Faith and growth: modeling the influence of religion on Madagascar's economy with DEOS model

Josué, ANDRIANADY and Andrianavony, Kanto Joviannah

Catholic Univeristy of Madagascar

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Faith and growth: modeling the influence of religion on Madagascar's economy with DEOS model

Josué R. ANDRIANADY*[1] and Kanto J. ANDRIANAVONY[2]

[1]Catholic University of Madagascar
[2]Catholic University of Madagascar

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Abstract

Abstract: This paper rigorously examines the influence of religious beliefs on economic development in Madagascar by employing the DEOS (Dynamic Equilibrium of Observed Spirituality) model. Surpassing the inherent limitations of traditional DSGE approaches, the study integrates the spiritual dimension into mechanisms of human capital formation, the structuring of formal and informal sectors, and economic governance. Utilizing a dynamic framework enriched with stochastic shocks, our analysis demonstrates that religion is not merely a source of moral norms but acts as a powerful catalyst for institutional and economic transformation. The findings invite a re-evaluation of public policies to incorporate sociocultural variables essential for a holistic understanding of growth dynamics.

Keywords: Religion, Economic Development, Madagascar, Human Capital, Governance, Informal Sector, Stochastic Modeling, DEOS

*Corresponding author: jravahiny@gmail.com

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1 Introduction

In a world where the interactions between religion and the economy are becoming increasingly complex, it is imperative to explore how these two dimensions intertwine to shape both individual and collective behavior. Religion, often regarded as merely a set of beliefs, in reality exerts a profound influence on the values and norms that govern our economic choices. This connection, although frequently underestimated in traditional economic analyses, warrants particular attention.

Far from being a marginal phenomenon, religiosity emerges as a key factor in the formation of human capital, influencing saving behaviors and even the dynamics of governance. Through the lens of various hypotheses, we aim to demonstrate that religion is not merely a contextual variable but a central actor that shapes economic and social structures. In this context, our study examines the mechanisms through which religion impacts economic decisions and social outcomes.

Thus, this research aspires to provide an innovative perspective on the integration of the religious dimension into economic models, while also opening the door to broader reflections on human nature and the challenges of sustainable development. By considering religion as a central element of economic analysis, we hope to enrich the debate regarding how beliefs shape not only individuals but also societies as a whole.

2 Literature review

The impact of religion on the economy constitutes a multidisciplinary field of study that engages institutional, behavioral, and macroeconomic approaches. Since Weber [15], researchers have sought to understand how religious values influence individual and collective economic decisions, market structures, and institutional efficiency.

In general, the literature highlights several channels through which religion shapes economic activity. Firstly, religion plays a key role in the accumulation of human capital, notably through the educational institutions it oversees. Secondly, it shapes the economic behaviors of individuals and households by influencing their saving, investment, and consumption decisions. Moreover, it intervenes in institutional regulation and governance by affecting corruption, the quality of institutions, and social trust. Finally, it contributes to market structuring by modulating the interactions between the formal and informal sectors.

2.1 Religion and human capital accumulation

One of the most studied effects of religion on the economy concerns its impact on human capital development. Religious education, whether formal or informal, has historically been associated with the transmission of skills and social norms. According to Glaeser and Sacerdote [8], religious institutions play a fundamental role in human capital acquisition by providing a stable educational framework, instilling values of discipline, and promoting learning.

Empirical studies indicate that faith-based schools often achieve better outcomes due to stricter management and enhanced moral oversight [3]. However, the effect of religion on education can be ambivalent. On one hand, it encourages learning and socialization; on the other, it may limit openness to innovation and new knowledge due to its conservative orientation [4]. In the specific case of Madagascar, where many

schools are administered by religious institutions, it is essential to analyze the impact of this influence on human capital accumulation, taking into account potential effects on educational access inequalities and curriculum orientation.

2.2 Religion, economic behavior, and resource allocation

Religion also influences the economic decisions of households, particularly regarding saving, consumption, and investment. Iannaccone [9] demonstrates that religious values structure individuals' intertemporal preferences, generally favoring a more cautious approach and a propensity to save. Religious beliefs often encourage moderation and prudence, which can translate into higher savings rates and increased risk aversion [5].

However, religion does not always promote productive investment. For instance, certain religious practices, such as tithing and contributions to religious institutions, reduce the share of disposable income available for investment. Similarly, some beliefs may limit the adoption of entrepreneurial behaviors by prioritizing short-term economic security over riskier opportunities for growth [7].

2.3 Religion, governance, and institutional efficiency

Another fundamental channel through which religion affects the economy is institutional governance. Numerous studies have explored the relationship between religiosity and corruption, yielding sometimes contrasting results.

On one hand, [10] Laporta suggest that societies with a strong religious influence tend to develop stricter ethical standards, which can enhance governance quality and reduce corruption. On the other hand, Nelson [12] emphasizes that this effect heavily depends on the level of independence of public institutions; in contexts where institutions are weak, religion can sometimes serve as a justification for rigid and opaque power structures. From an institutional perspective, North [13] demonstrates that religion shapes economic incentives by influencing moral and social behavior, although its effectiveness varies according to the legal and political framework in which it operates. In other words, while religion can play a stabilizing and regulatory role, it can also be instrumentalized by ruling elites to consolidate power and restrict certain economic freedoms. Moreover, Djankov [7] highlights a relationship between religiosity and the centralization of power, suggesting ambivalent effects on institutional efficiency.

2.4 Religion and market structuring: formal and informal sectors

One of the less studied aspects of the impact of religion on the economy concerns its role in market structuring, particularly the distinction between the formal and informal sectors. According to De Soto [6], religious norms influence the regulation of economic exchanges and partly explain the persistence of a dominant informal sector in certain societies.

One hypothesis advanced is that religion affects the productivity and organization of the informal sector by establishing specific work norms and business practices. For example, Levine [11] demonstrates that trust and cooperation, often reinforced by religion, can improve productivity and the organization of informal activities. However, Djankov [7] notes that these same norms can rigidify the market and slow the transition toward the formal sector, particularly by limiting the adoption of new forms of economic organization.

2.5 Conclusion and theoretical implications

The literature review highlights several channels through which religion influences economic dynamics:

- It structures the accumulation of human capital, with variable effects depending on educational norms and openness to innovation.
- It shapes the economic preferences of households, influencing saving and investment decisions.
- It intervenes in institutional regulation and governance, although its impact depends on the prevailing political framework.
- It plays a role in market organization, notably by influencing the boundary between the formal and informal sectors.

3 Religion in Madagascar

3.1 History and evolution of religion in Madagascar

The history of religion in Madagascar is both diverse and complex, marked by the coexistence and evolution of various beliefs and practices over time. Before the arrival of Europeans in the 16th century, Madagascar was inhabited by several ethnic groups, each with its own religious traditions. One of the dominant religions prior to European contact was animism, which involved belief in spirits and the veneration of ancestors.

With the arrival of European missionaries in the 19th century, Christianity began to spread rapidly across the island, with the Roman Catholic and Protestant denominations attracting the largest number of adherents. During the colonial period, Christian missionaries played a significant role in education and social services provided to the Malagasy people, which led to an increase in the Christian population. Nevertheless, traditional beliefs and practices, such as ancestor worship, continued to be observed alongside Christianity.

In the post-colonial era, various religious movements have emerged in Madagascar, including revivalist and Pentecostal movements as well as a renaissance of traditional Malagasy beliefs and practices. Today, Christianity remains the dominant religion in Madagascar, with the Roman Catholic and Protestant denominations representing the majority of Christians. However, traditional beliefs and practices, such as ancestor worship and the veneration of nature, continue to be important aspects of Malagasy culture and religion.

3.2 The significance of religion in Madagascar

Religion has had a significant impact on the culture, society, and politics of Madagascar. Christianity, in particular, has played an essential role in shaping the country's social and political landscape. One of the most notable impacts of Christianity in Madagascar has been its effect on education and literacy. Christian missionaries established schools and educational institutions throughout the island, contributing to higher literacy rates and providing access to education for many Malagasy.

Religion has also influenced the political history of the country. During the colonial period, Christian missionaries were often aligned with colonial powers, and their presence contributed to the erosion of traditional Malagasy power structures and the dissemination of Western values and norms. Today, religion remains an important element of Malagasy culture and identity. Traditional beliefs and practices remain deeply embedded in Malagasy society alongside the dominant Christian denominations.

Religious institutions continue to play an important role in providing social services and support to communities in Madagascar. Churches and other religious organizations are often involved in delivering healthcare, education, and other forms of assistance to those in need. Overall, religion has had a profound impact on Madagascar's history, culture, and society, influencing the country's social and political landscape and contributing to the development of its unique identity and traditions.

3.3 Religion and conflict in Madagascar: the complex roles of churches

The role of religion in conflicts in Madagascar is a complex and multifaceted phenomenon, with the involvement of churches varying and sometimes being contradictory. Churches have acted both as active participants in violent conflicts and as agents of peace and mediators during episodes of violence, resulting

in a perplexing situation that defies simple explanations. The interweaving of religion, politics, social classes, and socio-economic issues in Madagascar has further accentuated the complexity of the situation.

3.3.1 Instances in which religion was involved in conflicts

On certain occasions, Malagasy churches have directly participated in violent conflicts to attract more adherents. For example, in 2000 a conflict broke out between the Protestant Church known as FJKM (Church of Christ in Madagascar) and one of its congregation leaders. This dispute led to the formation of a new revivalist church called FPVM (New Protestant Church of Madagascar). The politician Marc Ravalomanana, involved in the 2009 conflict, was also the vice-president of the FJKM. Both sides engaged in both symbolic and direct violence, including physical assaults on pastors and catechists of the FJKM, the confiscation of their property and church funds, and street-level violence.

In Madagascar, politics, religion, social class, and socio-economic issues are closely intertwined. As a result, religious institutions have sometimes become involved in politics, with religious leaders taking positions and supporting various political factions. For instance, in 2002, during a period of violence, the Catholic Church openly supported Ravalomanana's presidential candidacy. However, during the political crisis of 2009, the Protestant Church backed Ravalomanana while the Catholic Church shifted its support to the opposition leader Andry Rajoelina.

Religious actors have been crucial in mobilizing support and devotion during conflicts, utilizing religious symbols, myths, and rituals for political purposes, which has led to strong mobilization among the faithful. For example, former President Ravalomanana used a verse from the Gospel of Mark 5:36, "Do not be afraid; just believe" (or *Aza matahotra, minoa fotsiny ihany*), as a political slogan to attract numerous supporters. Additionally, during the 2002 conflict, revivalist pastors were called upon to exorcise government buildings, significantly impacting mobilization processes and the creation of a solid base of devoted followers. More recently, Andry Rajoelina used the Catholic hymn "tena fitia" during his campaign for the 2018 presidential election after being elected president.

3.3.2 Instances in which religion preached peace

Despite their involvement in conflicts, churches have also acted as powerful agents of peace in Madagascar. Religious leaders have frequently leveraged their political, social, and cultural influence to call for peace, invoking values of tolerance, empathy, and understanding. They have been particularly effective in resolving local conflicts and are regarded as trustworthy mediators due to their societal importance. For example, during the violent episode of 1972, churches advocated for reforms and a revision of the cooperation agreements between France and Madagascar, aiming to bring peace and stability to the country.

In 1991, the Christian Council of Churches successfully mediated high-level negotiations that led to the establishment of a transitional government paving the way for the Third Republic, and they even played a powerful role in drafting the new constitution. The complex and interwoven nature of religion, politics, and societal issues in Madagascar means that achieving lasting and sustainable peace in the country cannot be realized without the contribution and participation of religious actors.

Despite their contradictory roles in conflicts, churches have proven influential in mobilizing support and devotion, as well as in mediating and resolving disputes. Their societal importance and influence make them key actors in the dynamics of conflict and peace in Madagascar, and their involvement is crucial for

achieving lasting peace in the country.

3.4 Summary of religion in Madagascar

In summary, religion has had a significant impact on the history, culture, and society of Madagascar. Christianity, in particular, has played a predominant role in shaping the country's education, politics, and social services. Traditional beliefs and practices, such as ancestor worship and the veneration of nature, remain deeply embedded in Malagasy society alongside the dominant Christian denominations.

Religious institutions continue to play an important role in providing social services and support to communities in Madagascar. However, religious differences have also led to tensions and conflicts between various religious groups, such as those between Catholics and Protestants. In some cases, religious leaders have acted as political actors, and their support for different political parties has contributed to political instability and conflict. Nonetheless, religious institutions have also played a role in peacebuilding and conflict resolution in Madagascar.

4 Description of the model

4.1 Origin of the model's name: DEOS (Dynamic Equilibrium of Observed Spirituality)

The name *DEOS* refers to a dynamic equilibrium model that integrates the influence of spirituality and religion on economic dynamics, particularly in Madagascar. The term *Deus*, meaning "God" in Latin, symbolizes the spiritual element of the model, while *Equilibrium* reflects the scientific and analytical approach, emphasizing the study of economic equilibria under the influence of religious and spiritual shocks.

The acronym *DEOS* thus encapsulates the framework of the model, which combines traditional economic dynamics (growth, production, consumption, etc.) with shocks and effects related to religious and spiritual beliefs. This model seeks to understand how these factors influence production, consumption, saving, and labor supply in a specific Malagasy economic environment. It is based on a dynamic general equilibrium analysis, where observed spirituality becomes a key element influencing economic choices and public policies.

In this way, the name *DEOS* captures the essence of studying the impact of spirituality on the economy in a quantitative and dynamic manner, while echoing the deep connection between religion and Malagasy society.

4.2 Main agents

The model is built around three main agents:

- **Households**: They decide on consumption, labor, and saving based on their income and religious values.
- **Firms** (both formal and informal): They produce goods using labor and human capital.
- **The state and religious institutions**: They influence education, public morality, and corruption.

4.3 Model equilibrium

General equilibrium is achieved when:

- Households choose C_t, S_t, L_t based on their income and religious ethics.
- Firms (formal and informal) maximize their production based on the available physical and human capital.
- The State and religious institutions influence H_t, τ_t, and I_t.

Equilibrium conditions:

- **Labor market**: The labor supply L_t depends on the influence of religion on discipline and the valuation of work.
- **Capital market**: K_t depends on saving and investments, which are influenced by religious beliefs.

- **Governance and corruption**: Religion may moderate corruption but does not have an immediate effect on the State.

4.4 Assumptions

The construction of a model that integrates the influence of religion on the economy is based on a set of theoretical and empirical assumptions supported by the existing literature. This section aims to justify these assumptions by drawing on relevant academic work and by highlighting the mechanisms through which religion interacts with the model's key economic variables.

Hypothesis 1: Religion influences the accumulation of human capital

Theoretical foundation

The economic literature highlights a strong link between religion and human capital, primarily through its role in the educational system. Barro [3] shows that religiosity can have a positive effect on education by reinforcing norms of discipline, effort, and perseverance. Furthermore,Glaeser [8] emphasizes that faith-based schools tend to yield better academic outcomes, particularly due to stricter management and structured moral oversight.

Link to the model

In the Malagasy context, where a significant portion of primary schools are administered by religious institutions, religion directly influences the formation of human capital. This influence is formalized in the model by a human capital evolution function:

$$H_{t+1} = \varphi E_t + \delta_H \theta_t H_t \tag{1}$$

where θ_t measures the influence of religion on education. Becker[4] has shown that religion can shape educational preferences by favoring certain academic disciplines at the expense of others, particularly in the sciences and technologies. Thus, although religion may stimulate the accumulation of human capital, it can also restrict innovation if it privileges rigid dogmas.

Hypothesis 2: Religion influences the economic behavior of households (saving and consumption)

Theoretical foundation

Religious values influence households' intertemporal trade-offs in consumption, saving, and investment.Iannaccone [9] and Carrol[5] demonstrate that more religious societies generally exhibit higher saving rates due to a preference for prudence and moderation in consumption. Conversely, religious obligations (tithes, donations to churches, participation in community works) can reduce the share of income available for investment.

Link to the model

In the model, this dynamic is captured by the household budget constraint:

$$C_t + S_t + D_t = w_t L_t + r_t K_t \tag{2}$$

where

$$D_t = \delta_D \theta_t Y_t \tag{3}$$

represents religious donations. This effect is consistent with the observations of Becker[4] regarding the relationship between religion and risk aversion: a highly religious society will favor saving and secure investments over riskier projects, which may slow down entrepreneurship and innovation.

Hypothesis 3: Religion influences governance and corruption

Theoretical foundation

The role of religious institutions in governance and in reducing corruption has been widely studied. Laporta [10] shows that societies with a strong religious influence tend to have stricter ethical norms, which can enhance governance quality. However,Treisman [14] points out that this effect is conditioned by the independence of public institutions; if the State is weak, religion alone is insufficient to combat corruption.

Link to the model

In the model, the relationship between religion and corruption is expressed as:

$$\tau_t = \tau_0 - \rho \theta_t \tag{4}$$

where τ_t represents the level of corruption and ρ measures the impact of religion in reducing corrupt behavior. This hypothesis builds on the work of [13], which underscores the role of cultural institutions in structuring economic incentives.

Hypothesis 4: Religion influences market structuring, specifically the transition between the informal and formal sectors

Theoretical foundation

The informal sector is often shaped by cultural and religious norms. [6] explains that societies where regulation relies more on local traditions than on state institutions tend to maintain a predominant informal sector. [11] shows that trust and cooperation, often reinforced by religion, can improve productivity.

Mathematical formulation:

$$Y_t = A_t K_t^{\alpha} (H_t L_t)^{1-\alpha} + \psi(\theta_t) I_t \tag{5}$$

where:

- I_t is the output of the informal sector.
- $\psi(\theta_t)$ represents the effect of religion on the productivity of the informal sector.

Possible effect: If religion promotes greater honesty and organization, the informal sector could become more productive and gradually formalize.

4.5 The role of religion in the model

Influence on education and human capital

Religion contributes to the accumulation of human capital through θ (theta), which alters the dynamics of $H(t)$ (human capital). At $t = 10$, a "religious shock" is introduced, abruptly increasing θ:

$$\theta(t) = \theta(t-1) + 0.5 \times (1 - \theta(t-1))$$

If θ is interpreted as an indicator of religiosity, this could represent a strengthening of religious norms influencing education (positively if religion encourages learning, or negatively if it inhibits certain forms of modern education).

Effect on labor supply

The labor supply, $L(t)$, depends on θ with a quadratic impact governed by λ_L:

$$L(t) = L_0 \times \left(1 + \lambda_L \times \theta(t)^2\right) + \varepsilon_L$$

If religion shapes the work ethic, it may reinforce or limit participation in the labor market depending on the context.

Impact on productivity and the formal/informal economy

θ influences the informal sector via ψ_1:

$$Y_{\text{informel}} = \max\left(0, (0.6 + \psi_1 \times \theta(t)) \times H(t)\right)$$

Depending on the sign of ψ_1, an increase in θ could either encourage or discourage informal economic activity (for example, by altering perceptions of taxation, corruption, or commercial norms).

Effect on governance and corruption

θ modifies both the perception and the impact of corruption, particularly through $\tau(t)$ (the level of corruption):

$$\tau(t) = \tau_0 \times \left(1 - \frac{\gamma_{\text{gov}} \times \theta(t)}{1 + \rho \times \theta(t)}\right) + \varepsilon_\tau$$

If θ reflects religious values, an increase may either reduce corruption (through stronger moral standards) or leave it unchanged if religion is instrumentalized by elites.

Impact on taxation and the public budget

Tax revenues $T(t)$ are affected by θ because religion can influence:

- The propensity to pay taxes (i.e., trust in the State),
- The level of social redistribution.

5 Components of the DEOS model

5.1 Households: consumption, savings, and labor

Households maximize their intertemporal utility, which represents their overall satisfaction over different periods. This maximization is formulated as follows:

$$U = \sum_{t=0}^{\infty} \beta^t \left[\frac{C_t^{1-\sigma}}{1-\sigma} + \lambda (1 - L_t)^{1-\gamma} + \eta \theta_t \right] \tag{6}$$

where:

- U: the total utility that the household derives over all periods.
- β: the discount factor, representing the household's preference for current consumption relative to future consumption. A value of β close to 1 indicates that the household places significant importance on future consumption.
- C_t: the household's consumption at period t.
- σ: the coefficient of relative risk aversion, which measures the household's sensitivity to fluctuations in consumption. A higher σ indicates a stronger preference for stable consumption levels.
- L_t: the leisure time of the household at period t.
- λ: a parameter measuring the trade-off between work and leisure, indicating the value the household places on leisure relative to consumption.
- γ: the parameter reflecting the household's preference for leisure, i.e., the sensitivity to the amount of leisure available.
- η: a coefficient that measures the impact of religious influence on the household's economic preferences.
- θ_t: the influence of religion on the household's economic behavior at period t.

5.1.1 Budget constraints

Each household earns income from labor and capital. This budget constraint is formulated as:

$$C_t + S_t + D_t = w_t L_t + r_t K_t \tag{7}$$

where:

- C_t: household consumption at period t.
- S_t: household savings at period t.
- D_t: donations to religious institutions, which can be influenced by religion. It is defined as:

$$D_t = \delta_D \theta_t Y_t \tag{8}$$

where:

  - δ_D: a coefficient representing the fraction of national income that households donate to religious institutions.
  - Y_t: national income at period t.

- w_t: the wage received by the household at period t.
- L_t: the amount of labor supplied by the household at period t.
- r_t: the return on capital at period t.
- K_t: the capital held by the household at period t.

5.1.2 Labor supply

The motivation of households to work is influenced by religious factors, which is captured by the following equation:

$$L_t = L_0 + \lambda_L \theta_t \tag{9}$$

where:

- L_t: the amount of labor supplied by the household at period t.
- L_0: the baseline labor supply in the absence of religious influence.
- λ_L: a coefficient that measures the effect of religion on labor supply. A higher λ_L indicates that religious influence increases the amount of labor supplied.
- θ_t: the influence of religion on the motivation to work at period t.

5.2 Production: formal and informal sectors

5.2.1 Formal sector

Production in the formal sector follows a Cobb-Douglas production function, given by:

$$Y_t^F = A_t K_t^\alpha (H_t L_t)^{1-\alpha} \tag{10}$$

where:

- Y_t^F: the total production of the formal sector at period t.
- A_t: total factor productivity at period t, representing the overall efficiency of production.
- K_t: the capital employed in the formal sector at period t.
- α: the share of capital in production, indicating the sensitivity of production to changes in capital.
- H_t: human capital used in production at period t, including the skills and education of workers.
- L_t: the labor employed in the formal sector at period t.

This function illustrates that production depends on both physical and human capital, as well as labor, with constant returns to scale.

5.2.2 Informal sector

In the informal sector, religious influence plays an important role in productivity. Production in this sector is modeled by:

$$Y_t^I = \psi(\theta_t) I_t \tag{11}$$

where:

- Y_t^I: the total production of the informal sector at period t.
- $\psi(\theta_t)$: a function representing the effect of religious influence on the productivity of the informal sector, defined as:

  $$\psi(\theta_t) = \psi_0 + \psi_1 \theta_t \tag{12}$$

  where:

  - ψ_0: the baseline productivity level in the informal sector, absent religious influence.
  - ψ_1: a coefficient measuring the impact of religious influence on productivity.
- I_t: the effort or input in the informal sector at period t, which may include activities of small entrepreneurs or self-employed workers.

This equation shows that productivity in the informal sector can be enhanced by values and behaviors inspired by religion.

5.2.3 Total production

The total production of the economy at period t is the sum of production in the formal and informal sectors:

$$Y_t = Y_t^F + Y_t^I \tag{13}$$

where:

- Y_t: the total production of the economy at period t.
- Y_t^F: production in the formal sector at period t.
- Y_t^I: production in the informal sector at period t.

This equation indicates that the overall economy is determined by the combined contributions of both sectors, underscoring the importance of the informal sector alongside the formal sector.

5.3 Human capital and education

A household's human capital evolves as a function of investments in education and religious influence. This evolution is modeled by the equation:

$$H_{t+1} = \phi E_t + \delta_H \theta_t H_t \tag{14}$$

where:

- H_{t+1}: the level of human capital at period $t+1$, representing the skills, knowledge, and abilities of individuals in the household after the effects of education and religion.
- ϕ: a coefficient measuring the effectiveness of investments in education. A high value of ϕ indicates that each unit of educational investment significantly boosts human capital.
- E_t: the investment in education at period t, which may include expenditures on training, formal education, or other forms of skill enhancement.
- δ_H: a coefficient representing the effect of religious influence on human capital, indicating the extent to which religion may either enhance or hinder learning and skill development.
- θ_t: the influence of religion on learning behaviors at period t, reflecting how religious values may encourage or discourage education.

This equation demonstrates that human capital in the next period depends on both educational investments and the influence of religion on learning.

5.4 Government and public policy in the model

Within the context of our model, the government plays a crucial role in regulating the economy through its interactions with religion, corruption, and governance. The government can influence the economy through its fiscal policy, resource redistribution decisions, and by managing corruption and the quality of public institutions.

5.4.1 Government behavior

The government's objective in this model is to maintain a balance between public expenditures and tax revenues while taking into account the religious influences that affect governance and corruption.

5.4.2 Governmental action equation

The level of governance, denoted G_t, is influenced by religion θ_t and corruption τ_t. In turn, the government adjusts its public spending and social transfers accordingly. The relationship can be expressed as:

$$G_t = G_0 + \gamma \theta_t - \rho \tau_t \tag{15}$$

where:

- G_0: the baseline level of governance (prior to the influence of religion and corruption).
- γ: a parameter that measures the impact of religious influence θ_t on improving governance. A strong religious influence may lead to better public management and more stable governance.
- ρ: a parameter that measures the impact of corruption τ_t on governance. Higher levels of corruption diminish the quality of governance, thereby hampering effective public policies.
- θ_t: the influence of religion on public morality and political management, promoting a more transparent and ethical governance.
- τ_t: the level of corruption which, if high, negatively affects the government's capacity to implement effective policies.

Thus, a higher religious influence θ_t improves governance and reduces the adverse impact of corruption τ_t on the state's ability to positively affect the economy.

5.4.3 State budget and fiscal policy

The government must balance its tax revenues and public expenditures. The state budget at any period t is given by:

$$B_t = T_t - G_t \tag{16}$$

where:

- T_t: total tax revenues, which may depend on governance and the government's fiscal policy.
- G_t: the level of public spending.

Tax revenues T_t can be influenced by fiscal efficiency, which is itself determined by governance. Better governance helps reduce corruption and improve tax collection. Thus, tax revenues can be modeled as:

$$T_t = T_0 + \theta_t \cdot f(Q_t) \tag{17}$$

where:

- T_0: the baseline level of tax revenues (prior to the influence of religion and governance).
- θ_t: the religious influence that increases confidence in fiscal institutions.
- $f(Q_t)$: an increasing function of the quality of governance Q_t, which enhances tax revenues when institutions are more transparent and efficient.

This formulation shows that religious influence and institutional quality are crucial for maximizing the resources available to the government, enabling it to better address the economic and social needs of the population.

5.5 Economic scenarios and stochastic shocks

In this section, we present the various economic scenarios while taking into account the stochastic uncertainties introduced into the model.

Scenario 1: Expansion of education under religious influence

Hypothesis: An increase in religiosity promotes education, thereby enhancing human capital and productivity.

Modified Parameters:

- Increased effect of θ_t on human capital ($\delta_H = 0.6$).
- Improved governance ($\gamma_{gov} = 0.3$).
- Stochastic shocks:
  - Education: $\varepsilon_H \sim \mathcal{N}(0, \sigma_H^2 = 0.1)$.
  - Productivity: $\varepsilon_A \sim \mathcal{N}(0, \sigma_A^2 = 0.03)$.

Expected Effects:

- An increase in human capital H_t and overall production Y_t.
- A reduction in inequality if education becomes more accessible.

Scenario 2: Religious radicalization and economic decline

Hypothesis: An excessive rise in religiosity leads to a restriction in labor market participation (e.g., exclusion of women, additional religious holidays, etc.) and a surge in conservatism.

Modified parameters:

- Reduction in governance ($\gamma_{gov} = 0.05$).
- Increase in institutional rigidity ($\rho = 0.05$).
- Shock on corruption: $\varepsilon_\tau \sim \mathcal{N}(0, \sigma_\tau^2 = 0.08)$.

Expected effects:

- A decline in labor supply L_t and overall production Y_t.
- Increased institutional instability.

Scenario 3: Transition of the informal sector under religious influence

Hypothesis: Moderate religious influence encourages better regulation of the informal sector and facilitates a transition toward a more formalized economy.

Modified parameters:

- Reduction in the significance of the informal sector ($\psi_1 = -0.2$).
- Increase in labor productivity ($\alpha = 0.45$, $\lambda_L = 0.2$).
- Shock on productivity: $\varepsilon_A \sim \mathcal{N}(0, \sigma_A^2 = 0.04)$.

Expected effects:

- An increase in total production Y_t.
- An increase in tax revenues T_t.

Scenario 4: Rise in consumption and religious savings

Hypothesis: Religion influences economic behavior by encouraging either more frugal consumption or a greater accumulation of savings for communal purposes.

Modified parameters:

- Increase in the propensity to save ($\beta = 0.98$).
- Stochastic shocks:
  - Consumption: $\varepsilon_C \sim \mathcal{N}(0, \sigma_C^2 = 0.05)$.
  - Savings: $\varepsilon_S \sim \mathcal{N}(0, \sigma_S^2 = 0.03)$.

Expected effects:

- An increase in savings S_t.
- A reduction in consumption C_t, which could potentially slow down growth.

Scenario 5: Multiple shocks and religious crisis

Hypothesis: A rise in religious tensions combined with the political instrumentalization of religion leads to widespread economic instability.

Simultaneous shocks:

$$\varepsilon_H \sim \mathcal{N}(0, \sigma_H^2 = 0.08)$$
$$\varepsilon_L \sim \mathcal{N}(0, \sigma_L^2 = 0.06)$$
$$\varepsilon_A \sim \mathcal{N}(0, \sigma_A^2 = 0.05)$$
$$\varepsilon_\tau \sim \mathcal{N}(0, \sigma_\tau^2 = 0.07)$$
$$\varepsilon_C \sim \mathcal{N}(0, \sigma_C^2 = 0.06)$$

Expected effects:

- Severe economic instability.
- An increase in corruption τ_t.
- A reduction in economic growth.

5.6 Equilibrium equations with a stochastic approach

In a deterministic framework, macroeconomic dynamics are entirely predictable. However, in reality, economies are subject to random shocks that affect key variables such as education, governance, labor supply, and consumption. To incorporate this uncertainty, we add error terms ε_t to several key equations of the model, with these shocks assumed to follow a centered normal distribution:

$$\varepsilon_i \sim \mathcal{N}(0, \sigma_i^2), \quad i \in \{H, L, A, \tau, C, S\}$$

where σ_i^2 represents the variance of the corresponding shock.

Human capital

The accumulation of human capital depends on educational investment and the sociocultural influence θ_t. We introduce a stochastic shock ε_H to capture the uncertainty associated with educational policies and funding:

$$H_{t+1} = \phi H_t + \delta_H \theta_t H_t + \varepsilon_H, \quad \varepsilon_H \sim \mathcal{N}(0, \sigma_H^2)$$

This shock represents unexpected events affecting the quality of education (e.g., reforms, budget crises, pedagogical innovations).

Labor supply

Labor supply is influenced by the participation of the active population, which may be affected by unforeseen changes in cultural preferences and economic opportunities:

$$L_t = L_0 + \lambda_L \theta_t^2 + \varepsilon_L, \quad \varepsilon_L \sim \mathcal{N}(0, \sigma_L^2)$$

The shock ε_L captures unexpected fluctuations in labor market participation due to social, demographic, or religious factors.

Total production

Overall output is the result of the combination of human capital and labor. We introduce a shock ε_A to productivity to reflect technological and structural fluctuations:

$$Y_t = (A + \varepsilon_A) K_t^{\alpha} (H_t L_t)^{1-\alpha} + (0.6 + \psi_1 \theta_t) H_t, \quad \varepsilon_A \sim \mathcal{N}(0, \sigma_A^2)$$

This shock may represent sudden technological innovations, natural disasters affecting productivity, or structural economic reforms.

Governance and corruption

Governance directly influences the perception and impact of corruption on the economy. We introduce a random shock ε_τ to reflect unforeseen variations in the level of corruption:

$$\tau_t = \tau_0 \left(1 - \frac{\gamma_{gov}\theta_t}{1+\rho\,\theta_t}\right) + \varepsilon_\tau, \quad \varepsilon_\tau \sim \mathcal{N}(0, \sigma_\tau^2)$$

The shock ε_τ models the uncertainty surrounding anti-corruption policies, political stability, and the transparency of institutions.

Public budget

Tax revenues depend on the level of corruption and the weight of religious values in adherence to fiscal obligations:

$$T_t = T_0 + \theta_t\big(\gamma(1-\tau_t)\big) + \varepsilon_T, \quad \varepsilon_T \sim \mathcal{N}(0, \sigma_T^2)$$

A fiscal shock may arise from tax reforms, unexpected adjustments in subsidies, or macroeconomic shocks affecting tax collections.

Consumption and savings

Consumption and savings are influenced by economic expectations and intertemporal dynamics. We introduce two independent shocks, ε_C and ε_S, which capture unexpected variations in these behaviors:

$$C_t = (1-\beta)\Big(Y_t - S_{t-1}\Big) + \varepsilon_C, \quad \varepsilon_C \sim \mathcal{N}(0, \sigma_C^2) \tag{18}$$

$$S_t = \beta\Big(Y_t - C_t\Big) - \delta_D\theta_t Y_t + \varepsilon_S, \quad \varepsilon_S \sim \mathcal{N}(0, \sigma_S^2) \tag{19}$$

- ε_C captures sudden changes in consumer confidence, redistribution policies, or shocks in the credit market.
- ε_S represents uncertainties in savings preferences, influenced by cultural and religious factors.

Parameter	Description	Estimated Value
β	Discount factor (preference for future consumption)	0.95 – 0.98
σ	Risk aversion	2
λ	Trade-off between work and leisure	1.5
γ	Preference for leisure	1
η	Impact of religion on economic preferences	0.1 – 0.3
θ_t	Influence of religion on the economy	0 – 1 (normalized index)
δ_D	Fraction of income donated to religious institutions	5 – 10%
L_0	Labor supply without religious influence	0.6 (60% of time)
λ_L	Effect of religion on labor supply	0.05 – 0.2
A_t	Total factor productivity	1
K_t	Physical capital	Varies by year
α	Capital share in production	0.3 – 0.4
H_t	Human capital	3 – 10 years of average schooling
ψ_0	Baseline productivity in the informal sector	0.5 – 0.7
ψ_1	Effect of religion on informal sector productivity	0.1 – 0.3
ϕ	Effectiveness of educational investment	0.6 – 0.8
δ_H	Effect of religion on human capital	0.1 – 0.5
τ_t	Level of corruption (scale 0–1)	0.5 – 0.8
ρ	Effect of religion on reducing corruption	0.1 – 0.3
G_0	Baseline level of governance	0.4 – 0.6
T_0	Baseline level of tax revenues	10 – 15% of GDP
Stochastic parameters		
δ_D	Shock on the fraction of income donated to religious institutions	0.05
σ_H	Shock on education	0.05
σ_L	Shock on labor supply	0.03
σ_A	Shock on productivity	0.02
σ_τ	Shock on corruption	0.04
σ_C	Shock on consumption	0.02
σ_S	Shock on savings	0.01

Table 1: Table of Model Parameters with Stochastic Components

6 Result

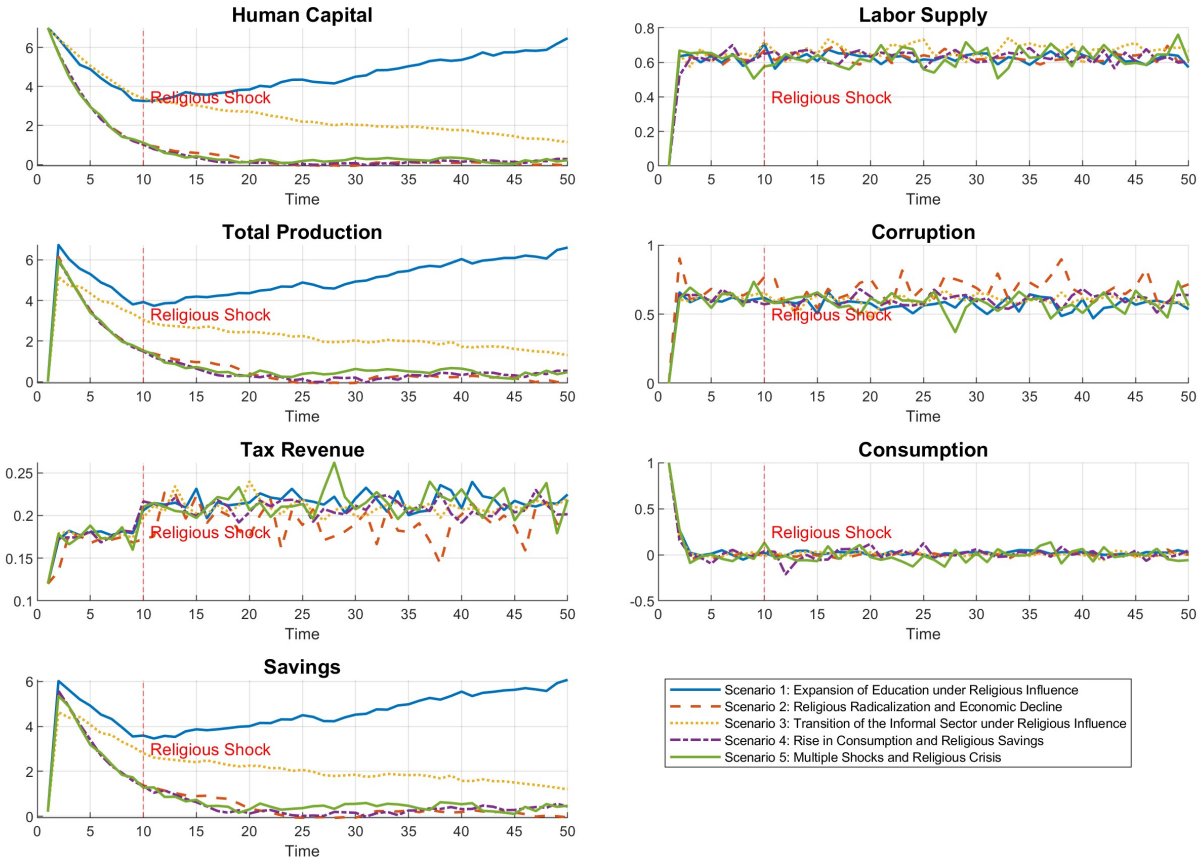

Figure 1: Result of the model

7 Discussion

The simulation results highlight the ambivalent role of religion in Madagascar's economy. According to the scenarios examined, religious influence can both stimulate human development and economic growth as well as generate institutional inefficiencies and an economic slowdown. Below, we analyze the main dynamics observed.

Expansion of education under religious influence

In this scenario, education benefits from strong support by religious institutions, leading to a significant increase in human capital (H). This increase fosters a rise in total production (Y), accompanied by improvements in both consumption (C) and savings (S).

However, this reliance on religiously influenced education can also pose challenges. A system heavily shaped by religious norms may favor certain disciplines over others, thereby reducing labor market adaptability and limiting innovative capacity.

Religious radicalization and economic decline

In this scenario, the rise in religious radicalization is accompanied by a deterioration in public governance and an increase in corruption (τ). This dynamic reduces the effectiveness of tax revenues (T), consequently limiting public investment.

As a result, economic growth slows down and production (Y) gradually declines. Moreover, economic uncertainty leads to lower levels of savings and consumption. These outcomes underscore the risks associated with the instrumentalization of religion for political or ideological purposes, which can undermine the stability of economic institutions.

Transition of the informal sector under religious influence

The impact of religion on the informal sector is twofold. On one hand, religious influence may encourage more ethical business practices and improved organization of labor; on the other, an excessively strict approach might hinder innovation and productivity.

The results indicate that a strong religious influence can reduce incentives to join the formal economy, thereby maintaining a significant share of economic activity within the informal sector. Although production (Y) experiences a modest increase due to improved human capital (H), its full potential remains underexploited because institutional barriers continue to impede the formalization of labor.

Rise in consumption and religious savings

The increase in consumption and savings driven by religious values leads to a reallocation of resources toward goods and services that conform to dominant religious ideals. This dynamic has mixed effects:

- In the short term, it stimulates domestic demand and boosts consumption (C).
- In the long term, an overemphasis on religiously motivated savings may reduce productive investment if these funds are not effectively reinvested into the economy.

Thus, although both consumption and savings rise, their impact on overall production (Y) remains moderate. This scenario illustrates that religion primarily shapes economic preferences without necessarily transforming the fundamental drivers of growth.

Multiple shocks and religious crisis

This final scenario explores a situation in which several negative shocks simultaneously affect the economy, exacerbated by a religious crisis. The combined effect of a deterioration in human capital (H), a decline in productivity (A), and a rise in corruption (τ) results in a significant contraction of production (Y).

This reduction in production is accompanied by decreases in both consumption (C) and savings (S). The scenario highlights the vulnerability of the economy to multifactorial crises and underscores the necessity of a robust institutional framework to mitigate the adverse effects of religious tensions.

Limitations

Nevertheless, it is essential to emphasize several significant limitations of this study. First, the model assumes homogeneity in the influence of religion, which is a major shortcoming because it overlooks the fundamental differences among various religious denominations (e.g., Christianity, Islam, and traditional religions) that may exert distinct influences on economic and social behavior. Moreover, available data on religious practices in Madagascar remain fragmented and incomplete, which hinders precise calibration of the model's parameters and limits its capacity to accurately capture the complex interactions between religion and the economy.

Future research should consider several avenues for further investigation. These include disaggregating the religious influence by denomination through a multi-agent approach to better represent the diversity of interactions and impacts associated with each religious tradition, integrating the dynamics of conflict and interaction between different religions to enrich the understanding of their social and economic implications, and conducting a longitudinal analysis of the impact of religious shocks (such as evangelical awakenings) on economic cycles. Such efforts could provide valuable insights into the long-term effects of religiosity on economic fluctuations and help elucidate the underlying mechanisms of these complex interactions.

8 Conclusion

In conclusion, this analysis demonstrates that religion exerts a significant influence on economic dynamics, prompting a deeper reflection on the relationship between belief, behavior, and human development. The various hypotheses formulated and scenarios considered underscore that religiosity is not merely a source of moral values; it also shapes economic behavior, educational choices, and even governance structures.

Philosophically, this study challenges our understanding of economic rationality. If humans are viewed solely as rational agents driven by material interests, an essential dimension is overlooked namely, non-economic motivations that are often rooted in deep-seated convictions. Religion, as a system of values, provides an ethical framework that guides individual and collective decision-making. While such guidance might occasionally come at the expense of immediate economic optimization, it can foster sustainable prosperity and social cohesion in the long term.

Thus, the proposed model reveals that integrating the religious dimension into economic analysis should not be seen merely as the adjustment of a variable, but as an acknowledgment of an intrinsic aspect of human societies. This perspective encourages a reconsideration of public policies and development strategies that account for this complexity, thereby achieving outcomes that are both economically viable and socially responsible. Ultimately, it reminds us that behind every number and equation lie human stories, aspirations, and struggles that deserve to be heard and respected.

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9 Matlab's code

```
%% 1. Define Model Parameters
params = struct(...
'T_sim', 50, ...
'H0', 7, ...
'theta_0', 0.5, ...
'tau_0', 0.7, ...
'L0', 0.6, ...
'A', 1, ...
'alpha', 0.35, ...
'rho', 0.2, ...
'phi', 0.7, ...
'delta_H', 0.3, ...
'lambda_L', 0.1, ...
'psi1', 0.15, ...
'gamma_gov', 0.2, ...
'beta', 0.96, ...
'sigma', 2, ...
'gamma', 0.3, ...
'T0', 0.12, ...
'deltaD', 0.05, ...
'sigma_H', 0.05, ... % Shock on education
'sigma_L', 0.03, ... % Shock on labor
'sigma_A', 0.02, ... % Shock on productivity
'sigma_tau', 0.04, ... % Shock on corruption
'sigma_C', 0.02, ... % Shock on consumption
'sigma_S', 0.01 ... % Shock on savings
);

%% 2. Define Scenarios with Uncertainty
scenarios = {
struct('name', 'Scenario 1: Expansion of Education under Religious Influence', ...
'delta_H', 0.6, 'gamma_gov', 0.3, 'sigma_H', 0.1, 'sigma_A', 0.03), ...
struct('name', 'Scenario 2: Religious Radicalization and Economic Decline', ...
'gamma_gov', 0.05, 'rho', 0.05, 'sigma_tau', 0.08), ...
struct('name', 'Scenario 3: Transition of the Informal Sector under Religious Influence', ...
'psi1', -0.2, 'alpha', 0.45, 'phi', 0.8, 'lambda_L', 0.2, 'sigma_A', 0.04), ...
struct('name', 'Scenario 4: Rise in Consumption and Religious Savings', ...
'beta', 0.98, 'sigma_C', 0.05, 'sigma_S', 0.03), ...
struct('name', 'Scenario 5: Multiple Shocks and Religious Crisis', ...
'sigma_H', 0.08, 'sigma_L', 0.06, 'sigma_A', 0.05, 'sigma_tau', 0.07, 'sigma_C', 0.06)
};
```

```
%% 3. Dynamic Simulation of the Model
results = struct();
for s = 1:length(scenarios)
p = mergeStruct(params, scenarios{s});

% Initialize Variables
[H, L, Y, tau, theta, C, S, T] = deal(zeros(1, p.T_sim));
H(1) = p.H0;
theta(1) = p.theta_0;
C(1) = 1;    % Initial consumption
S(1) = 0.2;  % Initial savings
T(1) = p.T0; % Initial tax revenue

for t = 2:p.T_sim
% Religious Shock at t = 10
if t == 10
theta(t) = theta(t-1) + 0.5 * (1 - theta(t-1));
else
theta(t) = theta(t-1);
end

% Stochastic Shocks
epsilon_H = p.sigma_H * randn;
epsilon_L = p.sigma_L * randn;
epsilon_A = p.sigma_A * randn;
epsilon_tau = p.sigma_tau * randn;
epsilon_C = p.sigma_C * randn;
epsilon_S = p.sigma_S * randn;

% Human Capital and Education
H(t) = p.phi * H(t-1) * (1 + p.delta_H * theta(t)) + epsilon_H;

% Labor Supply
L(t) = p.L0 * (1 + p.lambda_L * theta(t)^2) + epsilon_L;

% Productivity and Production
Y_formal = (p.A + epsilon_A) * (H(t)^(1 - p.alpha)) * (L(t)^p.alpha);
Y_informal = max(0, (0.6 + p.psi1 * theta(t)) * H(t));
Y(t) = Y_formal + Y_informal * (1 - 0.2 * theta(t));

% Governance and Corruption
tau(t) = p.tau_0 * (1 - p.gamma_gov * theta(t) / (1 + p.rho * theta(t))) + epsilon_tau;

% State Budget
T(t) = p.T0 + theta(t) * (p.gamma * (1 - tau(t)));
```

```
% Consumption and Savings
C(t) = (1 - p.beta) * (Y(t) - S(t-1)) + epsilon_C;
S(t) = p.beta * (Y(t) - C(t)) - p.deltaD * theta(t) * Y(t) + epsilon_S;
end

results(s).H = H;
results(s).L = L;
results(s).Y = Y;
results(s).tau = tau;
results(s).T = T;
results(s).C = C;
results(s).S = S;
results(s).name = scenarios{s}.name;
end

%% 4. Visualization of Results
figure('Position', [100, 100, 1200, 800], 'Color', 'w');
tLayout = tiledlayout(4, 2, 'TileSpacing', 'Compact', 'Padding', 'Compact');
titles = {'Human Capital', 'Labor Supply', 'Total Production', ...
'Corruption', 'Tax Revenue', 'Consumption', 'Savings'};
vars = {'H', 'L', 'Y', 'tau', 'T', 'C', 'S'};
colors = lines(length(results));
lineStyles = {'-', '--', ':', '-.'};

for v = 1:length(vars)
ax = nexttile;
hold(ax, 'on');
for s = 1:length(results)
plot(1:params.T_sim, results(s).(vars{v}), ...
'Color', colors(s, :), 'LineStyle', lineStyles{mod(s-1, length(lineStyles)) + 1}, ...
'LineWidth', 1.5);
end
xline(10, 'r--', 'Religious Shock', 'LabelVerticalAlignment', 'middle', 'LabelOrientation', 'horiz
title(ax, titles{v}, 'FontSize', 12, 'FontWeight', 'bold');
xlabel(ax, 'Time');
grid on;
legend({results.name}, 'Location', 'best');
end

%% MergeStruct Function to Combine Scenario Parameters
function out = mergeStruct(base, additional)
out = base;
fn = fieldnames(additional);
for i = 1:numel(fn)
```

```
out.(fn{i}) = additional.(fn{i});
end
end
```