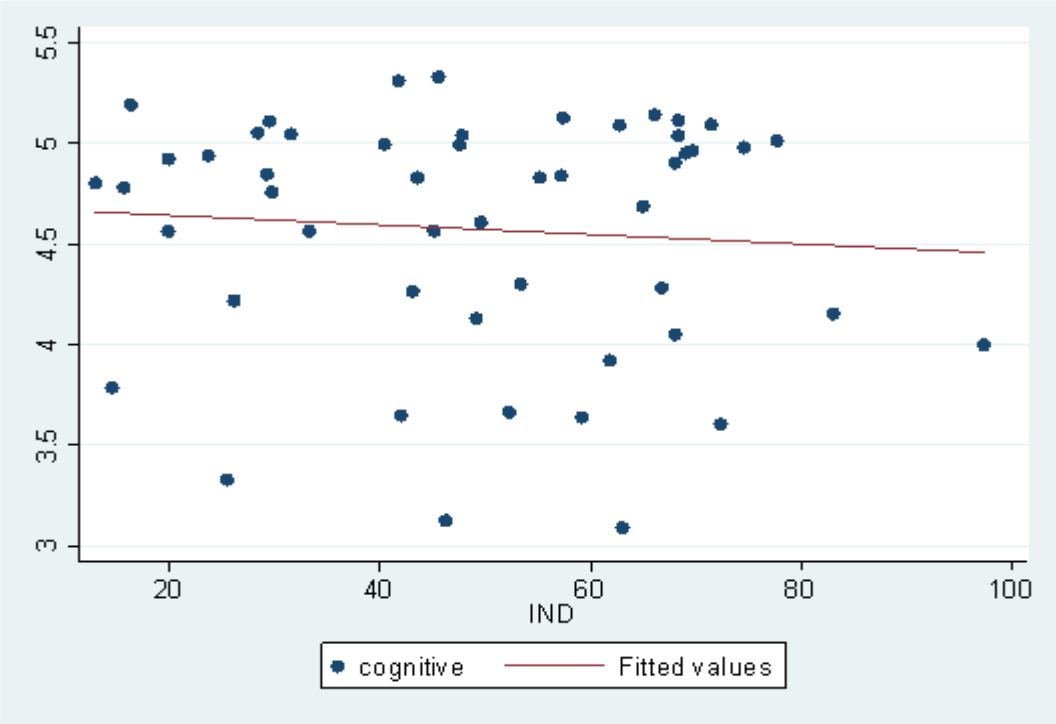


Figure 4: A slight downward trend for Power distance, but then again the spread is so high that as the numbers already hinted, no significant relationship can be withdrawn from this data.

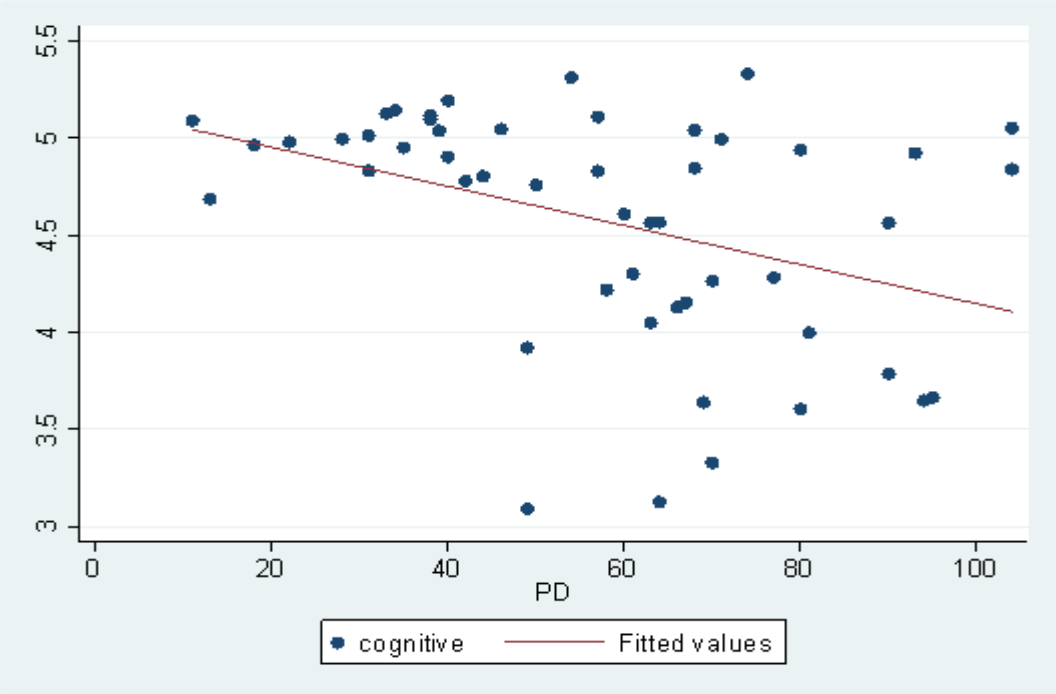


Figure 5: The figure for Uncertainty Avoidance, with also not a visible pattern in the scatterplot.

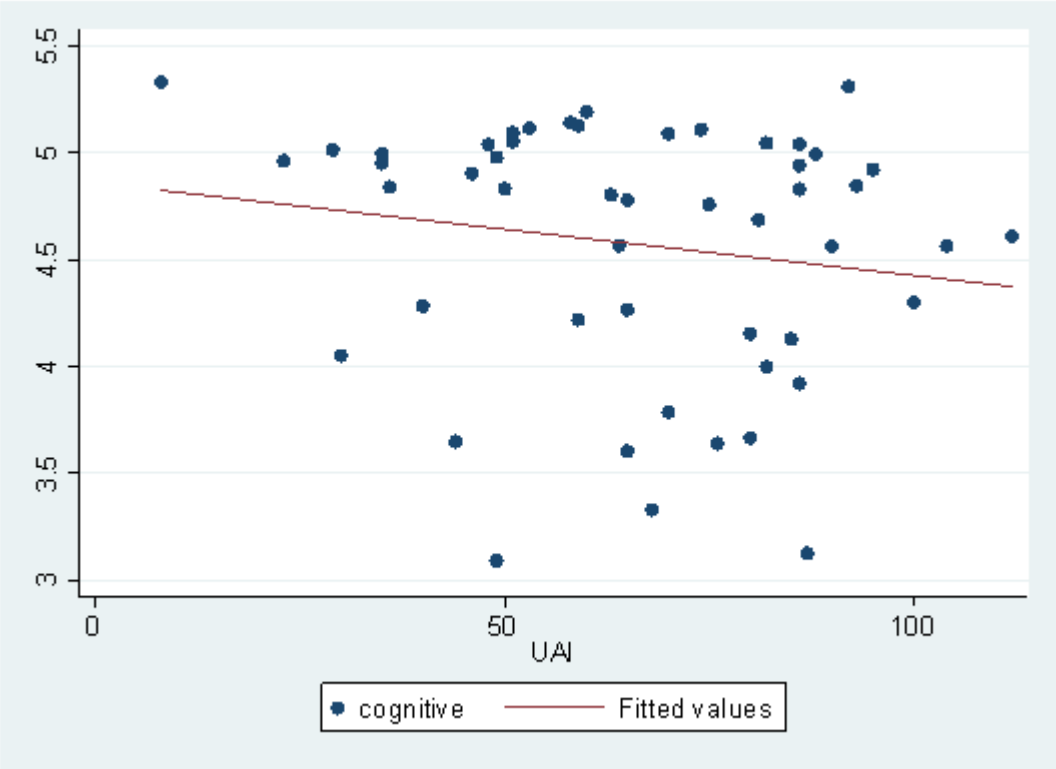


Figure 6: Below the interaction between the log value of individualism and cognitive proxy is given, in which a slight upward trend can be seen.

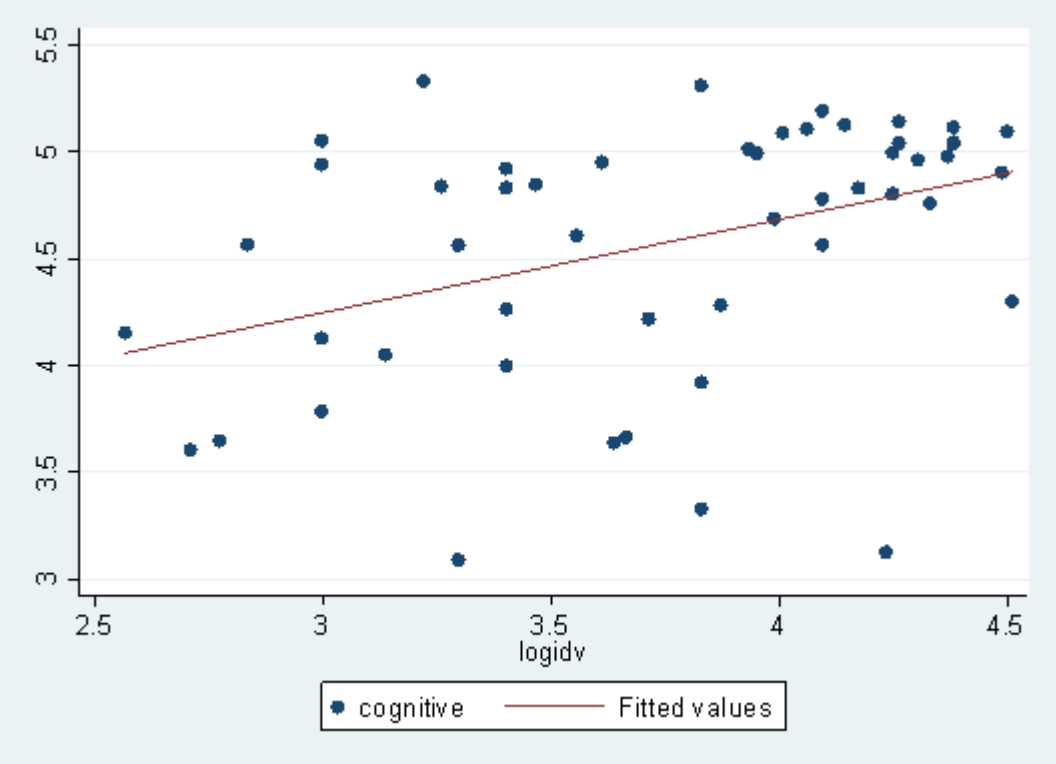


Figure 7: Descriptive statistics of the dataset on cognitive indicator

Variable	Obs	Mean	Std. Dev.	Min	Max
cognitive	51	4.572381	.5947151	3.089362	5.330431
top	51	.0614914	.0452449	.0000935	.1772688
Primary	51	4.633922	1.57893	1.11	8.3
Secondar	51	2.161961	.9540315	.69	4.72
loggdp	51	8.787686	.7235184	6.993041	9.853262
spending	51	4.361215	1.317117	1.844173	7.048664
LTO	51	45.08159	21.82908	3.526448	87.90932
MAS	51	49.7451	22.3104	5	110
PD	51	57.70588	23.32577	11	104
UAI	51	65.94118	22.84068	8	112
IND	51	49.10994	20.2595	12.94643	97.32143
logidv	51	3.74747	.5423741	2.564949	4.51086

Figure 8: Descriptive statistics dataset for each of the 3 PISA dimensions

Variable	Obs	Mean	Std. Dev.	Min	Max
PRIMARY	44	4.942955	1.41937	2.68	8.3
SECONDARY	44	2.306136	.9407227	.69	4.72
AVGMATH	44	472.6531	54.30084	352.9426	581.3493
AVGREADING	44	472.7363	44.72547	369.6183	539.7859
AVGSCIENCE	44	478.8552	47.9401	368.1224	557.5048
MAS	44	49.04545	23.71924	5	110
LTO	44	48.18348	21.1122	13.09824	87.90932
IND	44	49.01786	20.64649	12.94643	97.32143
logidv	44	3.801535	.5351597	2.564949	4.51086
loggdp2015	44	10.11545	.5590464	8.981162	11.09643
IDV	44	50.75	23.34187	13	91
UAI	44	67.22727	23.78182	8	112
PD	44	55	23.16674	11	104

Where Cognitive = the proxy of cognitive skill level, Primary is average years of Primary schooling, Secondar/Secondary is average years of secondary schooling, loggdp is the log value of average gdp per capita, spending is the average percentage on education, AVGREADING/MATH/SCIENCE are the average test scores on each of the 3 dimensions, MAS stands for masculinity LTO for long term orientation,IND for indulgence , logidv for the ln value of individualism, UAI = uncertainty avoidance and PD is short for Power distance top= share of top performers

Figure 9: Correlations between independent variables suggesting multicollinearity not an issue for this data.

	cognit~e	top	Primary	Secondar	loggdp	spending	LTO	MAS	PD
cognitive	1.0000								
top	0.8550	1.0000							
Primary	0.5789	0.6072	1.0000						
Secondar	0.5378	0.4894	0.4386	1.0000					
loggdp	0.6275	0.6031	0.5651	0.7016	1.0000				
spending	0.2989	0.2398	0.2175	0.4607	0.4021	1.0000			
LTO	0.5617	0.5535	0.3279	0.1775	0.1883	0.0965	1.0000		
MAS	-0.0398	0.1724	0.1778	-0.0966	-0.1062	-0.1861	0.1068	1.0000	
PD	-0.3952	-0.3514	-0.3238	-0.6131	-0.6401	-0.4950	0.0156	0.2289	1.0000
UAI	-0.1664	-0.2171	-0.0474	-0.2923	-0.1537	-0.4169	0.0542	0.1313	0.2372
IND	-0.0811	-0.0417	-0.0131	0.2578	0.2852	0.1163	-0.4576	-0.0284	-0.3045
logidv	0.3968	0.3703	0.3125	0.5261	0.6187	0.4059	0.1089	-0.1659	-0.6275

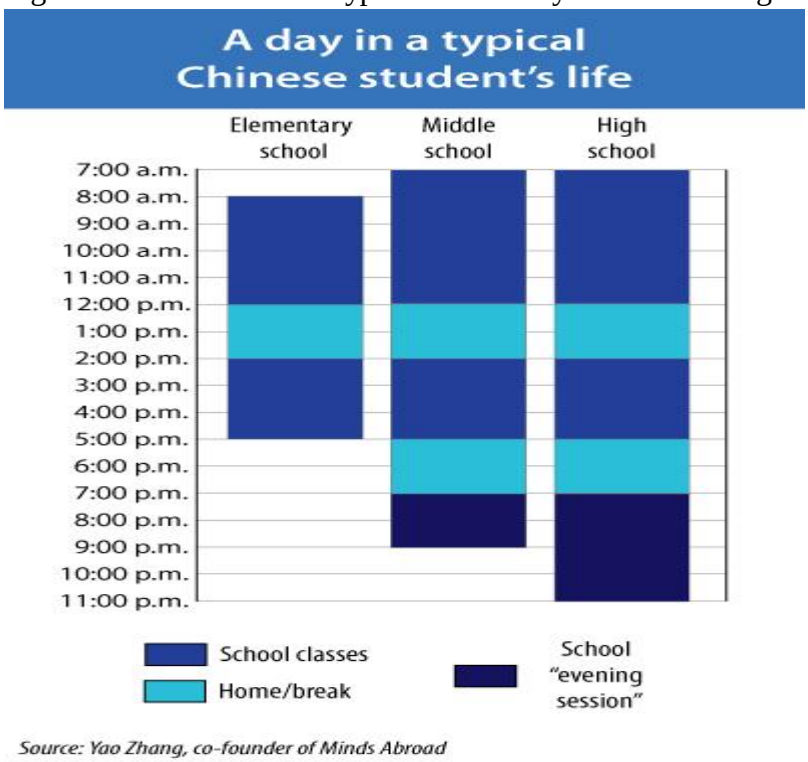
	UAI	IND	logidv
UAI	1.0000		
IND	-0.3063	1.0000	
logidv	0.0152	0.0412	1.0000

Figure 10: the same as the previous figure but then for the 3 PISA dimension database:

	PRIMARY	SECOND~Y	AVGREA~G	SPE~2015	MAS	LTO	IND	PD	UAI
PRIMARY	1.0000								
SECONDARY	0.2615	1.0000							
AVGREADING	0.4180	0.5301	1.0000						
SPENDING2015	0.1724	0.3975	0.4351	1.0000					
MAS	0.2625	-0.0539	-0.0893	-0.3827	1.0000				
LTO	0.1994	0.1124	0.2957	-0.1480	0.0925	1.0000			
IND	-0.0863	0.2635	0.0364	0.3597	-0.0149	-0.5749	1.0000		
PD	-0.1945	-0.5883	-0.5428	-0.5907	0.2073	0.1232	-0.3413	1.0000	
UAI	-0.1207	-0.3818	-0.3720	-0.4136	0.1482	-0.0059	-0.3019	0.2881	1.0000
IDV	0.2395	0.5205	0.4386	0.2984	-0.1109	-0.0491	0.0875	-0.5887	-0.0398
loggdp2015	0.4905	0.5768	0.8127	0.5723	-0.1060	0.1407	0.2439	-0.5541	-0.3227
logidv	0.2633	0.5253	0.4752	0.3500	-0.1471	0.0243	0.0485	-0.6121	-0.0094

	IDV	log~2015	logidv
IDV	1.0000		
loggdp2015	0.4635	1.0000	
logidv	0.9756	0.5148	1.0000

Figure 11: Overview of a typical school day for Chinese high-school students.



Source: Yao Zhang, co-founder of Minds Abroad

Figure 12: correlation hours spent on homework and test scores