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Does religion impact economic growth? A study across countries and time.

A quantitative study of religions' affect on economic growth from a chronological perspective.

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Abstract

Since the inception of Hinduism some 3500-4300 years ago, religion has been at the forefront of human, cultural, and social development, but how influential has it been on economic growth during the past century? This study examines this intriguing question to find whether or not religion is as prominent in the prosperity and development of modern economies as it once was. Seven carefully selected economic control variables in addition to 3 dummies for religion, natural resources, and freedom, were used in 8 separate regressions spanning over 69 years and 95 countries. On a micro-level, religion could be argued to have a significant role in behavior and values, leading to more or less favorable economic outcomes. However, on a macro-level, previous studies have not been able to find consensus on the matter; some studies imply that religion is significant, others not. We hypothesize that the studies finding religious significance could have found time-specific ones which instead could– and should be explained by macro– political– and socioeconomic variables. The results found in this study suggest that this hypothesis reflects economic growth from a more macroeconomic perspective than its predecessors.

Keywords: *Religion, Econometrics, Macroeconomics, Economic Growth, Economic History.*

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1. Introduction

Religion has arguably been the most important cultural phenomenon of human existence, and its importance is to this day debated. This paper aims to examine the importance of religion from the perspective of economic growth theory. Studies conducted during the late 20th– and early 21st century have come to inconclusive results regarding religions' affect on economic growth and appear to be ambiguous which we reckon can depend on different theoretical frameworks, timeframes, and variables.

Barro and McCleary (2003) conducted a study of 59 different countries between 1981-1999, focusing on the level of religious beliefs and growth. The results show that time spent in religious associations harms growth, while a belief in heaven, hell, and a life after death positively impact growth. This conclusion has been revisited by Durlauf, Kourtellos, and Tan (2012) who fail to find compelling evidence and declare no robust relationship between religiosity and growth. Another study conducted by Sala-i-Martin (1997) examines the impact of religion on growth between 1960 and 1992 and shows that Confucianism, Buddhism, and Islam have a positive impact, while Protestantism and Catholicism negatively impact growth.

Our critique of these results is the short-term perspective, which we suspect gives rise to misleading results. The studies also choose different methods and variables to examine, making it challenging to draw coherent conclusions. We thus intend to apply a regression model that includes fundamental economic variables over a longer time horizon and divide this into shorter periods. The plan is to go back as far in time as relevant data allows us, which we estimate to be around 1950–2019, and then make individual regressions at shorter intervals of 10 years. We then believe that we can get a more accurate view of the impact of religion on growth over time; we suspect that circumstances other than religion are what have a causal connection with the economic progress of a country. In contrast to studies that found causal relationships between religion and economic growth, our hypothesis is that religion only appears as significant due to time-specific factors. Therefore, we, unlike Barro and McCleary (2003) and Sala-i-Martin (1997), will conduct several regressions over several time-periods and believe that growth during these periods can be explained better by factors other than religion.

This study's main objective is to get a comprehensive understanding of whether or not religion could be considered a causal variable in economic growth over time. To do this we have cross-referenced our different data sources and compiled data for 95 countries from every inhabited continent, representing all major global religions and various forms of government and states of development. To lay the theoretical foundation for this paper, we will review previous studies, articles, publications, and research in the field of religion's impact on economic growth. The two main areas that have been studied are the indirect impact of religion on growth through cultural attitudes and the direct impact of different religions on economic growth through legislation and economic systems.

The data is compiled from several sources; primarily World Values Survey, World Bank, Penn World Table, Barro-Lee, and the UN. The lack of data for specific countries during specific years will be attempted to be complemented by data from various sources or be omitted during the missing periods. From these data files, we find information on everything from GDP in a specific year to countries' overall religious affiliation and the attitudes of their inhabitants towards extensive issues concerning socio-economic and cultural claims.

Finally, a brief presentation of our conceptual idea of a model is intended to start from what macroeconomic and growth-applied theory says are essential variables for economic growth (GDP or GDP per capita) and then insert a new variable that reflects a country's religious affiliation as a dummy. A country's religious affiliation will then be analyzed based on previous studies and research on the current religion's attitude towards certain economic aspects to finally compare these results between the practical regression and the theoretical prediction.

We will section this paper into six chapters. Firstly this introduction is followed by a descriptive break-down of previously conducted research and published articles and applicable and relevant theories in chapter 2. With the background of these, chapter 3 will present our strategy and model. Following this, we offer our results and analyze these in chapter 4 and then discuss our conclusions in chapter 5. Finally, references will be found in chapter 6.

2. Theory, Background and Previous Studies

2.1 Religion and economic growth

A study conducted by German sociologist Weber (1930) introduced a linkage between religion and economics. The paper found a causal relationship between Protestantism and economic growth, thus Protestantism seemed more beneficial for capitalism than other religions. Weber's thesis has, over the years, been modified with the help of new theories, data, and methods but there still does not seem to be a broad consensus around the subject.

Huntington (1996), Landes (1999), and Ingelhart and Baker (2000) argue that culture is an important factor in economic growth in which religion is an important dimension, and so it is from this background Barro and McCleary's central work stems. One central perspective they bring to light is that religion affects economic growth by fostering religious beliefs that influence individual traits such as, but not limited to, thrift, work ethic, honesty, and openness to strangers. Barro and McCleary's main argument in some sense trickles down to a chain whereby church attendance affects religious beliefs, which affects individual traits, which affect economic outcomes, and, intuitively, this seems plausible. However, paradoxically, the secularization hypothesis, perhaps best described by Weber and his explanation of this process as the "disenchantment of the world", argues that economic development causes individuals to become less religious, in direct conflict with Barro and McCleary's hypothesis.

As some sort of middle ground between these two contradicting ideas could be the interpretation that religious diversity (religious pluralism) promotes economic growth. However, this explanation could suffer from reversed causation meaning that economic growth promotes religious pluralism since a wealthy nation attracts people from different countries and religions.

One of Barro and McCleary most prominent findings is that an increase in church attendance signifies that the religion sector is less productive; more resources in terms of time and foods are being consumed for given outputs (belief). However, opposing this, Sacerdote and

Glaeser (2001) and Putnam (2000) argue that houses of worship are essential as the networks and interactions fostered by these are elements of social capital.

Some further findings done by Barro and McCleary in regards to church attendance was: a positive relation to education and the presence of children but negatively to urbanization, that life expectancy was negatively related to church attendance but positively to religious beliefs, that religiosity is negatively associated with governmental regulation of the religion market and with the religious oppression from communism (abolition of communism tend to result in a recovery of religiosity), religious pluralism is associated with higher church attendance and beliefs, for given religious beliefs; higher church attendance tends to reduce economic growth, for given church attendance; increase in religious beliefs— notably in hell, heaven and after-life— increase economic growth and finally that church attendance negative affect is explained by an inefficient input of resources compared to output.

Conclusively, what these aforementioned studies have in common is that religious beliefs and houses of worship have an effect on economic growth; however, no clear consensus has been reached on whether or not the effect is positive or negative, which this study will try to find.

2.2 Is God in the details?

Duraluf, Kourtellos, and Tan (2012) make a reexamination of Barro and McCleary's (2003) study with the purpose of identifying whether there is any causality between religiosity and economic growth. Like Barro and McCleary, they use Catholicism as their reference, i.e., each religious coefficient should be interpreted relative to Catholicism to try to replicate the results of Barro and McCleary's 2003 findings.

Furthermore, Duraluf *et al* expand their model from the findings of Barro and Sala-i-Martin's 2003 study identifying which variables are empirically important growth determinants by adding explanations for inequality across nations that lie outside the domain of the canonical neoclassical model such as, but not limited to, geography (Sachs, 2003), institutions (Acemoglu et al., 2001, 2002); (Acemoglu and Johnson, 2003), and ethnic heterogeneity (Easterly and Levine, 1997; Alesina et al., 2003). We intend to expand further on this latter concept by adding the presence of natural resources.

Barro and Sala-i-Martin (2003) found the following variables robust determinants of growth: the log of initial per capita GDP, years of male secondary and higher school attainment, reciprocal life expectancy at age 1, average ratios of investments to GDP, the log of the fertility rate, the ratio of total export plus import to GDP, the average ratio for government spending to GDP, the growth rate of the terms of trade interacted with the average ratio for export plus import to GDP, the average of the political risk services indicator of the rule of law, the average for each period of the freedom house measure of political rights and its square and lastly, the consumer price inflation rate for each period. We intend to use most, but not all, of these variables to conduct our regression to determine whether or not momentary variables, specific for each time-period measured, could explain the growth experienced under said period to a greater extent than previous studies credit religiosity.

Duraluf, Kourtellos, and Tan's (2012) key findings from using this approach is that, whilst Barro and McCleary's results are replicable, they lack statistical robustness, i.e., they found no evidence that religious beliefs play a significant role in enhancing growth outcomes. Furthermore, they find no evidence that religious beliefs matter for growth once one uses Bayesian model-averaging to account for model uncertainty and that *"overall, there is simply insufficient evidence to support [...] that countries with more efficient religious sectors will tend to grow faster."* P.g 1071. Duraluf, Kourtellos, and Tan (2012) further suggest that there is little to no evidence that religiosity matters to growth at all.

2.3 Relationships of Religion to Economics

Muller and Welch (2010) studied how different economic systems and practices affect religion and vice versa. Two distinct characteristics of their thesis are economics in service of religion and the opposing alternative. They here argue that *"specific economic conditions or activities are seen as either necessary or desirable for the attainment of faith-based objectives."* P.g 191. Moreover, they describe the opposite as *"situations where appeals to religious beliefs or arguments are made to attain economic objectives"* P.g 193. They follow this by stating that this later concept is realized by the so-called *"radius of trust"*. A greater radius of trust is seen as an incentive for the members of society to honor its beliefs and thereby lower transaction costs. A practical interpretation of this could be that less developed countries with a solid religious belief would experience lower transaction costs than a similarly developed but more secular country.

This in turn imposes an interesting question of development and religious beliefs over time- will countries that have a tendency or trend in secularization see a lower rate of growth than a highly religious one? Paul (2005) finds little evidence for this; however, stating that a relatively theistic country such as the United States breaks this pattern. He finds *"that higher beliefs in and worship of a creator is correlates with higher rates of homicide, juvenile and early adult mortality, STD infection rates [...]"* P.g 7, even when looking at prosperous democracies. However, as our thesis states and as this paper will try to examine, we believe that these effects better can be described by circumstantial time-dependent factors.

2.4 I just ran four million regressions

Sala-i-Martin (1997) had an unconventional approach when choosing a method through economic theory compared to other studies we have mentioned. Instead of relying on fundamental economic variables such as technology, real capital, and education, the study instead used 63 different variables to determine which had an impact on economic growth. This method resulted in four million regressions when using every variable in every possible combination. Sala-i-Martin defined a variable as robust if it was significant (95 percent confidence interval) in a majority of the combinations. It turned out that 21 variables met the criteria of being robust and one subset of these were the religious variables. Sala-i-Martin concluded that Confucianism, Buddhism, and Islam were religions that positively correlated with growth while Protestantism and Catholicism had a negative relationship.

Note that the study's time span is between 1960-1992, which can be considered a short amount of time from a growth perspective. Sala-i-Martin also mentions that these results may not strictly prove causation between religion and growth because the Muslim variable may be correlated with oil production, for example. This is important to consider when interpreting this result as the consequences following the oil embargo in the 1970s were vast wealth and control of the commodity in the OPEC countries. Another aspect to consider is the 8 countries in Asia that had a dramatic positive economic growth between the 1960s and 1990s which probably explains the positive coefficients for Confucianism and Buddhism. Whether the growth in Hong Kong, Indonesia, Japan, Malaysia, the Republic of Korea, Singapore,

Taiwan (China), and Thailand was due to religion is impossible to confirm solely from Sala-i-Martin's result according to Sarel (1997) and Schneider (2018.).

2.5 Applicable theories

2.5.1 The Solow model

The model we have chosen for our thesis has its roots in the simple Solow model created by Robert Solow in 1956. This neoclassical model has served as a core equation in the evolution of modern models and is, until this day, used in the academic field. The model is built around two categories: capital, *K,* and labor, *L,* and these two are converted to output, *Y*. The production function is given by

$$Y = F(K, L) = K^{\alpha} L^{1-\alpha}$$

The alpha parameter is assumed to lie between (0,1) and the model also assumes constant returns to scale, meaning that an increase of inputs will result in an equivalent amount of output. The model also believes that the labor grows at the exogenous rate *n* and with perfect competition meaning that firms are profit-maximizing the production function. Scholars eventually added technological progress to the model, but we will not include it in this paper due to the lack of data.

The other important function in the simple Solow model shows the accumulation of real capital and is given by

$$\dot{K} = sY - \delta K$$

The *s* stands for a country's savings rate and the *delta* for depreciation rate. The real capital accumulation is equal to the amount of investment the country makes, *sY*, subtracted by the amount of capital deprecation, *δK*. Furthermore, *y* is the output per unit of labor (*Y/L*), and *k* is defined as real capital per labor unit *(K/L)*.

As stated previously, there has been an evolution of the Solow model augmented with new variables. Mankiw, Romer, and Weil did this in 1992. In the paper *A Contribution to The Empirics of Economic Growth* they argue that the original model predicts the steady-state income level relatively well. Still, the problem they found was the lack of estimated

magnitude of impact from savings and population growth on income. The solution to this was to add human capital, and the model is given by

$$Y(t) = K^{\alpha}H^{1.-\alpha}$$

The *alpha* parameter is still between (0,1) as in the original model and the added variable human capital, *H* is defined as

$$H = e^{\Psi u}L$$

Human capital is dependent on the quality of education (*psi*), the number of years spent in school (*u*) and the population (*L*). This is the model that we will base our final model on when implementing religion and other relevant variables (Mankiw et al., 1992).

2.5.2 Convergence

Convergence is an important and frequently discussed subject of economic growth theory. The hypothesis suggests that all countries eventually converge to the same per capita income (absolute convergence). This theory grounds itself in observations of less developed countries that grow at a higher rate than wealthier countries implying that all nations will eventually converge. Empirically, proof of convergence has been found to an extent but only in countries with similar economic characteristics. Therefore, the hypothesis of convergence in countries with similar steady states seems to hold but not for countries that differ in steady states (Jones & Dietrich, 2013). The theory has been tested by Barro and Sala-i-Martin (1992), and the results do suggest proof of conditional convergence. The study found evidence for a sample of 98 countries from 1960 to 1985 if the control variables for steady-state are held constant.

Checherita (2009) tests the hypothesis of conditional convergence in the United States over the period 1960-2005. She finds, through the perspective of neoclassical growth theory, evidence of conditional convergence similar to Barro and Sala-i-Martin (1992). This study elucidates a vital insight that convergence speed varies over time, by decade to be exact, which is in line with the time span we have chosen to examine.

Bernard and Charles (1996) present criticism on the negligence of technology's impact on economic convergence, or lack thereof, from oft-cited studies. Bernard and Charles' study concludes that there is substantial variation in technology across countries, but this variation

is closely comparable to variation in labor productivity. They concluded that, during the time period measured (1970-1988), there was a tendency of convergence in cross-country dispersion of total industry and total technological productivity (TTP); however, evidence of a divergence in manufacturing and TTP was present during the 1980s.

Our understanding of these conflicting predictions on whether or not absolute convergence has any empirical relevance is that only time will tell. In our study, we examine a greater number of countries over a longer period than the aforementioned studies and therefore predict that our model will more accurately account for convergence or lack thereof.

3. Empirical strategy

This study hopes to get insight into the affect religion has on economic growth, and a cross-sectional regression analysis will be used to do so. In addition to the religion dummy, multiple economic growth variables will be used to augment the model, and therefore a multiple linear regression will be applied. Furthermore, we will focus on the varying affects religion potentially has over time from 1950-2019, divided into decades. Hence multiple regressions will be conducted, compared, and analyzed to see if a pattern can be found for the religion coefficients.

The sample size for our study is larger than previously conducted studies by Sala-I-Martin (1997) as well as Barro and McCleary (2006). Our original data is characterized as panel data and consists of 95 countries from all populated continents over 69 years. However, in order to make religion a relevant variable, we converted the data into cross-sectional; since religion does not, in broad strokes, change over time, it can not explain why something else does, (data for some countries are not available for this entire time period due to simple reasons such as the fact that some had not gained their independence yet or in other ways were unable to provide the required data). The data has a diverse representation of all major global religions and different economic systems. To combat unbalance of data, we have chosen to run regressions in ten-year intervals with all available countries for each time period- i.e., countries will progressively be integrated into the regression with time. One large regression, including all available data, will also be conducted to eliminate unbalance in the model and regression.

The data used for control variables in this study is mainly gathered from the latest edition of Penn World Table (2021). This dataset was then cross-referenced with data for relevant countries from the World Values Survey on religious attitudes and Pew Research's study on the global religious landscape. By incorporating these two later mentioned data files into our own, we could identify the most predominant religious faction and what religious values and tendencies these demonstrate. Furthermore, like Barro and Sala-i-Martin (2003), we used Freedom House's measurement for the global freedom score to create a proxy dummy for how open and democratic a nation is. In addition to Barro and McCleary's 2006 findings, life expectancy was incorporated from data by the United Nations.

The variable of the main focus in this study is the dummy for religion in which each religion was assigned a given numerical value as representation. The inherent values and attitudes were interpreted from WWS. Unlike ours, previously conducted studies have placed their primary focus on how different attitudes in different religions can impact economic growth. In contrast, we instead try to analyze if religion as an independent variable has any significant impact on economic growth or whether it is explained to a greater extent by somewhat circumstantial factors such as the presence of natural resources and a democratic society. By doing this, we can identify which variables are significant and differentiable over different time periods and ultimately see if religion has any significant affect on economic growth over time.

3.1 Regression Model

For each of our regressions, we used the same model to keep consistency instead of trying fitted models that perhaps more accurately could analyze each time period. Our final model is as follows:

$$\overline{\Delta}GDP\ per\ cap_i = \beta_0 + \beta_1 \cdot \overline{\Delta}Real\ Capital_i + \beta_2 \cdot \overline{\Delta}Human\ Capital_i + \beta_3 \cdot \overline{\Delta}Current\ Account_i + \beta_4 \cdot log\ Life\ Expectancy_i + \beta_5 \cdot log\ GDP\ per\ capita_i + \beta_6 \cdot \overline{Exchange\ Rate}_i + \beta_7 \cdot \overline{\Delta}Population_i + \gamma_1 \cdot Religion_i + \gamma_2 \cdot Natural\ Resources_i + \gamma_3 \cdot Freedom_i + \varepsilon_i$$

In this illustration of the model, $\bar{\Delta}$ represents the average annual change in a variable for each ten-year time-period observed. β_0 through β_7 are the estimated coefficients for the explanatory variables, while γ_1 through γ_3 are the coefficients for the dummy variables; all of which will be presented in the results.

3.2 Dependent variable

The core objective of our study is to analyze and theorize whether religion as a whole has a significant impact on the average economic growth per capita. In light of this, we chose the growth rate of GDP per capita as our dependent variable. There is a nameworthy debate on whether GDP and GDP per capita are accurate measurements for economic growth; for example, Stiglitz in his 2020 article "Measuring what matters" questions whether this connection is sensical. However, most economists agree that GDP is an accurate indicator of the size of an economy and therefore an accurate measurement of its growth. Our dependent variable is defined as the average annual percentage growth rate of real GDP divided by the total population at constant 2017 prices, expressed in US dollars (Penn World Table).

3.3 Independent variables

In order to identify which variables would be of interest to our study, we researched what had been done in similar studies prior to ours in addition to what traditional economic growth models identify as signific; mainly referring to Romer, Schumpeter, and Solow models. From these, we found ten variables of interest, some to account for correlation and convergence and others in a more straightforward analytic sense. Definitions and motivations for these variables will be presented in the following passage. Since we are interested in long-term growth, we have converted the growth variables into averages of 10 years. Inflation is undoubtedly a variable of interest in a growth study like this one but has been left out due to a lack of data for periods prior to the 1990s. We decided that if we were to include the variable for the periods that had sufficient data, concern for sample selection bias could potentially become a problem.

3.3.1 Religion variable

This is the variable which we have chosen to lay our focus and formulate our hypothesis around. Unlike previously conducted studies where the main religious focus is placed on differences in attitudes and the changes of these over time, we focus on religion as a compiled variable of all these underlying factors. Therefore, we have created a dummy variable for six different world religions and a seventh for nations with no general affiliation. We have decided to omit religious orientations within the religions due to the massive number of orientations that exist and the difficulty of creating a dummy variable that covers a majority of these. Catholicism will is used as the benchmark category and the other categories included are the following: Protestantism, Orthodox, Islam, Hinduism, Buddhism, Judaism and Unaffiliated.

3.3.2 Control variables

A critique of ours towards research in the field has been the aspect of time dependency and a causal relationship between economic growth and religion. Based on Duraluf, Kourtellos, and Tan's (2012) study, we have decided to include several control variables in our model to account for deceptive results. We start by deriving the *average growth in real capital*– and *human capital* from the augmented Solow model. The former is defined as the average year-on-year change in real capital stock at current PPPs (in mil. 2017 $US) for each ten-year period divided by the total population. In turn, capital stock is defined as the amount of goods as well as the amount of common– and preferred shares that a company is authorized to issue. From economic theory, we know that the consequence of new capital formation with a constant slower-growing population will increase the quota between capital and population, resulting in a higher output per worker, which eventually results in higher long-term growth in GDP (Aikman et al., 2011). Moving on to the *average percentage change in human capital index per capita* in which human capital index is based on years of schooling and returns to education which in turn are gathered from Barro's (2015) and Mincer equation estimates for the assumed rate of return to education (Psacharopoulos, 1994). Previously conducted research performed by Pelinescu (2015) revealed that there is "[…] a positive relationship, statistically significant between GDP per capita and innovative capacity of human capital

(evidenced by the number of patents) and qualification of employees (secondary education) as expected according to economic theory".

We continue deriving macroeconomic variables to account for the weaknesses of the augmented Solow model. *The logarithm of initial GDP per capita* for each year was used as a control variable for conditional convergence and the correlation between growth rate and initial GDP. A logarithmic property enables us to interpret the coefficient divided by 100 as the unit change in the dependent variable for a percentage change in the explanatory variable. Furthermore, since we are indirectly comparing the competitiveness of countries, we include the *logarithm of the average exchange rate.* The variable is computed as the average domestic currency exchange rate in relation to the US dollar for each ten-year interval. Pettinger (2017) explains how long-term growth in exchange rate captures some insights into inflation rates and the overall state of growth; appreciating exchange rates is a sign of low inflation, improving competitiveness, and strong domestic economic performance. The competitive aspect is captured in the *average current account* as well. Defined as the average of the ratio of total export plus total import in relation to GDP. The current account is an insightful measurement of how consumer spending is developing in a country over time; import is assigned as a negative value, implying that higher domestic consumption and, therefore, higher import harms the current account. This, in turn, can be interoperated as a proxy measurement for how the domestic demand affects economic growth, Barro, Sala-i-Martin (2003). There is conflicting research on whether trade volumes or trade policy is the driving factor behind growth. However, we have implemented the first interpretation in this instance and used the dummy as a proxy for policy. Besides this, a variable that captures a measurement of freedom gives insight into the well-being of the democratic state of a country.

The variable for *average current account* is in conjunction with the *freedom dummy* an approximate measurement for openness. The Solow model lacks a variable that emphasizes democracy in a country despite the indirect impact it has on life expectancy and secondary schooling (Lake & Baum 2001). Barro (1996) explains that democracy shows a positive relationship with growth for low-level democracies but a negative relationship when a certain

level is reached. Furthermore, Lake and Baum (2003) revisit this question and find that democracy does indeed have an important indirect positive effect on growth. This result suggests a positive effect on growth through life expectancy in developing countries and secondary schooling in developed countries. Our dummy for freedom is derived from Freedom House's democratic index and is divided into free (F), partially free (PF), or not free (NF).

Average population growth and *the logarithm of life expectancy* are included to control for the welfare of a country. Average annual growth of the entire population year-on-year for each time period; lack of data prevented us from computing the growth rate from year t-1 to t1 (1949-1950). However, population growth is also of great interest to us since many of our variables are in relation to per capita, i.e., divided by the population size. Life expectancy at birth is derived from the United Nations database on the life expectancy at birth measured in 5-year intervals. From Barro and Sala-i-Martin's (2003) study as well as Barro and McCleary (2006), life expectancy has a great impact on people's attitudes towards different religious concepts, such as belief in heaven and hell, i.e., an afterlife; these changes in behavior are in turn noticeable in people's attitudes and behaviors towards different economic concepts, such as work ethic, self-preservation drive, and a more long term mindset; seeing long term investments as viable since one is still expected to be alive when the returns actualize. Life expectancy is, for these reasons, also linked with religion and economic growth.

Lastly, to control for findings of natural resources and, as a result, a flourishing economic growth, we include a natural resource dummy. Defined as a variable that captures whether a country has access to natural resources or not. The dummy variable equals 0 if the country misses' access and one if it has access. This measurement gives useful insight into economic activities such as production, exchange, and consumption. At first glance, natural resources seem to impact economic growth positively; however, Sachs and Werner (1995) found contradicting results. They show that countries with a high ratio of natural resources in their exports surprisingly seem to have slower growth rates. On the other hand, we have seen OPEC countries in the middle east flourish in tandem with oil findings, and it is safe to say that natural resources make up a large part of the world's exports.

4. Results

In the following section we present the descriptive statistics, regressions, and tests of interest. The coefficients, standard errors, and significance levels are presented in tables with the variable names on the vertical axis and time period on the horizontal axis. The benchmark category for the religion variable is declared as Catholic thus the coefficients for the different coefficients should be interpreted as effects relative to those for Catholic. The natural resources variable should simply be interpreted relative to no access to natural resources and the freedom variables benchmark category is no freedom. Table 1 presents descriptive statistics for all the non dummy control variables and table 2 shows the fractions of the dummy variable categories, were row 1 to 8 are factions of the religion variable, row 9 shows the fraction of countries who have natural resources, and row 10-12 shows the fraction of the freedom variable. Table 3 presents benchmark regressions, where the control variables have been omitted. Table 4 shows the regressions discussed later in this section, where annual GDP growth depends on all the presented variables.

Table (1) Descriptive statistics using the observations 1-95

Variable	Mean	Median	S.E.	Min	Max
Avg real capital growth	0.0534	0.0517	0.0291	-0.000417	0.246
Avg human capital growth	0.00927	0.00911	0.00357	0.00213	0.0194
Avg current account	-0.0333	-0.0246	0.115	-0.403	0.374
Log life expectancy	4.03	4.15	0.237	3.33	4.29
Log GDP per capita	8.35	8.41	1.08	6.00	11.5
Avg exchange rate	$1.18e^{-4}$	4.51	$1.12e^{-5}$	0.295	$1.10e^{-6}$
Avg population growth	0.0144	0.0174	0.0135	-0.0115	0.0696

Table(2) Dummy variable fractions

Variable	Fraction
Catholic	0.4
Protestant	0.0842
Orthodox	0.137
Muslim	0.253
Hindu	0.0105

Buddhist	**0.0316**
Jewish	**0.0105**
Unaffiliated	**0.0737**
Natural resources	**0.168**
Free	**0.463**
Partly free	**0.337**
Not Free	**0.2**

Table(3) Benchmark regressions

Variabel/Period	1950-19	1950-60	1960-70	1970-80	1980-90	1990-00	2000-10	2010-19
Const	0.024*** (0.001)	0.023*** (0.003)	0.030*** (0.003)	0.024*** (0.005)	−0.000 (0.005)	0.019*** (0.004)	0.044*** (0.006)	0.025*** (0.003)
Protestant	0.002 (0.003)	0.003 (0.009)	0.027 (0.023)	$-5.284e^{-5}$ (0.014)	0.015** (0.006)	−0.001 (0.008)	−0.012 (0.014)	0.004 (0.008)
Orthodox	0.002 (0.003)	0.018 (0.021)	0.041*** (0.003)	0.036** (0.018)	0.021** (0.008)	−0.044*** (0.013)	0.017 (0.011)	0.009 (0.006)
Muslim	0.007*** (0.002)	0.004 (0.008)	−0.005 (0.005)	0.015* (0.008)	−0.003 (0.011)	0.006 (0.015)	0.027*** (0.009)	−0.000 (0.005)
Hindu	0.005 (0.010)	−0.003 (0.021)	−0.005* (0.003)	−0.034 (0.030)	0.009* (0.005)	0.021*** (0.004)	0.027 (0.037)	0.029 (0.021)
Buddhist	0.027*** (0.006)	−0.017 (0.021)	0.046*** (0.003)	0.037** (0.018)	0.060*** (0.011)	0.027** (0.011)	0.035 (0.022)	0.017 (0.012)
Jewish	0.003 (0.010)	0.013 (0.021)	0.015*** (0.003)	0.000 (0.030)	0.025*** (0.005)	0.027*** (0.004)	−0.045 (0.037)	0.002 (0.021)
Unaffiliated	0.020*** (0.004)	0.007 (0.012)	0.010 (0.031)	0.032** (0.013)	0.047*** (0.009)	0.016* (0.010)	0.009 (0.015)	0.007 (0.008)
R-squared	0.344	0.054	0.210	0.190	0.253	0.161	0.148	0.064
Adjusted R-squared	0.289	-0.102	0.106	0.103	0.172	0.093	0.079	-0.013

Note: Standard error in (parenthesis)

*** **-Significant at one percent level***

** ***- Significant at five percent level***

* ***- Significant at ten percent level***

Table (4) Regressions

Variable/Period	1950-19	1950-60	1960-70	1970-80	1980-90	1990-00	2000-10	2010-19
Const	0.003 (0.035)	−0.250** (0.113)	−0.024 (0.105)	−0.116 (0.100)	−0.204* (0.107)	−0.252 (0.171)	0.164 (0.202)	0.124 (0.119)

Protestant	**0.00 (0.002)**	**-0.003 (0.006)**	**−0.006 (0.006)**	**−0.010 (0.013)**	**0.008 (0.009)**	**−0.002 (0.010)**	**−0.003 (0.008)**	**0.009 (0.006)**
Orthodox	**−0.002 (0.003)**	**0.035 (0.027)**	**0.018 (0.013)**	**0.004 (0.018)**	**−0.005 (0.014)**	**−0.030** (0.013)**	**0.026*** (0.007)**	**0.002 (0.006)**
Muslim	**0.004 (0.002)**	**0.015 (0.012)**	**0.003 (0.009)**	**0.006 (0.008)**	**−0.002 (0.008)**	**−0.011 (0.013)**	**0.008 (0.008)**	**−0.005 (0.005)**
Hindu	**0.000 (0.005)**	**0.030* (0.017)**	**0.007 (0.018)**	**−0.022 (0.029)**	**0.026 (0.024)**	**−0.026* (0.015)**	**−0.019 (0.021)**	**0.021 (0.017)**
Buddhist	**0.015** (0.005)**	**−0.020 (0.014)**	**0.042*** (0.014)**	**0.021 (0.018)**	**0.032** (0.014)**	**−0.021 (0.022)**	**0.028*** (0.009)**	**0.025** (0.011)**
Jewish	**0.010** (0.004)**	**0.002 0.023**	**0.013 (0.008)**	**0.019 (0.027)**	**0.010 (0.021)**	**−0.005 (0.009)**	**0.003 (0.008)**	**0.012 (0.015)**
Unaffiliated	**0.013** (0.006)**	**0.009 (0.021)**	**0.016 (0.017)**	**−0.004 (0.014)**	**0.025** (0.011)**	**−0.038*** (0.011)**	**0.011 (0.011)**	**0.008 (0.007)**
Avg real capital growth	**0.111* (0.065)**	**0.332 (0.211)**	**0.025 (0.040)**	**0.592*** (0.140)**	**0.360*** (0.094)**	**0.688*** (0.126)**	**0.392*** (0.069)**	**0.382*** (0.060)**
Avg human capital	**0.310 (0.335)**	**−0.067 (0.608)**	**2.07 (0.854)**	**0.061 (0.642)**	**0.851** (0.409)**	**0.902 (0.700)**	**0.274 (0.710)**	**−0.167 (0.306)**
Log GDP per capita	**−0.006*** (0.002)**	**−0.000 (0.005)**	**0.000 (0.005)**	**−0.008 (0.005)**	**−0.006 (0.004)**	**0.008 (0.007)**	**−0.006 (0.006)**	**−0.006 (0.003)**
Log avg exchange rate	**−0.000 (0.000)**	**0.000 (0.000)**	**−0.000 (0.000)**	**0.001 (0.000)**	**$-2.838e^{-5}$ (0.000)**	**0.003* (0.001)**	**−0.001 (0.001)**	**−0.000 (0.000)**
Avg current account	**0.023 (0.015)**	**0.001 (0.038)**	**0.001 (0.026)**	**0.063** (0.028)**	**−0.013 (0.027)**	**−0.024 (0.041)**	**0.061* (0.033)**	**0.026 (0.021)**
Avg pop growth	**−0.486*** (0.181)**	**−0.119 (0.520)**	**−0.788*** (0.284)**	**−1.220*** (0.366)**	**−0.928*** (0.264)**	**−0.315** (0.145)**	**−0.479 (0.317)**	**−0.536** (0.211)**
Log life expectancy	**0.019** (0.008)**	**0.069** (0.031)**	**0.012 (0.031)**	**0.050 (0.031)**	**0.063* (0.032)**	**0.043 (0.049)**	**−0.021 (0.055)**	**−0.009 (0.033)**
Natural resources (=1)	**0.003 (0.003)**	**−0.006 (0.009)**	**−0.004 (0.010)**	**0.015 (0.009)**	**−0.019** (0.008)**	**0.021** (0.010)**	**0.023* (0.012)**	**−0.010 (0.006)***
Partly free	**−0.001 (0.002)**	**−0.008 (0.011)**	**0.000 (0.009)**	**0.011 (0.008)**	**−0.002 (0.006)**	**−0.023** (0.010)**	**0.009 (0.012)**	**−0.001 (0.006)**
Free	**0.000 (0.002)**	**−0.016 (0.010)**	**0.003 (0.010)**	**0.002 (0.010)**	**0.006 (0.009)**	**−0.011 (0.011)**	**0.000 (0.015)**	**−0.002 (0.006)**
R-squared	**0.663**	**0.431**	**0.695**	**0.517**	**0.746**	**0.626**	**0.623**	**0.582**
Adjusted R-squared	**0.561**	**0.129**	**0.572**	**0.368**	**0.667**	**0.537**	**0.530**	**0.475**

Obs	**74**	**50**	**60**	**73**	**72**	**89**	**87**	**84**

Note: Standard error in (parenthesis)

****** -Significant at one percent level***

******* - Significant at five percent level***

******** - Significant at ten percent level***

The R-Squared value displays how much of the variation in the dependent variable can be explained by the predictors. A value of 0,5 for example, tells us that half of the variation in the dependent variable (growth in GDP per capita) can be explained by the computed model. Thus a high value indicates a good fit of the model and therefore is desirable given that the model does not suffer from any severe errors (which turned out to be true). Our model's R-squared values range from 0,431 to 0,746 and the majority of the regressions possess a value above 0,55. Heteroscedasticity and multicollinearity will be mentioned more in detail later in this section, and we can confirm that the former was tested with the Breusch-Pagan test and solved with robust standard errors, while the latter was tested with VIF estimates (see appendix) and showed no values of concern.

4.1 Catholicism

To replicate the religious conditions of both Sala-i-Martin's (1997) and Barro and McCleary's (2003) studies, Catholicism was chosen as our reference religion. The regression constant can be interpreted as its coefficient. Catholicism being one of the world's oldest major religions in addition to being established in some of the world's oldest and wealthiest countries, we see this as an appropriate reference point. In anticipation of our results and following our hypothesis, we believed that Catholicism, for these stated reasons, would have a relatively small and insignificant effect on growth, if any, due to its longevity and establishment in wealthy countries.

Analyzing the regression tells us that Catholicism only has significance in two of our measured time periods: 1950-60 and 1980-90, with both instances having a negative coefficient, although no significance over the entire time period. Post World War II, western Europe's economic growth has been described as *"the golden age"*, Toniolo (1998). The predominant European catholic countries in our dataset during this time period are France, Germany, Italy, Netherlands, Spain, and Switzerland, all of which showed 4%-8% average annual growth from 1950-60. Likewise, in South America, several catholic countries saw positive economic growth with large-scale economic reform in countries such as Argentina

and Brazil, Kittleson (1998). However, out of the ten best-performing countries in our dataset during this time period, only three were catholic, while the other seven were Islamic (Iran, Jordan, Turkey), Protestant (Finland), Orthodox (Greece), Unaffiliated (Japan) and Jewish (Israel). We believe this skew in representation and that the predominant Catholic European countries showed relatively low growth rates in human capital are the leading causes of the seeming negative impact of Catholicism during this time period despite only one country (Bolivia) seeing negative GDP per capita growth (-1.2%).

During 1980-90 there were great hardships in South America while eastern Asia, and Islamic states that were not dependent on oil, saw an economic boom. Sometimes referred to as *"the lost decade",* almost 80% of South American and Caribbean countries saw a decline in GDP per capita levels as well as a stagnation in growth due to soaring inflation as a consequence of the oil price hike of the late 1970s, Lüders (1991). This, in combination with the then stagnated growth from the golden era in Europe, is what we believe to be the proper explanation of why Catholicism had a significant negative coefficient during this time period.

4.2 Protestantism and Islam

These two religions are the ones that do not need a more thorough examination to confirm our hypothesis. However, the results still bring fascinating insight, and thus a descriptive and plausible explanation as to why these two are not significant will be presented next. Firstly, the protestant countries in our dataset are characterized by their longevity and the fact that they are all at the forefront of industrial and technological development. From the beginning of our measurements, the Nordics and the United States of America have seen a steady growth rate in all traced variables and so are therefore an approximate benchmark for economic growth in and of itself. For Islamic countries, the sample size is much greater than for Protestants, with greater diversification in geographic location and cultural values, which dictates the presence of natural resources, population growth, and different types of government, all of which have a time-specific significance. This, in turn, poses the question of multicollinearity in our explanatory variables, but after controlling the variance inflation factor (VIF) for each variable, we found no troubling results.[1]

[1] ***See appendix for VIF table***

4.3 Orthodox

Orthodoxism has its most prominent presence in states that, before their severance, were a part of the Soviet Union. In fact, all but one of the countries in our dataset that Orthodoxism characterized, this being Greece, were a part of the Soviet Union. So our conclusion as to Orthodoxies' negative coefficient during 1990-00 and positive coefficient 2000-10 is a result of the dissolution of Soviet and independence and development of the newly sovereign states. The dissolution of the Soviet Union meant the installment of new governments and institutions in all the new states, which Acemoglu et al. (2001, 2002) describe as empirically important for economic growth.[2]

Once these were established and well-integrated, countries such as Romania and Russia saw annual average growth rates in GDP per capita in excess of 8%. In comparison, Armenia saw an impressive annual average of 9.5% over the next 10-year period. The average annual growth rate in GDP per capita for post-Soviet states during the 00s was an impressive 6.5%, which we believe can be explained by convergence and technology diffusion. However, normality could be an issue during these two time periods since these twelve countries saw abnormal growth rates, both negative and positive, during the two time periods. For other periods where we suspected problems with normality, we corrected by omitting outliers, but for these two periods, we found that the number of countries omitted would instead skew the results in a different direction, namely toward east Asia and oil-states, which also saw impressive growth during these periods. This later problem with outliers and omitted data could also cause heteroscedasticity, which we identified in some of our time periods. The variances for the variables during these periods are suspected to be of lesser value than the true BLUE variance values. A Breusch-Pagan test was conducted for each period, and for those that displayed heteroskedasticity (1950-60, 1960-70, 1990-00, 2000-10) robust standard errors were used.

4.4 Hinduism

Our Hinduism dummy is a proxy for India, considering India is the only Hindu country in our dataset. Table (4) shows that the estimated coefficient for Hinduism is significantly positive for the period 1950-60 and significantly negative for the period 1990-00. The former period's positive relationship with growth can be explained by India being declared independent in

[2] ***See appendix for VIF table***

1947. The consequences of this were a particular strategy of economic development where the democratically elected leaders implemented five-year plans intending to raise living standards for the Indian population. These five-year plans led to rapid industrialization and large investments in industries that produced goods such as steel and locomotives. The industrialization did not become the success the government expected and came to an end in the late 1950s due to insufficient demand, overstaffed industries, and drained government resources (Adhia, 2015).

Moving on to the period 1990-00 where we observe a significant negative coefficient, which we can link to the economic crisis in mid-1991, which was a result of many factors but most significantly of balance payment deficits, political uncertainty, and international shocks such as the gulf war and fall of the Soviet Union. These factors resulted in a devaluation of the rupee to change economic policies and get funding from the IMF to cover import costs and a loss of trust in the democratic state of the country (Kolte & Simonetti, 2018). We can therefore ascertain that the significant coefficients of the Hindu dummy are not a result of religious affiliations but from other macro- and socioeconomic factors.

4.5 Buddhism

Table (4) reveals several significant positive coefficients for Buddhist countries in the periods: 1960-70, 1980-90, and 2000-19. The most plausible reason for these estimates is the specular growth in East Asian countries since the 1960s, specifically in Singapore and Thailand (Sarel, 1997). Singapore became the main driver of growth in the 1960s after a rapid pace of industrialization and joined the ranks of South Korea, Hong Kong, and Taiwan in terms of employment. This economic flourish has continued through the decades, and in 2019 the country was ranked by The World Bank (2019) 1st in human capital development, which shows a high degree of efficiency in the workforce and educational system. Other than this, Singapore was ranked by The World Bank (2017) as one of the world's most competitive economies in 2017-2018. Thailand went through a similar economic development but was not as successful as the Singaporean economy. Through urbanization in the 1970s, the country transitioned from an agricultural society to an industrial one and by the next decade, Thailand had become one of the major exporters of manufactured goods. The economic

growth took a hit due to the 1997 crisis, although the economy recovered quickly, and by the early 10s, Thailand joined the group of upper-middle-income economies (OECD, 2020).

4.6 Judaism

The only included Jewish country in the dataset is Israel. The insignificance can probably be explained by the fact that the country has not experienced a dramatic positive average growth in any of the decades included in this study. However, we do find a significant positive coefficient for the period 1950-2019, which probably is due to the steady average growth of the country over the entire period. We can from this information not declare a pattern of a significant relationship between Judaism and economic growth.

4.7 Unaffiliated

This category is defined by countries that have an absence of declared religion by the state, and table (4) presents a significant positive coefficient for the period 1980-90 and a significant negative effect in 1990-00. We can link these coefficients to the East Asian countries that are not declared Buddhist in the data set: China, Hong Kong, Macau, Japan, South Korea, and Vietnam. We are confident that the positive estimated coefficient in the 80s can be explained by the "East Asian Miracles" (Sarel, 1997), which resulted in high growth rates and improvements in living standards.

Two different factors can explain the following decades' negative coefficient. The first event we predicted to lay the ground for the presented result was the burst of the financial bubble in Japan in 1989. This had a negative effect on the banking system and led to a stagnation of the Japanese economy. The second event has already been mentioned in this chapter, and it is the Asian financial crisis (1997) that originated in Thailand (Kanaya & Woo, 2000). This fact may raise concern for multicollinearity, considering multiple variables being affected by the same shocks. This was, however, tested with VIF estimates (see appendix) and showed no signs of errors.

4.8 Control variables

Table (4) shows that the control variables that remain statistically significant for a majority of the time periods are average real capital growth and average population growth. Suppose we were to use the period 1980-90 for reference. In that case, the estimated coefficient of .360 (S.E = 0.094) implies, if viewed causally, that an increase in real capital growth by one standard deviation would increase GDP growth per capita by 0,0003 percentage points annually. The coefficient −0.928 (S.E = 0.264) suggests that an increase in population growth by one standard deviation would reduce the annual growth rate by 0,0024 percentage points. These estimates are unsurprising considering the agreement with the augmented *Solow model* that our model is based on. At first glance, the insignificant relationship between human capital and economic growth may seem surprising considering the opposing result to the Solow model. As previously stated in section (4.2.2) the human capital variable is composed of average years of schooling and returns to education. Ahsan and Haque (2017) explain that this finding is in line with a large portion of economic literature, although despite this, they conclude that human capital is beneficial for economic growth. This conclusion is drawn from a dynamic threshold model. Furthermore, they explain that the impact of human capital is dependent on an economy's level of development which our variable does not capture.

As for the remaining control variables identified by Barro and Sala-i-Martin (2003) as significant for their study, which did not correlate to significance in ours; at least not for the entire time period, we credit to two main reasons: Firstly, the time span for the two studies vary by 30 years which is a considerable difference, especially considering that both a golden economic era and a global financial crisis was captured in our data but not in Barro and Sala-i-Martin's, secondly, Barro and Sala-i-Martin's sample of 126 countries outnumber our sample of 95 which implies an even greater representation of the population and country-specific factors. With this being said, some of the variables whose significance is not replicated in the full time span of our study do, in fact, exhibit significance during the same time periods as found in Barro and Sala-i-Martin's study, implying that they, to some extent, are time-specific.

5. Conclusion

We have used a cross-country regression analysis on 95 countries that includes data on religion by state to investigate the relationship between economic growth and religion. These data are collected from Barro-Lee, Freedom House, Penn World Table, Statista, United Nations, World Atlas, World Values Survey, and the World Bank between 1950-2019. This allowed us to construct a regression model for several periods in which we could analyze patterns of correlation between religious affiliations and economic growth among a set of control variables. The regressions were sectioned by decade, beginning from 1950-60 and ending in 2010-19.

The null hypothesis that religion is uncorrelated to economic growth can frequently be rejected but we fail to find a robust pattern throughout the different time periods. The only religion that remains statistically different from zero throughout every time period is Buddhism which is in line with the findings of Sala-i-Martin (1997). Furthermore, as stated in section (2.3) the measured time period for Sala-i-Martin's study is short (1960-92) and the robust positive coefficients can be a result of unprecedented growth in East Asia over the last 30 years (Sarel, 1997). All things considered, we think our results for Buddhism are inconclusive considering that other explanations for growth can be found other than religious affiliation. Our results show significance for shorter time spans notably for Catholicism, Orthodox, Hinduism, Buddhism, and unaffiliated countries; however, these estimates can also be explained by other macro- and socioeconomic factors. When analyzing the different periods by geographical area based on associated religion, we found factors like war, financial crises, political reforms, and industrialization more plausible determinants of the shifts in GDP growth rates. Therefore, we conjecture that previous studies have come to conclusions based on empirical research in which the correlation between religious effects and GDP growth rates has been misinterpreted as causal effects due to the selected time periods.

An interesting extension to this study would be to analyze the relationship between religion and GDP growth on a more concentrated level from both a religious and geographical perspective. An example of this future study could be analyzing countries in a specific area exposed to similar external factors. The religion variable could be declared based on religious affiliation or orientations within a religion. This way of analyzing the question could give

more insight into how different state religions (or orientations) have handled external or internal macro- or socioeconomic shocks throughout history.

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7. Appendix

Variance inflation factor

Variable/Period	1950-19	1950-60	1960-70	1970-80	1980-90	1990-00	2000-10	2010-19
Protestant	1.35	1.46	1.62	1.41	1.26	1.38	1.27	1.20
Orthodox	2.04	3.14	1.53	1.55	1.37	1.95	1.28	1.62
Muslim	1.47	1.52	1.50	1.76	2.09	1.93	2.04	1.81
Hindu	1.34	1.64	1.41	1.33	1.35	1.23	1.24	1.24
Buddhist	1.25	1.45	1.67	1.51	1.34	1.32	1.12	1.07
Jewish	1.32	2.10	1.15	1.14	1.09	1.08	1.08	1.08
Unaffiliated	1.46	1.48	1.54	1.76	1.64	1.78	1.52	1.47
Avg real capital growth	2.52	2.01	1.76	1.91	1.88	2.06	2.20	1.41
Avg human capital	1.68	2.49	2.28	1.54	1.91	1.80	1.81	1.35
Log GDP per capita	5.70	4.00	3.85	3.87	4.88	7.31	7.40	5.63
Log avg exchange rate	1.39	1.49	1.50	1.54	1.60	1.65	1.75	1.85
Avg current account	1.38	1.25	1.59	2.11	1.44	1.69	1.83	1.64
Avg pop growth	4.24	3.29	1.76	2.82	2.26	1.74	2.41	2.03
Log life expectancy	4.96	6.14	4.99	3.87	4.42	5.03	4.94	4.07

Natural resources (=1)	**1.46**	**1.58**	**1.74**	**1.81**	**1.85**	**1.83**	**1.69**	**1.64**
Partly free	**1.90**	**2.347**	**1.80**	**1.58**	**1.91**	**2.56**	**2.41**	**2.87**
Free	**2.88**	**3.985**	**3.28**	**2.59**	**3.16**	**3.99**	**5.33**	**3.98**

Val av ämne, problemställning, avgränsning, titel och syfte

Disposition av uppsatsen

Författaren väljer ett intressant ämne och frågeställning då maskininlärning och AI är två ämnen som är extremt centrala i dagens samhälle med tanke på all information de kan generera. Utifrån data varuhus (DW) kan företag i olika sektorer analysera och prediktera kundbeteende med hjälp av olika analysverktyg vilket indirekt gör information något av det mest värdefulla som finns i dagens samhälle. Ett förslag på inledning anser vi skulle kunna vara att få in frågeställningen tidigare i texten innan man kastas in i tung teoretisk bakgrund. Med tanke på att ekonometri, maskininlärning och AI är komplexa ämnen hade det underlättat för läsaren om studien inledde texten med en mer övergripande inledning. Här anser vi att läsarens intresse ska fångas genom en mycket kort beskrivning av problemet (eller möjligheten) som uppsatsen undersöker, man ska förstå varför uppsatsen görs och härigenom introduceras till en frågeställning. På detta vis förstår man sedan varför man läser den teoretiska bakgrunden och vad det är man borde vara uppmärksam på. Förslagsvis skulle skribenten kunna flytta upp punkt 2.4 som en alternativ introduktion och härigenom presentera frågeställningen.

Frågeställningen: *”Hur presterar logistisk regressionsanalys som binär klassificeringsalgoritm jämfört med random forest?”* är intressant och ambitiös men vi anser inte att den är tillräckligt ögonfångande och hade möjligtvis kunnat formuleras på annat sätt. Möjligtvis kopplat dessa områden till kreditskortkunder på något vis då läsaren då kan få en mer intuitiv bild av vad uppsatsen är ute efter att undersöka. Detta för oss vidare till titeln: *”klassificering av kreditkortskunder”* som vi anser vara något missvisande då analysering av kreditvärdighet egentligen bara är underlag för metoden för att undersöka huruvida logistisk regression står sig mot beslutsträd. Detta dataset hade i vår mening lika gärna kunnat ersättas av något annat klassificeringsproblem och är därmed inte tillräckligt centralt för uppsatsen för att befinna sig i själva titeln. Punkt 2.6 anser vi är bra och underlättar för läsaren att förstå de olika begreppen som tas upp i texten. Vi hade möjligtvis önskat att fler begrepp togs upp som

big data, beslutsträd och RMP-process men de som tas upp ger mycket bra information till läsaren.

För att sammanfatta den inledande delen anser vi att uppsatsen hade gynnats av en titel mer kopplad till logistisk regression och beslutsträd samt presenterat frågeställningen tidigare i inledande del. Vi anser också att inledningen kan vara mer ”berättande” i den mening att skribenten målar upp ett scenario för läsaren, där det centrala antingen är ett problem som ska lösas, eller möjlighet som ska utforskas; på detta vis blir den röda tråden tydligare och texten upplevs som mer progressiv.

Metod- och materialval

Val av metod har vi inga större synpunkter på då denna anses som god och lägger en bra grund för kvalitativa resultat. Vi anser att de variabler som inkluderas läggs fram på ett tydligt sätt för läsaren i en tabell och att tolkningen av kreditvärdigheten också är tydligt presenterad. Den deskriptiva statistik som presenteras i tabell 4 anser vi hade kunnat illustreras i andra tabeller då texten och siffrorna är något små. Litteraturgenomgången anser vi vara en ganska tung läsning då stora delar av texten refereras till Kelleher, Mac Namee & D’Arcy och det känns ibland som man läser en lärobok. Uppsatsen hade antagligen fått en tydligare röd tråd om denna information, mer tydligt, kopplas till vad studien avser att undersöka.

- **Slutsatser eller brist på slutsatser, dvs. återkoppling till syftet**
- **Grad av självständighet och originalitet**
- **"Formalia" såsom källförteckningar, rubriker, tabeller, språk osv. (Obs! Kortfattat)**