

Interplay between religious affinity and global socio-economic development

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Abstract

This paper investigates the impact of religion on development using cross-sectional data from 108 countries, classified by daily prayer intensity into those with less than 50% (low) and those with more than 50% (high). Causal inference methods, namely propensity score matching and difference-in-differences, are employed to determine the impact of prayer intensity across these groups. The results indicate that a unit increase in variables such as continental effects, population growth rate, life expectancy, and the Gini index is associated with a reduction in GDP per capita of up to 6.32, while total factor productivity (TFP) may increase by up to 232.43. Individually, factors such as Global Innovation Index, labour force participation, Gini index, number of universities in

the top 1000 (Top1000) and growth in GDP can reduce the propensity score of prayer intensity by up to 21.8% whereas, whereas collectively they can reduce the score by 8.6%. As changes occur, differences between countries widen, and prayer intensity does not provide any meaningful solution to the development challenge.

Keywords: prayer intensity, propensity scores, regime type, income grouping, social and economic development, causal inference

Introduction

The role of religion in socio-economic development, growth and progress in a constantly evolving world requires further examination. In the last few years, expressions of faith and religious belief have become more prominent. There is a growing concern as to whether people are over-relying on divine intervention to drive development and growth, rather than pursuing self-reliant and objective economic strategies. Hence, there is a need to constantly evaluate their impact on global development irrespective of status, faith, colour and creed (The Lutheran World Federation, 2013; Nurrachmi, 2018; Ogbonnaya, 2012; United Nations, 2008).

The major aim of this research is to unravel the inter-relationship between the level of religiosity and socio-

economic development on a global scale, disaggregated by regime type and continent. The specific research questions include:

- i. What is the relationship between prayer intensity and GDP per capita, agricultural total factor productivity (TFP) and labour force participation (LFP) rate based on regime type and continent?
- ii. What is the impact of prayer intensity on GDP per capita, TFP and LFP based on regime type and continent?

The study is predicated on the relationship between religiosity and economic development (Fig. 1), i.e., religiosity can influence economic outcomes through financial development, entrepreneurship, and social capital, although the direction and magnitude of

this influence depend on institutional and regional contexts (Ohene Kwatia et al., 2024; Aprilliantoni, 2024). Furthermore, economic conditions and human capital interact with religious behaviour in a complex, two-way relationship within development processes (Alfonsi et al., 2024).

Theory

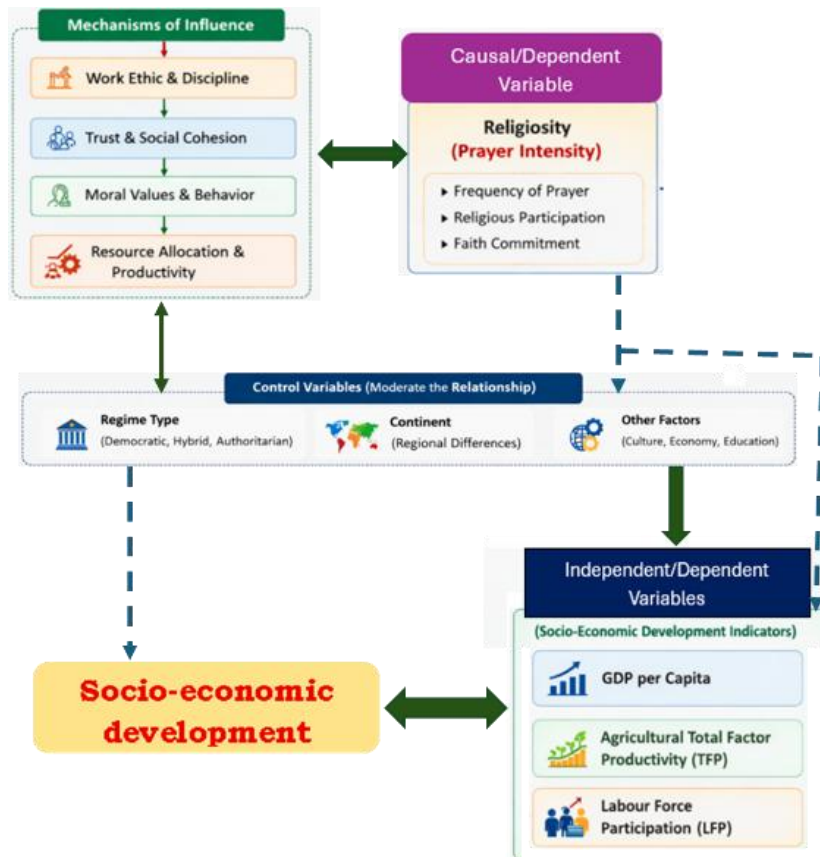
This study is grounded in a multi-disciplinary approach, combining sociological theory, cultural anthropology, religious studies and economics to analyse the multifaceted effects of religious engagement, such as prayer intensity, on social and economic development globally. The study examines how variations in religious engagement, such as intensity of prayer, influence key socio-economic indicators, including income levels, education,

healthcare, and social cohesion. While previous studies have suggested a relationship between religion and development, few have examined the specific impact of prayer intensity on economic and social outcomes. This inter-relationship has been explored through various theoretical lenses, particularly the Weberian Theory of Religion (Weber, 1930) as well as the Social Capital Theory (Inglehart & Baker, 2000; Putnam, 2000).

The analytical framework for this study is built upon the concept of causal inference. This approach seeks to identify the cause-and-effect relationships between prayer intensity and socio-economic development variables such as income, education, health, social cohesion, etc.

Figure 1: Conceptual framework of the influence of prayer intensity on socio-economic development

The framework relies on both theoretical reasoning and empirical data analysis to uncover the pathways through which prayer intensity influences socio-economic outcomes. This framework integrates economic, social, and religious factors and identifies pathways through which prayer intensity might influence both positive and negative socio-economic outcomes. These methods are



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intensity while controlling for confounding variables such as education, income levels, governance, and cultural factors.

Literature review

Studies show a mixed but significant relationship between religious practices and economic outcomes. In a study of 59

countries, Barro and McCleary (2003) found that higher levels of religious adherence are associated with economic growth. Similarly, Guiso et.al. (2003) found that religion positively influences economic attitudes such as cooperation, work ethic, and trust. However, the type of religious adherence matters—cultures that promote hard work (Guiso et. al., 2006) and discipline (e.g., Protestantism) often see more pronounced positive economic outcomes than those that emphasise collective religious rituals without individual responsibility. For instance, Noland (2005) pointed out that excessive religious adherence may detract from economic development by prioritising spiritual pursuits over material well-being. Furthermore, high levels of religious adherence can have mixed effects, promoting values that may be incompatible with modern economic growth (Barro & McCleary, 2003). Countries like the United States have historically shown high levels of religious engagement alongside robust economic growth, whereas others like Nigeria exhibit strong religious adherence with less visible economic benefits (Sacks, 2007). This suggests that the relationship between religion and economic development is complex and may be

mediated by other socio-political factors. Similarly, McCleary (2008) is of the view that an increase in the cost of religious activities would reduce GDP per capita. Hence, people will participate less in religious activities if their time is more valuable to them.

Cultural factors, intertwined with religious practices, significantly shape socio-economic development. The intensity of prayer can reflect broader cultural attitudes toward work, wealth, and social mobility. For instance, countries in the Middle East and Africa with high levels of prayer intensity often have strong community cohesion, but face challenges related to economic development due to rigid cultural traditions, political instability, or governance issues (Tawney, 1926), whereas countries such as South Korea, where Christianity has a strong influence, have witnessed rapid economic development (Cho, 2002). Cultural factors related to religion significantly affect socio-economic outcomes. For instance, in many traditional societies, high levels of religiosity can reinforce patriarchal norms (Inglehart & Baker, 2000).

Religious and cultural factors are deeply embedded in the socio-economic fabric of many countries. For example, zakat (charity) and restrictions on interest-based lending in Islamic countries (Kuran, 2004), as well as work ethics and charitable practices in Christian nations, play important roles. Others include the provision of social services like education and healthcare (Marshall, 2013). In sub-Saharan Africa, faith-based organisations provide nearly 50% of healthcare services, which directly influences socio-economic outcomes. Strict religious adherence in some countries has been associated with more traditional views on women's participation in the workforce (Seguino, 2011). In Southeast Asia, Confucianism blends spirituality with practicality and economic dynamism. Meanwhile, in Latin American countries with strong Catholic traditions, prayer intensity often intersects with socio-political factors (Inglehart & Baker, 2000). While some researchers argue that economic growth should be broadened to include cultural determinants (NBER, 2003), others focus broadly on religious adherence (Levin, 2013).

Despite growing research on religion and development, gaps remain in

understanding the actual effects of religious intensity on socio-economic outcomes across different regions. While the link between general religious adherence and socio-economic outcomes has been studied, few have isolated prayer intensity as a variable affecting social and economic outcomes. This study analyses the intensity of prayer practices in selected countries and their direct correlations with development indicators. In addition, most studies focus on Western or predominantly Christian countries, with limited research in Islamic, Hindu, or multi-religious contexts. The effect of prayer intensity on socio-economic outcomes may differ significantly based on cultural and religious backgrounds. Therefore, this study includes diverse countries in the analysis to determine the effect of time spent in prayer on productivity, innovation, and economic performance, which remains unclear. For instance, how does religious intensity in predominantly Muslim or Buddhist countries compare to Christian or secular societies? In the same manner, there is limited research on how religious intensity influences technological innovation, a key driver of economic development. There is also limited understanding of how exactly

prayer intensity influences socio-economic factors. Is it through increased social capital, mental health, or other mechanisms? This is an area requiring further investigation, which this study explores. The pathways through which prayer intensity impacts education, health, income inequality, and governance are investigated. In view of the enumerated research gaps above, the following hypotheses are proposed to adequately investigate the stated objectives of this study:

- H₁: There is no difference in TFP of selected countries with low and high prayer intensity
- H₂: There is no difference in the GDP of selected countries with low and high prayer intensity
- H₃: There is no difference in the LFP rate of selected countries with low and high prayer intensity
- H₄: There is no difference in the crime rate of selected countries with low and high prayer intensity
- H₅: There is no difference in the Top 1000 of selected countries with low and high prayer intensity.

Materials and methods

The research concerns 258 countries and independent territories divided into nine continents/regions and five different regime types. The countries that have not been given Democracy Index by the Economic Intelligence Unit (2022) are termed an unclassified regime type. To adequately address the aim and specific objectives of the research, data were solicited from the sources presented in Table 1.

The data were analysed for causal inference using propensity matching and difference-in-difference (DiD, linear) regression. To estimate the treatment effect, the treatment variable was created using the 108 countries that have reported the percentage of daily prayer participation by the Pew Research Centre (PEW, 2023) as the experimental countries, while the remaining 150 countries that did not have a daily prayer index were the non-experimental countries. The experimental countries used in the estimation were further divided into those with high prayer intensity (daily prayer ≥ 50) and those with low prayer intensity (daily prayer < 50). The probability that being experimental, a country is positively related to the key objective variables, and

some cofounders were determined before and after performing propensity matching. The propensity matching is necessary to reduce bias and to align measured covariates with the unmatched observations.

The estimations are carried out in stages in line with Austin (2011), Greifer (2024), and McGowan et al. (2023). Stage one involves the estimation of propensity scores of experimental countries across various variables using a logit modelling technique. Stage two involves using the propensity scores to estimate the various types of treatment effects using some enhanced procedures and subsequently estimating the impacts of each variable. In stage three, the propensity scores were used to estimate the DiD models after

matching. The data distribution characteristics, matching properties and cumulative probability distribution, which provide insight into all the variables in this research, are all presented in Tables 2, 3 and 4.

All the distributions, visualisation, estimations and hypothesis testing are carried out using the R programming language (vers. 4.3.2, R Core Team, 2023) employing various functions developed for different tasks, for example, Ho et al. (2011) for propensity matching; Makowski et al. (2019) for correlation analysis and network visualisation; Nmadu, (2024) for modelling and treatment effects estimation; Wickham, (2016) for visualization

Table 1: Data description and their sources

Variable	Description	Proxy	Source
Country	Names of countries		World Bank/FAOSTAT https://www.fao.org/faostat/en/#data/OA
Continent	The continent in which the country falls	Continent	World Bank/FAOSTAT https://www.fao.org/faostat/en/#data/OA
daily prayer	Per cent of those who say prayers daily	Intensity of religious commitments	Pew Research Centre www.pewresearch.org

TFP	Total factor productivity (1961-2022)	Land productivity	https://www.ers.usda.gov/data-products/international-agricultural-productivity/
GDP capita	GDP per capita (2022)	Welfare	World Bank/FAOSTAT https://www.fao.org/faostat/en/#data/MK
GDP growth	Average growth of GDP recorded (1961-2022)	Growth and progress of the economy	World Bank/FAOSTAT https://www.fao.org/faostat/en/#data/MK
Population	Per cent share of global population (2022)	Does belief increase population?	World Bank/FAOSTAT https://www.fao.org/faostat/en/#data/OA
Democracy index	index of democracy (2021)	Level of civil liberty and freedom to innovation	Economist Intelligence Unit
Crime index	index of crime (2023)	Level of crime	https://www.worldometers.info/
Life Expectancy	life expectancy (2022)	Impact of welfare	https://www.worldometers.info/
Top1000	No of top 1000 universities per country (2022)	The degree to which the country is relying on technology	https://webometrics.info/en
Gini	Distribution of wealth (2022)	Wealth distribution	World Bank/FAOSTAT https://data.worldbank.org/
Poverty	National headcount of poverty (2022)	Level of poverty	World Bank/FAOSTAT https://data.worldbank.org/

LFP	labour force participation rate (2022)	The level to which relying on hard work can initiate progress	World Bank/FAOSTAT https://www.fao.org/faostat/en/#data/OEA
Democracy	The type of regime in place in each country based on the index of democracy (2023)	Level of democracy	Nmadu et al., (2023)
Income grouping	Classification of countries based on the level of income	Level of income	World Bank/FAOSTAT https://data.worldbank.org/
Global Innovation Index (GII)	Level of technology and innovation (2022)	Level of innovation	World Intellectual Property Organisation (www.wipo.int)

Table 2: Distribution and Summary of matching statistics of all respondents

Variable	Non-experimental	Experimental
All (ESS)	150.00	108.00
All	150.00	108.00
Matched (ESS)	108.00	108.00
Matched	108.00	108.00
Unmatched	42.00	0.00
Discarded	0.00	0.00

Table 3: Summary statistics of variables before and after propensity matching

	After matching						Before matching					
Variable	1*	2	3	4	5	6	1	2	3	4	5	6
N	50	16	53	21	14	62	59	20	55	21	14	89
Prayer intensity (mean (SD))	0.62 (0.49)	0.75 (0.45)	0.70 (0.46)	0.76 (0.44)	0.86 (0.36)	0.00 (0.00)	0.53 (0.50)	0.60 (0.50)	0.67 (0.47)	0.76 (0.44)	0.86 (0.36)	0.00 (0.00)
continent (%)												
Africa	19 (38.0)	5 (31.2)	5 (9.4)	1 (4.8)	8 (57.1)	7 (11.3)	27 (45.8)	8 (40.0)	6 (10.9)	1 (4.8)	8 (57.1)	9 (10.1)
Antarctica	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	3 (4.8)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	3 (3.4)
Asia	7 (14.0)	2 (12.5)	9 (17.0)	3 (14.3)	2 (14.3)	3 (4.8)	7 (11.9)	3 (15.0)	9 (16.4)	3 (14.3)	2 (14.3)	7 (7.9)
CIS	8 (16.0)	2 (12.5)	1 (1.9)	0 (0.0)	1 (7.1)	1 (1.6)	8 (13.6)	2 (10.0)	1 (1.8)	0 (0.0)	1 (7.1)	1 (1.1)
Europe	0 (0.0)	1 (6.2)	23 (43.4)	12 (57.1)	0 (0.0)	11 (17.7)	0 (0.0)	1 (5.0)	23 (41.8)	12 (57.1)	0 (0.0)	13 (14.6)
Middle East	12 (24.0)	0 (0.0)	1 (1.9)	0 (0.0)	1 (7.1)	2 (3.2)	13 (22.0)	0 (0.0)	1 (1.8)	0 (0.0)	1 (7.1)	3 (3.4)
North America	0 (0.0)	0 (0.0)	1 (1.9)	1 (4.8)	0 (0.0)	2 (3.2)	0 (0.0)	0 (0.0)	1 (1.8)	1 (4.8)	0 (0.0)	5 (5.6)
Oceania	0 (0.0)	1 (6.2)	1 (1.9)	2 (9.5)	0 (0.0)	14 (22.6)	0 (0.0)	1 (5.0)	1 (1.8)	2 (9.5)	0 (0.0)	16 (18.0)
South America	4 (8.0)	5 (31.2)	12 (22.6)	2 (9.5)	2 (14.3)	19 (30.6)	4 (6.8)	5 (25.0)	13 (23.6)	2 (9.5)	2 (14.3)	32 (36.0)
Income grouping (%)												
High income	5 (10.0)	1 (6.2)	23 (43.4)	18 (85.7)	0 (0.0)	15 (24.2)	6 (10.2)	1 (5.0)	23 (41.8)	18 (85.7)	0 (0.0)	28 (31.5)

Lower middle income	16 (32.0)	8 (50.0)	11 (20.8)	0 (0.0)	6 (42.9)	8 (12.9)	18 (30.5)	10 (50.0)	12 (21.8)	0 (0.0)	6 (42.9)	9 (10.1)
Upper middle income	14 (28.0)	4 (25.0)	18 (34.0)	2 (9.5)	3 (21.4)	8 (12.9)	16 (27.1)	4 (20.0)	18 (32.7)	2 (9.5)	3 (21.4)	10 (11.2)
Low income	14 (28.0)	3 (18.8)	0 (0.0)	0 (0.0)	5 (35.7)	2 (3.2)	18 (30.5)	5 (25.0)	0 (0.0)	0 (0.0)	5 (35.7)	2 (2.2)
Not classified	1 (2.0)	0 (0.0)	1 (1.9)	1 (4.8)	0 (0.0)	29 (46.8)	1 (1.7)	0 (0.0)	2 (3.6)	1 (4.8)	0 (0.0)	40 (44.9)
daily prayer (mean (SD))	37.92 (36.7 6)	46.88 (31.6 0)	29.81 (28.0 3)	16.29 (17.7 4)	57.79 (30.1 3)	0.00 (0.00)	32.14 (36.4 8)	37.50 (34.0 3)	28.73 (28.0 8)	16.29 (17.7 4)	57.79 (30.1 3)	0.00 (0.00)
TFP (mean (SD))	88.54 (30.5 2)	85.68 (33.2 4)	85.96 (34.6 1)	82.44 (13.9 9)	84.24 (13.6 3)	18.84 (43.4 3)	90.64 (32.2 6)	89.16 (32.8 7)	86.08 (34.0 9)	82.44 (13.9 9)	84.24 (13.6 3)	15.89 (39.1 7)
GDP Capita (mean (SD))	0.14 (0.26)	0.10 (0.18)	0.29 (0.27)	0.98 (0.46)	0.07 (0.06)	0.46 (0.77)	0.14 (0.25)	0.09 (0.16)	0.29 (0.27)	0.98 (0.46)	0.07 (0.06)	0.60 (0.80)
GDP growth (mean (SD))	8.69 (3.00)	7.34 (1.28)	7.33 (1.84)	7.56 (1.76)	7.23 (1.24)	4.37 (4.33)	8.71 (3.00)	7.42 (1.24)	7.34 (1.80)	7.56 (1.76)	7.23 (1.24)	4.78 (4.75)
pop_rate (mean (SD))	0.61 (2.13)	0.24 (0.43)	0.61 (2.09)	0.25 (0.34)	0.71 (0.78)	0.03 (0.19)	0.52 (1.97)	0.21 (0.39)	0.59 (2.06)	0.25 (0.34)	0.71 (0.78)	0.19 (1.58)
Democracy index (mean (SD))	2.67 (0.84)	5.29 (0.52)	6.55 (1.73)	8.78 (0.50)	5.07 (0.65)	0.10 (0.76)	2.65 (0.82)	5.16 (0.61)	6.57 (1.70)	8.78 (0.50)	5.07 (0.65)	0.07 (0.64)
Crime index (mean (SD))	5.56 (1.52)	5.01 (1.83)	4.99 (1.55)	4.08 (1.23)	6.12 (1.07)	1.47 (1.89)	5.44 (1.46)	4.99 (1.67)	4.97 (1.53)	4.08 (1.23)	6.12 (1.07)	1.19 (1.79)
Life Expectancy (mean (SD))	69.87 (6.78)	71.12 (6.34)	75.81 (6.42)	82.33 (2.10)	69.25 (7.02)	58.67 (32.5 5)	69.04 (7.06)	69.75 (6.69)	75.87 (6.31)	82.33 (2.10)	69.25 (7.02)	59.31 (32.5 9)
Top1000 (mean (SD))	3.22 (16.5 0)	0.38 (1.50)	9.09 (33.4 4)	15.81 (19.6 3)	1.07 (2.43)	0.02 (0.13)	2.73 (15.2 1)	0.30 (1.34)	8.82 (32.8 5)	15.81 (19.6 3)	1.07 (2.43)	0.01 (0.11)
Gini (mean (SD))	29.80 (16.9 1)	39.50 (13.0 9)	37.21 (13.2 1)	29.11 (10.9 3)	40.49 (6.91)	9.81 (16.9 0)	29.97 (17.9 1)	39.69 (11.6 9)	37.55 (13.0 8)	29.11 (10.9 3)	40.49 (6.91)	8.02 (16.2 8)
Poverty (mean (SD))	23.52 (18.1 1)	35.90 (17.3 4)	19.25 (13.0 7)	10.08 (7.31)	32.20 (16.9 8)	8.10 (16.5 5)	26.95 (21.4 9)	35.85 (16.5 9)	20.01 (13.4 7)	10.08 (7.31)	32.20 (16.9 8)	6.16 (14.8 9)

LFP (mean (SD))	58.26 (17.48)	64.24 (10.93)	56.90 (12.89)	60.60 (14.70)	57.84 (11.55)	15.46 (27.07)	59.04 (16.95)	64.45 (9.90)	57.01 (12.66)	60.60 (14.70)	57.84 (11.55)	15.83 (27.48)
Unemployment (mean (SD))	6.66 (5.65)	6.56 (5.51)	9.21 (5.66)	5.91 (2.40)	7.01 (4.04)	2.90 (6.18)	6.94 (6.00)	6.07 (5.12)	9.28 (5.57)	5.91 (2.40)	7.01 (4.04)	2.93 (5.97)
Global innovation index (mean (SD))	15.48 (13.79)	19.28 (13.14)	31.58 (16.71)	49.63 (15.64)	22.28 (9.34)	0.83 (4.59)	13.82 (13.79)	17.14 (13.09)	31.36 (16.44)	49.63 (15.64)	22.28 (9.34)	0.58 (3.84)

*1= Authoritarian, 2 = Authoritarian Hybrid, 3 = Democracy Flawed, 4 = Democracy Full, 5 = Hybrid Democracy, 6 = Unclassified

Table 4 Disaggregated eCDF* of experimental and non-experimental samples

Variable	Means Experimental	Means Non-experimental	Std. Mean Diff.	Var. Ratio	eCDF Mean	eCDF Max	Std. Pair Dist.
Distance	1.00	0.00	4.6E+09	1.07	0.87	1.00	4.6E+09
daily prayer	49.79	0.00	1.83	9.6E+23	0.52	1.00	1.83
TFP	84.91	48.72	1.48	0.20	0.17	0.50	2.33
GDP capita	0.28	0.40	-0.31	0.33	0.04	0.12	1.17
LFP	58.84	33.72	1.82	0.19	0.21	0.44	2.50
Top1000	8.75	0.48	0.30	251.94	0.14	0.34	0.31
Crime index	5.34	2.85	1.75	0.34	0.32	0.53	2.25
Population	0.70	0.07	0.30	122.24	0.38	0.63	0.33
GDP growth	7.64	5.99	0.85	0.21	0.12	0.27	1.92
Democracy index	5.54	2.11	1.47	0.64	0.34	0.58	1.87
Life Expectancy	73.95	64.80	1.24	0.08	0.06	0.15	2.28
Gini	36.94	17.51	1.78	0.30	0.23	0.52	2.33

Poverty	22.98	13.46	0.65	0.56	0.18	0.47	1.55
Unemployment	7.68	4.62	0.62	0.60	0.23	0.46	1.39
Global innovation index	29.56	8.97	1.18	1.19	0.31	0.61	1.46
Continent-Africa	0.24	0.18	0.15		0.06	0.06	0.76
Continent-Antarctica	0.00	0.03	-0.26		0.03	0.03	0.26
Continent-Asia	0.10	0.14	-0.12		0.04	0.04	0.61
Continent-CIS	0.10	0.02	0.28		0.08	0.08	0.40
Continent-Europe	0.28	0.16	0.27		0.12	0.12	0.85
Continent-Middle East	0.06	0.08	-0.08		0.02	0.02	0.60
Continent-North America	0.02	0.02	0.00		0.00	0.00	0.04
Continent-Oceania	0.03	0.14	-0.68		0.11	0.11	1.01
Continent-South America	0.17	0.24	-0.20		0.07	0.07	0.80
Democracy-Authoritarian	0.29	0.18	0.25		0.11	0.11	0.74
Democracy-Authoritarian-Hybrid	0.11	0.04	0.24		0.07	0.07	0.47
Democracy-Democracy-Flawed	0.34	0.15	0.41		0.19	0.19	0.88
Democracy-Democracy-Full	0.15	0.05	0.29		0.10	0.10	0.44

Democracy-Hybrid-Democracy	0.11	0.02	0.29		0.09	0.09	0.35
Democracy-Unclassified	0.00	0.57	-1.53		0.57	0.57	1.53
Income grouping-High income	0.31	0.27	0.08		0.04	0.04	0.80
Income grouping-Upper middle income	0.29	0.17	0.27		0.12	0.12	0.76
Income grouping-Lower middle income	0.28	0.18	0.23		0.10	0.10	0.81
Income grouping-Low income	0.13	0.09	0.11		0.04	0.04	0.61
Income grouping-Not classified	0.00	0.30	-0.85		0.30	0.30	0.85

*eCDF = Empirical Cumulative Distribution Function

Results

In addition to all the facts presented in Tables 2, 3 and 4, Fig. 2 shows the spatial distribution of countries based on regime type, while Fig. 3 also shows the spatial distributions of countries based on key variables in this study, and Fig. 4 shows the spatial distribution of the various countries based on their experimental status. Fig. 5 shows the religious

composition of the top 15 prayerful countries in the world, whereas Fig. 6, Fig. 7 and Fig. 8 are the distribution of key variables disaggregated based on regime type, continent and income levels. The data distribution in Tables 1 and 2, which show the matching summary and the distribution of all the variables in this study, are closely related to the visuals presented in Fig. 2 to Fig. 8.

A closer examination of Fig. 2 reveals that Norway, Finland and ten other Western European countries, Canada and two other countries in the Americas, Taiwan and two other Asian countries, New Zealand and Australia in Oceania, as well as Mauritius in Africa, are classified as full democracies. All other countries, including the United States (US), are either flawed, hybrid or authoritarian. On the other hand, Fig. 3 shows that Afghanistan is the most prayerful nation, followed by Nigeria; China is the least prayerful country. China is the most populous country, followed by India. Namibia has the highest TFP, while the US is the largest economy, closely followed by China. It could also be observed in Fig. 4 that countries in the West, Africa and the Middle East exhibit higher prayer intensity than the countries in the East. Note should be taken of Africa, in which all the countries with daily prayer entries exhibited high prayer intensity, except Angola, although Africa is the least developed continent in the

world. The effects of this distribution will be further examined shortly.

On Fig. 5, of the top 15 prayerful countries in the world, five are in the Middle East and Asia, eight are in Africa, and two are in the Americas. In the same vein, only three countries: Iran, Indonesia and the Philippines have Top1000. Also, the Philippines, Indonesia and Iran have an innovation index above 25. The implication of this finding would be clearer as other results unfold.

In terms of regime type (Fig. 6), the most prayerful are those practising a hybrid democracy, while the least prayerful are practising full democracy. It is remarkable to note that an authoritarian regime has the highest TFP and LFP, while full democracies have the highest GDP per capita. Hybrid democracies exhibit the highest crime index, whereas both full democracies and hybrid regimes have the highest innovation index.

Figure 2: Spatial Distribution of counties under different regime types

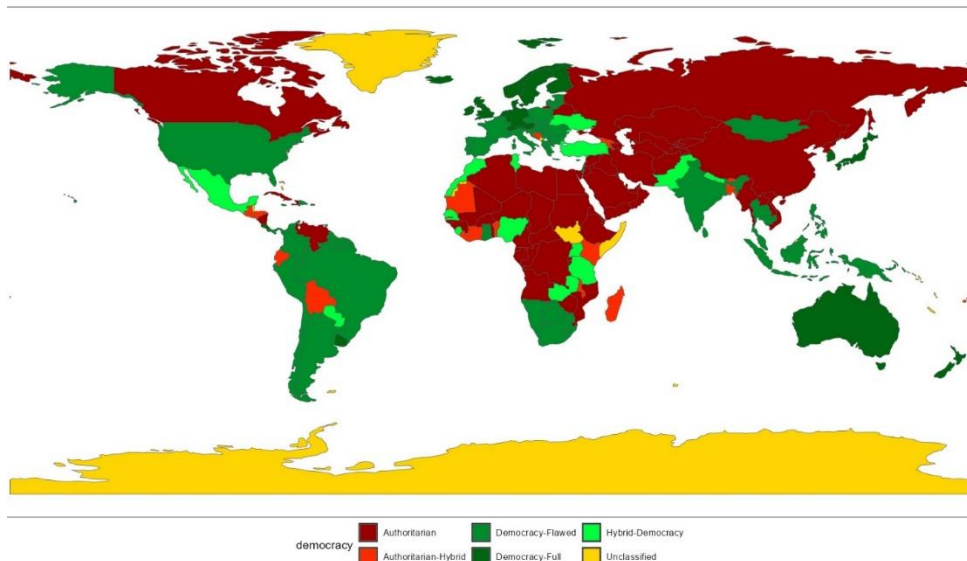


Figure 3: Spatial distribution based on some key variables in this study

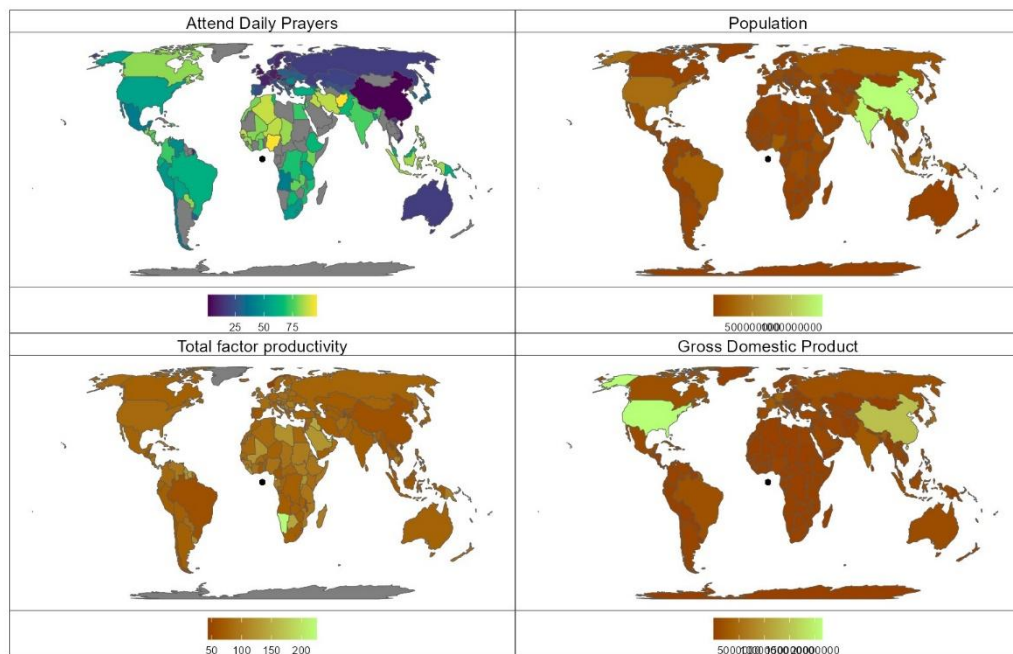


Figure 4: Spatial distribution of countries based on experimental status

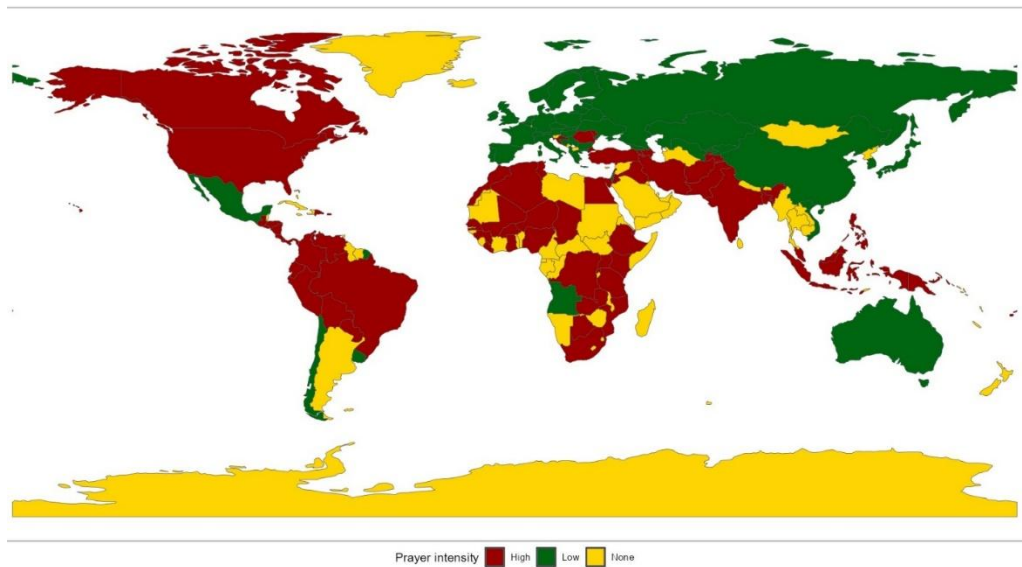


Figure 5: The top 15 prayerful countries along with their GII and Top1000

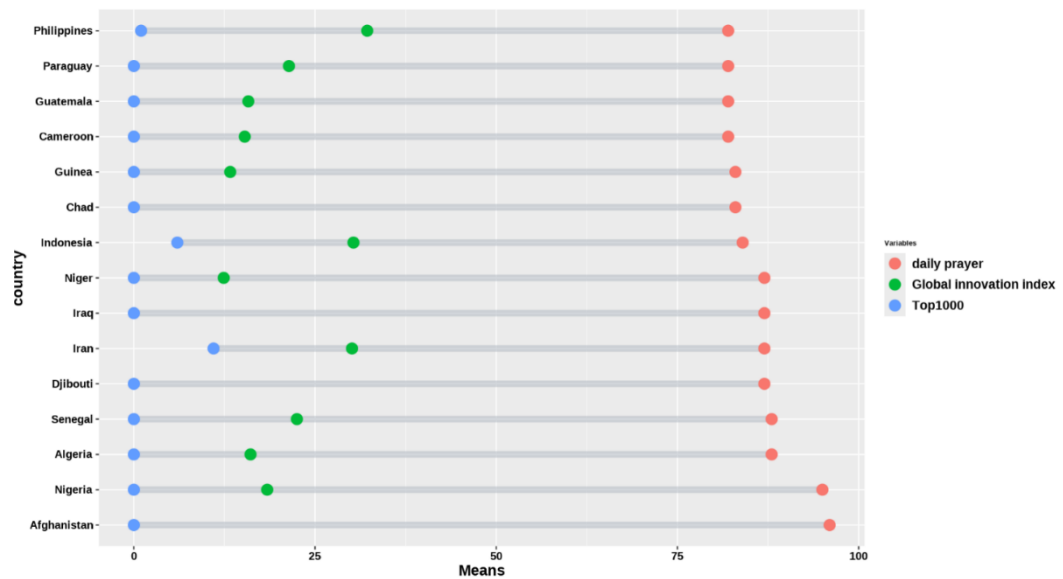


Figure 6: Key variables disaggregated based on the regime type

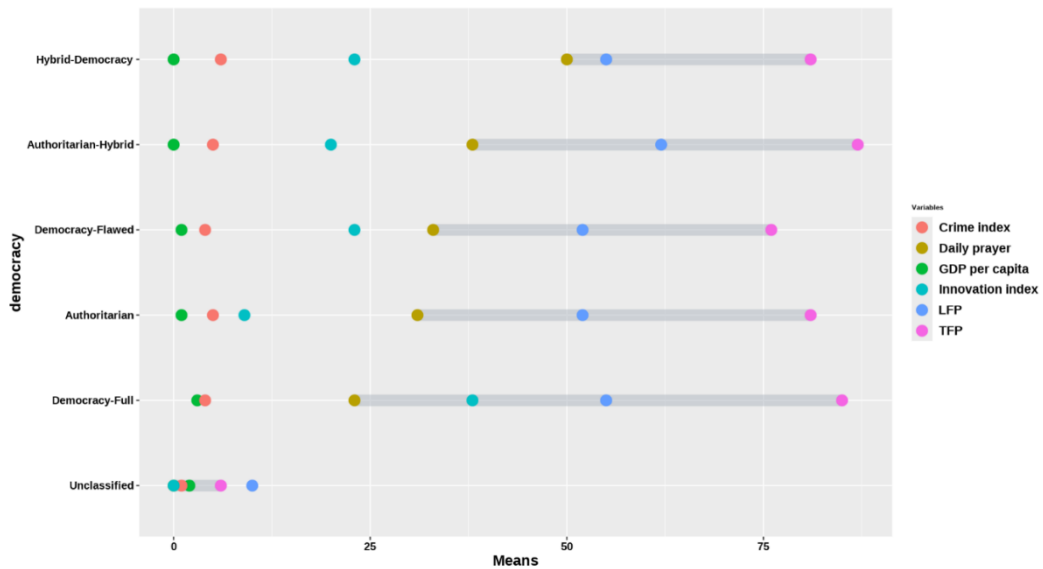


Figure 7: Key variables disaggregated into the various continents

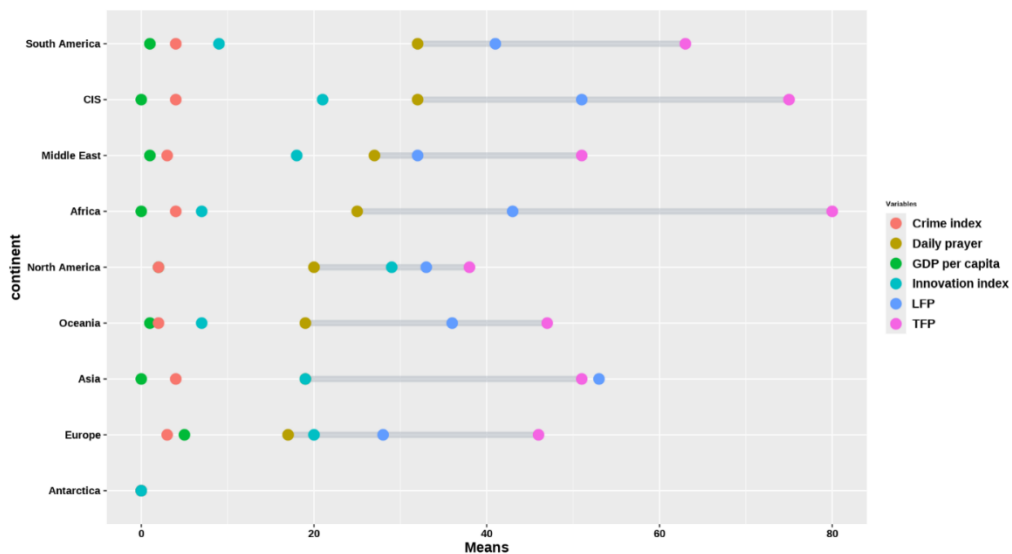
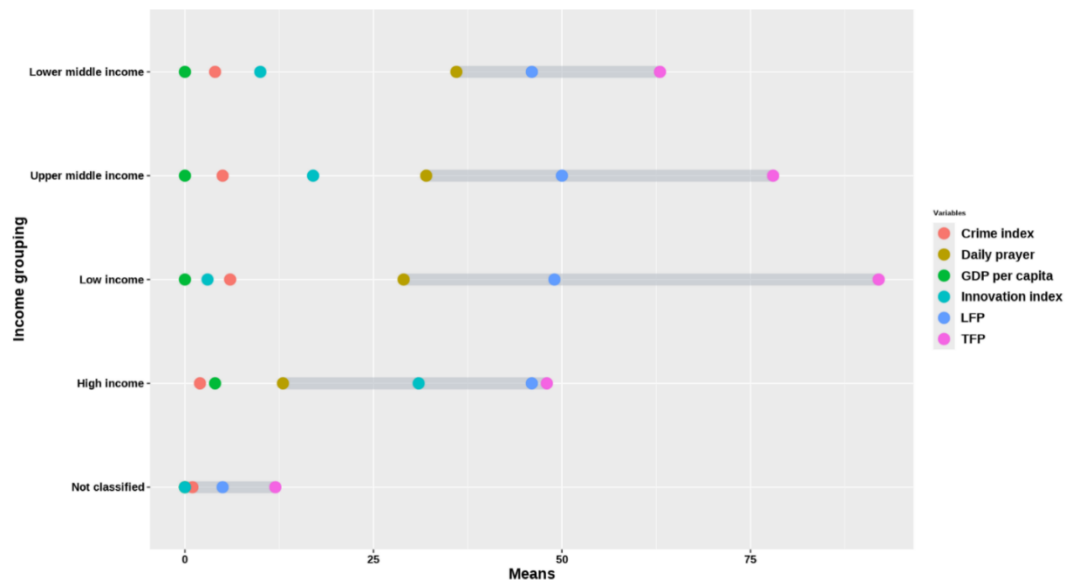


Figure 8: Key variables disaggregated into the various income groups



In Fig. 7, CIS and South America say the most daily prayers, whereas Africa has the highest TFP, and North America has the largest GDP per capita. Similarly, CIS has the highest LFP, while CIS, South America, Africa and Asia jointly had the highest crime index. In the same vein, North America, CIS and Europe had the highest innovation index, respectively.

It is quite remarkable to note that lower middle-income countries say the highest number of daily prayers, whereas the high-income countries say the least

prayers but have the largest GDP per capita and the highest innovation index (Fig. 8). Low-income countries have the highest TFP and crime index, whereas the situation also reveals that upper middle-income countries have the highest LFP. The full analysis will reveal the causal effects of prayerfulness on development and growth, and will provide a basis for accepting or rejecting the various null hypotheses proposed.

Although the various highlights above are in line with the available data and distributional and matching characteristics (Tables 2, 3 and 4), the major task in this research is to investigate further how being a prayerful nation either accelerates or exacerbates socio-economic developments in the light of these results. Particularly, it is desirable to find out if prayer positively affects TFP, LFP and GDP per capita. These are key economic indices that show the progress a country or a region is making towards sustainable development and the improved welfare of the citizens, which is why the estimations presented in Tables 5 and 6 are very important for confirming these relationships and testing the stated hypotheses.

In order to isolate the factors that tend to promote socio-economic development or otherwise in the face of prayer intensity, propensity scores (Fig. 9a, b and c) of all the variables were estimated through which the various treatment effects were estimated as presented in Table 5. The impact of each variable was presented in Fig. 10, while the role played in the treatment effects by the individual variables is presented in Tables 6 and 7. The results in Table 5 show that the

experimental countries reacted to the treatment of prayer intensity or otherwise in a variety of ways but in significant manner (Table 7 also Fig. 11). The results in Table 7 indicated that all the variables acting individually can reduce propensity score by up to 21.8%, while acting collectively could reduce it by 8.6% due to significant variation in GII, LFP, the Gini index, Top1000 and GDP growth. This then means that the disparity in social and economic status of the experimental countries could continue to widen, as reflected in the current patterns observed among countries (see Fig. 2 and Fig. 6, Fig. 8a, b and c). However, it should be noted that the results in Fig. 8a, b and c also suggest that differences in the probability of prayer intensity either increasing or decreasing across countries within the same continent produce more systematic and pronounced changes in propensity scores than differences among countries within the same income group or regime type. So, prayer intensity does not in any way confer certain advantages on any of the countries in the experiment, but as changes occur, differences between countries would certainly widen. To foster development, more efforts are needed than prayer alone, particularly through variables that are

forward-looking, like Top1000, which can make development have a greater impact on the social and economic life of the citizens by way of research and development. In the same vein, the variables included in the DiD model could cause a fall in GDP per capita of up to 6.32, while a rise of up to 232.43 in TFP is possible. The variables that could cause a fall by their unit increase or unit change include countries in Asia, CIS, Europe, and the Middle East, population growth rate, life expectancy, and Gini index. The rise of TFP is consistent with future

development, but largely reflects natural resource endowments, particularly land. In this sense, the expected fall in GDP growth, which is forward-looking, is critical and should be prevented as much as possible. This then brings in the need for a sustainable population growth rate and goods and services produced with low capital and LFP, also pointing to the need to have research and development institutions that are well-funded and have the capacity to create new and better goods and services for the growing population

Table 5: Estimated treatment effects of the variables on experimental countries

Variable	ATE*	ATT	ATC	ATM	ATO
All	699.64	708.24	688.67	692.18	693.16
Gini	64.29	52.67	73.03	65.64	65.76
Poverty	36.44	22.51	46.32	31.04	31.67
GDP growth	15.38	14.24	15.99	14.34	14.75
Crime index	10.24	9.32	10.77	9.94	10.10
GDP per capita	23519.78	41092.84	7924.17	14359.10	14240.46
Unemployment	15.76	16.79	15.21	16.75	16.14
Population rate	1.42	1.35	1.46	1.35	1.38
Life Expectancy	150.13	158.53	145.29	154.34	153.94

Democracy index	10.00	13.34	8.60	12.50	11.95
Top1000	59.41	115.30	14.45	21.54	23.39
Global innovation index	73.20	98.98	50.07	69.79	69.54
Total Factor Productivity	167.05	161.10	170.32	161.86	164.43
Labour Force Participation	119.72	122.89	117.98	122.89	121.49

*ATE-Average Treatment Effect, ATT-Average Treatment Effect Among the Treated, ATC-Average Treatment Effect Among the Controls, ATM-Average Treatment Effect Among the Evenly Matchable, ATO-Average Treatment Effect Among the Overlap Population

Fig. 9a Propensity scores and fitted values of various continents

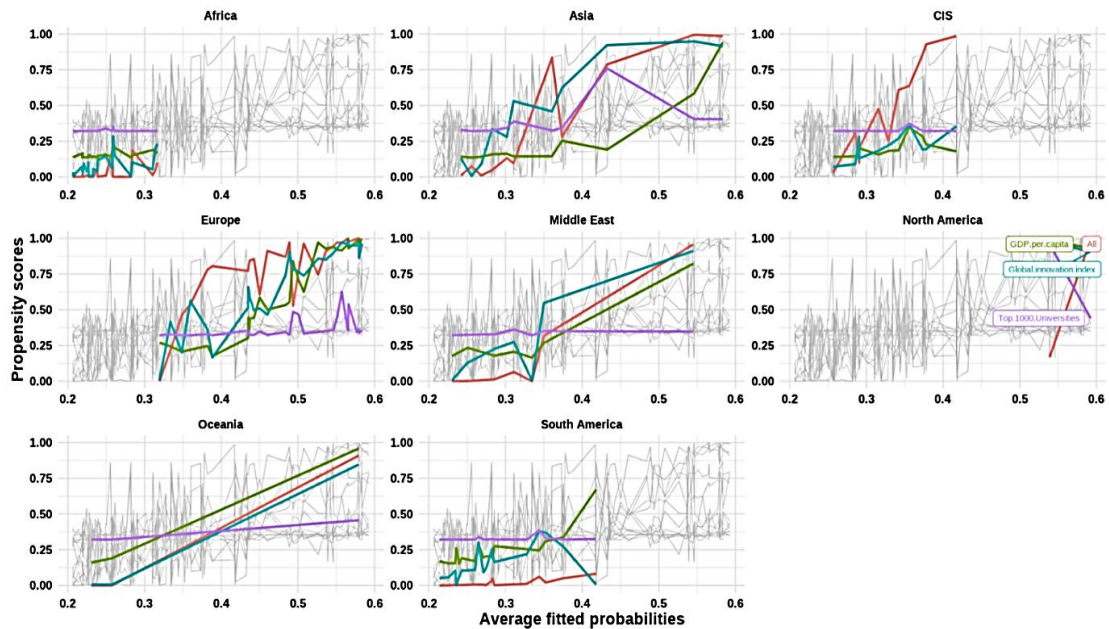


Fig. 9b Propensity scores and fitted values of various income groupings

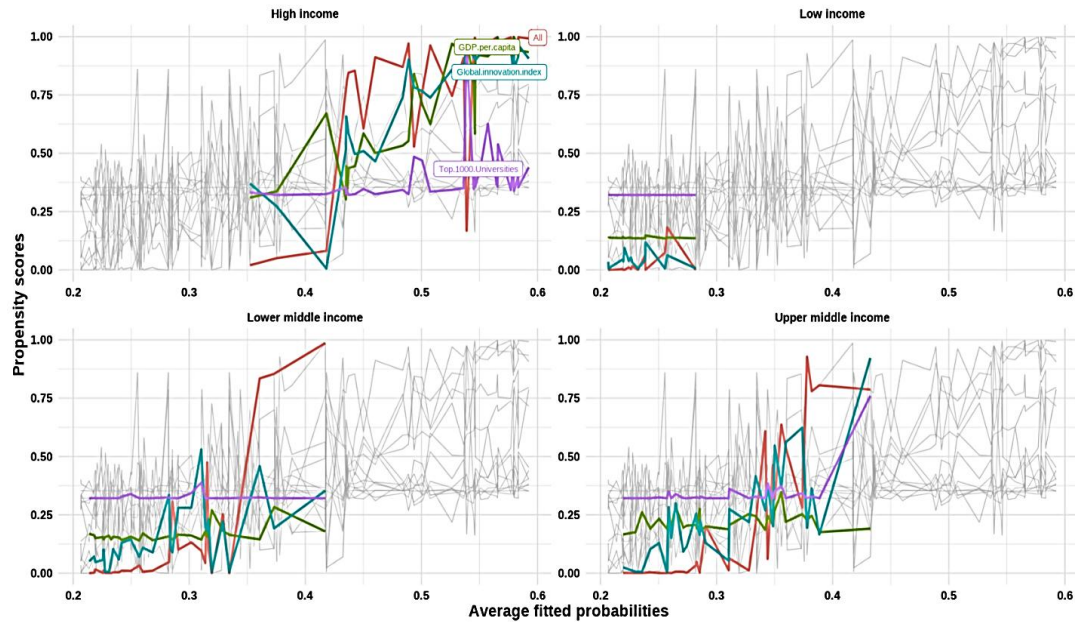


Fig. 9c Propensity scores and fitted values of various regime types

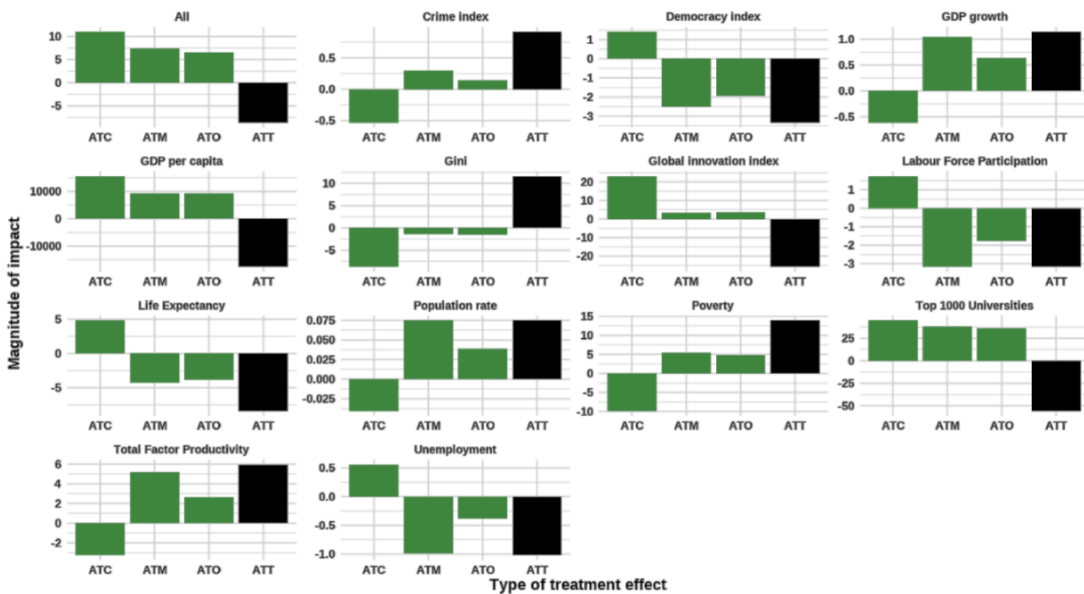


Fig. 10 Impacts created by the variables on experimental countries

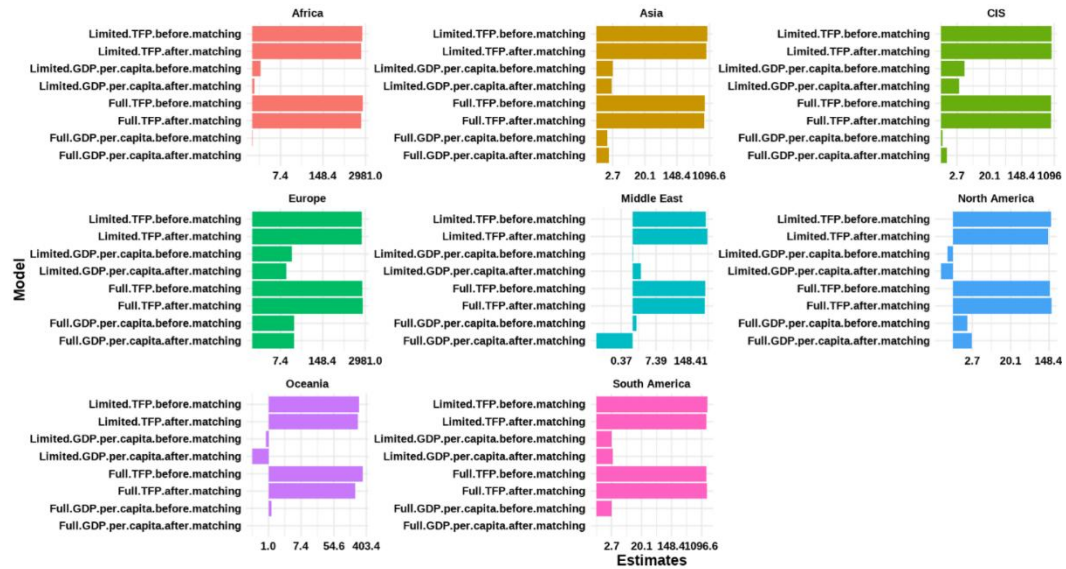


Table 6: Estimated coefficients of factors affecting propensity scores of experimental countries

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 14	All
(Intercept)	-	0.977	-	0.167	-	-	1.308**	1.817*	-	-	-	1.317	-	-8.603
	5.084***	(0.815)	3.754***	(0.759)	1.801+	0.602**	(0.457)	(0.867)	0.872*	0.749***	21.799***	(0.936)	1.913***	(13.823)
	(0.924)		(0.811)		(1.038)	(0.213)			(0.377)	(0.220)	(4.508)		(0.341)	
Global innovation index	0.137***													0.217**
	(0.026)													(0.080)
Crime index		-												0.238
		0.301*												(0.407)
		(0.150)												
Democracy index			0.527***											-0.195
			(0.123)											(0.322)
TFP				-0.009										-0.021
				(0.009)										(0.030)
LFP					0.020									0.161*
					(0.017)									(0.066)
pop_rate						-0.012								-0.046
						(0.101)								(0.209)
Poverty							-							-0.067
							0.095***							(0.060)
							(0.022)							

Gini								-0.067**						-0.174*
								(0.023)						(0.082)
Unemployment								0.034						0.110
								(0.040)						(0.128)
Top1000									0.016					-0.033*
									(0.011)					(0.016)
Life Expectancy										0.279***				0.061
										(0.058)				(0.169)
GDP growth											-0.258*			-0.609+
											(0.124)			(0.317)
GDP capita												0.000***		
												(0.000)		
GDP Capita														-1.845
														(2.659)
AIC	84.3	139.7	118.7	142.9	142.5	144.1	115.3	133.4	143.4	140.7	100.4	139.2	101.7	74.7
BIC	89.7	145.1	124.1	148.3	147.9	149.4	120.7	138.8	148.8	146.0	105.8	144.5	107.0	112.3
Log.Lik.	-	-	-	-	-	-	-	-64.725	-	-	-48.210	-	-48.836	-23.358
	40.158	67.871	57.372	69.464	69.266	70.040	55.664		69.702	68.336		67.576		
RMSE	0.34	0.47	0.41	0.48	0.48	0.48	0.42	0.45	0.48	0.46	0.39	0.47	0.37	0.24

Number Observations 108, $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7: Estimates of prayer intensity and socio-economic factors in experimental countries

Variables	Limited TFP after matching	Limited GDP per capita after matching	Full TFP after matching	Full GDP per capita after matching	Limited TFP before matching	Limited GDP per capita before matching	Full TFP before matching	Full GDP per capita before matching
(Intercept)	111.175*** (13.095)	1.364*** (0.309)	232.430*** (55.429)	-1.844** (0.579)	52.322** (15.949)	0.599** (0.199)	146.788* (64.486)	-0.071 (0.512)
daily prayer	-0.110 (0.125)	-0.007** (0.002)	0.322+ (0.173)	0.004* (0.002)	0.166 (0.174)	-0.006** (0.002)	0.096 (0.201)	0.000 (0.002)
GDP per capita	-11.473* (4.866)		-16.071 (11.061)		-3.856 (7.964)		2.796 (14.623)	
TFP		-0.004* (0.002)		-0.002 (0.001)		-0.001 (0.001)		0.000 (0.001)
LFP	-0.315 (0.190)	-0.006 (0.004)	-0.165 (0.257)	0.001 (0.003)	0.413* (0.169)	0.000 (0.002)	0.472+ (0.245)	0.000 (0.002)
Crime index			-1.330 (1.815)	0.061*** (0.017)			1.710 (2.199)	0.008 (0.017)
Top1000			0.017 (0.112)	-0.001 (0.001)			0.005 (0.134)	0.001 (0.001)
Experiment (low/high)	-5.895 (4.378)	-0.184* (0.085)	8.035 (5.188)	0.150** (0.050)	3.249 (9.460)	0.153 (0.116)	-1.461 (9.911)	-0.067 (0.076)
GDP growth			-0.980 (1.176)	-0.012 (0.012)			1.193 (1.698)	-0.002 (0.013)
Population rate			-0.857 (0.842)	-0.018* (0.008)			-0.432 (1.445)	-0.010 (0.011)
Democracy index			0.526 (2.136)	-0.041+ (0.021)			0.574 (2.710)	-0.008 (0.021)
Life Expectancy			-1.959** (0.027***)				-1.670* (0.007)	

Variables	Limited TFP after matching	Limited GDP per capita after matching	Full TFP after matching	Full GDP per capita after matching	Limited TFP before matching	Limited GDP per capita before matching	Full TFP before matching	Full GDP per capita before matching
			(0.659)	(0.006)			(0.794)	(0.006)
Gini			-0.824*	-0.016***			-0.069	-0.004
			(0.382)	(0.003)			(0.382)	(0.003)
Poverty			-0.289	-0.001			-0.270	0.002
			(0.229)	(0.002)			(0.266)	(0.002)
Unemployment			0.347	-0.007			2.635***	-0.006
			(0.549)	(0.005)			(0.584)	(0.005)
Global innovation index			0.904+	0.019***			-0.230	0.006*
			(0.479)	(0.004)			(0.419)	(0.003)
ContinentAsia			-4.078	-0.417***			9.632	-0.195*
			(10.110)	(0.090)			(12.635)	(0.095)
ContinentCIS			6.421	-0.160+			15.088	-0.092
			(8.678)	(0.086)			(12.673)	(0.098)
ContinentEurope			8.011	-0.299**			14.786	0.010
			(11.377)	(0.110)			(14.150)	(0.110)
ContinentMiddle East			-9.419	-0.347**			5.143	-0.046
			(10.970)	(0.104)			(13.921)	(0.107)
ContinentNorth America			-0.648	0.165			5.817	0.081
			(22.473)	(0.225)			(23.741)	(0.182)
ContinentOceania			0.083	-0.212			36.117*	0.067
			(14.744)	(0.146)			(17.280)	(0.136)
ContinentSouth America			27.714*	-0.230+			12.060	-0.086
			(12.043)	(0.122)			(12.231)	(0.094)
Income groupingLow income			11.576	0.132			2.261	-0.308*
Variables	Limited TFP after matching	Limited GDP per capita after matching	Full TFP after matching	Full GDP per capita after matching	Limited TFP before matching	Limited GDP per capita before matching	Full TFP before matching	Full GDP per capita before matching
			(13.477)	(0.135)			(16.664)	(0.123)
Income groupingLower middle income			-11.739	-0.043			-20.011	-0.235*
			(7.310)	(0.074)			(13.061)	(0.098)
Income groupingUpper middle income			6.582	-0.015			-12.484	-0.220**
			(5.478)	(0.055)			(10.963)	(0.081)
DemocracyAuthoritarianHybrid			14.453	0.306**			10.906	-0.020
			(10.358)	(0.099)			(11.329)	(0.088)
DemocracyDemocracyFlawed			-1.775	0.215*			-1.133	-0.005
			(10.300)	(0.101)			(12.312)	(0.095)
DemocracyDemocracyFull			10.866	0.577***			3.119	0.363**
			(15.842)	(0.146)			(18.242)	(0.134)
DemocracyHybridDemocracy			10.362	-0.015			3.324	-0.032
			(8.641)	(0.088)			(9.845)	(0.076)
R ²	0.078	0.140	0.745	0.938	0.077	0.410	0.441	0.862
Adj. R ²	0.043	0.106	0.655	0.917	0.041	0.387	0.243	0.813
AIC	1159.4	311.4	1068.5	74.6	998.6	49.7	992.4	-59.0
BIC	1175.5	327.5	1148.9	155.1	1014.7	65.8	1072.8	21.5
Log. Lik.	-573.725	-149.720	-504.243	-7.302	-493.321	-18.837	-466.186	59.507
F	2.193	4.185	8.265	43.021	2.138	17.863	2.229	17.567
RMSE	25.76	0.35	25.50	0.29	23.31	0.29	18.13	0.14

Number Observations 108, + p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

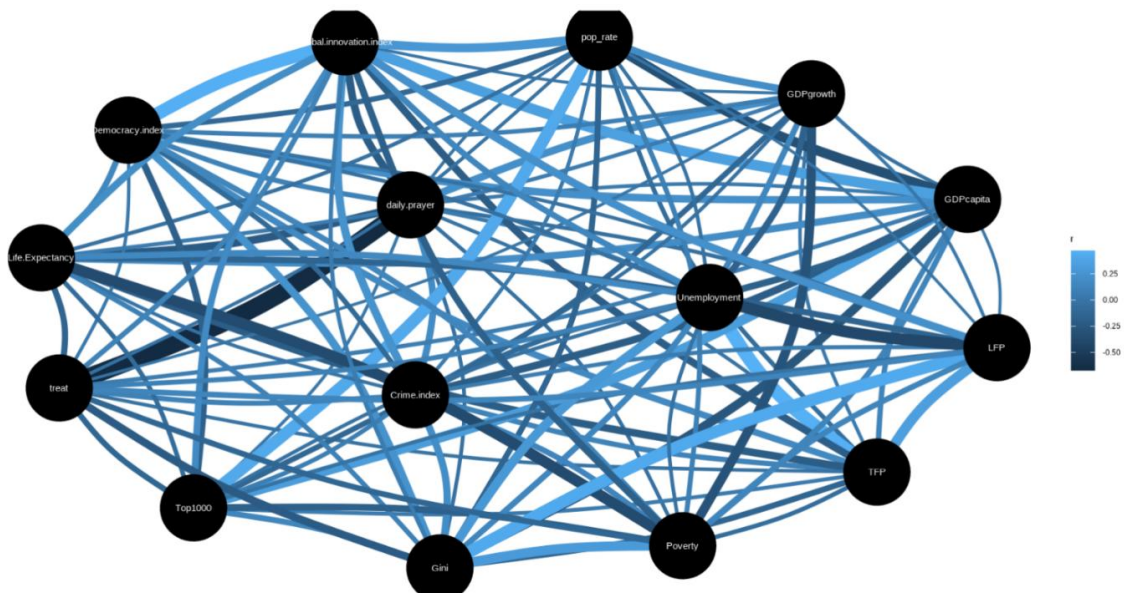
On the impacts of the variables on the treatment effects, the results in Fig. 9 show that all variables acting jointly, GDP per capita, unemployment, life expectancy, democracy index, Top1000, GII and LFP have negative impacts (Table 5), whereas Gini index, poverty status, GDP growth, crime index, population rate and TFP have positive impacts. The largest negative impacts were caused by variation in GDP per capita; therefore, GDP per capita, rather than religiosity, seems to be a better indicator of development and progress. This therefore reinforces the earlier assertion that we need a shift towards a development paradigm which is capable of enhancing personal welfare and social development, which also leads to national growth and progress. It is really contrary to a priori expectations that the crime rate exhibits positive impacts arising from high prayer intensity. However, this may reflect the complex ways in which religious behaviour interacts with social realities. What is needed are positive impacts driven by research and development, as well as improved and innovative technology. This is why Pureza (2024) asserts that technology is one of the factors that severely impacted total

factor productivity in the last twenty decades. Before the Industrial Revolution, it was impossible to scale and automate business as efficiently as it is done today. This is because when a business has access to the best technology, it can increase the TFP by optimising all aspects of production. According to Pureza (2024), the continent, region or location of a business may affect its access to technology because there is a huge technological gap between underdeveloped and developed countries. This advantage favours countries that have developed strong technologies and can use them to get an edge in the economy. In any case, the behaviour of each variable in the estimations, as shown in Tables 6 and 7, provides a better guide as to the real effect of prayer intensity on social development. There is a need to understand the interconnectivity among the variables, which is presented in Fig. 11. It has been shown that there is a positive correlation (0.17) between Top1000 and GII (Shehatta & Mahmood, 2016; Yüregir et al., 2022), confirming that a higher Top1000 is associated with faster progress towards development, while a lower value may slow such progress, *ceteris paribus*. In the same vein, there is

a positive correlation (0.41) between population growth rate and Top1000, indicating that as population increases, there is a need to have a higher Top1000

in order to ensure that technology keeps pace with growing food demand (Food and Agriculture Organisation, 2015; Stone

Fig. 11 Correlation network of all the variables in the models



[<https://medium.com/migration-issues/higher-education-propels-population-growth-probably-4607e3dcf797>], 2016).

The following tests of hypotheses were carried out:

HO₁: There is no difference in TFP of treated and untreated countries. This is accepted, meaning that prayerful and less prayerful countries have similar TFP.

HO₂: There is no difference in the GDP of treated and untreated countries. This is rejected, invariably showing that there have been remarkable differences in the GDP of prayerful and less prayerful countries. However,

there is every indication that even less prayerful countries have larger GDP than more prayerful countries going in line with the assertion by McCleary (2008) earlier mentioned.

- HO₃: There is no difference in the LFP of treated and untreated countries. This is accepted, indicating that prayer intensity has not affected LFP.
- HO₄: There is no difference in the crime rate of treated and untreated countries. This is accepted even though it was expected that there would be a lower crime rate in more prayerful countries. This is just an indication that prayerfulness does not alter social development.
- HO₅: There is no difference in the Top 1000 of treated and untreated countries. This is rejected. It was noted earlier that most of the Top1000 are in countries not as prayerful but that are socially more developed. Universities and other tertiary institutions lead research into development and

progress which solve human and socio-economic problems.

Conclusion

The results so far present very interesting scenarios. Some citizens strongly hold the believe that religious adherence and practice are necessary tools for achieving development, progress and bubbling economy (Lim & Putnam, 2010); as such they spend more time in prayers and religious worship than in work with the hope that the sovereign being will use some invincible means to create goods and services in abundance and bring about prosperity and social welfare (Ezenagu, 2021) without physical efforts (Agujiobi et al., 2022). Our results so far do not support these thoughts. On the other hand, there are citizens who hold the belief that development, growth and progress have nothing to do with magical or invincible forces, but rather with hard work, ingenuity, innovation and imagination. To this class, time and resources should be devoted to physical, mental and psychological efforts to bring about development and progress. This class does not rely on the sovereign being or sometimes does not even believe in the sovereign being to achieve greatness, which is also not strongly supported by

the results so far. Interestingly, a similar study by Joshanloo (2024) did not find any evidence to support the relationship between the position of the sun (zodiac signs) on the day of birth and development outcomes. In the view of Conti (1999), religious adherence and intensity of participation seem to favour personal benefits and social participation over national goals and aspirations, like the encapsulated 2030 goals, hence the need to balance time and resources. The other way to ensure that adherents buy into the development agenda is to recognise the role religion plays in personal lives and how they connect with social and economic development on a national scale. Referring to the results in Fig. 11, we could conclude that both classes have a positive influence on development except in the case of Top1000 and GDP per capita. But the negative impact of GDP per capita is of serious concern because every other factor or variable in this analysis is contributing to the GDP. GDP is a very strong measure of growth, development, and progress. In fact, a negative impact of GDP per capita suggests that to ensure balanced development, there is a need for both strong adherence to sovereignty as well as strong physical and mental

efforts, as argued by NBER (2003); McCleary (2008). This line of thought is also supported by the positive impact of Top1000, a very strong proxy of desired steps towards development through innovation and ingenuity. After all, the ability to innovate and imagine is both natural and impacted through education, training and skills development. Ultimately, a balanced development leads to progress, growth, enhanced welfare, reduction in poverty, hunger and starvation. The resultant effects of all these are fair distribution of wealth, reduction in unemployment and hence crime. To achieve these outcome, all the policy variables highlighted, i.e., daily prayer, unemployment, GII, how Oceanic and Asian, as well as low-income, lower-middle, upper-middle-income, and those unclassified countries and unclassified democracies in the results, need to be aligned to the path of development. Of particular interest is GII; property rights, land holding rights, intellectual property remuneration, freedom and civil liberties, functioning political and governance institutions, speedy dispensation of justice and a host of actions aimed at promoting productivity must be strengthened. The adherence to

sovereignty must also be encouraged to promote innovation.

Understanding the inter-relationship between the level of religiosity and socio-economic development on a global scale, disaggregated on the type of regime in place in the countries and continent in which the country falls, was the major aim of this project. Particularly, it is desirable to find out how being prayer-intensive may accelerate or exacerbate socio-economic developments, especially with regard to TFP, LFP and GDP per capita. There is a need to constantly evaluate their impact on global development and progress, particularly as answers and means are always sought on how to feed the ever-growing population, as well as how to bring about enduring and sustainable prosperity to all, irrespective of status, faith, colour and creed.

A total of 258 countries were used for the study, which were divided into two groups: 108 countries that had a percentage daily prayer published by PEW (2023) (as experimental) and the other 150 countries that did not have such data (as non-experimental). Based on the causal inference approach used to

determine the impact of prayer intensity on those treated and the associated effect on the untreated group, the study concludes that Afghanistan is the most prayerful nation, while China is the least prayerful and most populous country. Namibia has the highest TFP, while the US is the largest economy. Also, the most prayerful are practising a hybrid democracy, while the least prayerful are practising a full democracy. More so, lower-middle-income countries say more daily prayers than high-income countries, but high-income countries have higher GDP per capita and the highest innovation index. It was also found that countries with Top1000-rated could achieve significant progress towards development faster than those which do not have. The study further concludes that an increase in GDP per capita, not religiosity, seems to be a better estimator of development and progress. The negative impact of GDP per capita is an indication that to ensure balanced development, there is a need for strong adherence to sovereignty as well as strong physical and mental efforts, which is supported by the positive impact of Top1000, a very strong proxy of desired steps towards development through innovation and ingenuity. Based on the

findings of the study, it is recommended that all the policy variables need to be aligned with the path of development. More so, adherence to sovereignty must also be encouraged because it reinforces character traits such as hard work, honesty, thrift, and religious rewards, which motivate people to work hard and cultivate virtuous behaviour.

The study concerns 258 countries and self-governed independent territories, but the data on daily prayer attendance is

available for only 108 of them. Moreso, there are other forms of religious practices, apart from prayers, that can also affect people's attitude to work ethics, which are preludes to economic and social development. Being able to incorporate these into the study could provide more robust findings, which would guide policy direction. It is our hope that these limitations would be addressed in future studies connecting religiosity with social and economic development.

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