




The Impact of Religious Traditions and Education Levels on Innovation Activity in Countries with Different Income Levels

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Abstract. It is estimated that over 80% of the world's population identifies with a religious group. Religious beliefs can influence people's attitudes towards science, technology, and progress. Religious institutions can also provide resources and support for innovation. This means that religion has a significant impact on the lives of billions of people. The purpose of the article is to explore the impact of different religious traditions and the level of education of the population on innovative activity in countries with different income levels. The study formulated and confirmed three hypotheses: (1) Different religious institutions influence innovation differently; (2) Spreading of education enhances the positive effect of patent activity while the lack of education, on the contrary, weakens this effect; (3) Growth in religious diversity positively influences patent activity. The authors use panel data for 46 countries for the period between 1996 and 2016 and employ the fixed effects estimation. The results indicate that the spread of education among Protestants changed their attitude to the protection of property rights and, thus, increased the positive influence of the latter on patent activity. The growth of religious diversity, usually associated with greater tolerance in society, strengthens the positive influence of Protestantism. Our findings are consistent with the idea that religious institutions can influence innovation in different ways. Protestantism may be more conducive to innovation because it emphasizes the importance of individual freedom and creativity. Religious diversity may be beneficial for innovation because it can lead to greater tolerance and understanding.

Key words: innovation; patenting; R&D; property right; religious diversity; religion; Protestant; Catholic; Muslim; education.

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1. Introduction

Consumers, businesses, and the economy as a whole benefit from innovation, which is a critical driver of economic progress. In economic terms, innovation refers to the development and application of ideas and technologies that improve goods and services or increase the efficiency of their production. Innovation is about the interaction of different societies and institutions. For innovation to thrive, different players need to work towards that goal. Innovation creation and adoption all

rely on institutions, and religious institutions are one of the biggest influencers of the behavioral patterns of people. The generally accepted behavior of different religious groups tends to affect how members perceive innovation.

Pew Research 2010¹ indicated that about 83.7% of the world's population is religious; this is evident that almost all decisions made in the corporate settings

¹ <https://www.pewresearch.org/religion/2015/04/02/religious-projections-2010-2050>

are in one way or the other influenced by religion. Every facet of our life is in one way or the other influenced by our religious affiliation and that also includes how we perceive innovation. Organizational behavior research provides theoretical justifications for the conjecture that religion induces social norms that foster sound moral judgment, and ethical behavior in organizations [1] and Psychology research indicates that an individual's religiosity often has a positive and constructive impact on personality, cognition, attitude, and behavior in both non-business and business contexts [2], and [3]. Considering religion as an institution shows the magnitude of power this institution possesses.

It is not always clear whether religion has a positive or negative impact on innovation. The relationship may vary depending on the specific religion, the context, and other factors. We examine the impact of religion on innovation across different religious traditions and cultural contexts to identify how religion influences innovation in different ways. We hypothesize that different religious institutions influence innovation differently and religious diversity positively influences patent activities.

To explore this topic, we use a methodology that fully explores the question of religious teachings and innovation. We use panel data for 46 countries for the period between 1996 and 2016 and employ the fixed effects estimation.

The purpose of the article is to explore the impact of different religious traditions and the level of education of the population on innovative activity in countries with different income levels.

Research hypotheses:

H1: Different religious institutions influence innovation differently.

H2: Spreading of education enhances the positive effect of patent activity while the lack of education, on the contrary, weakens this effect.

H3: Growth in religious diversity positively influences patent activity.

The remainder of this paper is organized as follows. First, we describe the results of previous work in the field of institutional economics. Within the framework of the methodology section, we justify and formulate the hypotheses, characterize the variables included in the model, present the results of our modeling, and draw conclusions from our model. In the final section, we formulate conclusions.

2. Literature review

2.1. The impact of institutions on innovation activity

Institutions can have a significant impact on innovation, both positively and negatively. Research suggests that institutions with strong property rights, low corruption, and good governance tend to promote innovation, while those with weak institutions and regulatory barriers may impede innovation.

Belderbos et al. [4] showed that strong intellectual property rights protection and effective contract enforcement promote innovation in firms.

Okrah & Hajduk-Stelmachowicz [5] showed that effective regulation can foster innovation in the financial sector.

On the other hand, research by Acemoglu & Robinson [6] has shown that extractive institutions, which are characterized by limited property rights and a lack of rule of law, can stifle innovation and economic growth.

Fu et al. [7] showed that regulatory barriers, such as excessive licensing requirements, can inhibit innovation in the health-care industry.

Knack & Keefer [8] substantiated that patent protection can boost growth and investment by encouraging innovation and patent activity, R&D, and knowledge transfer, ultimately leading to long-term economic growth.

Acemoglu & Akcigit [6] have explored the optimal protection level and form of intellectual property to promote innovation and patent activity.

Protecting the rights of investors and creditors is also crucial for encouraging R&D investment diversification. However, the strength of creditors' rights protection may have a negative effect on research and development investment. Formal and informal norms can also play a role in enhancing or undermining institutional impact, with informal institutions often shaping the design and realization of formal institutions. Religious institutions can foster potential whistle-blowers who internalize religious social norms and feel bound to unmask manipulators [9].

2.2. Religiosity and Innovation

The relationship between religiosity and innovation is complex, and scholars have offered various perspectives on the topic. Some studies suggest that religiosity may hinder innovation, as religious individuals may be more inclined to adhere to traditional values and practices, which can limit their openness to new ideas and ways of thinking. Other studies suggest that religion can promote innovation by providing individuals with a sense of purpose and a community that supports their efforts.

One example of the latter perspective is the role of religion in promoting innovation in the Islamic world during the medieval period. Islamic scholars made significant contributions to the fields of mathematics, astronomy, medicine, and other areas, often inspired by their religious beliefs. They believed that the pursuit of knowledge was a religious duty, and they drew on the Qur'an and other Islamic texts to develop new theories and methods.

Another example of the potential link between religiosity and innovation can be found in the history of the Protestant Reformation in Europe. The Protestant emphasis on individual interpretation of scripture and direct communication with God challenged traditional religious authority and helped to pave the way for new religious and philosophical movements. This emphasis on individualism and personal

responsibility also influenced the development of capitalism and the rise of the modern business enterprise.

Hilary and Hui [10] showed that companies in countries and regions with a higher degree of religiosity demonstrate a lower degree of risk exposure.

Hoogendoorn [11] substantiated that religion affects entrepreneurship. Entrepreneurs' choice of venture is mostly connected to their religious affiliation, example is Jehovah Witness, they don't venture into alcoholic and tobacco industry, and they are also prohibited from entering what they consider unclean practices such as receiving blood transfusions and entering military service is prohibited. Islam prohibits usury, ambiguity in contracts (*gharar*), gambling and games of chance (*maysir*), fraud, bribery, the use of false weights and measures, and taking others' property unlawfully, these are considered as "haram" [12].

Bénabou et al. [13] found that religiosity has a negative impact on economic growth, this is due to the diverse approach to life of people within the religious institution.

Guiso et al. [14] showed that religious people tend to be more racist and to have negative attitudes towards working women, which is detrimental to innovation and, consequently, economic growth.

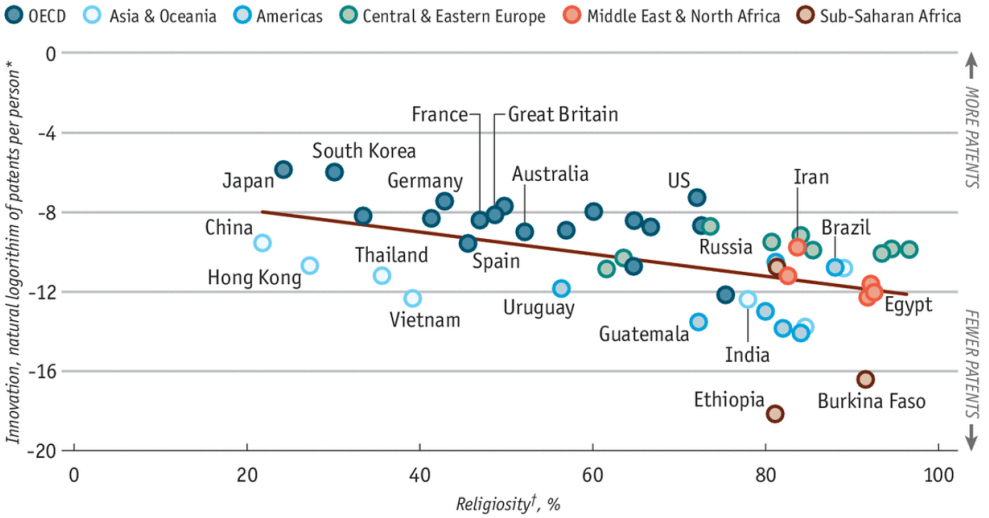
McCleary & Barro [15] demonstrate that high rates of church attendance negatively affect the countries' economic performance.

Dana [16] showed that religion can build social networks based on different religious traditions, doctrines, and values.

Herbig & Dunphy [17] showed that religion can influence creativity and innovation through norms, customs, and beliefs that are to some extent pervading.

Religion has been understood to have a strong effect on innovation policies even in advanced economies. A well-known example is the stem cell research funding limit imposed by the USA former American

Innovation and religiosity



Source: National Bureau of Economic Research *2005
 †World Values Survey, % of people who self-described as religious, 2005

Economist.com

Figure 1. The influence of religiosity on the activity of patent activity in different countries

president George W. Bush. Cohen, a former adviser to President George W. Bush’s Council on Bioethics, believes human life must be respected from conception and warns of the dangers of labeling a group of people as unworthy of life. Religion forms a strong base of our modern society.

The Figure 1 above shows the impact of religiosity on innovation. It has a negative effect because if the leader or the community is more religious certain research activities will be prevented.

The figure 1 also shows that countries with the most patents are less religious. The US and Russia are the only advanced economies that also have higher levels of religiosity.

2.3. Religion and Property Rights

The relationship between property rights and religion is a complex and multifaceted topic that has been explored by scholars from a variety of disciplines. Some argue that religious beliefs can shape attitudes towards property ownership, while others emphasize the importance of cultural

and historical factors in shaping the meaning and value of property.

Lea [18] examines the impact of property rights on indigenous communities in the developing world, arguing that Western concepts of property rights often conflict with indigenous views of communal ownership. This conflict can result in the marginalization, displacement, and impoverishment of indigenous people.

González [19] argues that religious faith can shape attitudes towards property rights and the meaning of property ownership. Many religious traditions emphasize the importance of stewardship, charity, and social responsibility in the context of property ownership. Firth’s book provides insights into the broader social and cultural context in which property rights are embedded. While not focusing specifically on property rights, Firth examines the ways in which cultural beliefs and practices shape social organization.

Ellis & Peterson [20] compare the relationship between property rights and religion across different cultures and religious

traditions. They argue that religious beliefs can influence attitudes towards property ownership, but that the relationship between religion and property is complex and depends on a range of social, economic, and historical factors.

The Catholic Church's view on property rights is rooted in the principles of natural law and social justice, as articulated in Catholic social teaching. The Catechism of the Catholic Church, in paragraph 2402, states that "The goods of creation are destined for the whole human race. However, the earth is divided up among men to assure the security of their lives, endangered by poverty." This recognizes the legitimacy of private property, but also places it in the context of serving the common good.

The Compendium of the Social Doctrine of the Church, published by the Pontifical Council for Justice and Peace, explains that "The right to private property, acquired or received in a just way, does not do away with the original gift of the earth to the whole of mankind". The Compendium goes on to emphasize that the right to private property must be exercised considering the universal destination of goods, and that it is subject to the principle of social justice.

Pope Francis, in his encyclical *Laudato Si'*, emphasizes the need to balance the right to private property with the common good and the care for creation. He writes, "The natural environment is a collective good, the patrimony of all humanity and the responsibility of everyone. If we make something our own, it is only to administer it for the good of all". He also warns against the "idolatry of money" and the exploitation of the poor and vulnerable. The Catholic Church recognizes the right to private property as a fundamental natural right, but also emphasizes that this right is not absolute and must be balanced with the common good and social justice. Private property should be used in a responsible way that serves the needs of all people, particularly the poor and vulnerable, and respects the integrity of creation.

Protestant views on property rights are diverse and varied, as there is no single unified Protestant theology. However, some general principles can be discerned from the teachings of various Protestant traditions.

In general, Protestants recognize the importance of private property as a means of securing individual freedom and promoting economic development. They view property ownership as a natural right that is grounded in the biblical principle of stewardship, the idea that God has entrusted resources to human beings to be used for the good of all. At the same time, they also emphasize the need for responsible stewardship and the obligation to use resources in ways that benefit society.

One key source of Protestant teaching on property rights is the doctrine of the "priesthood of all believers", which holds that all Christians are called to serve God and one another in all aspects of life, including economic activity. This view emphasizes the importance of individual responsibility and the role of private property in enabling individuals to fulfill their God-given vocations.

Another important Protestant principle is the idea of "just price," which holds that goods and services should be sold at a fair price that reflects their true value. This principle reflects a concern for justice and fairness in economic exchange and seeks to prevent exploitation of the vulnerable by those with greater economic power.

Protestant views on property rights are reflected in the social teachings of various Protestant denominations, such as the Reformed tradition, the Methodist tradition, and the Lutheran tradition. For example, the United Methodist Church's Social Principles state that "We support the right to property as a natural right to be used for the good of all, but recognize that property rights are not absolute and unconditional". The Reformed Church in America's Belhar Confession emphasizes the importance of stewardship and the obligation to

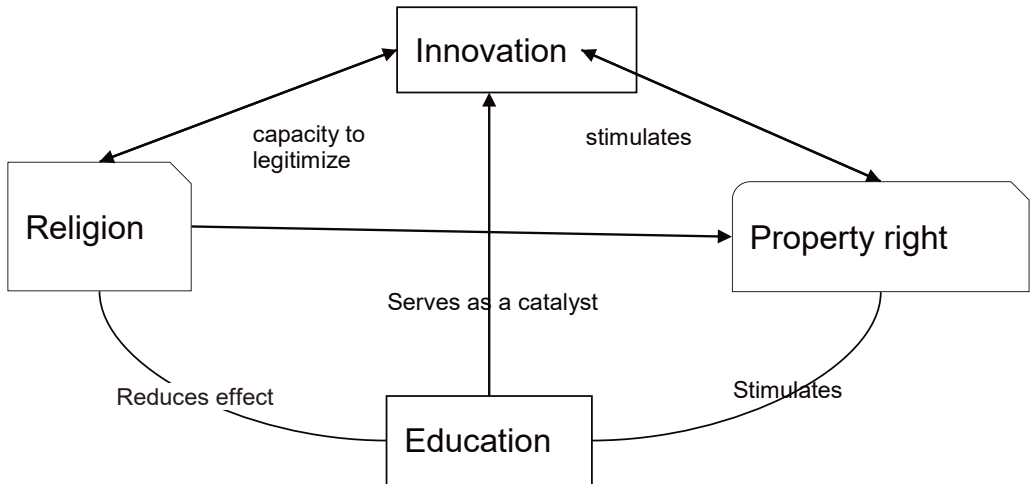


Figure 2. Hypothetical diagram establishing relationship between Innovation, Religion and Property Right

use resources in ways that promote justice and peace. Finally, the Lutheran World Federation’s statement on economic justice and the economy recognizes the importance of private property as a means of promoting economic growth, but also emphasizes the need for social responsibility and the obligation to use resources in ways that benefit all members of society.

In Islam, property rights are considered to be an important aspect of economic justice and social responsibility. Muslims believe that property is a gift from God and that it should be used in accordance with His will, with a focus on the well-being of society as a whole. The Islamic perspective on property rights is rooted in the teachings of the Qur’an and the Hadith, as well as the principles of Islamic law.

The Qur’an emphasizes the importance of fair economic exchange and the obligation to use wealth for the benefit of all. This emphasizes the importance of the proper distribution of wealth and resources, including property rights.

Islamic law, or sharia, recognizes the right to private property, but also emphasizes the responsibility to use it in a way that benefits society. For example, Islamic law allows for inheritance and bequests, but also places limits on the concentration

of wealth and the exploitation of the poor. The concept of zakat, or almsgiving, is also an important part of Islamic economics, which involves the distribution of wealth to the needy.

In Islamic economic thought, property rights are not absolute, but rather subject to the principle of *maslahah* or the public interest. This means that individual rights to property must be balanced with the collective good of society. According to the Islamic scholar, M.A. Mannan, “Private ownership is permitted, but it is not an end in itself; it is a means to an end, namely the fulfillment of the Islamic goals of social welfare and social justice.”¹ Muslims view property rights as an important aspect of economic justice and social responsibility. The right to private property is recognized, but it is subject to the principle of *maslahah* or the public interest. Islamic law places emphasis on the responsible use of property for the benefit of all members of society, particularly the needy.

In Figure 2, we presented the studied relationships.

¹ Mannan, M.A. (1986). *Islamic Economics: Theory and Practice*. United Kingdom: Westview Press. P. 138.

2.4. Hypotheses

Different religions demonstrate different attitudes towards Innovation and labor. The evidence we found in various scientific and theological works shows that different religions can have different effects on Innovation.

In Protestantism, for instance, God is not the only source of ownership and wealth as 'whoever sheds human blood, by humans shall their blood be shed; for in the image of God Has God made mankind. In the Protestant's eyes, pursuit of wealth is not a sin but a virtue [21] and economic and technological progress is agreeable to God [21].

Although in scientific and theological literature there is ample evidence supporting the positive influence of Protestantism on innovation, we take a different approach by considering religion in this case as a formal institution.

The opposite situation is characteristic of Catholicism: Jesus taught his followers not to accumulate wealth, above what is necessary, and to lead a simple life. The same principles were found in the teachings of St. Catherine of Siena, and those of the founder of the first European monastic order – Benedict of Nursia [22]. These principles were also followed by the Dominicans and the Augustinians Rano [23].

Furthermore, there is economic evidence supporting the negative influence of Catholicism on accumulation of wealth. Catholicism negatively affects the rule of law (Berggren & Bjornskov [24]) and innovation [25, 26].

Islam encourages believers to spend rather than to save. At the same time, Allah says: 'wealth and sons are ornaments of the life of this world. There is evidence for the negative impact of Islam on property rights and innovation as Islam hinders accumulation of property through the system of inheritance and impedes innovation activity [27]. Thus, we have formulated the following hypothesis.

H1: Different religious institutions influence innovation differently.

The impact of religion on innovation fits into the IPI (Indecision, Procrastination, and Indifference) model. Such attitudes, however, can be changed through education [28]. Protestantism and Judaism as well as religious diversity have a positive impact on people's attitude towards science and education and, therefore, on technological innovation [29]. Religious pluralism enhances students' diligence while rigorous adherence to Catholic norms, on the contrary, has a negative influence on their studies. Affiliation with Islam has a negative impact on Muslim women's education, which, in its turn, affects entrepreneurial activity and innovation [30]. The lack of education exacerbates ignorance and contributes to spreading of superstitions and distorted beliefs, while education stimulates entrepreneurship in Muslim communities [31].

Education can modify the impact that religion has on property rights and, consequently, on patent activity. It should be noted that the combined impact of education and religion on property rights and patent activity has not been sufficiently explored and we are going to address this question by formulating the following hypotheses.

H2: Spreading of education enhances the positive effect of patent activity while the lack of education, on the contrary, weakens this effect.

The combination of different religions or religious diversity can also shape the impact of religion-related factors on patent activity. Some indirect evidence pointing to this fact is provided by economic studies on the role of religious diversity in economic development. Religious diversity and tolerance towards other religions and ethnic groups contributes to retaining talent in a company and is favorable for innovation [32].

Tolerance towards other religions and religious diversity stimulate tourist exchange and foreign trade as well as foreign investment [33, 34]. Religions that are intolerant towards other faiths exacerbate polarization in society and hinder

cooperation [35], which is detrimental to investment and economic growth

We have been unable to find studies demonstrating the impact of religious diversity on innovation, which is why we have formulated the following hypothesis.

H3: Growth in religious diversity positively influences patent activity.

3. Data and Methodology

3.1. Data

Our sample includes 46 countries in the period 1996-2016. We limited the data to 2016 because of the availability of religious data. We thus have an unbalanced panel with 969 observations. Countries without patents were excluded since, we will not be able to consider the factors contributing to growth in patent activity. To measure innovation, we use (log-) patents per capita. The patent counts taken from the World Intellectual Property Organization (WIPO) are total patents filed in specific countries by their residents [13].

'Property Rights' serves as an index of property rights. The source of the data was the Heritage Foundation. It varies from 0 (minimal property rights) to 100 (maximal property rights).

To measure the impact of religion we used the data provided by the Cline Center for Democracy. We managed to find sufficient data on three religions – Catholicism, Protestantism, and Islam.

3.2. Methodology

To study the impact of various doctrines on innovation, we use panel data analysis. The literature on panel data suggests observations of many individuals with several observations for each individual. Combining time series with cross-sections improves the quality and quantity of data in ways that would otherwise be impossible using only one of these two dimensions.

The method used makes it possible to detect and measure statistical effects and minimize estimation errors that may occur when combining groups into a single time

series. Initially, the author used three analytical models, namely combined effects models, fixed effects models and random effects models, then settled on one model using the Hausman test (the Hausman test evaluates the significance of an estimate compared to an alternative estimate).

Basic model:

$$y_{it} = \alpha_i + \beta x_{it} + \mu_{it}. \quad (1)$$

The dependent variable is y_{it} , x_{it} is a vector of time-varying explanatory variables, and $i = 1, \dots, n$ individual index (countries), $t = 1, \dots, t$ is the time index and μ_{it} is the error term.

3.3. Dependent Variables

To study the influence of factors related to religion and the ownership of innovation, we use patents as a proxy for innovation.

The variable 'Patent' is traditionally regarded as one of the key characteristics of innovation and innovation activity [36, 37], and it is used by the US Patent and Trademark Office to analyze innovation activity [38].

This variable is also considered as a performance indicator [39]. In our study, we use the number of patents per capita to compare large and small countries.

3.4. Independent Variable

The property rights component is a qualitative assessment of the extent to which a country's legal framework allows individuals to freely accumulate private property secured by clear laws that are effectively enforced by the Government. It measures the extent to which a country's laws protect private property rights and the extent to which laws are enforced. The index of property rights from the World Intellectual Property Organization. The minimum value is 0, and the maximum value is 100.

Rel is a vector of factors related to religion, including religions and religious diversity. We also consider ownership as

Table 1. Summary of variables and sources used in this study (1996–2016)

Variable	Unit of measurement	In the model	Mean	Std. Dev.	Min	Max	Source
Patents	Application/person	Ln-Pat-PC	1.63	0.87	-0.82	3.52	World Intellectual Property Organization
Property Right	Index	PrRig	63.85	24.81	10.00	95.00	The index of Property Right (Heritage Foundation)
Catholic	Share of population (%)	Catholic	38.21	35.35	0.00	99.20	Cline Center for Democracy
Protestant	Share of population (%)	Protestants	21.51	27.92	0.00	96.30	Cline Center for Democracy
Muslim	Share of population (%)	Muslims	15.80	32.13	0.00	100.00	Cline Center for Democracy
Religious diversity	Index	rel_Diversity	5001.57	3323.58	0.00	10000.04	Measured through the Herfindahl – Hirschman index
GDP	millions of US dollars	Ln-GDP	7.894e+5	2.046776e+6	4.746e+3	1.860e+7	The World Bank
Percentage of people with higher education	Share of population (%)	Education	51.85	23.97	2.74	121.86	The World Bank
Share of R&D as a percentage of the GDP	Percentage of GDP (%)	Ln-R&D	1.43	0.91	0.05	4.28	The World Bank

a factor in assessing the impact of religious factors on innovation.

Soc is a vector for managing economic, social, and educational characteristics, including the natural logarithm of gross domestic product (GDP) per capita, education calculated as a percentage of people with higher education, research and development calculated as a percentage of GDP.

Table 1 shows all variables and data sources used in our study.

3.5. Robustness Check

To understand the effect of religious pluralism, the author groups societies into three groups: homogeneous, semi-homogeneous (titular) and heterogeneous. Using this approach helps to explore

different conditions and how this affects behavior and attitude to innovation. The author studied the effect using the *Herfindahl-Hirschman Index* (HHI).

$$HHI = S_1^2 + S_2^2 + S_3^2 + \dots + S_N^2 \tag{2}$$

S_i is the share of each religion in the population of the country, %.

The ranges of the *Herfindahl-Hirschman Index* are shown in Table 2.

4. Results

4.1. Results of modeling of the impact of religion-related factors

To study the impact of religious institutions on innovation, the author considered certain religious groups due to limited data. The author used the equation below:

$$InPatent_{it} = \alpha_i + \beta_1 PrRig + \beta_2 \sum Rel_{it} + \beta_3 \sum Soc_{it} + \mu_{it} \tag{3}$$

where $i = 1, \dots, n$ is the individual index (of the country), $t = 1, \dots, t$ is the time index and μ_{it} is the error term.

“Patent” represents the number of patent applications per capita.

PrRig is an index of property rights from the World Intellectual Property Organization.

Rel is a vector of factors related to religion, including religions and religious diversity.

Soc is a vector for managing economic, social, and educational characteristics, including the natural logarithm of gross domestic product (GDP) per capita, education calculated as a percentage of people with higher education, research and development calculated as a percentage of GDP (Table 3).

Initial analysis shows a strong positive impact of property rights and religious diversity on innovation, and this effect can be seen in all three models. In the pooled model, only Catholicism is significant

Table 2. Value ranges

Range	Characteristic
Diversity > 0.9025	Society is homogeneous
Diversity = [0.5693; 0.9025]	Society is semi-homogeneous (Median for religious diversity is 0.5693)
Diversity < 0.5693	Society is heterogeneous (Median for religious diversity is 0.5693)

Table 3. Results of modeling of the impact of religion-related factors and property on patent activity

LnPatent Per Capita	Pooled OLS regression (Std Error)	Fixed effects model (Std Error)	Random effects model (Std Error)
LnGDP	4.065e-02*** (9.879e-03)	5.346e-02*** (1.303e-02)	4.776e-02*** (1.217e-02)
Education..Tertiary	9.825e-03*** (8.736e-04)	7.157e-03*** (8.132e-04)	7.510e-03*** (8.020e-04)
LnR&D	1.201e+00*** (7.215e-02)	1.344e+00*** (7.046e-02)	1.342e+00*** (6.919e-02)
PrRig	2.605e-03*** (8.880e-04)	2.341e-03*** (8.411e-04)	2.313e-03** (8.281e-04)

End of table 3

LnPatent Per Capita	Pooled OLS regression (Std Error)	Fixed effects model (Std Error)	Random effects model (Std Error)
Catholics	-1.681e-03* (8.019e-04)	-4.444e-03*** (1.104e-03)	-3.828e-03*** (1.010e-03)
Protestants,	-1.850e-03 (9.566e-04)	-3.992e-03 *** (1.173e-03)	-3.495e-03** (1.099e-03)
Muslims	-2.147e-03 (1.452e-03)	-6.856e-05 (1.564e-03)	1.977e-04 (1.483e-03)
rel_diversity	6.777e-06 (7.741e-06)	2.867e-05** (9.958e-06)	2.424e-05** (9.223e-06)
Intercept	6.045e-02 (2.634e-01)		4.933e-02 (3.174e-01)
R-squared	0.780	0.746	0.749
Theta			0.796
Country FE	Yes	Yes	Yes
Years FE	No	No	No

Notes: Coefficients and the standard errors in parenthesis. Significance codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘.’ 1

among religious factors, but its influence is negative. In other models, this effect has become more negative. Protestantism is significant in the second and third models, but its effect is negative. For further analysis of this effect, the author determines the estimate that best matches the data, using the Hausman test. The results of the Hausman test showed that the fixed effect estimate best explains the data.

4.2. Analysis of the General Results of all Countries

Further analysis was then carried out using fixed effect estimates. Table 4 shows expanded results based on the fixed effect model.

In model 2, the results change slightly with the introduction of the homogeneous variable. Homogeneity is negatively significant to innovation which confirms the work of Gelfand et al. [40]. Religious Rigidity has a negative implication on innovation. The strong positive significance

is reduced for *PrRig*, while the Muslim becomes negatively significant. Catholics are still negatively significant.

In model 3, we introduce semi-homogeneous variables which are positively significant to innovation, which confirms the work of [41]. The other variables have almost similar results as the base model.

In Model 4 we introduce dummy Catholics greater than 5%, this variable is significant to innovation. This indicates the higher the catholic population the higher it correlates with innovation.

In model 5, we introduce a dummy of protestants greater than 5%. The results show a weak negative significance to innovation, but it improves the significance of *PrRig* and increases its coefficient.

In model 6, dummy Muslim less than 5% is introduced and it is negatively significant to innovation. The results also show a weak positive significance of GDP per Capita.

Table 4. General model for all countries

Patent Per Capita	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
LnGDP	0.054** (0.013)	0.036** (0.012)	0.055*** (0.0123)	0.035*** (0.010)	0.040*** (0.010)	0.024* (0.010)
Education.. Tertia	0.007*** (0.001)	0.008*** (0.001)	0.007*** (0.001)	0.001 *** (0.001)	0.009 *** (0.001)	0.009*** (0.001)
LnR&D	1.340*** (0.070)	1.35*** (0.071)	1.302*** (0.069)	1.111 *** (0.070)	1.133 *** (0.070)	1.125 *** (0.075)
PrRig	0.002*** (0.001)	0.002* (0.001)	0.002*** (0.001)	0.002* (0.001)	0.003*** (0.000)	0.003*** (0.000)
Catholics	-0.004*** (0.001)	-0.002** (0.001)	-0.004*** (0.001.)		-0.001 (0.001)	-0.001 (0.001)
Protestants,	-0.004 *** (0.001)	-0.001 (0.001)	-0.004*** (0.001)	0.001 (0.001)		-0.001 (0.001)
Muslims	0.000 (0.002)	-0.004** (0.001)	0.002 (0.001)	-0.001 (0.001)	-0.001 (0.001)	
rel_diversity	2.87e-05** (0.000)			-1.122e-05* (0.000)	-2.666e-06 (0.000)	-1.393e-05 (0.000)
Homogeneous		-0.196* (0.080)				
Semi- Heterogeneous			0.184*** (0.038)			
Dummy.5.Cat				0.106* (0.042)		
Dummy.5.Pro					-0.070 * (0.034)	
Dummy.5.Mus						-0.094 * (0.046)
R-squared	0.746	0.745	0.753	0.764	0.750	0.755
Country FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Coefficients and the standard errors in parenthesis. Significance codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘.’ 1

4.3. Analysis of the results of High-Income countries

The results need to be further elaborated to see if GDP level has any significant role to play in the outcome.

We form three clusters based on GDP, Higher income countries, Middle and Low Income. The table below shows

the results of the High-Income Countries (Table 5).

In model 1, catholic and protestants are positively significant but religious diversity is also negatively significant. This result can be explained by the work of Henrich [42] which suggests that the West got rich (and its people got WEIRD) by accident

Table 5. Model for High income countries

LnpatPC	Model 1	Model 2	Model 3	Model 4	Model 5
Education.. Tertia	0.001 (0.002)	0.000 (0.001)	-0.000 (0.002)	0.000 (0.002)	0.001 (0.002)
LnR&D	0.316* (0.156)	0.600*** (0.171)	0.595*** (0.142)	0.433** (0.157)	0.322* (0.161)
PrRig	-0.001 (0.004)	0.001 (0.004)	-0.001 (0.003)	-0.010* (0.004)	-0.002 (0.003)
Catholics	0.011*** (0.003)	0.005* (0.002)		0.002** (0.001)	0.011*** (0.003)
Protestants,	0.022*** (0.003)	0.007** (0.002)	0.012*** (0.001)		0.022*** (0.029)
Muslims	-0.002 (0.008)	-0.001 0.008	0.002 (0.007)	-0.019* (0.008)	
rel_diversity	-1.264e- 04*** (0.000)		3.313e-05** (0.000)	-4.974e-06 (0.000)	-1.238e-04 *** (0.000)
Semi- Homogeneous		-0.209*** 0.061			
Dummy.5.Cat			0.782*** (0.096)		
Dummy.5.Pro				0.494*** (0.077)	
Dummy.5.Mus					-0.010 (0.045)
R-squared	0.445	0.284	0.493	0.410	0.446
Country FE	Yes	Yes	Yes	Yes	Yes

Notes: Coefficients and the standard errors in parenthesis. Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

because of reforms implemented by the Catholic church. WEIRD being the acronym for western, educated, industrialized, rich, and democratic. The concept was first introduced by Henrich et al. [43]. In the developed countries, there seems to be more religious competition than collaborations.

In model 2, Semi-homogeneous is negatively significant.

In model 3 and model 4, we see strong positive significance of both protestants and

catholics. There are interesting results for property rights in high income countries, introducing the dummy of protestant and catholic greater than 5%, its influence on property rights is negative and insignificant for catholic but significant for protestants. The results confirm the works of Gangopadhyay & Mondal [44].

According to Gangopadhyay & Mondal [44], the relationship between IPR protection and innovation can be U-Inverted,

Table 6. Model for Middle-Income countries

LnpatPC	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Education..Tertia	0.007*** (0.002)	0.007*** (0.002)	0.007*** (0.002)	0.010*** (0.016)	0.008*** (0.001)	0.010*** (0.002)
LnR&D	1.858*** (0.151)	1.678*** (0.141)	1.682*** (0.142)	1.687*** (0.163)	1.728*** (0.146)	1.583*** (0.153)
PrRig	0.009*** (0.002)	0.009*** (0.002)	0.009*** (0.002)	0.005*** (0.002)	0.009*** (0.002)	0.009*** (0.002)
Catholics	-0.0002 (0.001)	0.002* (0.001)	0.002 (0.001)		0.001 (0.001)	-0.002 (0.001)
Protestants,	-0.004 (0.003)	-0.004 (0.003)	-0.004 (0.003)	-0.005* (0.003)		0.001 (0.002)
Muslims	0.051*** (0.011)	0.047*** (0.012)	0.047*** (0.011)	-0.002 (0.001)	0.045** (0.011)	
rel_diversity	4.072e-05** (0.000)			2.647e-06 (0.000)	3.057e-05* (0.000)	4.312e-05** (0.000)
Homogeneous		0.004 (0.178)				
Non .Homogeneous			0.022 (0.093)			
Dummy.5.Cat				0.020 (0.099)		
Dummy.5.Pro					-0.150** (0.055)	
Dummy.5.Mus						0.402** (0.121)
R-squared	0.794	0.779	0.779	0.753	0.802	0.720
Country FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Coefficients and the standard errors in parenthesis. Significance codes: 0 **** 0.001 *** 0.01 ** 0.05 * 0.1 ' ' 1

implying that stronger IPR protection may discourage innovation. Due to the level of protection offered in developed countries for intellectual property rights, it limits access and reproduction and counterfeiting.

4.4. Analysis of the results of Middle-Income Countries

Table 6 shows results of Middle-Income countries’ religiosity to innovation. We realize that there are opposing results of

religious diversity between high income countries and Middle-Income countries.

Religious diversity is positively significant to innovation in the middle-income countries as it can be seen in table 6, model 1, and it is reflective in all models.

We also realize that Muslim is positively significant in middle income countries while Protestants have a negative effect on innovation as can be seen in model 5. Property right protection has a strong

influence on innovation in middle income countries as compared to high-income and low-income countries.

4.5. Analysis of results of Low-Income countries

Table 7 shows results of Low-Income countries' religiosity to innovation. Table 7, model 1 shows there is a negative effect of

property right protection to low-income countries but not significant, this can be due to lack of strong institutional structures that protect properties. This can also be attributed to the extractive nature of the institutions in such countries. infringement of intellectual property rights is also a major challenge in low-income countries, low-income countries have become a target

Table 7. Model for Low-Income countries

LnpatPC	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Education..	0.029*** (0.003)	0.029*** (0.002)	0.028*** (0.002)	0.028*** (0.002)	0.026 (0.003)	0.027*** (0.003)
Tertia						
LnR&D	0.935*** (0.164)	0.985*** (0.129)	1.029*** (0.166)	0.855*** (0.125)	0.989 (0.163)	0.780*** (0.177)
PrRig	-0.003 (0.003)	-0.003 (0.003)	-0.004 (0.003)	-0.005 (0.003)	-0.001 (0.003)	-0.001 (0.003)
Catholics	-0.003* (0.002)	-0.003* (0.001)	-0.004* (0.002)		-0.004 (0.002)	-0.004* (0.002)
Protestants,	0.012* (0.004)	0.011* (0.004)	0.011* (0.004)	0.015** (0.005)		0.014** (0.005)
Muslims	-0.001 (0.002)	0.001 (0.003)	-0.001 (0.002)	-0.002 (0.001)	-0.003 (0.001)	
rel_diversity	-2.988e-06 (1.653e-05)			-1.038e-05 1.549e-05	1.128e-05 (1.714e-05)	-2.711e-05 (1.671e-05)
Homogeneous		-0.264 (0.250)				
Non .Homogeneous			0.098 (0.140)			
Dummy.5.Cat				-0.281* (0.139)		
Dummy.5.Pro					0.046 (0.152)	
Dummy.5.Mus						-0.116 (0.115)
R-squared	0.871	0.874	0.872	0.856	0.843	0.820
Country FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Coefficients and the standard errors in parenthesis. Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

destination and transit route for counterfeit and pirated goods over the years. Foreign and local traders flood the market with low-quality counterfeits, while local manufacturers illegally imitate established brand products. This is all due to weak institutions, corrupt leaders and lack of better policies.

Catholicism has a negative influence on innovation in low-income countries. This is a bit surprising looking at the level of investment in education done by the catholic church in most of these countries. This can be due to the teachings which are more deterministic of how people behave towards innovation. The teaching is based more on salvation and not prosperity and personal development compared to the protestants in low-income countries. The results show that protestants have a positive significance on innovation. This can be associated with the teachings of the protestant church.

Education has a strong influence on innovation at all financial levels, from high income to low-income countries. Where there is strong association of religion to education there is a higher level of innovation, and this is what has been a pivotal part of countries' innovativeness.

5. Discussion

In this study, we utilized panel data from 46 countries over a period of 20 years (1996-2016) and employed fixed effects estimation to investigate the relationship between religious institutions and innovation [29]. Our findings show that the level of education among Protestants has positively impacted their attitude towards innovation, which is in line with previous studies [45, 46]. The positive correlation between education and innovation has been widely established in the literature, with studies highlighting the role of education in developing human capital, which is essential for innovation [47, 48].

The study's findings show that countries that have a high level of R&D spending, strong intellectual property rights,

a high level of education, a large population, and a high level of religious diversity tend to have a high number of patents per capita [29]. These results are similar to previous studies that have found a positive correlation between education level and innovation [49, 50]. Countries that are religiously homogeneous and have a small population tend to have a low number of patents per capita, which is consistent with previous research [29, 51]. The study also supports previous research that has suggested that diversity can enhance innovation and creativity [46, 52].

The results of the study support *H1*, which proposes that different religious institutions have varying effects on innovation, and are consistent with previous research that has suggested that religion can impact innovation and economic development [21, 46]. Specifically, the study found that Protestant countries tend to have more patents per capita than Catholic countries due to the more entrepreneurial culture in Protestant countries [46]. Our study supports the idea that the impact of religion on innovation may vary depending on the religious institution. This is consistent with previous research that has found differences in the impact of religion on economic development depending on the religious institution [53]. Our study found that Protestant countries tend to have a higher number of patents per capita than Catholic countries, which is in line with previous research suggesting that Protestantism may be more conducive to entrepreneurship and innovation [21].

The study also supports *H2*, which suggests that education plays a key role in innovation, and is consistent with previous research that has found a positive correlation between education level and innovation [49, 50]. The study found that the lack of education can weaken the positive effect of patent activity, which is consistent with previous research [46, 51].

The study also supports *H3*, which proposes that religious diversity positively

influences patent activity, and is consistent with previous research that has suggested that diversity can enhance innovation and creativity [46, 52]. The study found a positive correlation between religious diversity and innovation, which is likely because religious diversity can lead to a more open and tolerant society that is conducive to innovation [46].

6. Conclusion

The purpose of the article, set by us - to study the influence of different religious traditions and the level of education of the population on innovative activity in countries with different income levels, has been fully implemented.

In the study, we confirmed the H1 hypothesis, which suggested that different religious institutions influence innovation differently.

The study also supports H2 hypothesis, which suggests that education plays a key role in innovation.

The study also supports H3 hypothesis, which proposes that religious diversity positively influences patent activity.

The research results provide significant contributions to the academic understanding of the relationship between religion, education, diversity, and innovation. The study's findings support the idea that religion can impact economic development and innovation differently based on the religious institution. It also supports the notion that education is crucial for innovation and highlights the role of diversity in enhancing creativity and innovation. The study's theoretical significance lies in its ability to advance the

understanding of the complex relationship between religion and innovation, as well as the importance of education and diversity in promoting innovation. By using panel data from multiple countries over a long period, the study provides robust evidence for the impact of these factors on innovation.

The research results have practical significance for policymakers, entrepreneurs, and investors. The findings suggest that investing in education and promoting religious diversity can positively impact innovation and economic development. Policymakers can use this information to design policies that encourage education, promote religious diversity, and support innovation. Entrepreneurs and investors can also use the study's findings to make informed decisions about where to invest their resources. The study highlights the importance of considering the religious and cultural context when assessing innovation potential in a particular region. It also emphasizes the importance of education and diversity in promoting innovation, which can guide investment decisions.

This line of analysis can have several directions, for example, taking into account external shocks (migration) that destabilize the religious structure of the population, which can also change the influence of religions.

Moreover, the lack of statistical data on innovation and, more specifically, on patent activity prevented us from investigating the role of religions such as Orthodox Christianity, Buddhism, Judaism and Hinduism. These issues could also be explored in the course of further research.

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Влияние религиозных традиций и уровней образования на инновационную активность в странах с разным уровнем дохода

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Аннотация. По оценкам, более 80 % населения мира идентифицируют себя с какой-либо религиозной группой. Религиозные убеждения могут влиять на отношение людей к науке, технологиям и прогрессу. Религиозные институты также могут обуславливать ресурсы и поддержку инновациям. Это означает, что религия оказывает значительное влияние на жизнь миллиардов людей. Цель статьи – исследовать влияние разных религиозных традиций и уровня образования населения на инновационную активность в странах с разным уровнем дохода. В исследовании сформулированы и подтверждены три гипотезы: 1) разные религиозные институты по-разному влияют на инновации; 2) распространение образования усиливает положительный эффект патентной деятельности, а отсутствие образования, наоборот, ослабляет этот эффект; 3) рост религиозного разнообразия положительно влияет на патентную деятельность. Авторы рассматривают панельные данные по 46 странам за период с 1996 по 2016 гг., используя оценку фиксированных эффектов. Полученные результаты свидетельствуют, что распространение образования среди протестантов изменило их отношение к защите прав собственности и, таким образом, усилило положительное влияние последних на патентную деятельность. Рост религиозного разнообразия, обычно связанный с большей толерантностью в обществе, усиливает положительное влияние протестантизма. Наши выводы согласуются с идеей о том, что религиозные институты могут по-разному влиять на инновации. Протестантизм, возможно, больше благоприятствует инновациям, потому что он подчеркивает важность индивидуальной свободы и творчества. Религиозное разнообразие может быть полезным для инноваций, поскольку оно может привести к большей терпимости и пониманию.

Ключевые слова: инновации; патентование; НИОКР; право собственности; религиозное разнообразие; религия; протестантизм; католицизм; мусульманство; образование.

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