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Assessing the effect of the Round Table on Responsible Soy certification on soybean exports

Yuquan Chen[1] | **Dela-Dem Doe Fiankor**[2] | **Fuli Tan**[1]

[1]Academy of Global Food Economics and Policy, China Agricultural University, Beijing, China

[2]Economic Modelling and Policy Analysis Group, Agroscope, Ettenhausen, Switzerland

Correspondence
Dela-Dem Doe Fiankor, Economic Modelling and Policy Analysis Group, Agroscope, Tänikon 1, Ettenhausen, Switzerland.
Email: dela-demdoe.fiankor@agroscope.admin.ch

Abstract

To minimise the negative ecological effects of soybean production, multi-stakeholders along the global soybean supply chain collaborated to develop, implement and verify a global certification standard called the Round Table on Responsible Soy (RTRS). RTRS certification is almost a quasi-mandatory sustainability standard; however, its potential trade effects remain poorly understood. Using a structural gravity model that exploits country variations in RTRS-certified production volumes and certified land areas, we assess the effect of RTRS certification on soybean trade flows. We show that RTRS certification reduces trade flows, especially exports to non-OECD countries. In essence, developing countries experience lower imports in response to standards than do developed countries. Thus, reconciling international trade with environmental sustainability goals remains a challenge.

KEYWORDS

agricultural trade, global supply chains, gravity models, Round Table on Responsible Soy, voluntary sustainability standards

1 | INTRODUCTION

In response to growing concerns about sustainability, private sector-driven initiatives, particularly the use of Voluntary Sustainability Standards (VSS), emerged as a way to regulate and promote sustainable agricultural production and trade. By internalising the social, environmental and economic costs of production into the price of a commodity, VSS influences sustainability by modulating production, sourcing and consumption decisions of producers, firms and consumers. Thus, VSS have sparked a debate over the role of supply chain certification in governing global agricultural trade (Henson & Humphrey, 2010). The extent to which their effects are reflected in observed trade patterns is an empirical question, one for which the existing literature reflects heterogeneity. One strand argues that VSS generate positive trade effects (Andersson, 2019; Bemelmans et al., 2023; Ehrich & Mangelsdorf, 2018; Fiankor, Flachsbarth, et al., 2020; Latouche & Chevassus-Lozza, 2015; Melo et al., 2014) and reinforce existing trade partnerships by signalling quality to importers (Herzfeld et al., 2011). For example, GlobalGAP standards enhance import demand and increase the probability of accessing high-value export markets (Andersson, 2019; Fiankor et al., 2019; Fiankor, Flachsbarth, et al., 2020). Bemelmans et al. (2023) offer even more compelling evidence based on multiple VSS—that is, 4C, IFOAM, GlobalGAP, RSPO, FairTrade and UTZ/Rainforest Alliance. Others, however, remain sceptical about their potential trade effects, because compliance and certification increase the costs of production for farmers (Schuster & Maertens, 2015; Shepherd & Wilson, 2013). Besides, smaller producers may lose out if the high compliance costs exclude them from participating in private certification schemes (Dolan & Humphrey, 2000; Martinez & Poole, 2004). To improve and foster more sustainable trade relations, especially between developing and developed countries, assessing whether and the extent to which VSS achieve the goals that motivated their creation is crucial (UNFSS, 2021). In this regard, our paper offers additional insights into the trade effects of VSS at the country level.

Our product focus is soybeans. Produced on a colossal international scale, soybeans have a huge environmental impact. Growing demand is putting pressure on forests and natural habitats, which increases biodiversity losses, carbon emissions, soil erosion and water contamination. Consequently, private sector actors responding to growing consumer concern in mostly high-income countries, especially in the EU, founded the Round Table on Responsible Soy (RTRS) in 2006 in Zürich, Switzerland. The RTRS was to serve as a platform for value chain stakeholders along the soybean supply chain—including industry representatives, non-governmental organisations, financial institutions and supermarkets—to collaboratively set new priorities toward sustainability.[1] Hence, the RTRS is a private-initiative supply chain certification scheme that enforces voluntary (but often quasi-mandatory) standards on soybean production and sourcing behaviours. Farmers seeking certification must produce environmentally sustainable (e.g. free from deforestation and land conversion), socially appropriate (e.g. responsible labour conditions) and economically viable soybeans (RTRS, 2021c). Production is audited and verified at the farm level by accredited certification bodies. Producers who meet the requirements receive an RTRS credit—a certificate that attests to the responsible conditions of production—for each tonne of soybeans produced. Although existing works provide evidence on the impact of supply chain certifications on soybean

[1]In the wake of the Rio Earth Summit, similar roundtables were established earlier for other key agricultural commodities, such as coffee (e.g. Global Coffee Platform), oil palm (e.g. the Roundtable on Sustainable Palm Oil), rice (e.g. Sustainable Rice Platform), and beef (e.g. Global Roundtable on Sustainable Beef).

production (Carlson et al., 2018; Garrett et al., 2016; Lambin et al., 2018), we assess how country-level compliance with RTRS requirements affects soybean trade flows.

Our empirical analysis uses data on RTRS-eligible soybean-producing countries as exporters and all other countries as export destinations. We focus on exporters in the tropics because as soybean demand increases, fragile ecosystems, such as rainforests, feel the strain the most. In many tropical countries, extensive natural areas are destroyed to allow soybean cultivation (Brown et al., 2005). Thus, these regions stand to gain more from the positive sustainability signalling effect of RTRS certification. We estimate a gravity model that exploits time and exporting country-specific variations in the certified soybean production volumes and production area. Our results show that RTRS certification reduces export volume. Given existing developed–developing country divergences regarding the use of VSS (UNFSS, 2020), we consider these differences in assessing the trade effects of RTRS certification. We split our sample into two groups of developed and developing countries, defined as OECD and non-OECD member states. This distinction is necessary because globally, the OECD is one of the most important soybeans importing regions, and developed countries are more willing to purchase agricultural and food products with low environmental costs. Across importing countries, we find that certification reduces trade volumes to non-OECD countries, whereas trade volumes to OECD countries are unaffected. Developing countries are more likely to experience lower imports in response to standards than developed countries.

Our work contributes to the literature in two ways. First, the empirical literature on the trade effects of VSS on trade flows is scant. In their review of the existing literature, Elamin and de Cordoba (2020) could only reference nine studies. Although interest is growing, products such as soy remain largely underrepresented (Traldi, 2021). This highlights the timeliness of our study and its potential policy relevance. Further, existing attempts have focused mainly on high-value agricultural products, such as fruits and vegetables (Andersson, 2019; Fiankor, Flachsbarth, et al., 2020; Schuster & Maertens, 2015) and processed products (Ehrich & Mangelsdorf, 2018; Latouche & Chevassus-Lozza, 2015). Much less attention has been paid to how VSS affect trade in other commodities, such as soybeans. Nevertheless, this is very important, as the environmental footprints of soybeans are immense. Moreover, soybeans have lower consumer exposure and awareness relative to fruits and vegetables, given that almost 90% of their total production is used as livestock feed; thus, their trade dynamics may also differ. As highlighted by Bemelmans et al. (2023), the VSS-trade literature is highly case-specific, with an overemphasis on GlobalGAP in the fresh produce sector. The effects observed for GlobalGAP, a standard with a main emphasis on product safety and quality, might not necessarily hold true for VSS in general. Our results also confirm this conclusion. Furthermore, certification of commodity crops happens mostly in tropical regions (Tayleur et al., 2018) which mostly consist of developing countries that are often standard takers. Thus, it is hard to imagine situations in which VSS certifications in tropical commodities are being used to protect domestic producers in high-income importing countries. This is not necessarily the case for mandatory public standards and many fruits and vegetables. Thus, our contribution helps enhance our understanding of the potential trade effects of a product-specific VSS within the agricultural sector.

Second, since VSS are developed by the private sector to regulate their supply chains, certification requirements are the same for producers everywhere. This means that in terms of stringency, there are no country variations. Estimating the effects of such unilateral trade policy measures is problematic in structural gravity frameworks, as the policy effect is then perfectly collinear with the multilateral resistance terms, which are captured by country-year fixed effects (Ghodsi, 2023). Existing works have circumvented this problem by restricting multilateral resistance terms to be time-invariant (Ehrich & Mangelsdorf, 2018; Fiankor, Flachsbarth, et al., 2020). We improve on existing works by adopting a two-step estimation procedure (Head & Mayer, 2014; Kinzius et al., 2019) to analyse the effect of our unilateral RTRS-trade policy measure. We first estimate a theory-consistent gravity model that includes country-time fixed effects and thus excludes the RTRS measure. We then regress the predicted exporter–time fixed effects from the first step on exporter-specific RTRS measures to assess the average change in exporter market access caused by the RTRS standard.

The rest of the paper is structured as follows. Section 2 provides detailed information on the requirements and content of the RTRS. This is followed by our empirical framework in Section 3. Section 4 describes the data, and Section 5 presents the results and major findings. We conclude and discuss the policy implications in Sections 6 and 7.

2 | BACKGROUND AND CONCEPTUAL DISCUSSION

2.1 | The role of RTRS

The RTRS is a supply chain certification programme that promotes zero deforestation and ecological sustainability (Schleifer, 2017). The basic framework of the RTRS originates from the Amazon Soy Moratorium, which was initiated by Greenpeace, the Brazilian Association of Vegetable Oil Industries and the National Association of Grain Exporters. They required that their contracted soybean producers avoid deforestation of the Amazon biome within the soybean supply chain. After a time-consuming process of negotiations on criteria, all the stakeholders agreed to implement RTRS certification for sustainably produced soybeans in Argentina, Brazil, Uruguay and India starting in 2010 (Cameron, 2017; Steward, 2007). A year later, the RTRS issued the first certification to the Dutch Food and Feed Industry, with a total trading volume of 85,000 tonnes of soybeans (Solidaridad, 2014). According to the agreement, RTRS certification is designed to make soybean production more compatible with environmental concerns and halt further expansion in areas converted to soybean farms. The major interest of the RTRS is to set the growing soy industry on a sustainable path going forward, as rapidly increasing soybean demand from the international market might result in increased forest loss (RTRS, 2021c; Schilling-Vacaflor et al., 2021; Voora et al., 2020). Since 2006, the impact of the RTRS has continually increased. By 2021, the RTRS had already covered 1.3 million hectares of certified soybean planting land, with 4.4 million tonnes of soybean produced on about 9536 certified farms (RTRS, 2021b).[2] In terms of soybean trade, the ratio of RTRS production to global trade experienced a consistent increase from 2012 to 2019 (see Figure 1). In 2018, it reached a peak of about 4% of the total global soybean trade volume being certified. This growing ratio further depicts the importance of the RTRS in the international soybean market.

In practice, certified farmers self-declare how much RTRS-certified soybeans they produce and receive one ‘RTRS credit’ for each metric tonne produced. However, certified farms need to

[2]According to *RTRS Accreditation and Certification Procedure* (Version 4.3), the unit of certification is the farm on which soy is cultivated and is delimited by the farm boundaries. RTRS certification covers fields where soy is cultivated as well as all non-soy growing areas, non-cultivated areas, infrastructure and installations, and other areas that form part of the farm.

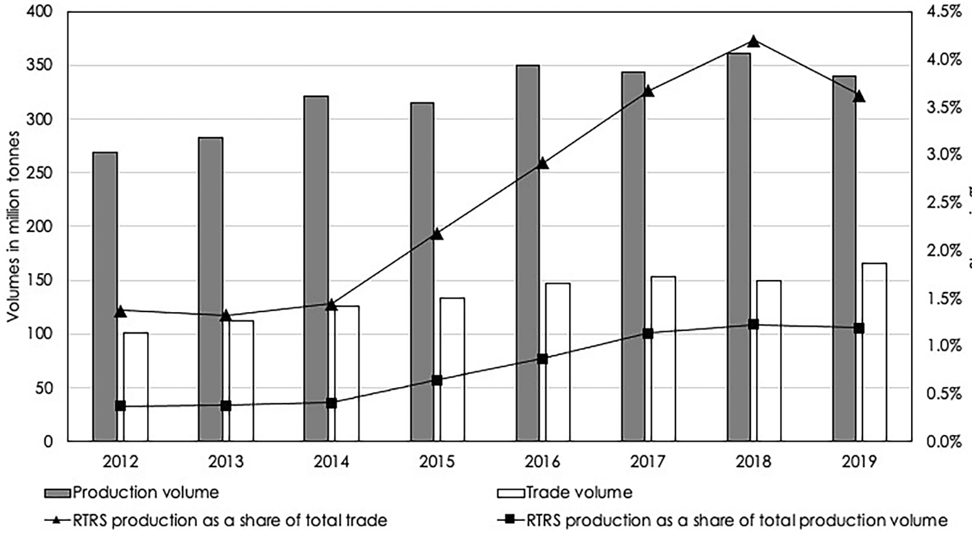

FIGURE 1 Share of RTRS production in global soybean production and trade.
Source: USDA and RTRS data.

engage third-party auditors to verify that their products meet the regulations of RTRS certification.[3] The certification bodies (CBs) affiliated with the RTRS may also conduct unannounced surveillance assessments to verify that farmers adhere to RTRS standards. International buyers can source RTRS-certified soybeans in different ways. One sourcing method is based on a mass balance accounting system. Here, certified soybean producers directly sell their products to crushing plants. Farmers deliver volumes of RTRS-certified soybeans or derived products that correspond to the volumes of RTRS-certified soybeans. However, crushing plants do not only purchase soybeans that comply with the RTRS standards; they also purchase from non-certified sources. Hence, soybeans from one or more RTRS-certified sites may be mixed with sources of non-certified soybeans. It is the responsibility of the crushing company to report the exact percentage of its output that is RTRS-certified. This approach enables buyers to purchase credits from soybean growers with the assurance that the overall consumption of RTRS-certified soybeans does not exceed production. The second sourcing method is a system of segregated supply chains. The RTRS also offers a segregation system that provides buyers with 100% RTRS-certified soybeans. In this case, from production, storage, transport and processing to the end users, RTRS-certified soybeans are kept physically separate from non-RTRS-certified soybeans (Heron et al., 2018; RTRS, 2021a).

[3]The third-party auditors we mentioned here are specific to CBs. As outlined in the *RTRS Accreditation and Certification Procedure* (Version 4.3), CBs procedures involve various methods of collecting objective evidence of compliance with the relevant RTRS field standard, including document review, field visits, and interviews with relevant stakeholders. Auditors are required to visit different sites within each operation to directly observe conformity with RTRS-documented systems and procedures. The scope of surveillance assessments covers farm boundaries, encompassing soy and non-soy growing areas, non-cultivated areas, infrastructure, installations, and other parts of the farm. Further, the RTRS also employs accreditation bodies (ABs) responsible for supervising and overseeing CBs. Only ABs officially endorsed by RTRS are authorised to accredit CBs for conducting compliance evaluations and issuing certificates for RTRS soybean production. The ABs must maintain autonomy from the CBs being assessed.

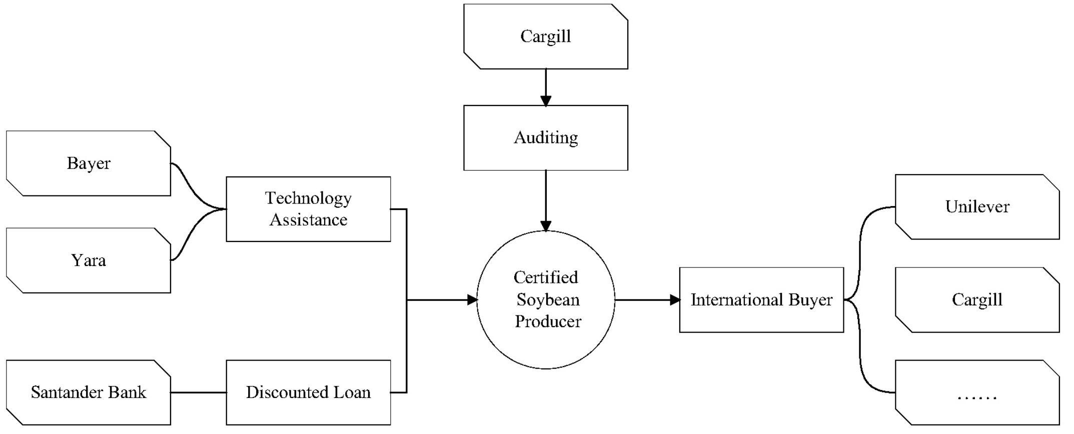

FIGURE 2 An illustration of the RTRS in the global soybean supply chain.

2.2 | Trade effects of RTRS certification

In this section, we discuss the potential trade-enhancing and trade cost effects of RTRS certification on the international soybean trade.[4] Following the RTRS protocols, certified farmers adopt better farm management practices. They may also obtain financial help from stakeholders who are integrated into the supply chain (Jia et al., 2020; Meijer, 2015). These supportive measures enhance soybean productivity. For example, stakeholders such as Bayer and Yara would provide technical assistance to farmers on how to use their products (see also Figure 2). Santander Bank would offer discounted loans to reduce the financial burdens for farmers. Cargill would buy from the farmers and hire professional auditors to certify their crushing plants.[5] Lastly, multinational companies such as Unilever use RTRS certification to green their soybean supply chains; thus, they commit to buying certified oil as an input for their production (Cameron, 2017).

RTRS certification also provides an efficient approach for buyers to identify farmers producing in compliance with sustainable environmental criteria (Fiankor, Flachsbarth, et al., 2020). Every production step is audited and verified for compliance by accredited certification bodies. Thus, certification acts as a cost-effective signalling mechanism, showing that soybeans and related byproducts are environmentally sustainable, socially fair and economically feasible. The transparent and traceable certifying process solves the information asymmetry problem between farmers and their potential buyers (Henson & Jaffee, 2008). This reduces transaction costs, enhances market share and enhances reputation. International buyers may reward sustainable production by paying price premiums for certified products. The average premium for RTRS-certified soybeans is $3 to $4 per tonne (KPMG, 2013).

High certification costs and incremental production expenses to meet RTRS requirements are major burdens for soybean production and exports. The RTRS standard is a holistic certification

[4]For a conceptual description of the trade costs and potential trade benefits of certification, see Figure A1 in the appendix.

[5]The RTRS certification generates competitiveness for all players in the supply chain, even for crushing plants. For instance, in 2019 Cereal Docks, an Italian global agribusiness company in primary feed and food processing, obtained RTRS certification for its Marghera plant in Venice. According to the group, RTRS certification gives crushers a competitive advantage in the marketplace by allowing them to assure their clients that the soybean meal, oil and lecithin produced at its Marghera plant were obtained from responsible practices, that do not involve deforestation, impoverishment of natural resources or human rights violation of any kind.

scheme that includes five principles and 106 mandatory criteria on (i) legal compliance and good business practices, (ii) responsible labour conditions, (iii) responsible community relations, (iv) environmental responsibility and (v) good agricultural practices. In essence, the farmer needs to work to ensure conformity with all the RTRS' mandatory rules. For instance, to curb the contamination of ground or surface water, the farmer must implement environmentally friendly agricultural practices, for example, reducing the use of chemical pesticides and fertilisers. Further, the RTRS strictly compels certified farmers to ensure zero deforestation and zero rainforest conversion in their soybean production. Farmers are only allowed to plant soybean in designated areas. The RTRS contracts geo-engineers to segregate soybean production areas. Any soybean production carried out within or near rainforest areas would not be certified. Thus, complying with the RTRS principles increases production costs, potentially dragging down production volume. This impact is transmitted within the supply chain and eventually affects the international soybean trade.

Transaction costs are also an indispensable expenditure for RTRS participants. To approve membership applications, producers with >10,000 ha soybean area pay more than €2500 per farm. All others pay €250 per farm. Soybean processing companies, trade dealers and financial institutions also have to pay membership fees (approx €2500) to remain involved in the supply chain (RTRS, 2009). Participating members must submit a written annual progress report to the RTRS secretariat to reveal and self-monitor their soybean planting practices. Since certification systems rely on third-party auditors to inspect whether farms meet and maintain standards, producers are responsible for paying periodic audit fees. All these requirements imply increased transaction costs for agents along the soybean supply chain while also allowing them to signal quality to participants along the supply chain.

2.3 | A theoretical discussion of the standards and trade effect

This section provides concise theoretical justifications for the ambiguity of the trade effects of standards in an importing country. The introduction of a quality standard at home will shift both the demand and supply curves (Figure 3). In a small open economy, the VSS will shift the domestic

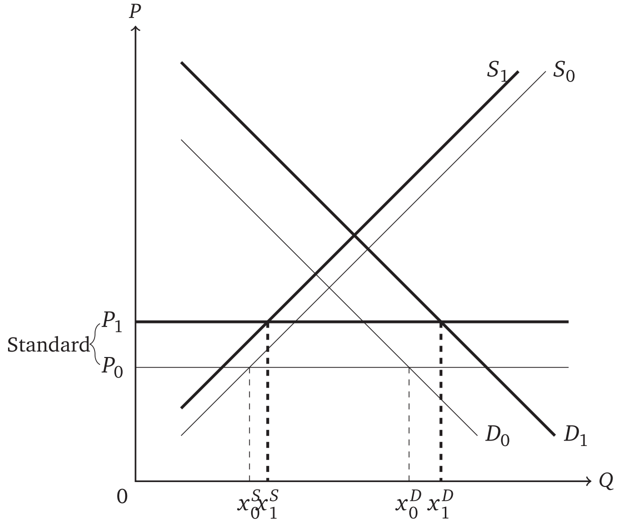

FIGURE 3 Standards-trade effect in a small open economy (Swinnen, 2016).

supply curve from $S_0 - S_1$, reflecting the increased cost of production for farmers. However, because the VSS addresses information asymmetries between producers and consumers, it will increase import demand from $D_0 - D_1$. This improves consumer welfare, as the gains from the outward shift of the demand curve are greater than the inward shift of the supply curve. If we assume that before the introduction of the standard at home, there was equivalence with standards abroad (i.e. the free trade scenario), then imports could enter the home country at P_0. The introduction of standards in the importing country raises the import competitive price to P_1. The difference, $P_1 - P_0$, reflects compliance cost pass-through to consumers in the importing country as higher prices, quality upgrading and signalling or a combination of the two effects.

Although the standards-trade effect may look similar to tariffs (e.g. raising domestic prices of imports, as in Figure 3), direct comparisons between the two are not valid. Given that a public standard is applied to all products marketed in the domestic country, regardless of whether they are manufactured by foreign or domestic firms, its effect (unlike that of a tariff) does not directly discriminate. However, in our setup, we focus on a voluntary standard. When certain firms adopt a public standard while rivals apply their own private standards (inducing a higher quality level), the impact of a stricter public standard on entry/exit is ambiguous and depends on the elasticity of fixed costs to a change in the level of quality. When fixed costs increase rapidly with quality, the prices of private standard firms can increase sufficiently to induce a reallocation of demand toward public standard firms (Gaigné & Larue, 2016). In a small open economy, the socially optimal tariff level is zero. This is not necessarily the case for VSS. A call for zero standards ignores potential consumer, producer and societal benefits. At home, the optimal standard must consider the marginal gain in utility for consumers and the marginal cost for producers. Tariffs are by construction trade-reducing, but standards may also be market-creating measures. The market creation effect is depicted in Figure 3, which shows that the introduction of a VSS increases domestic consumption ($|X_0^D - X_1^D|$), domestic production ($|X_0^S - X_1^S|$) and imports ($|X_0^S - X_0^D|$ to $|X_1^S - X_1^D|$). Note that a virtually identical approach can be used to show standards that induce a trade-reducing effect. Here, the trade-increasing effect is used only for representation. In any case, quality standards will always affect trade positively or negatively unless their effect on production offsets their effects on consumption (Swinnen, 2016).

3 | EMPIRICAL MODEL

To assess the effect of certification on bilateral soybean trade at the country level, we follow a standard approach in the trade literature and estimate a demand-side structural gravity model. Gravity equations are a well-established relationship in economics. They are expenditure functions that indicate how consumers allocate their spending across countries under trade cost constraints. For a model that, until the twenty-first century, was disconnected from economic theory, several theoretical models now yield predictions that are close to gravity. In this paper, we adopt the Armington-CES specification of Anderson and Van Wincoop (2003) as follows:

$$X_{ijt} = \frac{Y_{it}E_{jt}}{Y_t}\left(\frac{\tau_{ijt}}{\Pi_{it}P_{jt}}\right)^{1-\sigma_t}, \tag{1}$$

The right-hand side of Equation 1 is a product of two ratios. The first ratio is the predicted trade flow under free trade, and the second ratio captures exogenous bilateral trade costs. The trade cost term consists of three components: (i) the numerator, τ_{ijt}, is the bilateral trade cost between exporting country i and importing country j and contains our variable of interest. The denominator is made up of two structural terms that measure the ease of market access for both the importer and the exporter. Controlling for P_{jt} and Π_{it} is important to achieve precise estimates of our variables of interest. σ_t is the elasticity of substitution parameter for the generic goods class.

In this paper, our interest lies in τ_{ijt}. This term enables us to empirically show how RTRS modifies predicted frictionless trade. As we see from Equation 1, the observed bilateral trade flows are lower if trade costs τ_{ijt} increases relative to P_{jt} and Π_{it}. We model τ_{ijt} as the following log-linear function of observed trade frictions:

$$\tau_{ijt} = D_{ij}^{\beta_1} \mathrm{RTRS}_{it}^{\beta_2} \exp \sum_{n=3}^{N} \beta_n \Omega_{ijt}, \quad (2)$$

where D_{ij} is the bilateral distance between i and j, and Ω_{ijt} is a vector of gravity covariates, including dummies for sharing a common language ($\mathrm{Language}_{ij}$), past colonial ties (Colony_{ij}), sharing a common border (Border_{ij}) and membership in a regional trade agreement RTA_{ijt}.

3.1 | Model specification

To estimate our theoretical model, we need to incorporate the trade cost (Equation 2) into our reduced-form structural gravity Equation 1. We can then log linearise Equation 1 and specify our empirical estimation model as follows:

$$X_{ijt} = \exp\left[\alpha_0 + \alpha_1 \ln \mathrm{RTRS}_{it-1} + \alpha_2 \ln Y_{it} + \alpha_3 \mathrm{RTA}_{ijt} + \Pi_i + P_{jt} + \lambda_{ij} + \varepsilon_{ijt}\right], \quad (3)$$

where X_{ijt} is soybean trade flows measured in US dollars from exporter i to importer j at year t. Y_{it} represents the domestic soybean production of exporting country i, and RTA_{ijt} is a dummy variable that takes the value of 1 if both countries are members of a regional trade agreement. In alternative specifications, we replace λ_{ij} with the time-invariant country-pair variables contained in Ω_{ijt} in Equation (2). However, we note, that the λ_{ij} fixed effects are better measures of bilateral trade costs than the standard set of bilateral varying gravity variables (Fiankor, Curzi, & Olper, 2020).[6] Our variable of interest, RTRS_{it}, is concentrated in six countries in our dataset. We add a constant value of one to the RTRS_{it} variable before taking logarithms. We also use the inverse hyperbolic sine transformation as an alternative approach (Bellemare & Wichman, 2020). RTRS certification is a non-discriminatory trade policy measure. Within theory-consistent gravity models, identifying the effects of such country-specific measures can be challenging, as these variables are accounted for by the country-specific fixed effects. To circumvent this identification problem, we allow our exporter fixed effects to be time-invariant, that is, Π_i, thus avoiding perfect collinearity with RTRS_{it}.[7] Consequently, we capture the theoretical size term from the gravity

[6]Custom tariffs are not included in our models as there is no variation in the variable for many country pairs. As a result, most of the variation in tariffs is explained by our bilateral fixed effects. Furthermore, given that many bilateral trade agreements negotiate tariff cuts, we believe that our RTA variable captures some of the tariff effect.

[7]Heid et al. (2021) recently proposed a theoretically consistent way of getting around this perfect collinearity problem by incorporating domestic trade flows into their bilateral trade data matrices. With developing countries dominating our sample, this domestic trade data is unfortunately not available for us to exploit. We are thus unable to employ this approach.

equation on the supplier side as domestic soybean production, Y_{it}. This should account for some of the exporter-specific time-varying effects that our model may miss because we exclude Π_{it}. P_{jt} accounts for all country- and time-varying effects that are specific to importing countries. ε_{ijt} is our error component, which we cluster at the country-pair level.

3.2 | Identification strategy

The presence of zero-valued dependent variables would seriously bias the econometric estimates of gravity models (Martin & Pham, 2020). The work of Silva and Tenreyro (2006) makes it clear that zero values in trade render the elasticities of log-linearised models estimated by ordinary least squares (OLS) inconsistent. Given that our focus is only on the soybean sector in this paper, zeroes dominate our bilateral trade dataset. To deal with the zeroes while also controlling for heteroskedasticity, we use the Poisson pseudo-maximum likelihood estimator (PPML) estimator. This estimator has been widely used in the empirical agricultural trade literature (Fiankor, Flachsbarth, et al., 2020; Ghazalian, 2019; Zhang et al., 2017), and is generally well-behaved, even when the proportion of zeros in the sample is very large (Silva & Tenreyro, 2011).

Another potential challenge for identification is endogeneity due to omitted variable bias and reverse causality. To deal with this, we do two things. First, we incorporate importer-time (P_{jt}) fixed effects, exporter (Π_i) fixed effects and country-pair fixed effects (λ_{ij}) into our estimation equations. The host of fixed effects in our estimation controls for the unobserved characteristics that are specific to the importer, exporter and trading pair. Second, we use the one-year lag variable of the RTRS to deal with the potential simultaneity of the standards-trade effect (Fiankor, Flachsbarth, et al., 2020; Shepherd & Wilson, 2013). Using a one-year lagged RTRS cancels out the amount of time between the time the certification decision is made and when a trade effect is realised.

4 | DATA

This paper estimates the effects of RTRS certification on soybean trade using panel data on bilateral soybean trade volumes for the period from 2012 to 2019. Production and export volumes are consistently increasing (Figure 1). Over the last decade, total production has increased by 3.4% in compound annual growth rate (CAGR). Trade volumes also grew from 100.38 to 165.17 million tonnes with a 7.37% CAGR (USDA, 2022). The RTRS share of the total soybean trade has also increased. There are about 89 soybean-producing and exporting countries in the world. Since one of the core objectives of RTRS certification is to prevent deforestation, we restrict our sample of exporting countries to producing countries that have rainforests. This reduces our sample of exporters to 34 countries that are mostly located in the tropics. Of these, six countries were RTRS-certified over the study period. Time and country variations of the certified areas in these six countries are presented in Figure 4.[8,9]

[8] A similar graph is presented Figure A2 of the Appendix for total certified production volumes. The observed patterns are similar to those for the certified areas.

[9] As indicated in the RTRS Management Report 2018, the sharp reduction in certification levels in Argentina and India can be attributed to a combination of reduced demand for RTRS-certified materials from these regions, as well as localised economic and climatic challenges. In some instances, these issues have resulted in the discontinuation or suspension of certifications.

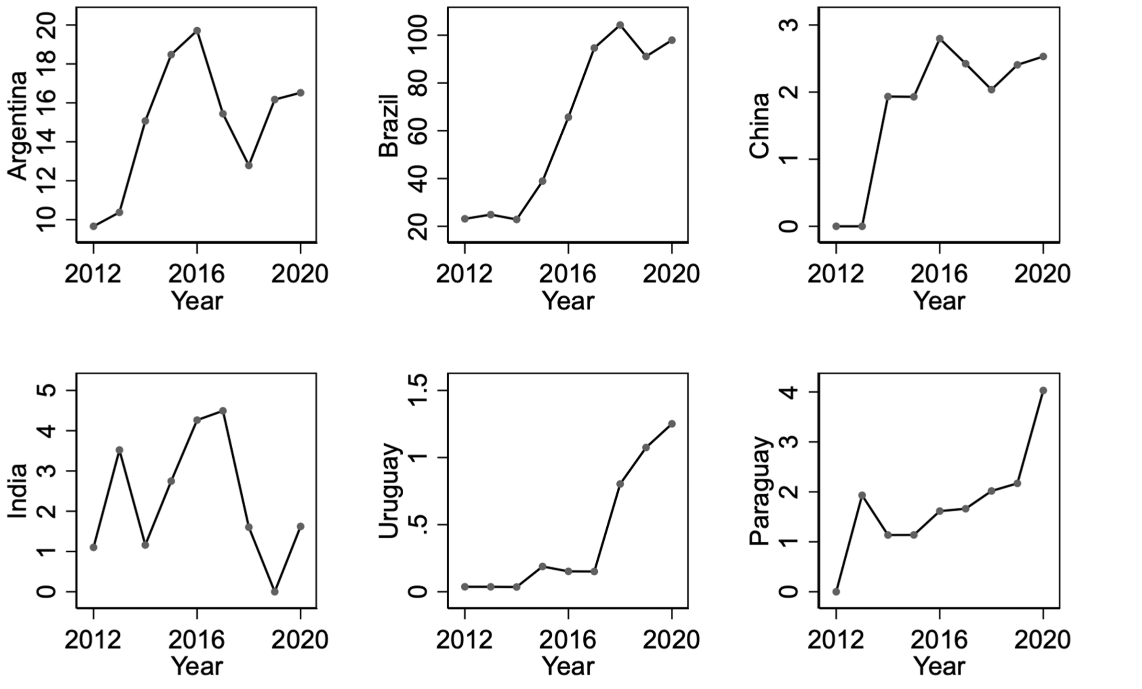

FIGURE 4 RTRS-certified soybean production area by countries ('000 hectares).

One dimension in which standards have been shown to be heterogeneous is across destination markets. Usually, developed countries make more extensive use of standards than do their developing country counterparts. This is in part because consumer awareness and sustainability concerns are relatively higher in these countries, and thus may influence consumer behaviour. High-income OECD countries are increasingly strict on issues related to quality control and sustainability. Usually, the higher the income level of a country, the lower the level of tariffs and the more it is likely to make extensive use of standards. To assess this heterogeneous effect, we separate our full sample of importing countries into 33 high-income OECD and 32 non-OECD countries (Table A1). To track the changes in total soybean imports over the study period, we graph the evolution of imports that come from countries certified to the RTRS (see Figure A3). The percentage of imports from RTRS-certified countries rose from approximately 78% in OECD countries to nearly 99% in non-OECD countries. This is expected, considering that these six countries also dominate the global soybean export market. However, it is worth noting that only a small portion of these exports are certified.

Our soybean trade values come from CEPII's BACI database. We assess the data at the four-digit level of the Harmonised System (HS) 2017 classification, that is, HS1201 for soybean. Data on soybean production volumes come from the FAOSTAT database of the Food and Agricultural Organisation. We use the effective applied tariff data from the TRAINS database via the World Integrated Trade Solution (WITS) under the product item of soybeans (HS1201). The RTRS-certified soybean production areas and volumes for each country are from the certified volumes and producers section of the RTRS official website. The bilateral country-pair data of distance, colonial relationships, common borders and common languages are from CEPII. The information related to RTAs comes from Mario Larch's Regional Trade Agreements Database (Egger & Larch, 2008). Summary statistics on the variables used in the analysis are provided in Table 1.

TABLE 1 Summary statistics.

Variables	Unit	Observations	Mean	SD	Min	Max
RTA		8080	0.377	0.485		
Applied tariffs	%	8080	2.380	9.237	0	80
RTRS-certified area	1000 hectares	8080	7.315	19.83	0	104.3
RTRS-certified quantity	10,000 tonnes	8080	24.21	71.07	0	394.5
Trade value	m. USD	8080	32.95	716.8	0	41119
Soybean production	m. tonnes	8080	17.34	29.77	0	117.9

5 | RESULTS

5.1 | Baseline model

Table 2 reports the results of our benchmark estimations of the PPML fixed-effect model. In the odd-numbered columns, we measure RTRS certification as the volume of certified soybean production in a country. In the even-numbered columns, we measure RTRS certification as the area of certified soybean production in a country. All the model estimations include exporter and importer–time fixed effects to capture both market-size effects (e.g. importing country GDP) and multilateral resistance. However, they also include bilateral fixed effects to account for all country-pair varying effects that are time-invariant (e.g. bilateral distance, colonial ties, contiguity and linguistic similarity).

Our interest is in the RTRS certification effect. The coefficients of the RTRS variables in the total sample show a negative and statistically significant effect of certification on exports. In Column (1), the parameter estimate is − 0.124, indicating that 100% growth in the certified soybean production area decreases bilateral trade by about 12.4%. Producers use RTRS certification to signal to international soybean buyers their commitments to zero deforestation, decent labour conditions and sustainable production practices. The certification, in turn, grants them access to the destination markets with a price premium while also reducing the absolute sales volumes. For example, if importing firms have a fixed budget to spend on sourcing soybeans but now have to pay more for certified soybean, their overall trade values may decrease. Furthermore, we find that the RTRS certification has no statistically significant effect on the probability of exporting (see Table A3).

To further understand what factors are driving our findings, we split the full sample of importing countries into OECD and non-OECD subgroups. For OECD imports, the coefficients of the RTRS variables are statistically insignificant. For non-OECD imports, we see a negative and statistically significant effect of certification on trade flows. In Columns (5) and (6), the estimated parameters are − 0.108 and − 0.123, indicating that a 10% growth in certified soybean production volumes and area is associated with a decrease in bilateral trade of 1%. The heterogeneous results in the two subgroups reveal that the negative effects in columns (1) and (2) are driven mainly by developing country imports. For OECD countries, the RTRS has a null trade effect. This implies that while certification is a necessary requirement for imports into the OECD region, certification in itself does not necessarily lead to increased trade volumes. However, for developing importing countries, the RTRS reduces the volume of certified soybeans they import. This finding is intuitive. Compared to OECD countries, non-OECD countries care relatively less about certification or are unwilling to pay the premiums associated with certified products. Indeed, VSS remains a

TABLE 2 PPML results for the effect of the RTRS certification on global soybeans trade.

	Full sample		OECD imports		Non-OECD imports	
	(1)	(2)	(3)	(4)	(5)	(6)
Log RTRS-Certified Quantity$_{it-1}$	−0.124***		−0.163		−0.108***	
	(0.000)		(0.202)		(0.000)	
Log RTRS-Certified Area$_{it-1}$		−0.096		0.019		−0.123*
		(0.180)		(0.901)		(0.072)
Log Production$_{it}$	2.407***	2.369***	2.750***	2.560***	2.323***	2.375***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
RTA$_{ijt}$	1.559***	1.552***	0.491	0.529	1.675***	1.740***
	(0.000)	(0.000)	(0.434)	(0.425)	(0.000)	(0.000)
Exporter FE	Yes	Yes	Yes	Yes	Yes	Yes
Importer-time FE	Yes	Yes	Yes	Yes	Yes	Yes
Importer-exporter FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6239	6239	2334	2334	3905	3905

Note: *p* Values in parentheses. ***, **, and * denote statistical significance at 1%, 5% and 10%, respectively. Intercepts included but not reported. The dependent variable is the log of soybean trade values in USD.

predominantly developed country concern. This indicates a trade-off between RTRS-certified and non-certified soybean products regarding imports in developing countries.

Focusing on the control variables, the parameter estimate for the production variable is positive and statistically significant across all model specifications, implying that countries with higher soybean production also tend to export more. Regional trade agreements increase trade, as expected.

5.2 | Robustness checks

In this section, we test the robustness of our findings from the baseline model specification. To assess if there are any non-linearities in the RTRS-trade effect, we add square terms of the RTRS variables in Table 3. The coefficients of the RTRS variables are still negative and statistically significant at the 5% significance level, but the square terms are positive. The results imply potential non-linearities; while the impact of the RTRS still holds, the marginal impact of certification on trade gradually decreases. Since increasing RTRS-certified soybean production will generate economies of scale for certified supply chains, the decreasing cost of production will allow soybean farmers to produce more RTRS-certified soybeans for trade. Further, sufficient supply on the international market would decrease the prices of RTRS-certified soybeans, allowing importing countries, especially non-OECD countries, to buy more certified products. Therefore, the negative effects of standards on soybean trade will be felt relatively less strongly.

It can also be argued that transforming our variable of interest as $\log(1 + \text{RTRS}_{it-1})$ is a problematic way of dealing with variables that contain zero values (see Bellemare & Wichman, 2020). To ensure that our findings are not sensitive to the choice we make, we use the inverse hyperbolic sine transformation of RTRS and report the results in Columns (3) and (4) of Table 3. The results are negative and statistically significant, as in all our other specifications.

TABLE 3 Robustness check.

	Non-linear effect		Inverse hyperbolic sine transformation	
	(1)	(2)	(3)	(4)
Log RTRS-Certified Quantity$_{it-1}$	−0.395***			
	(0.001)			
Log RTRS-Certified Quantity$^2_{it-1}$	0.0358**			
	(0.033)			
Log RTRS-Certified Area$_{it-1}$		−0.559***		
		(0.001)		
Log RTRS-Certified Area$^2_{it-1}$		0.0693**		
		(0.021)		
arcsinh(Certified RTRS Area$_{it-1}$)			−0.118**	
			(0.032)	
arcsinh(Certified RTRS Quantity$_{it-1}$)				−0.135***
				(0.000)
Log production$_{it}$	2.035***	2.057***	2.418***	2.416***
	(0.000)	(0.000)	(0.000)	(0.000)
RTA$_{ijt}$	1.169***	1.208***	1.580***	1.546***
	(0.000)	(0.000)	(0.000)	(0.000)
Exporter FE	Yes	Yes	Yes	Yes
Importer-time FE	Yes	Yes	Yes	Yes
Importer-exporter FE	Yes	Yes	Yes	Yes
Observations	6239	6239	6239	6239

Note: *p*-Values in parentheses. ***, **, and * denote statistical significance at 1%, 5% and 10%, respectively. Intercepts included but not reported.

5.3 | Two-step estimation approach

Finally, for our estimation of Equation 5 to be exactly consistent with the theoretical gravity model we specify in Equation 3, the exporting country fixed effect Π_i must be time-varying. We make the compromise by using just exporter fixed effects, as the time-varying fixed effects will absorb all the variations in our RTRS$_{it}$ variable. To be sure that this compromise does not drive our findings, we follow Head and Mayer (2014) and, more recently Kinzius et al. (2019) to employ a two-step estimation procedure to analyse the effect of our unilateral RTRS-trade policy measure. In the first step, we estimate a theory-consistent gravity model (Equation 4) that includes country-time fixed effects and thus excludes the RTRS measure.

$$X_{ijt} = \exp\left[\rho_0 + \rho_1 \mathrm{RTA}_{ijt} + \Pi_{it} + P_{jt} + \lambda_{ij} + \varepsilon_{ijt}\right], \quad (4)$$

In step two, we regress the predicted exporter-time fixed effects Π_{it} from the first step on exporter-specific RTRS measures (Equation 5), to assess the average change in exporter market access caused by the RTRS standard. We also include country ξ_i and time κ_t fixed effects.

$$\ln\widehat{\Pi}_{it} = \varphi_0 + \varphi_1 \ln\text{RTRS}_{it-1} + \xi_i + \kappa_t + v_{ijt}. \quad (5)$$

The results are presented in Table 4. The first-stage results are shown in Column (1), and the results for the second stage are reported in Columns (2) and (3). The estimated coefficient φ_1 of the RTRS variable in the second estimation stage is negative and statistically significant, providing further evidence in support of our baseline findings. Due to the potential heterogeneity contained in the error term from the predicted fixed effects from Equation 4, we bootstrap our standard errors to check the sensitivity of our findings. The results presented in Table A2 remain qualitatively similar to those presented in Columns (2) and (3) of Table 4, in which we cluster the standard errors at the bilateral level. Overall, the findings support our main results that RTRS certification negatively affects market access for exporters (Table A3).

5.4 | RTRS certification status and global soybean trade

Our main estimations use the area certified to the RTRS or the quantity of certified RTRS production in a country as the variable of interest. However, it is possible that importers from the destination country care mainly about the certification status of the exporter rather than how widespread the certification is within the country. In this section, we therefore replace the continuous measure of RTRS certification with a dummy variable that takes the value of 1 if a country has RTRS certification in year t and 0 otherwise. The results presented in Table 5 confirm our main findings that RTRS certification reduces trade flows.

6 | DISCUSSION

Current evidence of VSS impacts remains inconclusive. Review studies find positive, zero or negative effects on environmental and social outcomes. The limited empirical trade evidence from gravity models mainly finds positive effects (Andersson, 2019; Bemelmans et al., 2023; Fiankor, Flachsbarth, et al., 2020). In this regard, our negative findings are contrary to existing empirical evidence—which motivates our conceptual framework in Figure 3—adding further nuance to the VSS and standards debate.[10] Nevertheless, given the large environmental impact of soy production, the negative effects we estimate suggest that the RTRS helps in this regard. Many developed countries are continuously discussing ways to reduce their reliance on destructive overseas soy imports and the RTRS is also encouraging ways to reduce the effects of soy production on ecological outcomes. Thus, our negative findings could highlight the importance of VSS in significantly reducing the detrimental impact of global agriculture (Smith et al., 2019). Nevertheless, the strong negative effects on export values to non-OECD countries we find are consistent with the existing literature that developing countries are more likely to experience lower imports in response to standards than developed countries (Ehrich & Mangelsdorf, 2018).

The trade-reducing effects we find do not provide any insights into the welfare of certified producers. Although sales values may have been reduced because of lower production

[10]Also note that in our conceptual framework, the standards apply also to domestic producers. However, soy production is restricted to a limited set of countries which means that in our case the standards do not necessarily affect domestic farmers if domestic production is absent.

TABLE 4 Two-stage estimation results for the effect of the RTRS certification on global soybeans trade.

	First stage	Second stage	
	(1)	(2)	(3)
RTA_{ijt}	−0.839		
	(1.104)		
Log RTRS-Certified $Quantity_{it-1}$		−0.145***	
		(0.024)	
Log RTRS-Certified $Area_{it-1}$			−0.246***
			(0.039)
Exporter-time FE	Yes	No	No
Importer-time FE	Yes	No	No
Importer-exporter FE	Yes	Yes	Yes
Exporter FE	No	Yes	Yes
Year FE	No	Yes	Yes
Observations	6095	6095	6095

Note: *p*-Values in parentheses. ***, **, and * denote statistical significance at 1%, 5% and 10%, respectively. Intercepts included but not reported. The dependent variable is the log of soybean trade values in USD.

TABLE 5 PPML results for the effect of RTRS certification status on global soybeans trade.

	(1)
RTRS $dummy_{it-1}$	−0.401***
	(0.006)
Log $Production_{it}$	2.081***
	(0.000)
RTA_{ijt}	1.254***
	(0.000)
Exporter FE	Yes
Importer-time FE	Yes
Importer-exporter FE	Yes
Observations	6239

Note: *p* Values in parentheses. ***, **, and * denote statistical significance at 1%, 5% and 10%, respectively. Intercepts included but not reported. The dependent variable is the log of soybean trade values in USD.

volumes, producers may be selling their certified production at higher prices. We test this by assessing the effect of RTRS on export prices measured as unit values—defined as the ratio of import values to import volumes.[11] Our findings, presented in the Appendix (Table A4), show that RTRS has no statistically significant effects on export prices. Given that we work with data at the HS4 digit level, the statistical insignificance of our price effects is not surprising. Nonetheless, existing reviews based on micro-level studies provide some guidance on the

[11]Since unit values are usually noisy, we drop observations in below the 5th percentile and above the 95th percentile of the unit value distribution.

other possible welfare effects of VSS. Farmers who comply with non-tariff measures achieve higher yields and receive higher output prices and incomes with little variation across the VSS (Meemken, 2020; Oya et al., 2018).

In terms of policy implications, our empirical results provide us with a new perspective for understanding voluntary private standards. Strict controls on the production side eventually generate pressure on trade flows. Thus, private standards-setting bodies should provide more technical assistance and financial support and decrease the transaction cost component of certification, which could help stabilise certified soybean production and make it more attractive. This will moderate the trade-reducing effects.

7 | CONCLUSION

Deforestation and other environmental challenges associated with soybean production motivated the introduction of RTRS certification in 2006. From the viewpoint of stakeholders involved in the standard-setting process, RTRS certification is a demonstration of competitiveness in the context of a global market, a reputation signal in the agro-industry sector and a synonym for sustainability. However, the relatively higher prices of certified products also increase the costs for buyers. This provides room for empirical analysis of the impact of the RTRS on soybean trade flows.

The empirical analysis in this paper uses data from 2012 to 2019 on all RTRS-eligible soybean-producing countries in the tropics as exporters and all other countries as potential export destinations. Our structural gravity estimates confirm a general trade-reducing effect of RTRS certification on soybean trade flows at the country level. The finding is robust to the two certification measures, that is, the volume in tonnes and the area in hectares of certified soybean production. However, this general finding is heterogeneous across destination countries, based on the divides between developed and developing countries. For OECD imports—that is, our proxy for developed countries—the RTRS certification has no trade effect. For non-OECD imports, the negative trade effects are statistically significant. RTRS-certified products are usually more expensive due to the premiums that they attract. Although this price premium may not be a hindrance for developed countries, for example, OECD member countries, our analysis suggests that they significantly reduce trade flows to relatively less developed regions, that is, non-OECD countries. The heterogeneous effects we find are intuitive, as VSS still remain more a developed country phenomenon than a developing country one (Schleifer et al., 2019).

This study is not without limitations. Export performance is determined by firm characteristics, such as productivity, size, tax and regulation policy. Given the lack of firm-level trade data, we are unable to assess the heterogeneous effects of certification across soybean traders of different sizes within a country. Firm-level data could help us understand the responses of importer firms and producers in the framework of the RTRS. This will allow for a broader generalisation of the results and to bring up comprehensive policy implementations. Furthermore, a key feature of the type of standard we study is its credibility. To reach good credibility, verification (or control audits) and sanctions have to be well-known and well-established in all countries. Our aggregate level of analysis indicates that we are unable to ascertain and deal with the severity of country-level conformity assessment and enforcement mechanisms. Nevertheless, our results constitute a promising point of departure for future empirical research targeting the trade effects of VSS at the micro level.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are all openly available from secondary sources.

ORCID

Yuquan Chen https://orcid.org/0000-0002-8014-4084
Dela-Dem Doe Fiankor https://orcid.org/0000-0003-0510-0476

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APPENDIX A

TABLE A1 List of importing and exporting countries.

Country groups	Members
Importers	Aruba, Angola, United Arab Emirates, Argentina, Armenia, Australia, Austria, Azerbaijan, Burundi, Belgium, Benin, Burkina Faso, Bangladesh, Bulgaria, Bahrain, Bahamas, Bosnia and Herzegovina, Belarus, Belize, Bermuda, Bolivia, Brazil, Barbados, Brunei Darussalam, Bhutan, Botswana, Central African Republic, Canada, Switzerland, Chile, China, Côte d'Ivoire, Cameroon, The Democratic Republic of the Congo, Congo, Cook Islands, Colombia, Comoros, Cape Verde, Costa Rica, Cuba, Christmas Island, Cayman Islands, Cyprus, Czechia, Germany, Djibouti, Dominica, Denmark, Dominican Republic, Algeria, Ecuador, Egypt, Spain, Estonia, Ethiopia, Finland, Fiji, France, Micronesia, Gabon, United Kingdom, Georgia, Ghana, Guinea, Gambia, Equatorial Guinea, Greece, Greenland, Guatemala, Guyana, Hong Kong, Honduras, Croatia, Hungary, Indonesia, India, Ireland, Iran, Iraq, Iceland, Israel, Italy. Jamaica, Jordan, Japan, Kazakhstan, Kenya, Kyrgyzstan, Cambodia, Kiribati, Republic of Korea, Kuwait, Laos, Lebanon, Liberia, Sri Lanka, Lesotho, Lithuania, Luxembourg, Macao, Morocco, Moldova, Madagascar, Maldives, Mexico, Marshall Islands, Macedonia, Mali, Malta, Myanmar, Mongolia, Mozambique, Mauritania, Mauritius, Malawi, Malaysia, Namibia, New Caledonia, Niger, Norfolk Island, Nigeria, Nicaragua, Netherlands, Norway, Nepal, Nauru, New Zealand, Oman, Pakistan, Panama, Peru, Philippines, Palau, Papua New Guinea, Poland, North Korea, Portugal, Paraguay, French Polynesia, Qatar, Romania, Russian Federation, Rwanda, Saudi Arabia, Sudan, Senegal, Singapore, Solomon Islands, Sierra Leone, El Salvador, Suriname, Slovakia, Slovenia, Sweden, Seychelles, Syrian Arab Republic, Turks and Caicos Islands, Chad, Togo, Thailand, Tonga, Trinidad and Tobago, Tunisia, Turkey, Tanzania, Uganda, Ukraine, Uruguay, United States, Uzbekistan, Venezuela, British Virgin Islands, Viet Nam, Vanuatu, Yemen, South Africa, Zambia, Zimbabwe
Exporters	Argentina, Australia, Benin, Bangladesh, Belize, Bolivia, Brazil, China, Cote d'Ivoire, Cameroon, Democratic Republic of the Congo, Colombia, Ecuador, El Salvador, Gabon, Ghana, Guatemala, Honduras, India, Indonesia, Cambodia, Laos, Mexico, Myanmar, Nigeria, Nicaragua, Panama, Peru, Paraguay, Suriname, Togo, Thailand, Venezuela, Viet Nam

TABLE A2 Two-stage estimation results with bootstrapped standard errors.

	First stage	Second stage	
	(1)	(2)	(3)
RTA_{ijt}	−0.839		
	(1.104)		
Log RTRS-Certified $Quantity_{it-1}$		−0.145***	
		(0.025)	
Log RTRS-Certified $Area_{it-1}$			−0.246***
			(0.050)
Exporter-time FE	Yes	No	No
Importer-time FE	Yes	No	No
Importer-Exporter FE	Yes	Yes	Yes
Exporter FE	No	Yes	Yes
Year FE	No	Yes	Yes
Observations	6095	6095	6095

Note: *p* Values in parentheses. ***, **, * denote significance at 1%, 5% and 10%. Intercepts included but not reported. The dependent variable is the log of soybean trade values in USD.

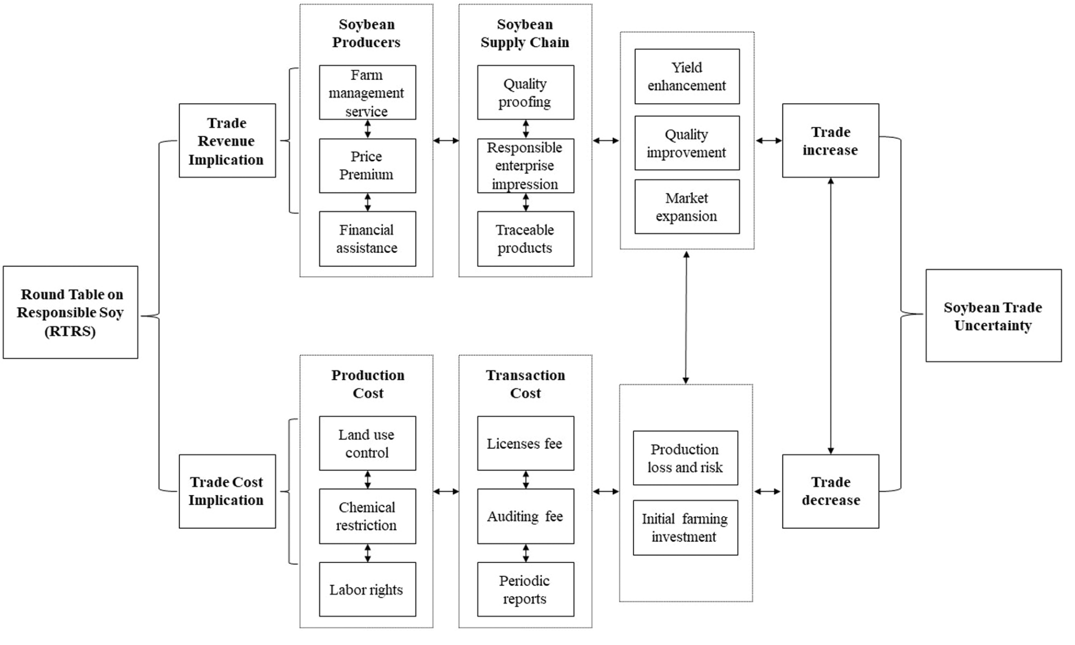

FIGURE A1 Cost–benefit analysis of RTRS on soybean trade.

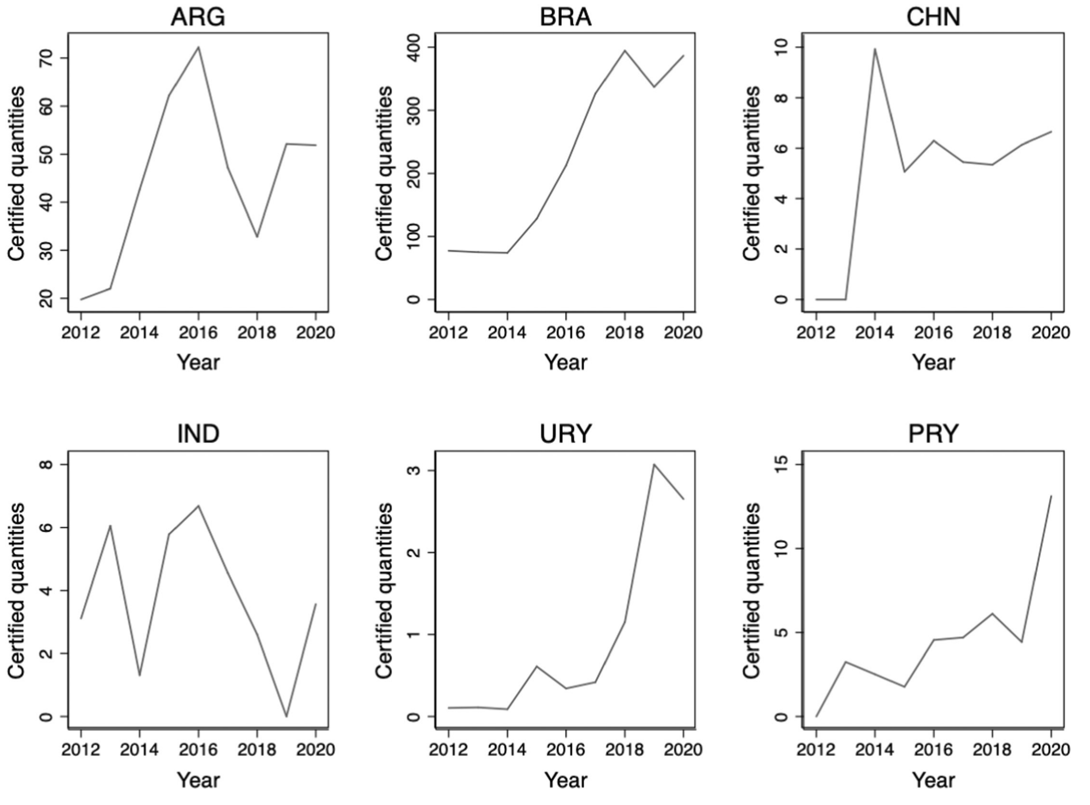

FIGURE A2 RTRS-certified soybean production volumes by countries in 1000 tonnes.

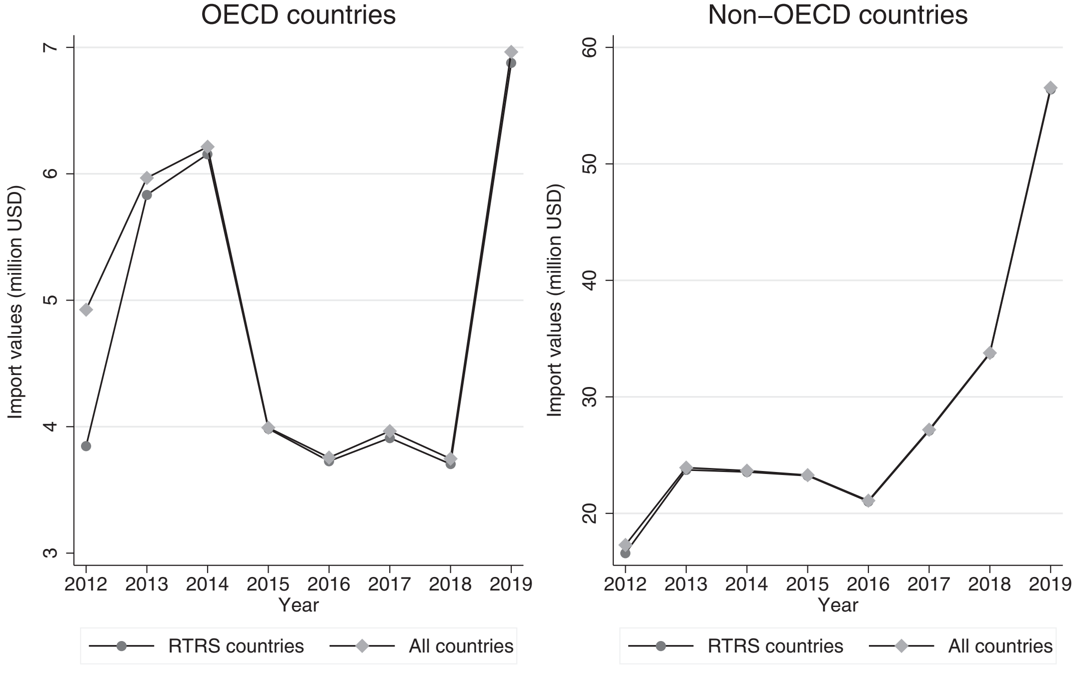

FIGURE A3 Evolution of total soybean imports over time.

RTRS certification and the extensive margin of trade

To assess the extensive margin of trade adjustment—which we define as the probability of trade—we estimate a linear probability model of the following form:

$$X_{ijt} = \alpha_0 + \alpha_1 \ln \text{RTRS}_{it-1} + \alpha_2 \ln Y_{it} + \alpha_3 \text{RTA}_{ijt} + \Pi_i + P_{jt} + \lambda_{ij} + \varepsilon_{ijt}, \quad (6)$$

where all variables remain as defined in Equation 3 but the outcome variable is defined as a dummy variable that takes the value 1 if observed bilateral trade between two countries is positive and 0 otherwise.

RTRS certification and unit values

TABLE A3 The effect of RTRS on the probability of trade.

	Full sample		OECD imports		Non-OECD imports	
	(1)	(2)	(3)	(4)	(5)	(6)
Log RTRS-Certified Quantity$_{it-1}$	−0.003		−0.004		−0.003	
	(0.838)		(0.847)		(0.871)	
Log RTRS-Certified Area$_{it-1}$		−0.003		−0.008		−0.001
		(0.891)		(0.781)		(0.976)
Log production$_{it}$	0.119***	0.118***	0.081*	0.082*	0.147***	0.146***
	(0.000)	(0.000)	(0.065)	(0.063)	(0.000)	(0.000)
RTA$_{ijt}$	−0.016	−0.016	−0.051	−0.052	0.069	0.068
	(0.831)	(0.829)	(0.588)	(0.584)	(0.510)	(0.513)
Exporter FE	Yes	Yes	Yes	Yes	Yes	Yes
Importer-time FE	Yes	Yes	Yes	Yes	Yes	Yes
Importer-Exporter FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6923	6923	2499	2499	4424	4424

Note: *p* Values in parentheses. ***, **, * denote significance at 1%, 5% and 10%. Intercepts included but not reported. The dependent variable is the log of soybean trade values in USD.

TABLE A4 The effect of RTRS on import prices.

	Full sample		OECD imports		Non-OECD imports	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Log RTRS-Certified Quantity$_{it-1}$	0.003		−0.003		0.013	
	(0.956)		(0.973)		(0.877)	
Log RTRS-Certified Area$_{it-1}$		−0.016		−0.053		0.032
		(0.855)		(0.638)		(0.806)
Log Production$_{it}$	0.032	0.044	0.330	0.356	−0.315	−0.324
	(0.874)	(0.833)	(0.290)	(0.258)	(0.174)	(0.176)
RTA$_{ijt}$	−0.032	−0.027	0.265	0.279	−0.353	−0.354
	(0.953)	(0.960)	(0.555)	(0.530)	(0.646)	(0.646)
Exporter FE	Yes	Yes	Yes	Yes	Yes	Yes
Importer-time FE	Yes	Yes	Yes	Yes	Yes	Yes
Importer-Exporter FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1377	1377	681	681	696	696

Note: *p*-Values in parentheses. ***, **, and * denote statistical significance at 1%, 5% and 10%, respectively. Intercepts included but not reported. The dependent variable is the log of soybean trade values in USD.