Effects of religious heterogeneity on global beef trade

Efeitos da heterogeneidade religiosa no comércio global de carne bovina

Efectos de la heterogeneidad religiosa en el comercio mundial de carne de vacuno

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ABSTRACT

This study evaluates the effect of religious distance on bilateral beef trade flows between 21 exporting countries and 167 importing countries from 2000 to 2021. The analysis examines both facilitating and hindering effects of religious factors on commercial flows. Religious similarity may reduce transaction costs through shared norms and trust networks, while religious differences may create exclusionary practices functioning as trade barriers. Using a structural gravity model, the results show that religious asymmetry does not impact overall beef trade flows, except when controlling for major Halal and Kosher-certified exporters. The findings reveal that religion does not systematically affect beef trade, though certification creates competitive advantages in specialized market segments.

Key words: Religion; Beef; International Trade; Cultural Barriers; Gravity Model.

RESUMO

Este estudo avalia o efeito da distância religiosa nos fluxos de comércio bilateral de carne bovina entre 21 países exportadores e 167 países importadores de 2000 a 2021. A análise examina tanto os potenciais efeitos facilitadores quanto restritivos dos fatores religiosos nos fluxos comerciais. A similaridade religiosa pode reduzir custos de transação por meio de normas compartilhadas e redes de confiança, enquanto diferenças religiosas podem criar práticas excludentes que funcionam como barreiras comerciais. Utilizando um modelo gravitacional estrutural, os resultados mostram que a assimetria religiosa não afeta os fluxos comerciais gerais de carne bovina, exceto quando controlados os principais exportadores certificados Halal e Kosher. Os achados revelam que a religião não afeta sistematicamente o comércio de carne bovina, embora a certificação crie vantagens competitivas em segmentos especializados globalmente.

Palavras-chave: Religião; Carne bovina; Comércio internacional; Barreiras culturais; Modelo gravitacional.

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RESUMEN

El estudio evalúa el efecto de la distancia religiosa en los flujos de comercio bilateral de carne de vacuno entre 21 países exportadores y 167 países importadores de 2000 a 2021. El análisis examina tanto los potenciales efectos facilitadores como restrictivos de los factores religiosos en los flujos comerciales. La similitud religiosa puede reducir los costos de transacción a través de normas compartidas y redes de confianza, mientras que las diferencias religiosas pueden crear prácticas excluyentes que funcionan como barreras comerciales. Utilizando un modelo gravitacional estructural, los resultados muestran que la asimetría religiosa no afecta los flujos comerciales generales de carne de vacuno, excepto cuando se controlan los principales exportadores certificados Halal y Kosher. Los hallazgos revelan que la religión no afecta sistemáticamente el comercio de carne de vacuno, aunque la certificación crea ventajas competitivas en segmentos especializados globalmente.

Palabras clave: Religión; Carne de vacuno; Comercio internacional; Barreras culturales; Modelo gravitacional.

1 INTRODUCTION

International trade is necessary for ensuring food security and maintaining public food reserves. A 14% global supply expansion in the meat market is anticipated by 2030, accompanied by a 5.9% rise in beef availability (OECD-FAO, 2024). This growth trend is also observed on the demand side. The consumption of animal protein is driven by dietary changes resulting from urbanization and rising global average income. Consequently, there is an anticipated increase in international meat flows, particularly towards Asia and the Middle East (OECD-FAO, 2024).

Although commodity trade is generally associated with products that have uniform characteristics, are produced on a large scale and with homogeneous physical attributes (Martins; Martinelli, 2010), products can be differentiated by historical, institutional and cultural factors, such as religious traditions and cultural ties (Ermgassen *et al*., 2021; Carneiro *et al*., 2022). This is especially applicable in the meat trade, which, despite being categorized as a commodity, may be ascribed other characterizations that are not solely reliant on its physical and observable characteristics (Fonseca *et al*., 2021).

International negotiations have included specific provisions for meat products, considering unobservable quality attributes, including adherence to processing and slaughter methods, which are essential for markets influenced by religious beliefs. Regulations that define these qualities can influence market access and generate trade possibilities (Dall'Azen; Weise, 2014).

The Halal industry, which follows processing rules following the Islamic religion, encompasses more than 1.8 billion consumers across 112 countries. By 2030, the industry is expected to continue growing, given the forecast that the Muslim population will reach 29% of the global population (Daud; Lee, Ismail; 2022). Furthermore, the number of young Muslims with higher educational levels is rising, reflecting the growth of a new market segment with high purchasing power, estimated at approximately USD 2.57 trillion by 2024 (Hossain *et al*., 2021).

Similarly, the Kosher meat business offers appealing possibilities. The term Kosher denotes items prepared by Jewish law and is linked to health and hygiene due to rigorous food processing, demanding cooperation and transparency from supplying companies (Hossain *et al*., 2021; Rudy *et al*., 2019). In 2021, the global Jewish population was predicted to be roughly 15.2 million, constituting about 0,195% of the total global population (DellaPergola, 2022). The primary slaughter requirements for this religious group require the animal's vitality and awareness during the slaughter and the complete removal of blood, which is considered impure and unsuitable for consumption (Rudy *et al*., 2019).

Halal and Kosher products not only represent religious symbols with potential for the Islamic and Jewish consumer markets, are also associated with excellence in quality assurance, attracting non-Muslim and non-Jewish consumers who value quality, safety, health, and authenticity (Hossain *et al*., 2021; Abdul-Talib; Abd-Razak, 2013). To ensure these characteristics, religious agencies must certify products which attest to compliance with technical standards and the brand's symbol.

In the realm of certifications, trust among the parties involved is important, influencing the selection of the governance framework and commercial partner to guarantee reliability. Implementing procedures that cultivate trust among agents is essential for alleviating uncertainty, deterring opportunistic behavior, and reducing transaction costs (Colares-Santos; Shanoyan; Schiavi, 2020).

However, religious and cultural issues, when incorporated into contracts, can be considered trade barriers (Audu; Okorie; Orekoya, 2023). Companies wishing to export products in compliance with religious requirements must adapt their production processes to the standards established by their trading partners to ensure market access (Aguiar, 2020). This leads to additional costs that may reduce exporters' competitiveness, with the consequences of leaving the market.

Eventually, this is questioned. Audu; Okorie; Orekoya (2023) state that religious asymmetries appear to have little impact on trade flows, even when comparing the most and least religious nations globally. Regardless of the level of religiosity, countries do not typically form trade partnerships based on shared religious beliefs. Instead, trade reciprocity and economic considerations are more relevant in shaping trade. For instance, countries with high levels of religiosity, such as Israel, Saudi Arabia, and India, continue to maintain stable trade relations with nations that do not share their religious traditions, indicating that religion does not directly influence trade decisions (Audu; Okorie; Orekoya, 2023). However, Costa *et al* (2023) and Hamid *et al* (2022) argue that religion can affect positively or negatively the trade of certain products, such as cultural products (films) and food.

New investigations further underscore how religious, cultural and economic factors shape trade patterns. Applying a gravity model to Indonesia's seafood exports, Herianingrum *et al*. (2024) highlight how GDP and common language can strengthen export performance and bolster the Halal market. Meanwhile, Muchtar *et al* (2025) employ a computable general equilibrium approach to show that free trade agreements

with countries members of the Organization of Islamic Cooperation (OIC) can boost welfare and real GDP for Indonesia's halal food sector, though some product segments may face export declines.

From a different angle, Zhang; Saghaian; Reed (2023) use a stochastic frontier gravity model to analyze U.S. bourbon whisky exports, demonstrating that economic size, common language, and policy measures can promote trade, again indicating how specialized product attributes, religious or otherwise, interact with classical trade drivers. Within the European Union, Zaninovi (2025) further confirms that factor productivity, resource endowments and the ability to meet evolving standards are key determinants of agricultural trade flows. These more recent studies show that production attributes (e.g., Halal compliance, resource use and geographical indication) intertwine with broader economic variables to shape the contours of trade, reinforcing the importance of analyzing religious and cultural distance alongside conventional drivers.

This study adopts an agnostic stance regarding religion's role in beef trade, recognizing that cultural factors can both facilitate and hinder commercial flows. Religion may reduce transaction costs by fostering trust among members sharing religious traditions, while religious differences can create exclusionary practices that function as trade barriers (Lewer; Van Den Berg, 2007; Lee; Park, 2016).

This analysis contributes to International Relations by examining how informal institutions shape trade patterns beyond formal agreements and tariffs. While traditional international trade literature focuses on state policies and formal arrangements, this study addresses how cultural norms influence economic decisions between states, enriching understanding of how identity factors affect countries' integration into the global economy. Based on expansion opportunities in this market segment and different possibilities of trade effects (positive, negative, or non-significant), the question arises: what is the effect of religious distance on global beef trade? This study evaluates, through a statistical model, the effect of religious asymmetry on beef trade flows between 2000 and 2021.

2 THEORETICAL FRAMEWORK

2.1 Religious institutions in international relations

International relations theory provides some frameworks for understanding how cultural factors influence interstate economic behavior. Liberal institutionalism suggests that shared norms and values reduce transaction costs in international cooperation by creating predictable behavioral patterns and common standards (Keohane; Nye, 2011). Constructivist approaches emphasize how cultural identities shape state preferences and interests beyond material calculations, arguing that actors' understanding of their interests is socially constructed through cultural practices and shared meanings (Wendt, 1999).

Religious institutions operate within these theoretical frameworks as informal constraints that create both opportunities for cooperation

and potential conflicts in trade relations. Unlike formal institutions such as trade agreements or international organizations, religious norms are embedded in social practices and cultural traditions that persist across political changes, making them stable but potentially rigid factors in international economic relations.

When religious backgrounds align between trading partners, facilitative mechanisms emerge. Shared religious practices establish common products, production, and business conduct expectations, reducing the need for strict monitoring and verification procedures. Religious networks provide information channels about market conditions and regulatory requirements that complement formal commercial information systems. Additionally, transnational religious communities maintain social capital that enables reputation-based contract enforcement, reducing dependence on formal legal mechanisms for dispute resolution.

The diaspora literature offers perspectives into these dynamics. Graham (2014) demonstrates how ethnic and religious networks reduce information asymmetries in international trade, while Cruz (2013) shows that diaspora connections help overcome formal trade barriers through relationship networks. This is because these communities sustain shared norms, repeated interactions, and reputational mechanisms that lower transaction costs and improve information flow. Religious communities function similarly, creating bridges between geographically separated markets through shared cultural understanding and trust.

However, religious differences can generate exclusionary practices that function as non-tariff barriers. Religious dietary restrictions create market segmentation requiring specialized certification procedures, separate supply chains, and costly production adaptations. This segmentation can exclude countries lacking appropriate religious or conformity infrastructure while providing preferential access to those with established certification systems.

The dual nature of religious influence reflects broader dynamics between cultural preservation and economic integration in the international political economy. States must balance domestic religious constituencies' demands for cultural authenticity with international market access requirements, creating policy choices that extend beyond traditional economic considerations.

2.2 Transaction costs and institutional economics

Classical international trade theories, which focus on productivity and factor endowment, did not initially highlight trade costs. However, Anderson and van Wincoop (2004) observe that, as trade expands, transaction costs may surpass transportation costs and tariffs. These transaction costs encompass all stages of international business, from negotiations to final delivery (Maragno; Kalatziz; Paulillo, 2006).

Transaction Cost Theory (TCT) underscores key assumptions such as bounded rationality, which refers to limited decision-making capacity; uncertainty, which addresses information asymmetry; opportunism, which involves exploiting these asymmetries; and asset

specificity, which concerns exclusive features in transactions (Dall'Azen; Weise, 2014). Economic agents, mindful of these costs, choose governance structures that minimize them (Mendes; Figueiredo; Michels, 2008). In this regard, institutions arise as governance solutions for production and trade (Dasilva-Glasgow, 2020; Cabarello; Soto-Oñate, 2016; Acemoglu; Antràs; Helpman, 2007), establishing norms and mechanisms that reduce risks and foster trust (Dall'Azen; Weise, 2014).

North (1993) defines institutions as the "rules of the game" that direct economic behavior, whether formal (laws, regulations, contracts) or informal (traditions, customs, religion). When informal practices become formalized, they promote predictable market behavior (Dall'Azen; Weise, 2014; Mendes; Figueiredo; Michels, 2008). Consistent with New Institutional Economics, these rules reduce uncertainty, transaction costs, and opportunities for fraud (Bueno, 2004). By implementing regulations, institutions encourage trust and cooperation, limiting deceptive conduct and enhancing transparency (Mendes; Figueiredo; Michels, 2008). Religion, as an informal institution, shapes norms regarding acceptable meat products, slaughter practices, and labeling, thus influencing supply and demand in the meat trade. Importers' quality requirements reinforce consumer confidence in suppliers (Thomé; Reis; Paiva, 2003).

Yet, if producers fail to meet certain religious guidelines, they may face barriers in entering specific markets (Dall'Azen; Weise, 2014). Studies indicate that shared religious culture can strengthen bilateral trade by reducing transaction costs (Lewer; Van Den Berg, 2007; Bonne; Vermeir; Verbeke, 2008; Lee; Park, 2016; Irshad *et al*, 2018), fostering trust and minimizing the need for costly adaptations (Czelusniak; Ribeiro; Dergin, 2018).

Conversely, divergent cultural norms can act like tariffs (Lee; Park, 2016). Meeting religious requirements often entails additional investments in specialized slaughter procedures, certifications, or training, all of which can limit access to specific markets (Dall'Azen; Weise, 2014). Similarly, cultural factors such as language, colonial heritage, labor relations, and religion tend to remain unchanged over time, reinforcing consumption patterns and challenging exporters' efforts to reach certain markets (Lopez; Gama, 2010).

As a result, the historical, religious, and institutional characteristics of each region influence trade patterns. When religions and cultural customs differ, mistrust generally increases transaction costs and constrains bilateral trade. Therefore, the economic burden associated with reduced trade flows can become relevant for key markets.. In light of this, it is important to examine cultural aspects, particularly religion, as a possible determinant of export performance. This consideration is vital in the meat industry, which faces strict regulations and anticipates growth in both consumption and numbers of Jewish and Muslim consumers. The following section explains the methodology employed in this study.

3 METHODOLOGY

3.1 Theoretical gravity model

Tinbergen (1962) was the first to propose a gravity model to explain international trade flows, suggesting that trade volume between countries is influenced by their economic size and the distance between them. His model laid the groundwork for quantifying deviations between observed and expected trade in the absence of barriers. However, despite its empirical success, the gravity model lacked a solid theoretical foundation for decades. This gap was addressed by Anderson and van Wincoop (2003), who developed a micro-founded version of the gravity model based on a constant elasticity of substitution (CES) utility function and market-clearing conditions. Their framework provided the necessary theoretical consistency, enabling more accurate estimations of bilateral trade flows, following the 1 equation:

$$X_{ijt}^{k} = \frac{E_{jt}^{k} Y_{it}^{k}}{Y_{t}^{k}} \left(\frac{\tau_{ijt}^{k}}{P_{jt}^{k} \Pi_{it}^{k}} \right)^{1-\sigma} \quad (1)$$

where the variable is the exports of product from country to importer in year; is the expenditures of country on products in year; and are, respectively, the quantity of produced in country and the aggregate international production of such products in the world, in; and are multilateral resistance terms of trade in; is the elasticity of substitution among products, represent the bilateral trade costs betweenand countries in year for product.

The major contribution of Anderson and van Wincoop (2003) was the consolidation of the multilateral resistance terms. The variables and were formally defined to show that bilateral trade flows are influenced not only by the trade costs between two countries but also by costs incurred with other trading partners. In other words, trade between countries *i* and *j* is affected not only by their direct costs but also by the costs between country *j* and a third country. Mathematically, these indices are represented by the following equations:

$$(\Pi_{it}^{k})^{1-\sigma_k} = \sum_{j} \left(\frac{\tau_{ijt}^{k}}{P_{jt}^{k}} \right)^{1-\sigma_k} \frac{E_{jt}^{k}}{Y_{t}^{k}} \quad (2)$$

$$(P_{jt}^{k})^{1-\sigma_k} = \sum_{i} \left(\frac{\tau_{ijt}^{k}}{\Pi_{it}^{k}} \right)^{1-\sigma_k} \frac{Y_{it}^{k}}{Y_{t}^{k}} \quad (3)$$

represents external multilateral resistance, indicating that exports from country *i* to country *j* depend on the trade costs between country *j* and all potential export markets. denotes internal multilateral resistance and reflects how country *j* imports depend on trade costs with all possible supplier countries for products *k*. The inclusion of these terms marked an advancement in the gravity model, allowing for more accurate estimates. According to Carneiro *et al* (2022), omitting these terms is a major econometric issue that leads to biased estimates due to omitted variable bias. A

common method to address this issue involves using fixed effects, which account for any variables representing potential trade frictions.

is a function of all bilateral barriers that affect trade. Literature often approximates this using a set of variables representing costs, which may be geographic or historical-institutional, such as distance, contiguity, common language, cultural ties, or religious differences. Also, it can incorporate measures of trade policy, including tariffs and non-tariff barriers.

Building on this theoretical development, the gravity model has become a widely used tool in empirical studies involving trade volumes. Given that trade flows are a key element in economic relations and the necessary data for estimating the model is easily accessible, many studies have adopted the gravity model, solidifying it as one of the most utilized methods in the field of international economics (Baldwin; Taglioni, 2006; Carneiro *et al*, 2022).

The evolution of the model, as well as improvements in estimation techniques, as discussed by Yotov *et al* (2016), has enabled the use of gravity equations to contrast the influence of trade preferences against other determinants of trade, such as distance between countries, income levels, language, borders, trade agreements, religion, among others Anderson; Larch; Yotov (2020), Carneiro *et al* (2022) and Costa *et al* (2023) employed the gravity model approach to estimate trade determinants.

3.2 Empirical model

The analysis of the relationship between beef exports and bilateral religious disparity covered the years 2000 to 2021[2]. The trade flow occurred between 21 major beef exporters and 164 trading partners, representing 95% of the global exports of the product during this period. The selection of exporters was based on countries responsible for 95% of global beef imports, similar to the methodology employed by Peci and Sanjuan (2020), who identified 40 importing countries that accounted for 80% of global pork imports.

The estimates utilized a panel data framework, analyzing information from individuals (countries) across several time points. This data structure improves estimator efficiency and parameter inference accuracy, as panel data offers increased degrees of freedom (Hsiao, 2005). Various beef products were incorporated into the panel alongside the nation and year measurements. The products were categorized at the six-digit level following the Harmonized Commodity Description and Coding System (HS).[3]

The model is estimated to be using the Poisson Pseudo-Maximum Likelihood (PPML) estimator, which is appropriate for analyzing trade flows as it addresses the issue of bilateral flows equal to zero in dependent

2. The period from 2000 to 2021 was selected due to the availability of consistent and standardized data, enabling long-term analysis of cyclical and structural patterns in beef trade. More recent data remain under revision, making this time frame the most reliable for cross-country comparisons.

3. HS020110, 020120, 020130, 020210, 020220, 020230, 020610, 020621, 020622, 020629, that means beef cuts (fresh/frozen) and edible offal (tongue, liver, etc.), encompassing whole carcasses or bone-in/boneless portions.

variable, indicating the absence of trade for certain country pairs, year and the product, or data missing. Around 94% of the sample contains zero or missing data. The PPML surpasses the Ordinary Least Squares (OLS) estimator, omitting observations with zero trade flows, resulting in selection bias and the loss of significant information from null flows. Besides addressing this issue, the PPML can estimate the model despite the heteroscedasticity (Santos Silva; Tenreyro, 2006). The functional specification for the estimated equation is articulated as:

$$X^{k}_{ijt} = c + \theta_{ijk} + \phi_{ijk} + \beta_1 Relig_{ij} + \beta_2 lnDist_{ij} + \beta_3 Conti_{ij} + \beta_4 Rta_{ijt} + \beta_5 Col_{ij} + \beta_6 Lang_{ij} \quad (4)$$

Where represents beef imports[4] from to importing countries of in year; is the constant;, are fixed effects of exporter-year-product and importer-year-product; is an index variable; is the bilateral distance between countries of origin and destination, a proxy for transportation costs; is a dummy that takes the value 1 if and countries share a common border and 0 otherwise; is a dummy that takes the value 1 if and countries have a trade agreement in year and 0 otherwise; is a dummy indicating colonial ties between countries, with value 1 if there are colonial ties and 0 otherwise; is a dummy indicating whether the countries have the same official language, assuming value equal to 1 if so and 0 otherwise; is the error term.

The Religious Distance variable (refers to the religious proximity index (*comrelig*) developed by the Centre d'Études Prospectives et d'Informations Internationales (CEPII). It is a bilateral similarity measure in built from country-level shares of three denominations, Catholic, Protestant, and Muslim, sourced from La Porta *et al* (1999, 2008). Formally, where is the share of denomination in country Values near 1 indicate highly similar compositions; values near 0 indicate little or no overlap. The variable is symmetric, time-invariant in CEPII's Gravity dataset, and captures a narrow but tractable dimension of cultural proximity that can affect trade by shaping information flows and trust. A limitation is that it aggregates only three traditions and omits others, so it should be read as a coarse proxy rather than an exhaustive religious landscape (Mayer; Zignago, 2011).

To provide greater robustness to the model, some alternative estimations were carried out to verify whether the effect of the religious variable remains. Firstly, the estimations were categorized by product type: chilled beef, frozen beef and offal[5]. This distinction is interesting because the trade of offal may be influenced by cultural factors, such as the prohibition against consuming residues and blood in Jewish and

4. Although the analysis is based on export data, import data is used for reliability. Customs authorities have greater control over import data because it is on this data that customs duties are levied.

5. Chilled beef is fresh meat preserved at 0-4°C with limited shelf life, requiring fast transportation and serving premium markets. Frozen beef has extended shelf life enabling long-distance trade and representing 53.5% of beef trade during the analyzed period. Offal includes organ meats and by-products that face distinct religious restrictions, as certain traditions prohibit consumption of blood-containing organs, making this category potentially more sensitive to religious differences between trading partners.

Muslim religions. Additionally, there is a distinction for chilled products, as their trade is less frequent than that of frozen beef due to their perishability and the transportation costs associated with maintaining refrigeration. These categories may respond differently to religious distance because frozen beef dominates trade volumes where cultural trust matters more, while religious similarity may actually reduce offal trade when shared dietary restrictions prohibit organ meat consumption.

The second robustness strategy was to control the main exporters of Halal and Kosher-certified meat. To this, a dummy variable was implemented for the principal global exporters of these products in 2022[6] () (Equation 5), and an interaction between this variable and religion was analyzed (Equation 6). Also, there was an interaction between this variable and the religion variable to analyze (Equation 6). Religious slaughter involves costs associated with modifying manufacturing techniques. If these countries maintain access to consumer markets, it indicates that they have not only borne these costs but also remained competitive in international markets.

$$X_{ijt}^{k} = c + \theta_{ijk} + \phi_{rjk} + \beta_1 Relig_{ij} + \beta_2 HalalKosher_{i} + \beta_3 lnDist_{ij} + \beta_4 Conti_{ij} + \beta_5 Rta_{ijt} \quad (5)$$

$$X_{ijt}^{k} = c + \theta_{ijk} + \phi_{rjk} + \beta_1 Relig_{ij} + \beta_2 HalalKosher_{i} + \beta_3 HalalKosher \quad (6)$$

Still to test the robustness of the estimates, the population of each exporter allocated across various religions was included in the model. The latest data for this information is from 2010 and was applied to all years of the panel as a proxy for religious representation. While the number of devotees may fluctuate over time, no significant variation in the proportion of adherents to religions is expected. Consequently, utilizing lagged data is not anticipated to pose an issue.

$$X_{ijt}^{k} = c + \phi_{rjk} + \beta_1 Relig_{ij} + \beta_2 lnChristian_{i2010} ++ \beta_3 lnJewish_{i2010} + \beta \quad (7)$$

, refer to the number of individuals in the exporting country (*i*) who adhered to Christianity, Judaism and Islam (Muslims) in 2010, respectively. To estimate these variables, exporter-year-product fixed effects were removed because their inclusion would lead to the omission of those variables due to multicollinearity. Importer-year-product fixed effects were maintained.

Another strategy to test the robustness of the results is to insert the importer and exporter Gross Domestic Product [GDP] on the gravity model, replacing the time-varying unilateral fixed effects, which are replaced by fixed effects of importer, exporter, year and product (Capoani; Barlese, 2021; Nijkamp; Ratajczak, 2021; Ribeiro *et al*, 2019). The GDP variables are proxies for the importer's demand capacity and the exporter's supply capacity, respectively.

6. This data is a proxy for the largest exporters between 2001 and 2021. No time series were found to indicate which countries held the largest market shares for these goods. However, the inclusion of this variable allows us to associate the largest suppliers of beef with a comparative advantage in exports of meat with religious certificates.

$$X^{k}_{ijt} = c + \beta_1 Relig_{ij} + \beta_2 PIB_{it} + \beta_3 PIB_{jt} + \beta_4 lnDist_{ij} + \beta_5 Conti_{ijt} + \beta_6 Rta_{ijt} + \quad (8)$$

and represent the GDP of the exporter and the importer in year, respectively. Both variables were absorbed in equation (4) by the fixed effects importer-year-product and exporter-year-product.

The religion variable did not change for the evaluated years, as it varies only between countries. For this reason, bilateral fixed effects to country pairs are not included, as their inclusion would omit the variable of interest due to multicollinearity issues. The use of time-varying unilateral fixed effects (importer-year, exporter-year) controls multilateral resistance terms in the theoretical model (Feenstra, 2015; Head; Mayer, 2014). Fally (2015) notes that estimates containing these fixed effects correspond to the structural gravity terms, which differ from the traditional gravity model. In the structural model, the time-varying unilateral fixed effects determine the expenditures and output adjusted to the actual values of production and expenditures, represented as and in the theoretical model.

One particularly useful feature of the structural gravity model for empirical applications is its separability, allowing it to be applied to different product categories. This enables the study of bilateral flows for a specific product independently. Consequently, the unilateral fixed effects become importer-time-product and exporter-time-product fixed effects (Carneiro *et al*., 2022). Secondly, from a practical perspective, adding fixed effects ensures a consistent consideration of bilateral trade costs, which can be achieved in three simple steps: (i) estimating the gravity equation using PPML; (ii) constructing bilateral trade costs for each country pair, which this study did not address due to multicollinearity issues with the variable of interest; and (iii) aggregating bilateral trade costs at the desired level using the estimates of importer and exporter fixed effects (Yotov; Piemartini, 2016).

To address step (ii), standard variables commonly used in gravity models were included. Anderson and van Wincoop (2003) highlight traditional variables used as proxies for costs in gravity models, such as bilateral distance, shared borders, language, and colonial ties—factors that represent time-invariant bilateral costs. Additionally, Yotov *et al* (2016) recommend estimating the gravity model with spaced intervals, suggesting gaps of 3 to 5 years to capture adjustments in trade flows to trade policies. However, since this study does not aim to evaluate trade policies such as tariffs or non-tariff measures, the model was estimated without incorporating time gaps.

Table 1 provides a description of the variables used in econometric evaluation, including their measurement units and sources.

Table 1 - Description and data source of the variables of model.

Variable		Unit	Source
X^{h}_{ijt}	Bilateral imports of beef	1.000 USD	The United Nations Comtrade
$Relig_{ij}$	Religious similarity index. Ranges from 0 to 1 and increases when the pair of countries share a common religion practiced by a large part of the population	Index (0 to 1)	CEPII Research and Expertise on the World Economy
$lnPIB_{jt}$	Importer's GDP	Current US$	World Bank
$lnPIB_{it}$	Exporter's GDP	Current US$	World Bank
RTA_{ij}	Presence of trade agreements between countries involved in trade	Dummy	Mario Larch Database
$lnDIST_{ij}$	Bilateral distance between the capitals of the countries	Kilometers	CEPII Research and Expertise on the World Economy
$Cont_{ij}$	Presence of borders between those involved in trade	Dummy	CEPII Research and Expertise on the World Economy
Col_{ij}	Common colonial ties between countries	Dummy	CEPII Research and Expertise on the World Economy
$Lang_{ij}$	Common language between countries	Dummy	CEPII Research and Expertise on the World Economy
$HalalKosher_{i}$	Largest exporters of Halal and Kosher certified meat	Dummy	The Halal Times, (2022) e Grand View Research, (2022)
$lnChristian_{i2010}$ $lnJewish_{i2010}$ $lnIslamic_{i2010}$	Exporter population adherents to the Christian, Jewish and Islamic (Muslim) religions	Number of individuals allocated to each religion (2010 data)	World Religion Data

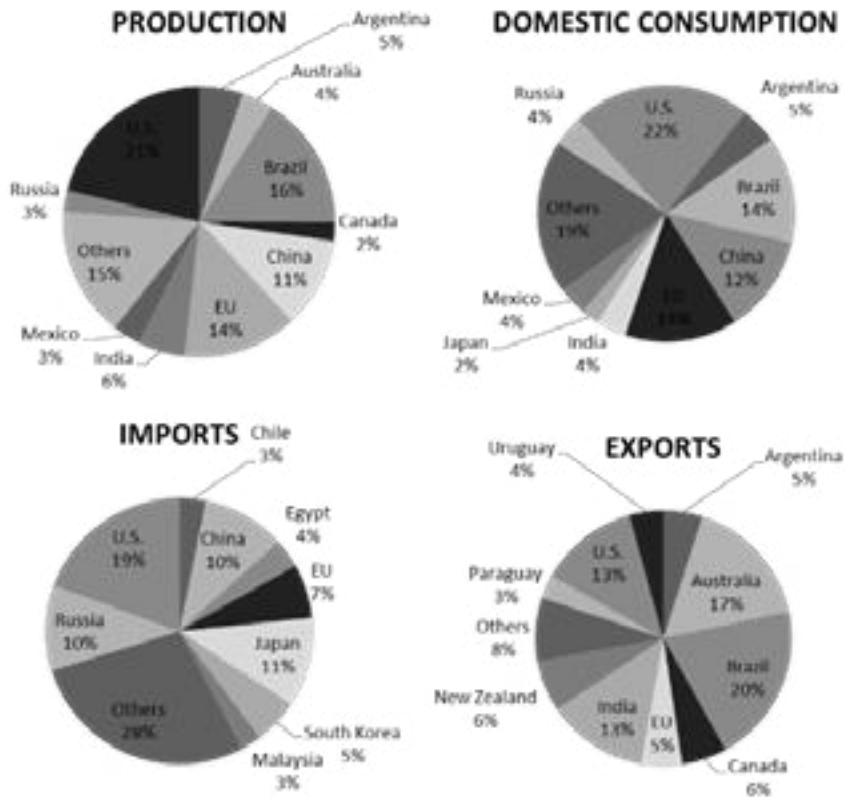
Source: Author's elaboration.

1 RESULTS

Before presenting the econometric results, Figure 1 presents information about the international beef market from 2000 to 2021, indicating the largest producers, importers, exporters, and consumers. The U.S. is the largest beef producer worldwide, with a cumulative production of 275,052 thousand metric tons (MT), underscoring its pivotal position in the global supply chain. Brazil (207,593 thousand MT) and the European Union (EU) (176,897 thousand MT) are the next largest producers. Brazil, with its vast agricultural land and favorable conditions for livestock farming, stands out as the leading producer in Latin America, while China and India are the major producers in Asia, accounting for 140,121 thousand MT and 72,949 thousand MT, respectively. Despite being the largest producer, the U.S. is also the top importer of beef, with 30,966 thousand MT of imports over the period, highlighting strong domestic demand. China, driven by rapid economic growth and shifting consumption patterns, imported 16,183 thousand MT. Other key markets include Japan (17,385 thousand MT) and the European Union (10,463 thousand MT), reflecting the global appetite for beef in both developed and expanding

economies.

Figure 1 – Main producers, importers, exporters and consumers of beef, 2000 to 2021 (in %).



Source: Author's elaboration based on Foreign Agricultural Service, Official USDA Estimates[7].

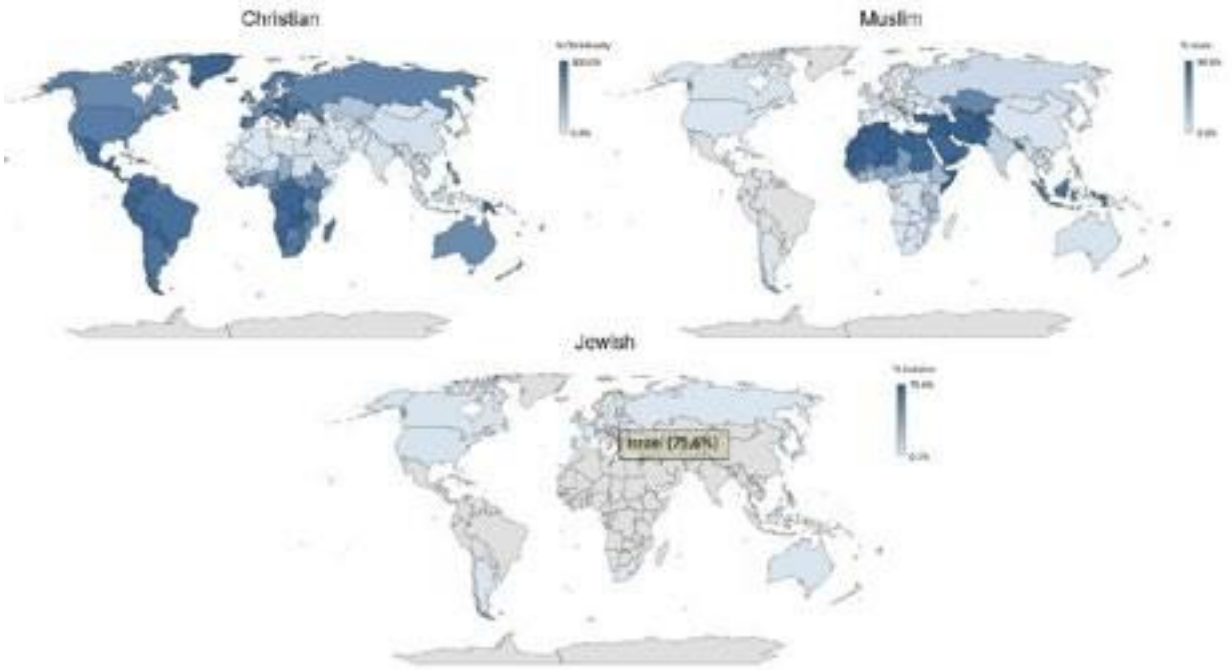
On the export side, Brazil leads with 39,318 thousand MT of beef exported, consolidating its position as one of the world's major suppliers. Australia (32,580 thousand MT), the U.S. (24,429 thousand MT), and India (24,844 thousand MT) also stand out as key suppliers to international markets. Domestic consumption trends reflect production and import patterns. The U.S., with total consumption of 281,449 thousand MT, leads the world in beef consumption, highlighting the role of domestic demand in influencing the global market. Brazil, with 169,451 thousand MT, and China, with 155,285 thousand MT, respectively, also emerge as consumers.

The data indicates that a few key players largely dominate the global beef trade. The U.S., Brazil, China, and the EU are major actors in both production and consumption, while Brazil, Australia, and India lead as top exporters. The growing demand in Asian markets, especially in China and Japan, suggests a shift in global consumption trends that were previously more concentrated in the U.S. and EU, with beef becoming a more important part of diets in these regions.

7. Available at: https://apps.fas.usda.gov/psdonline/app/index.html#/app/advQuery. Accessed in February 2025.

The territorial distribution of the Christian, Muslim, and Jewish religions is presented in Figure 2. Predominantly Christian countries are located in the Americas, Europe, southern Africa, and Oceania. Muslim populations are primarily concentrated in northern Africa, the Middle East, and parts of Asia. Israel is the country with the largest Jewish population, holding 75.6% of the world's Jewish population (Pew Research Center, 2024). The primary exporters of beef are predominantly Christian countries.

Figure 2 - Territorial distribution of the Christian, Islamic and Jewish religions in the world.



Source: Author's elaboration based in Pew Research Center[8]. Note: Data refer to 2010, the most recent year with available data.

Table 2 presents the descriptive analysis of the variables. The religious index measures religious similarity between country pairs, where values equal to or closer to 0 indicate lower religious similarity, and values closer to 1 represent greater similarity in the religions of the populations of two countries. The mean value of 0.204103 suggests that, on average, religious similarity between country pairs is low, indicating differences in religious practices among most pairs. The standard deviation of 0.261002 reflects considerable variation in the data, indicating a wide variation in similarity among countries. The minimum value of 0 indicates that some country pairs have no religious similarity at all, while the maximum value of 0.960284 suggests that the most similar country pair shares 96% religious proximity.

Table 2 - Descriptive analysis of variables.

8. Available at: https://www.pewresearch.org/religion/2014/04/04/religious-diversity-index-scores-by-country/. Accessed in February 2025.

Variable	Observations	Mean	Standard deviation	Minimum	Maximum
X^k_{ijt}	757,680	531.6	15,565.9	0.0	4,175,342.0
$DIST_{ij}$	757,680	7,967.7	4671.9	0.0	19,629.5
$Relig_{ij}$	757,680	0.204103	0.261002	0	0.960284
$Conti_{ij}$	757,680	-	-	0	1
$Lang_{ij}$	757,680	-	-	0	1
Col_{ij}	757,680	-	-	0	1
PIB_{jt}	750,330	3.83E+11	1.54E+12	7.60E+07	2.30E+13
PIB_{it}	757,680	1.78E+12	3.39E+12	7.20E+09	2.30E+13
Rta_{ijt}	757,680	-	-	0	1
$Jewish_{2010}$	757,680	373,098.7	1,252,069	1,600	5,942,248
$Islamic_{2010}$	757,680	8,604,929	3.39E+07	1015	1.60E+08
$Christian_{2010}$	757,680	4.36E+07	5.75E+07	2,361,557	2.33E+08

Source: Author's elaboration.

Based on descriptive analyses and the observation that some of the main importers consider the religious aspect as a determinant of beef consumption, this study estimates the average effect of religious similarity on trade volume. The econometric results are presented in Table 3, with each column representing the results of a different econometric equation.

Table 3 - Econometric results of the gravity model with fixed effects.

	1 Equation (4)	2 Equation (5)	3 Equation (6)	4 Equation (7)	5 Equation (9)	6 Equation (7 e 9)	7 Equation (5, 7 e 9)	8 Equation (6, 7 e 9)
PPMLHDFE (X^k_{ijt})	Only the religion variable	Insertion of the Halal-Kosher dummy	Insertion of the HalalKosher dummy and the HalalKosher and religion interaction	Insertion of the religious portion of the population	Insertion of GDP variables	Insertion of GDP and religious share variables	Insertion of GDP, religious share and HalalKosher dummy variables	Insertion of the variables GDP, religious share and the HalalKosher dummy and the interaction HalalKosher and religion
$Relig_{ij}$	1.256	1.392*	1.586	-0.693	-0.007	-0.151	-0.217	-0.440
	(0.800)	(0.815)	(1.008)	(0.696)	(0.646)	(0.743)	(0.698)	(0.744)
$HalalKosher_i$	-	-0.505 (0.445)	-0.481 (0.450)	-	-	-	1.841***	1.763***
							(0.322)	(0.424)
$HalalKosher_i \times Relig_{ij}$	-	-	-0.278	-	-	-	-	0.486
			(0.899)					(1.087)
$lnChristian_{2010}$	-	-	-	-0.110	-	-0.438	-0.756***	-0.756***
				(0.180)		(0.315)	(0.223)	(0.225)
$lnJewish_{2010}$	-	-	-	0.363***	-	0.316***	0.211**	0.210**
				(0.115)		(0.110)	(0.098)	(0.099)
$lnIslamic_{2010}$	-	-	-	-0.109*	-	-0.216**	-0.336***	-0.337***
				(0.062)		(0.096)	(0.067)	(0.068)

	1 Equation (4)	2 Equation (5)	3 Equation (6)	4 Equation (7)	5 Equation (9)	6 Equation (7 e 9)	7 Equation (5, 7 e 9)	8 Equation (6, 7 e 9)
$lnDIST_{ij}$	-0.718***	-0.570**	-0.565**	0.296	0.547** (0.258)	0.327	-0.235	-0.234
	(0.199)	(0.226)	(0.229)	(0.229)		(0.215)	(0.163)	(0.165)
Col_{ij}	0.825	0.962	0.968	2.757***	1.079 (0.815)	3.203***	1.999*	2.035*
	(0.800)	(0.811)	(0.811)	(1.013)		(1.141)	(1.089)	(1.116)
$Contl_{ij}$	0.642	0.758	0.78	0.981**	1.518*** (0.534)	1.036**	0.731**	0.727**
	(0.470)	(0.486)	(0.506)	(0.476)		(0.466)	(0.354)	(0.357)
$Lang_{ij}$	0.776**	0.821**	0.804**	1.193***	1.384*** (0.365)	1.092***	0.853**	0.858**
	(0.374)	(0.381)	(0.383)	(0.369)		(0.379)	(0.350)	(0.352)
Rta_{ijt}	0.600**	0.683***	0.683***	0.850***	0.797*** (0.276)	0.774***	0.605**	0.606**
	(0.254)	(0.246)	(0.247)	(0.317)		(0.279)	(0.245)	(0.244)
$lnPIB_{it}$	-	-	-	-	0.301*** (0.098)	0.475*	0.671***	0.679***
						(0.252)	(0.192)	(0.201)
$lnPIB_{jt}$	-	-	-	-	1.390***	1.377***	1.363***	1.365***
					(0.208)	(0.206)	(0.212)	(0.212)
Constante	16.795***	15.659***	15.602***	5.848*	-43.791***	-39.419***	-31.870***	-32.078***
	(1.925)	(2.094)	(2.138)	(3.211)	(6.817)	(6.708)	(6.459)	(6.483)
N	243516	243516	243516	268940	655190	655190	655190	655190
R^2								
EF	Yes a	Yes a	Yes a	Yes a	Yes a	Yes a	Yes a	Yes a

Source: Author's elaboration. Values in parentheses refer to robust standard errors clustered by country pair. * p<0.10.** p<0.05. *** p<0.01. a EF of importer-year-product, exporter-year-product; b EF of importer-year-product; c EF of importer, year and product. Missing values in the dependent variable were replaced by zero indicating the absence of bilateral trade for the country-sector-year pair combination.

For total beef exports, the variable wasn't statistically significant in trade across all regressions, except in 2 column. Various functional forms were employed to test the robustness of the effects of religious distance on trade flows, and in almost all estimations, beef trade wasn't affected by religious heterogeneity between parties. This finding is consistent with Iannaccone (1998) and Audu; Okorie; Orekoya (2023), who suggest that there is no relationship between religion and economic activity. Furthermore, the sample includes all types of meat, and there may be hidden heterogeneity among the beef modality heterogeneity that affects the average results.

Since the sample of countries considered in the study is quite heterogeneous, it is important to highlight specific characteristics of the exporters. When the analysis incorporates the dummy (column 2), it controls for the main exporting countries of Islamic and Jewish products. In this case, religion has a positive and significant effect on trade flows, that is, the impact of religious symmetry on trade when the main exporters of Halal and Kosher certified meat are not considered. When isolating from estimates, countries with appropriate certifications to foster trust among Halal and Kosher meat consumers, the religious proximity positively affects trade flows, suggesting that the greater the religious similarity, the higher the trade flows are likely to be. On the other hand, the interaction term (column 3) reinforces the previous finding that, for the

main exporters of meat subject to religious requirements, does not have significant trade effects.

To understand the effect of religion on beef trade, columns 4, 6, 7, and 8 include the proportion of religious people from different religions in the exporter country population in the estimations. In all cases, considering the religious population did not alter the non-significant effect of religious symmetry between country pairs on trade volume. To test the robustness of these estimates, the fixed effects for exporter-year-product were removed. Without any additional control variables, the results indicate that the number of Christians in the exporting country has no statistically significant relationship with trade. However, the larger the Jewish population in the exporting country, the stronger the positive relationship with beef exports, while the larger the Muslim population, the more negative the relationship with beef trade.

The results are robust when controls for the economic size of the countries are added, which includes the importer and exporter GDP (column 6), the dummy variable (column 7), and the interaction term (column 8). In the inclusion of these last variables, the Christian population, represented by ln, showed a negative statistical relationship with trade flows, suggesting that the larger the Christian population in the exporting country, the lower trade. In 8 column, populations were re-estimated one by one. In this case, the relationship between the Christian population and trade remained non-significant, while the Jewish population ($p < 0.01$) and Muslim population ($p < 0.001$) maintained their significance and sign.

The population size can have two distinct interpretations concerning trade in the context of religious differences. First, when most of a country's population follows religions different from those in another country, this may lead to a reduction in trade transactions due to the religious requirements imposed by consumers in importing countries, which limits meat exports from countries with religiously distinct populations. A second explanation concerns countries with predominantly religious populations that follow traditional practices. In such markets, much of the meat produced is likely for domestic consumption or trade with countries sharing similar religions. This argument is supported by Irshad *et al* (2018), who suggest that countries with similar religions tend to engage in more trade with one another.

The positive coefficient for Jewish populations may reflect the concentration of Jewish communities in developed countries with advanced meat processing capabilities and established export networks. Jewish dietary laws (Kosher) require extensive supervision and certification infrastructure, which may signal higher quality standards that benefit overall meat exports beyond religious markets. Conversely, the negative coefficient for Muslim populations may reflect supply-side constraints in countries with large Muslim populations. Many Muslim-majority countries may prioritize domestic consumption or have production systems less oriented toward international export markets. Additionally, Halal certification requirements may involve different production adaptations that create trade-offs between serving domestic religious populations and

competing in broader international markets.

The expectation that religion might matter in beef markets stems from the dominance of Christian-majority countries as major exporters, which creates an apparent puzzle. If comparative advantage based on land endowments and production costs primarily determines beef export patterns, religious factors should be irrelevant. However, the presence of religious minorities within exporting countries may create specialized production capacities that serve global religious markets. Countries like Australia and Brazil, while predominantly Christian, have developed Halal and Kosher certification infrastructure that enables access to rapidly growing Muslim and Jewish consumer populations, suggesting that religious considerations operate alongside rather than against traditional comparative advantage factors.

The analysis for disaggregated products (Table 4) shows that frozen meat trade (column 2) and offal (column 9) are significantly influenced by the variable in some particular cases. Religious proximity between country pairs indicates a positive relationship with trade flows for frozen meat and a negative relationship for offal.

Table 4 - Results of the gravity model with fixed effects, for different beef types.

	1 Equation (4)	2 Equation (4)	3 Equation (4)	4 Equation (6)	5 Equation (6 e 9)	6 Equation (6 e 9)	7 Equation (6, 7 e 9)	8 Equation (6, 7 e 9)	9 Equation (6, 7 e 9)
$PPML\,(X^{k}_{ij})$	Chilled beef	Frozen beef	Offal	Chilled beef, insertion of the HalalKosher dummy, HalalKosher interaction, religion and GDP	Frozen beef, insertion of the HalalKosher dummy, HalalKosher interaction, religion and GDP	Offal, insertion of the HalalKosher dummy, HalalKosher interaction, religion and GDP	Chilled beef, insertion of religious portion, Halal Kosher dummy, Halal Kosher interaction, religion and GDP	Frozen beef, insertion of religious portion, Halal Kosher dummy, Halal Kosher interaction, religion and GDP	Offal, insertion of religious share, HalalKosher dummy, HalalKosher interaction, religion and GDP
$Relig_{ij}$	1.717	1.963*	-1.502	-0.253	0.262	-0.563	0.517	-0.116	-1.722*
	(1.140)	(1.093)	(1.102)	(1.211)	(0.944)	(1.190)	(0.951)	(0.998)	(1.037)
$HalalKosher_{ij}$	-	-	-	0.586	0.891**	1.236**	0.808	1.680***	1.876***
				(0.642)	(0.386)	(0.524)	(0.779)	(0.408)	(0.447)
$HalalKosher_{ij} \times Relig_{ij}$	-	-	-	0.983	1.00	-0.100	1.764	0.801	0.034
				(1.878)	(0.978)	(1.534)	(2.123)	(0.974)	(1.507)
$lnChristian_{2015}$	-	-	-	-	-	-	-1.409***	-0.449**	-1.173***
							(0.443)	(0.215)	(0.426)
$lnJewish_{2015}$	-	-	-	-	-	-	0.624***	-0.013	0.392**
							(0.120)	(0.099)	(0.171)
$lnIslamismo_{2015}$	-	-	-	-	-	-	-0.636***	-0.237***	-0.503***
							(0.116)	(0.067)	(0.127)
$lnDIST_{ij}$	-1.052***	-0.413	-0.554	-0.189	-0.721***	-0.047	-0.488***	0.279	-0.702*
	(0.211)	(0.264)	(0.421)	(0.245)	(0.259)	(0.368)	(0.174)	(0.270)	(0.367)

	1 Equation (4)	2 Equation (4)	3 Equation (4)	4 Equation (6)	5 Equation (6 e 9)	6 Equation (6 e 9)	7 Equation (6, 7 e 9)	8 Equation (6, 7 e 9)	9 Equation (6, 7 e 9)
Col_{ij}	2.147**	0.727	-0.709	-0.233	1.167	2.493**	5.030***	1.657	0.692
	(0.847)	(0.804)	(1.350)	(0.683)	(0.879)	(1.072)	(1.295)	(1.022)	(1.631)
$Contij$	1.506*	-1.031	2.347***	1.375***	-0.077	2.274***	0.865*	-0.435	1.161
	(0.808)	(0.714)	(0.822)	(0.529)	(0.655)	(0.842)	(0.462)	(0.610)	(0.889)
$Lang_{ij}$	0.571	0.860**	-0.393	0.988**	1.468***	0.326	0.309	1.334***	-0.223
	(0.433)	(0.437)	(0.497)	(0.385)	(0.421)	(0.742)	(0.391)	(0.406)	(0.560)
Bta_{ijt}	0.527**	0.776***	-0.245	0.579*	0.948***	-0.339	0.519*	0.772***	-0.12
	(0.260)	(0.292)	(0.457)	(0.318)	(0.275)	(0.389)	(0.273)	(0.293)	(0.354)
$lnPIB_{it}$	-	-	-	0.316*** (0.121)	0367	0.372*** (0.129)	1.248***	0.516***	1.140***
					(0.083)		(0.452)	(0.191)	(0.303)
$lnPIB_{jt}$	-	-	-	1.477*** (0.221)	1.630***	0.540*** (0.192)	1.427***	1.617***	0.560***
					(0.280)		(0.288)	(0.282)	(0.184)
Constante	18.888***	14.323***	15.332***	-40.554***	-44.461	-17.484**	-37.394***	-42.704***	-11.342
	(2.200)	(2.533)	(3.940)	(7.276)	(8.708)	(7.772)	(11.113)	(9.172)	(7.084)
N	70389	84085	89042	191517	192840	250400	191517	192840	250400
R^2									
EF	Yes a	Yes a	Yes a	Yes a	Yes a	Yes a	Yes a	Yes a	Yes a

Source: Author's elaboration. Values in parentheses refer to robust standard errors clustered by country pair. * p<0.10.** p<0.05. *** p<0.01. a EF of importer-year-product, exporter-year-product; b EF of importer-year-product; c EF of importer, year and product. Missing values in the dependent variable were replaced by zero indicating the absence of bilateral trade for the country-sector-year pair combination.

In the frozen meat trade, the significant results occur only in the general model, the results are not consistent with the inclusion of the variable, the interaction term (column 5), and the proportion of adherents to religions variables (column 8). For offal beef, the results were only significant when the controls, the interaction term, and the religious share were included. Sharing religious norms reduces compliance costs and increases competitiveness for exporters with similar traditions as their trading partners. Stronger cultural and social ties facilitate trade and the formation of partnerships. These ties establish a greater degree of trust and mutual compliance in meat production and trade practices, easing trade transactions between partners. The frozen beef trade was particularly affected because transactions in this type of meat are more frequent than in other categories. Of the beef trade during the investigated period, 53.5% was frozen, 36.3% was chilled meat, and 10.2% was offal.

Countries with similar traditions tend to have similar food preferences. Some religions impose specific dietary restrictions that prohibit the consumption of certain foods, such as offal, which may be considered impure or associated with specific ritual practices. Therefore, countries with similar religious traditions are negatively correlated with the trade of this type of meat, as they avoid consuming offal to prevent impurity and demonstrate religious respect.

The variable was positive and significant in regressions (8) and (9) for frozen meat and offal, respectively. This dummy variable represents the largest exporters of Halal and Kosher meat and reflects the characteristics

and competitive advantages of these countries, making them more likely to engage in large-scale trade transactions for meats that meet religious requirements.

For the other variables, the trade elasticity of distance, represented by the estimated logarithmic variable, is negative and statistically significant, demonstrating its relevance as a trade resistance factor. More specifically, distance serves as a proxy for transportation costs, which may involve the need for specialized transportation, such as refrigerated containers, increasing logistical expenses over longer distances. This result aligns with Gani (2021), who argues that a 1% increase in the distance between a pair of countries causes a 0.71% decline in trade between them.

The binary variable measuring the colonial relationship between countries is not significant. This finding is consistent with Bampi; Zago de Azevedo; dos Reis (2020), who argue that global integration and the evolution of trade have made colonial trade relations irrelevant. Similarly, the coefficient for contiguity is also not significant. Junior, Massuquetti; Azevedo (2017) suggest that the establishment of trade agreements can enhance logistical development through the incorporation of transport technology, and therefore, sharing a common border may indeed be insignificant in explaining trade.

The language variable reveals statistical significance and a positive coefficient, indicating the advantage that a common language provides in increasing trade levels (Majeed *et al*, 2019). A common language facilitates communication and negotiation, reducing the language barrier and associated costs of translating packaging and labels. Moreover, it can also serve as a cultural link between countries that speak the same native language.

Membership in trade agreements, represented by the RTA variable, shows statistical significance with a positive effect on trade flows. Trade agreements facilitate trade between countries by establishing common terms and implementing less restrictive tariff policies. Majeed *et al* (2019), citing the case of Halal markets, discuss how commercial gains could be achieved if countries with similar cultural backgrounds developed a consolidated beef market, including a common certification body for Halal products. Such preferential agreements could enhance trade between religious countries while potentially limiting trade opportunities for non-member markets.

The GDP of importers and exporters countries also exhibited significance with positive parameters. The exporter's GDP indicates production capacity, while the importer's GDP reflects consumption capacity. In the context of trade influenced by religious considerations, exporting countries must adapt their production and marketing strategies to meet the cultural demands of the importing countries. These importers are expected to pay a premium for meat produced under religious certification. This aligns with the predictions of the gravity model, as noted by Gani (2021).

5 FINAL CONSIDERATIONS

Although the global beef trade is concentrated among a few exporting countries, the question arose whether this trade could be influenced by religion as a cultural factor. Some studies have demonstrated that shared religious beliefs favor shipments from economies with similar religious practices. To broaden the analysis, this study investigated whether this effect persisted across a larger sample that included all beef-importing countries.

The expansion of global supply chains and the increase in international shipments require countries to adapt to the demands of foreign markets. In the beef sector, this involves navigating a complex industry where slaughtering and processing practices are often dictated by religious specifications. Emphasizing the religious aspect underscores the need to examine the various barriers to exports, as trade with specialized markets necessitates suppliers adapt their practices and obtain the appropriate certifications. This study explored beef exports through the lens of different religious beliefs, focusing on the stringent requirements imposed by Halal and Kosher consumer markets.

The results show that bilateral beef trade is influenced by factors such as distance, importer and exporter income, common language, and trade agreements. However, no statistically significant relationships were found between religion and trade flows in the analysis that includes all types of beef, particularly without specific controls for major Halal and Kosher beef exporters. This result indicates that, for a broader group of countries, not just those with specific religious requirements, cultural variables were not a determinant of trade. This finding could be consistent with two key arguments: First, not all countries strictly enforce laws on beef slaughter based on religious beliefs like those of Islam and Judaism. While these religions profoundly influence the culture and lifestyles of their followers, affecting their dietary patterns. Second, the institutions in exporting countries may be sufficiently adapted to minimize transaction costs related to religious slaughter requirements.

However, when controlling for the major exporters of Halal- and Kosher-certified beef, religion emerges as a factor in determining the beef trade. The statistical significance of religion variable indicates that religious similarity between countries influences animal protein shipments. Nevertheless, countries that do not share similar religious practices with their trading partners can still establish successful international negotiations by understanding the institutions that shape market behavior, including cultural customs, laws, and religious considerations of the importing country.

The results suggest that trade effects operate primarily through religious population composition in exporting countries rather than bilateral religious distance per se. The significant coefficients for Jewish and Muslim population shares, combined with the generally non-significant religious distance variable, indicate that domestic religious demographics matter more for export performance than cultural similarity with trading partners. This pattern suggests that religious minorities within

exporting countries may drive specialized production capabilities that serve global markets, rather than religious proximity facilitating trade through reduced transaction costs between similar countries.

Religious culture can influence the international beef trade in several ways, as it shapes dietary preferences and consumption practices regarding animal protein. Specifically, religion plays a relevant role in determining beef imports for predominantly Islamic or Jewish countries in their trade with the global market. The procedures required for Halal and Kosher certification exemplify the specific standards that beef must meet to enter these markets.

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