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Evaluating the Effects of Nontariff Measures on Poultry Trade

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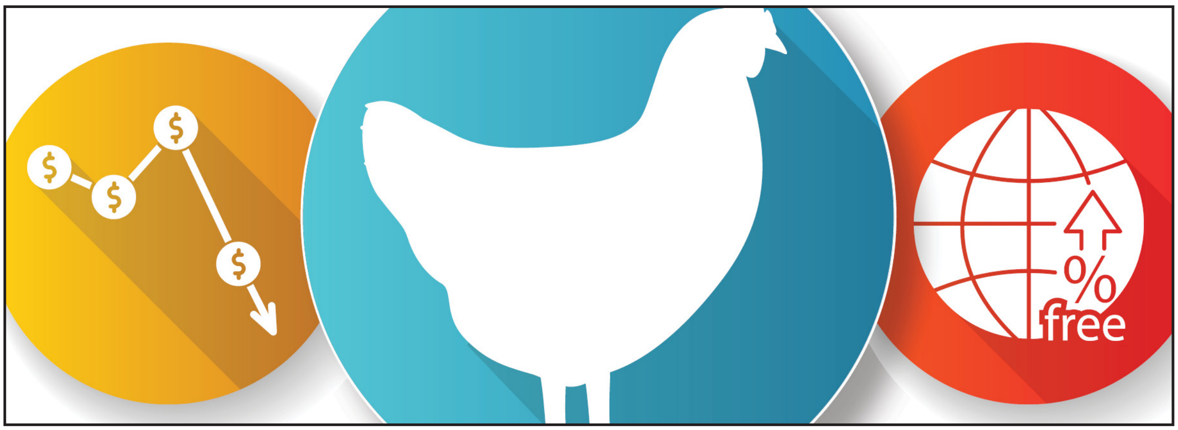

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Evaluating the Effects of Nontariff Measures on Poultry Trade

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Abstract

Poultry is the second most consumed meat in the world and the most traded livestock commodity by volume. Much of this trade is driven by rising demand in developing country markets; as such, poultry trade is expected to continue to grow over the next decade as incomes increase in these countries. However, poultry trade is among the most heavily protected agricultural sectors in terms of tariffs and tariff rate quotas (TRQs). In addition, many nontariff measures (NTMs) limit or even prohibit poultry trade. This report combines data on World Trade Organization (WTO) poultry NTM notifications with domestic and international poultry trade flows to estimate whether and to what extent different types of NTMs affect the value of poultry trade. The results suggest that, on average, nondiscriminatory poultry NTM initiations notified to the WTO have a small positive effect on the value of international poultry trade compared to domestic poultry trade. In aggregate, this finding suggests that the trade facilitation effect dominates, but this may not be the case for any individual NTM or country pair. This study also finds that the effects of WTO notifications appear to vary by importer region.

Keywords: Trade relations, poultry trade, chicken meat, nontariff measures, NTMs, gravity model, sanitary and phytosanitary measures, SPS, technical barriers to trade, TBTs, international development

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A report summary from the Economic Research Service — *May 2024*

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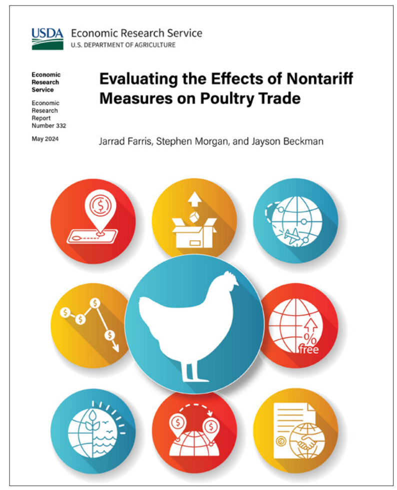


What Is the Issue?

Poultry is the most traded livestock commodity in the world by volume. Rising demand for poultry due to increasing incomes and changing dietary preferences—especially in emerging markets—is expected to persist over the next decade. However, international trade in poultry is subject to protections, including tariffs, tariff-rate quotas (TRQs), and nontariff measures (NTMs) that may distort trade flows. NTMs are policy measures other than ordinary customs tariffs which may affect the quantities and value of international trade flows. They are especially prevalent in poultry trade, but there is limited research on the effects of different types of NTMs on poultry trade. This is due to data limitations as well as the nondiscriminatory application (i.e., an NTM that applies to all countries) of many poultry NTMs, which make econometric analysis difficult.

What Did the Study Find?

The number of country notifications to the World Trade Organization (WTO) of upcoming nondiscriminatory poultry NTMs increased from a low of 18 in 1997 to a peak of 849 in 2018. These poultry NTM notifications include sanitary and phytosanitary (SPS) measures, which are standards applied to international trade flows to ensure food safety and protect human, animal, or plant life or health, and technical barriers to trade (TBTs), which are regulations, standards, and procedures that define the characteristics a poultry product should have to enter into a specific market. NTMs cover a wide variety of different types of measures, including those that may promote trade by harmonizing standards and production processes and those that may disrupt trade by preventing or severely restricting the movement of goods. Most of the increase in poultry NTMs was driven by notification of new poultry related SPS measures. Importers in the Europe-Eurasia region accounted for the majority of new poultry NTM initiation notifications, representing 74 percent of SPS and 40 percent of TBT notifications.

The nondiscriminatory SPS and TBT notifications evaluated in this study were estimated to have small positive effects on the value of international poultry trade relative to domestic trade, on average. This is consistent with previous research suggesting that some SPS and TBT measures may provide information to consumers that enhances demand.

This study also evaluates the extent to which NTM notifications' effects on poultry trade may vary across regions. The results suggest that, for importers in the Europe-Eurasia region, nondiscriminatory poultry SPS initiation notifications were associated with a reduction in the gap between the value of international and domestic poultry trade. However, we did not find corresponding effects for this region when looking at SPS implementation notifications. For importers in other regions, poultry SPS initiation notifications were associated with increases in the international-domestic poultry trade gap relative to the overall average effect. We found no significant regional differences in the effects of TBT initiation notifications on poultry trade.

How Was the Study Conducted?

This report estimated whether and to what extent different types of nondiscriminatory poultry NTMs affect the value of international poultry trade relative to domestic poultry trade. Our approach incorporated advances in the gravity model literature by including domestic trade flows to enable the identification of the effects of nondiscriminatory NTMs. The model also accounted for other factors that influence poultry trade, such as country characteristics and other trade policies. This study estimated the separate overall effects of SPS and TBT notifications to the WTO. To examine regional heterogeneity, this study allowed the estimated effects of nondiscriminatory NTMs to vary by importer region.

The report's estimates evaluated the effects of poultry-related notifications to the WTO on international poultry trade compared to domestic poultry trade. It did not evaluate the effects of specific NTM measures on individual countries, nor did it identify the effects of any bilateral NTMs that may be implemented between trading partner pairs. The report's estimates reflected the average effect across all nondiscriminatory SPS and TBT chicken meat WTO notifications; results may vary when focusing specifically on NTMs identified as trade barriers.

Evaluating the Effects of Nontariff Measures on Poultry Trade

Introduction

Poultry is the most imported livestock commodity by volume in the world. In 2021, global imports of poultry reached nearly 14.2 million metric tons, with imports projected to reach 17.5 million metric tons by 2031 (Miller et al., 2022; Dohlman et al., 2022). Poultry demand is rapidly increasing in emerging markets where rising incomes, growing populations, and urbanization are contributing to higher poultry consumption as a relatively affordable animal protein (Miller et al., 2022; United States International Trade Commission (USITC), 2020). Additionally, local production has often been unable to keep pace with consumer demand, which has often led to an increased demand for imported poultry. However, despite the high and growing demand for poultry imports around the world, poultry trade is significantly impacted by nontariff measures (NTMs).

NTMs are policy measures other than ordinary customs tariffs that may affect the quantities and value of international trade flows (United Nations Conference on Trade and Development (UNCTAD), 2022). NTMs are diverse in their application and capture a broad range of administrative rules and procedures as well as sanitary and phytosanitary (SPS) measures usually applied to imports. NTMs are frequently highlighted to be a larger barrier to trade than tariffs (Arita et al., 2017); however, the effects of NTMs on the value and volume of trade flows may vary based on the product and individual measure (see box, "Evaluating the Effects of Nontariff Measures).

Evaluating the Effects of Nontariff Measures

The effects of nontariff measures (NTMs) on agricultural trade flows may vary based on the measure, product, country, and methodology used to evaluate them (Santeramo & Lamonaca, 2019). Additionally, understanding the effects of NTMs can be further complicated when multiple NTMs and other trade policies are in effect for the same product (Ferrantino, 2006; Orden et al., 2012).

NTMs can function as barriers to trade by raising information and compliance costs for exporters. For example, an exporter may need to learn about new standards or treatment methods, acquire external testing, or meet other certification requirements before exporting. Given the context of a specific supply chain, compliance costs may limit the potential profitability from entry into markets imposing these NTMs (e.g., Jaffee & Henson, 2004; Fontagne et al., 2015). For some products and measures, increased exporter experience with an NTM may lead to different trade effects. For example, Peterson et al. (2013) estimated a gravity model with U.S. fruit and vegetable imports and found that while phytosanitary treatments have a negative overall effect on trade, this effect "diminishes as exporters accumulate treatment experience" (Peterson et al., 2013, p. 854). However, these effects could vary by product or the importer applying the NTM. Additionally, some sanitary and phytosanitary (SPS) or technical barriers to trade (TBT) measures may prevent products from entering the market at all. For example, the European Union (EU) bans the import of beef treated with hormones. U.S. producers wishing to export to the EU must participate in a specific nonhormone-treated cattle program to be certified for export (Beckman et al., 2021).

NTMs can also enhance trade by providing important information to consumers. For example, Thilmany and Barrett (1997) highlighted that NTMs can help resolve imperfect information problems by imposing labeling or safety standards on products. However, these benefits in resolving market failures are likely linked to science-based NTMs. Additionally, NTMs related to labeling or packaging can increase demand by providing low-cost information signals about product quality or attributes that are valued by consumers (Gourdon et al., 2020). Cadot et al. (2018) found that some types of NTMs—particularly SPS measures—can expand trade, likely due to regulatory harmonization between bilateral trading partners. Focusing on SPS and TBT measures, Disdier et al. (2008) found that agricultural NTM effects are negative in 8 sectors, insignificant in 10 sectors, and positive in 7 sectors, highlighting important product-level differences.

NTMs may also affect both demand and trade costs simultaneously (Xiong & Beghin, 2014; Cadot et al., 2018). Xiong and Beghin (2014) decomposed the effects of maximum residue limits (MRLs) on Organisation for Economic Co-operation and Development (OECD) imports of plant products and found MRLs significantly enhanced product demand and significantly raised trade costs, but the overall effect on trade flows was positive. Xiong and Beghin (2014) also found evidence of heterogeneous effects, with the increase in trade costs being larger for imports from developing countries and the demand-enhancing effects being larger for imports from developed countries.

This study used a gravity model approach to evaluate how World Trade Organization (WTO) notification of different types of nondiscriminatory NTMs have affected the value of poultry trade around the world. Nondiscriminatory measures are applied to all foreign imports, whereas discriminatory measures may impose barriers on a single trading partner. Thus, nondiscriminatory NTMs do not include market access commitments under preferential trade agreements.

This study focused on the two main types of nondiscriminatory trade measures:

- Sanitary and phytosanitary (SPS) measures: Standards applied to international trade flows to ensure food safety and protect human, animal, or plant life or health (WTO, 2023); and
- Technical barriers to trade (TBTs): Regulations, standards, and procedures that define the characteristics a product should have to enter into a specific market.

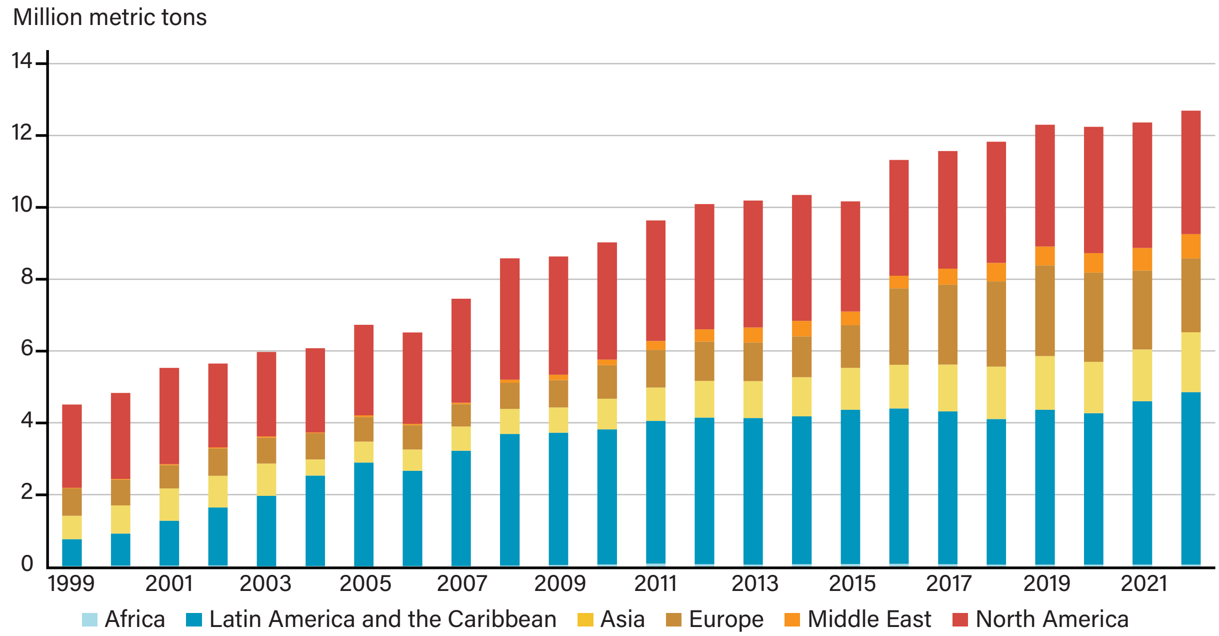
An example of a nondiscriminatory, poultry-related NTM is South Africa's TBT measure providing for and establishing levels for brine-based injections of poultry products. However, it is important to note up front that NTMs cover a wide variety of different types of measures, including those that may promote trade by harmonizing standards and production processes and those that may disrupt trade by preventing or severely restricting the movement of goods. By focusing on all regular NTM notifications to the WTO, this report estimated the average effect of an SPS or TBT notification on the value of international poultry trade relative to domestic trade. Given the different mechanisms and motivations behind different types of NTMs, it is important to investigate how these notifications affect trade across different products and markets.

Overview of Global Poultry Trade and NTMs

Global trade in chicken meat has been rapidly growing as poultry represents an increasingly important animal-sourced protein for consumers around the world. From 1999 through 2022, global exports of chicken meat have increased from 4.5 million metric tons to 13.6 million metric tons (USDA, Foreign Agricultural Service (FAS), 2023).[1] Figure 1 shows chicken exports for select world regions. Latin America and the Caribbean has grown to be the largest exporter of chicken meat, surpassing North America in 2004. Chicken meat exports from Latin America increased from 0.75 million metric tons in 1999 to 4.8 million metric tons in 2022. Exports from North America grew from 2.3 million metric tons to 3.4 million metric tons over the same period. Europe was the third largest exporter of chicken meat in 2022, exporting nearly 2.1 million metric tons.

[1] The USDA, Foreign Agricultural Service's (FAS) Production, Supply and Distribution database (2023) defines chicken meat as the meat of domestic Gallus domesticus, including broilers, layers, hybrids, domestic breeds, spent hens, and ex-breeding stocks. This includes fresh/chilled and frozen chicken meat (Harmonized System 020711-14) as well as processed chicken (HS 160232). For some countries, trade in salted poultry is also included (HS 021099). Chicken paws are excluded.

Figure 1
Exports of chicken meat by region, 1999–2022

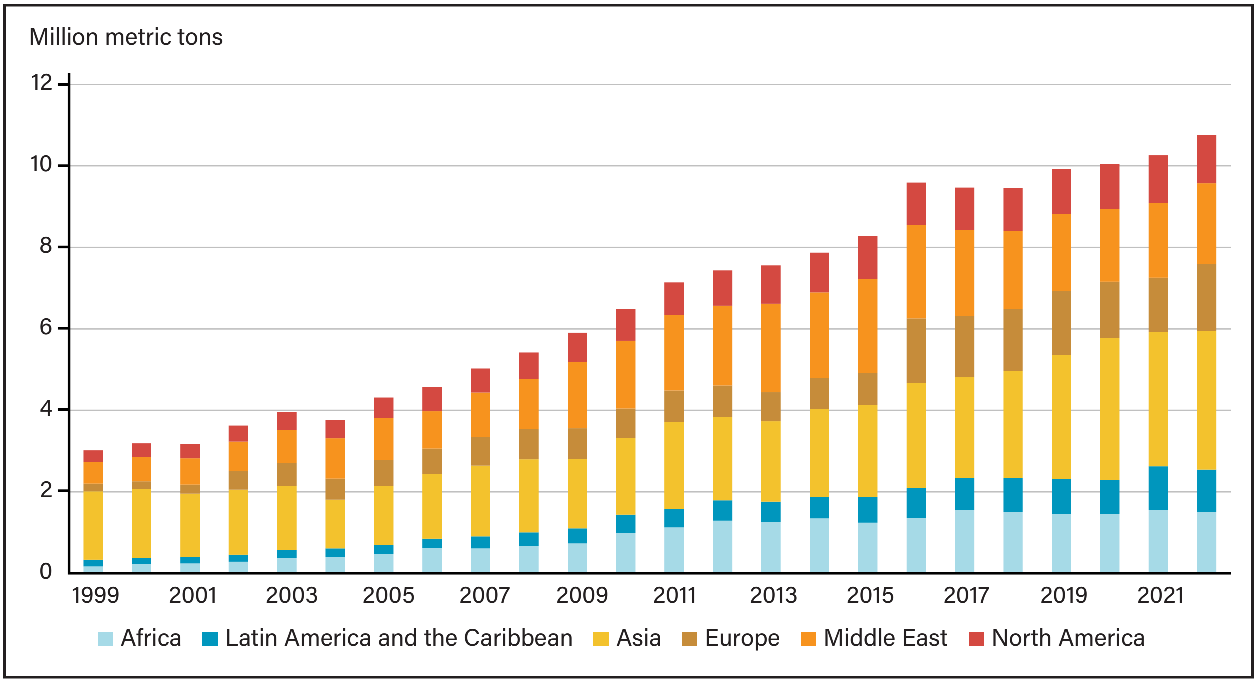


Note: Some regions aggregated from subregional groupings in USDA, Foreign Agricultural Service's *Production, Supply and Distribution* (*PSD*) database. Africa = North Africa and Sub-Saharan Africa; Latin America and the Caribbean = Caribbean, Central America, and South America; Asia = East Asia, South Asia, and Southeast Asia; Europe = European Union and Other Europe. This series incorporates the change in PSD trade calculations in moving from European Union 28 to European Union 27 plus the United Kingdom.

Source: USDA, Economic Research Service using USDA, Foreign Agricultural Service, *PSD* data (2023).

Figure 2 illustrates imports of chicken meat by world region from 1999–2022. Historically, Asia has been the largest importer of chicken meat by volume, importing over 3.4 million metric tons in 2022. The Middle East was the second largest importer of chicken meat in 2022, with imports of nearly 2.0 million metric tons, followed by Europe with 1.7 million metric tons. Over the past two decades, however, Africa has become an increasingly important market for global poultry trade. Africa's poultry imports grew from 0.17 million metric tons in 1999 to more than 1.5 million metric tons in 2022. Import projections expect poultry import volumes to continue to grow in emerging markets, with a projected 27-percent increase in Sub-Saharan Africa by 2031 (Miller et al., 2022). Taken together, Latin America and the Caribbean, North America, and Europe have been net exporters of chicken meat, whereas Africa, Asia, and the Middle East have been net importers.

Figure 2
Imports of chicken meat by region, 1999–2022



Note: Some regions aggregated from subregional groupings in USDA, Foreign Agricultural Service's *Production, Supply and Distribution (PSD)* database product. Africa = North Africa and Sub-Saharan Africa; Latin America and the Caribbean = Caribbean, Central America, and South America; Asia = East Asia, South Asia, and Southeast Asia; Europe = European Union and Other Europe. This series incorporates the change in PSD trade calculations in moving from European Union 28 to European Union 27 plus the United Kingdom.

Source: USDA, Economic Research Service using USDA, Foreign Agricultural Service *PSD* data (2023).

Table 1 presents the 10 largest exporters and importers of chicken meat and their shares of global trade. From 2018 to 2022, Brazil was the world's largest exporter of chicken meat, exporting an average of 4.1 million metric tons per year, followed by the United States, which exported 3.3 million metric tons per year. Together, Brazil and the United States accounted for more than 56 percent of global chicken meat exports, and the top 10 exporters represented 94.2 percent of the global total. Imports were significantly less concentrated across countries, with the top 10 importers accounting for only 58.6 percent of global chicken meat imports. Japan was the largest importer, accounting for 1.1 million metric tons of chicken meat per year, followed by Mexico, the United Kingdom, the European Union, and China.

Table 1
Top 10 exporters and importers of chicken meat, 2018–22

Exporter	2018–22 average (million metric tons)	Share (percent)	Importer	2018–22 average (million metric tons)	Share (percent)
Brazil	4.1	30.9	Japan	1.1	10.1
United States	3.3	25.3	Mexico	0.9	8.2
European Union	2.0	15.0	United Kingdom	0.8	7.3
Thailand	1.0	7.3	European Union	0.7	6.7
Turkey	0.5	3.5	China	0.7	6.3
China	0.5	3.4	Saudi Arabia	0.6	5.8
Ukraine	0.4	3.1	Philippines	0.4	3.7
United Kingdom	0.4	2.8	Iraq	0.5	4.4
Russia	0.2	1.5	United Arab Emirates	0.3	3.3
Argentina	0.2	1.5	Angola	0.3	2.7
Total	**12.3**	**94.2**	**Total**	**6.2**	**58.6**

Source: USDA Economic Research Service using USDA, Foreign Agricultural Service, *Production, Supply and Distribution (PSD)* database (2023).

Previous Research on Poultry NTMs

Several studies have analyzed the effects of NTMs and other measures on poultry trade. Peterson and Orden (2005) used a partial equilibrium framework to evaluate the effects of bilateral SPS measures on poultry trade while also considering tariff rate quotas (TRQ) and tariffs. The authors found that removing all barriers to poultry trade would present opportunities for the United States to expand poultry production and some poultry exports, particularly chicken and turkey drumsticks and thighs.

Arita et al. (2015) used a gravity model approach to estimate the effect of the European Union's (EU) NTMs on U.S. agricultural exports, including poultry. Of particular interest are the EU's restrictions on pathogen reduction treatments (PRTs) where antimicrobial treatments are applied to broiler meat after slaughter. The authors estimated the ad valorem equivalent effect of these NTMs to be between 95 and 102 percent. Disdier et al. (2008) found SPS and TBT measures have had a negative and significant effect on agricultural trade, and this relationship has also applied to meat trade specifically. Furthermore, Ghodsi et al. (2017) found that for poultry, TBTs are more trade restricting than SPS measures, with high estimated TBT effects for fresh and chilled chicken meat. Cadot and Gourdon (2014) estimated the price effects of NTMs in Africa and estimated that poultry-related SPS measures in Kenya and quantitative restrictions in Namibia had ad valorem equivalent estimates of 42.1 and 41.2 percent, respectively.

A significant amount of research has focused on NTMs that were implemented surrounding global outbreaks of highly pathogenic avian influenza (HPAI). Using data from 2000 to 2007, Wieck et al. (2012) found bans on poultry linked to HPAI were associated with nearly 100-percent reductions in uncooked chicken trade while cooked chicken trade had significantly increased. Simulation models found that exporters who were facing bans redirected poultry trade to domestic markets or to other countries facing bans, with some crowding out of third-party exports (Wieck et al., 2012). Another study also found that HPAI outbreaks in China or in other trading partners had not significantly increased the probability of new SPS or TBT measures being placed on cooked or uncooked poultry products (Zhou et al., 2018). However, it is important to note that, per the World Organization for Animal Health (WOAH), cooked poultry has not been included in HPAI-related restrictions. Additionally, HPAI is transmitted mostly through wild bird migration and not through commercial poultry trade, which may explain limited findings related to HPAI and NTM administration (Beato & Capua, 2011; Wieck et al., 2012).

This report made several contributions to the literature on poultry NTMs. First, this study analyzed regular nondiscriminatory poultry NTM notifications that were reported to the WTO using recent advancements in gravity model techniques (Heid et al., 2021). In previous studies, the effects of nondiscriminatory NTM measures were generally subsumed by model fixed effects. Second, by focusing on WTO notifications, this study assessed whether and to what extent the information contained in public notices of initiation and implementation of poultry-related NTMs affected the value of trade flows. This measure broadly captured any type of NTM notification, not just those associated with specific trade concerns raised at the WTO or formal WTO disputes.

Data

In order to estimate the effects of NTMs on poultry trade flows, this report constructed an unbalanced panel dataset with 92 importers and 176 exporters from 1995 through 2019. The starting year of 1995 was selected because data on NTM notifications to the WTO, one of the key variables of interest, were available from this point forward. On the other hand, 2019 was selected as the final year in the analysis because that was the last year for which all country-pair gravity control variables were available.

This report used data on poultry NTMs from the WTO's Integrated Trade Intelligence Portal (I-TIP). This database contains information on WTO member notifications of regular, nondiscriminatory NTMs imposed on poultry trade each year. This data can be broken down by the type of trade measure imposed. In this report, we focused on the two main types of nondiscriminatory trade measures: sanitary and phytosanitary (SPS) measures and technical barriers to trade (TBT). For more information, see the box "Measuring Global Agricultural Nontariff Measures (NTMs)." WTO notifications cover all types of NTMs, including those that may be trade facilitating and those that may be trade barriers.

Data on international poultry trade flows were drawn from the Trade Data Monitor's 2022 database. Poultry trade flows were aggregated across four different Harmonized System (HS) codes for fresh and frozen chicken meat.[2] This report used a mirroring process to fill in missing trade data between all country pairs that were included in the analysis. For a given country pair, importer-reported trade values were used where available first, followed by exporter-reported values. All other country-pair trade values were reported as zero.

Data on intranational poultry trade flows were constructed using data on the value of agricultural production from the Food and Agriculture Organization of the United Nations database (FAOSTAT).[3] For each country year, intranational trade was calculated as the value of domestic poultry production minus the value

[2] This category includes HS codes 020711-14, which covers fresh, chilled, and frozen chicken meat and offal.

[3] FAOSTAT provides estimates of the value of domestic poultry production by country with global coverage. However, it is important to highlight that this dataset may not integrate perfectly with international trade data. For example, if a country does not provide separate statistics, the chicken meat gross production estimate may include all types of poultry in addition to chicken (e.g., geese, ducks, etc.). The value of domestic production data likely contains a better approximation of upstream production of whole birds, while traded poultry products are largely in terms of downstream production. Additionally, some countries may not be reported in the value of domestic production data.

of poultry exports.[4] For cases where the value of intranational poultry trade was negative (i.e., the value of exports exceeds that of production), we recoded this value as zero.

Finally, data on other trading partner characteristics were drawn from the U.S. International Trade Commission's (USITC) Dynamic Gravity dataset (Gurevich & Herman, 2018). For each country pair, we included the measures of distance between countries and indicators for whether countries share a border, had a colonial relationship, share a common language, and have a preferential trade agreement.

Measuring Global Agricultural Nontariff Measures (NTMs)

The global landscape of agricultural NTMs is a complex network comprising large numbers of diverse measures applied across different trading partners and commodity groups. This report used global data on poultry NTM notifications submitted by importers to the World Trade Organization (WTO) that were accessed through the Integrated Trade Intelligence Portal (I-TIP). We focused specifically on nondiscriminatory NTM notifications, which are defined as measures that apply to imports from all trading partners rather than just a subset of trading partners.

Table B1 provides examples of the notification data available, which includes information on the countries involved, the date of the notification, the type of measure, the status of the measure, the affected products, and the measure description with reference to WTO documentation. Some notifications represent a single action like a 2005 European Union (EU) notification of a sanitary and phytosanitary (SPS) measure initiation related to maximum residue levels. Others may have represented a new measure's implementation. For example, in 2015, South Africa notified the WTO of the implementation of a previously notified technical barrier to trade (TBT) measure related to brine-based poultry treatment. Finally, some notifications have represented a type of stock taking or notification of previously enacted measures. These were especially common for measures related to the formation of the WTO.

Table B1

Examples of nondiscriminatory poultry notifications from the World Trade Organization's (WTO) Integrated Trade Intelligence Portal (I-TIP)

Date	Imposing member	NTM	Status	Details	WTO Reference
2005	EU	SPS	Initiation	Amendment regarding the maximum residue levels of fenbutatin-oxide, fenhexamid, and cyazofamid, among others.	G/SPS/N/EEC/275
2006	EU	SPS	In force	In force notification associated with 2005 initiation notification above.	G/SPS/N/EEC/275/Add.1
2013	South Africa	TBT	Notification	Amendment providing for poultry treatment with brine-based mixtures labelling, and consumer information.	G/TBT/N/ZAF/172

continued on next page ►

[4] This report used FAOSTAT's value of domestic production data reported under FAOSTAT Commodity List (FCL) code 1058, which corresponds to the value of gross production for fresh, chilled, and frozen chicken meat. However, if this value was missing for a given country year, we imputed the value using FCL code 1094, which represents indigenous chicken meat and corresponds to the livestock value of production. This report used FAOSTAT reported values of domestic production in current U.S. dollars, which were "converted from local currencies using official exchange rates as prevailing in the respective year" (Food and Agriculture Organization of the United Nations (FAO), 2023).

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Date	Imposing member	NTM	Status	Details	WTO Reference
2015	South Africa	TBT	In force	In force notification associated with 2013 initiation notification above.	G/TBT/N/ZAF/172
2015	Central African Republic	SPS	In force (since 1965)	Live animals and products of animal origin must be accompanied by a certificate issued by the authorities of the countries of origin.	G/SPS/N/CAF/1

NTM = Nontariff measure. EU = The European Union. SPS = Sanitary and phytosanitary. G/SPS/N = Committee on Sanitary and Phytosanitary Measures Notification. G/TBT/N = Committee on Technical Barriers to Trade Notification. EEC = European Economic Community. TBT = Technical barrier to trade. ZAF = South Africa. CAF = Central African Republic.

Source: USDA, Economic Research Service compiling World Trade Organization, Integrated Trade Intelligence Portal data.

The strengths of the WTO notification data on agricultural NTMs and other measures include broad global coverage, notification dates, and the linking of trade measures with specific commodities. However, it is important to highlight that this dataset has some limitations. One limitation is the potential sampling bias in self-reported notifications. Although WTO members are supposed to report notifications of NTMs and other trade measures, this may not always occur. Another limitation is that there may be some measurement error in extracting information from notifications associated with either the initiation and implementation dates, or even the commodities may be affected. For example, Ghodsi et al. (2017) documented some missing HS codes linked to NTM notifications in I-TIP. Finally, the WTO notification data do not distinguish between NTMs and other trade measures that are trade barriers and those that are trade enhancing.

Outside of the global-level notification data, there are several alternative datasets for analyzing global NTMs. One alternative is to focus only on specific trade concerns, which represent SPS and TBT measures raised by exporters in WTO committee meetings. Grant and Arita (2017) used this method to analyze SPS measures from 1995 to 2014. These data may help to identify NTMs that are more likely to negatively impact trade flows, but these data may be more limited in country coverage and in which countries choose to raise specific trade concerns. Another potential dataset would be formal WTO disputes. However, it is important to note that relatively few measures are disputed when compared with all NTMs and other trade measures in effect. A country's capacity to litigate a formal dispute may contribute to selection bias in a sample based on WTO disputes.

Additionally, there are other datasets that may be used to characterize global agricultural NTMs. The United Nations Conference on Trade and Development (UNCTAD) maintains the Trade Analysis Information System (TRAINS) database, which draws on WTO notifications supplemented with official national government sources. One advantage of UNCTAD's TRAINS database is the classification of NTM measures by the Group of Eminent Persons on NTMs, which can provide more insights into the type and scope of individual measures. However, this dataset does not have annual data for all countries and focuses on NTMs that were in force at any given data collection point (UNCTAD, 2023). Global Trade Alert (GTA) presents an alternative database of announced national government changes in the treatment of foreign versus domestic interests across trade, investment, and labor force migration policies (Evenett & Fritz, 2020). GTA coverage began in 2008 and evaluates the anticipated effects of policy announcements. However, GTA does not necessarily capture all global measures and may exclude NTMs or policies in effect before 2008.

Poultry Tariff Rate Quotas in World Trade Organization (WTO) Notifications

Tariff rate quotas (TRQs) are another important trade measure affecting global poultry trade. A TRQ is a measure where different tariff rates are applied to different quota levels of imported products. Generally, a specified level of imports is allowed at a low tariff rate, and imports over the quota face a significantly higher tariff rate. For example, as of 2019, Russia had a 20-percent in-quota tariff rate on select poultry products compared with an 80-percent over-quota tariff rate (International Trade Administration, 2019). Due to the high over-quota tariff rates, TRQs can be a binding constraint on agricultural trade flows—especially when the quota has been filled.

TRQs are one type of measure notified to the World Trade Organization (WTO) that can be accessed through the Integrated Trade Intelligence Portal (I-TIP). For the poultry products considered in this research, there were TRQ administration notifications (MA:1) from 39 different poultry importers that were both initiated and in force. Of these poultry-importing countries, 38 issued notifications in 1995 as part of the WTO's formation, and these issued notifications represented a form of taking stock of existing measures that went into effect. Russia also notified the WTO of a TRQ in 2013 after joining the WTO in 2012. In addition to the notifications in I-TIP, WTO members are also expected to provide separate notifications that provide updates on import volumes under TRQ rules (MA:2). Because TRQ notifications in the I-TIP database concurrently happen with accession to the WTO and there is minimal variation in notifications, TRQ notifications were not considered in this analysis.

Methodology

To estimate the effects of NTMs on the value of poultry trade flows, we used a gravity model approach. The gravity model is based on the idea that, much like the gravitational force between two objects, the amount of trade between two countries increases with size and decreases with distance (and other trade costs) (Yotov et al., 2016). Adapting the framework in Heid et al. (2021), we modeled poultry-specific, bilateral trade flows between countries in a given year as:

$$X_{ijt}=\mathrm{T}_{ijt}^{1-\sigma}\cdot\frac{Y_{it}}{\Omega_{it}}\cdot\frac{E_{jt}}{\Phi_{jt}} \qquad (1)$$

Where X_{ijt} is the nominal value of poultry trade flows from exporting country i to importing country j in year t. T_{ijt} are bilateral trade costs between countries i and j in year t. σ is the elasticity of substitution parameter. Y_{it} is the value of exporting country i's poultry production in year t. E_{jt} is the importing country j's total expenditure on poultry in year t. Ω_{it} is the exporting country i's outward multilateral resistance term in year t. And lastly, Φ_{jt} is the importing country j's inward multilateral resistance term in year t.[5] This structural gravity model emphasizes that the nominal poultry trade between two trading partners depends on bilateral trade costs (T_{ijt}) and the relative sizes of each country's poultry market (Y_{it} and E_{jt}), as well as the costs of each country's trade with the rest of the world (Ω_{it} and Φ_{jt}).

[5] The multilateral resistance terms form a system of equations, as detailed in Heid et al. (2021). Conceptually, the outward multilateral resistance term (Ω_{it}) encapsulates the barriers that country i faces when exporting to its other trading partners. Similarly, the inward multilateral resistance term (Φ_{jt}) encapsulates the barriers that country j faces when importing from its other trading partners (Anderson & van Wincoop, 2003; Anderson & van Wincoop, 2004).

To econometrically estimate equation (1), we controlled for all the unilateral country characteristics affecting poultry trade (e.g., Y_{it}, E_{jt}, Ω_{it}, Φ_{jt}) by including a set of exporter-time and importer-time fixed effects in the estimating equation. The exporter-time fixed effects controlled for all time-invariant and time-varying exporter-specific poultry trade determinants. For example, these exporter-time fixed effects accounted for the exporting country's Gross Domestic Product (GDP), population, poultry production (Y_{it}), outward multilateral resistance (Ω_{it}), nondiscriminatory tariffs, any other unilateral trade policies, and many other factors that have impacted the country's propensity to export poultry. Similarly, the importer-time fixed effects controlled for all the time-invariant and time-varying importer-specific poultry trade determinants. These importer-time fixed effects accounted for a similar set of trade determinants from the importing country's perspective, including poultry expenditure (E_{jt}) and inward multilateral resistance (Φ_{jt}). Thus, these exporter-time and importer-time fixed effects were key to accounting for various observed and unobserved factors that influenced countries' poultry trade. Replacing the unilateral country characteristics with these exporter-time and importer-time fixed effects and taking the natural logarithm of equation (1) led to:

$$\ln (X_{ijt}) = (1-\delta) \ln (T_{ijt}) + \gamma_{it} + \delta_{jt} + \epsilon_{ijt} \qquad (2)$$

Where γ_{it} and δ_{jt} are the exporter-year and importer-year fixed effects, respectively, and ϵ_{ijt} is the idiosyncratic error.

A major identification challenge in including these fixed effects, however, was that nondiscriminatory NTMs are themselves unilateral as they apply to all the poultry that the enacting country imports, regardless of the country of origin. This created perfect collinearity between nondiscriminatory poultry NTMs, which were our main variables of interest, and the set of included fixed effects. Therefore, the nondiscriminatory NTMs were subsumed in the importer-time fixed effects. As such, our effects of interest could not be identified without further changes to the model. We solved this problem by applying a method developed in Heid et al. (2021), which incorporated domestic sales (intranational trade) into the gravity model. Domestic sales observations (i.e., where $i = j$ in equation (1)) were not subject to the international trade restrictions that a country has imposed on its imports. Therefore, including intranational trade flows in the model and interacting our NTM variables of interest with an indicator for international trade enabled the NTM effects of interest to be identified in the presence of the rich set of time-varying importer and exporter fixed effects. By incorporating these changes, we were able to separate the NTM effects from the included fixed effects as follows:

$$\ln (X_{ijt}) = (1-\delta) \ln (T_{ijt}) + \beta(NTM_{jt} * INTL_{ij}) + \gamma_{it} + \delta_{jt} + \epsilon_{ijt} \qquad (3)$$

Where NTM_{jt} are indicator variables equal to 1 if the importing country j notified the WTO of at least one poultry-specific, nondiscriminatory NTM of the given type in year t; and $INTL_{ij}$ is an indicator variable equal to 1 for international trade (i.e. $i \neq j$) and 0 otherwise. WTO differentiates between when a country initiates an NTM notification to be applied as a future policy change and when a country places an NTM notification in force to be applied from the date onwards (World Trade Organization (WTO), 2023). To allow for differences in how initiation and in force poultry NTM notifications may have affected poultry trade flows, we estimated separate models for initiation, in force, and either, where the latter NTM indicator was given a value of 1 if the importing country either initiated or placed in force at least one poultry-specific, nondiscriminatory NTM in the given year.

In addition to exporter-time and importer-time fixed effects, separately identifying the effects of nondiscriminatory NTMs on countries' poultry trade also required us to adequately control for bilateral poultry trade costs (T_{ijt}), which differ across trading partner pairs. We controlled for bilateral trade costs in several ways. In our initial specification, we followed the standard practice of defining T_{ijt} as a function of a set of common, time-invariant gravity controls, including the distance between the two trading partners; whether the two countries shared an official language; whether the two countries had colonial ties; whether the two countries are contiguous; and including the time-varying control of whether the two countries had a preferential trade agreement with each other.[6] These standard gravity model controls were designed to account for observed, bilateral-specific trade frictions that exist between two trading partners. Proxying T_{ijt} with this set of gravity controls led to the following equation:

$$\ln(X_{ijt}) = \alpha(GRAV_{ij} * INTL_{ij}) + \rho(PTA_{ijt} * INTL_{ij}) + \beta(NTM_{jt} * INTL_{ij}) + \gamma_{it} + \delta_{jt} + \epsilon_{ijt} \quad (4)$$

Where $GRAV_{ij}$ are bilateral, time-invariant control variables from the USITC gravity database (e.g., log distance between i and j, indicator for shared language, indicator for shared border, etc.), and PTA_{ijt} is an indicator variable equal to 1 if the two countries had a preferential trade agreement in year t and 0 otherwise. As in the case of the nondiscriminatory NTMs, these gravity variables were interacted with the international indicator as they did not apply to domestic trade observations (Heid et al., 2021).

Although these standard gravity controls proxied observed bilateral trade costs, in practice, data on many bilateral poultry trade costs were only partially available or were not observed at all. Since any omitted bilateral trade costs would have appeared in the model's estimating error, the correlation between these unobserved costs and the observed gravity controls (i.e., endogeneity) could have led to bias in the estimated effects. Therefore, we also defined a more robust specification that replaced the standard bilateral gravity controls with directional, country-pair fixed effects. Directional, country-pair fixed effects controlled for all the time-invariant bilateral trade costs between two trading partners, whether observed (i.e., the gravity controls) or unobserved (i.e., everything else). Additionally, these directional fixed effects allowed for poultry trading costs to vary based on the direction of the trade flow. For instance, shipping poultry from country A to country B may have faced different trade costs than making that same shipment from country B to country A; directional, country-pair fixed effects allow for such asymmetries. To allow for these additional factors, we defined the more robust specification as follows:

$$\ln(X_{ijt}) = \varphi_{ij} + \alpha(PTA_{ijt} * INTL_{ij}) + \beta(NTM_{jt} * INTL_{ij}) + \gamma_{it} + \delta_{jt} + \epsilon_{ijt} \quad (5)$$

Where the time-invariant bilateral gravity controls were replaced with directional, country-pair fixed effects, φ_{ij}. Additionally, we continued controlling for the existence of a preferential trade agreement between trading partners in a given year, PTA_{ijt}, in order to account for time-varying bilateral market access commitments that would not be subsumed by the time-invariant, directional, country-pair fixed effects.[7]

Finally, estimating equations (4) and (5) in this log-linear form would have led to several biases. First, log-linear gravity equations are susceptible to bias when the error terms, ϵ_{ijt}, are heteroscedastic (Santos Silva & Tenreyro, 2006). Second, expressing poultry trade flows logarithmically would have also led to biases due to the large number of trade flows that were equal to zero. Many country pairs did not trade poultry with one another in a given year, and these zero-trade observations provided information about the state of poultry trade between two countries. For instance, if new poultry NTMs led to changes in the number or location of exporting poultry firms, then zero poultry trade observations may have been correlated with NTMs, and excluding them could have biased the estimated coefficients. To avoid these biases, we followed Santos Silva

[6] Whether two countries had an active preferential trade agreement, PTA_{ijt}, controlled for time-varying bilateral trade policies. Excluding this variable could lead to bias if NTM policies were correlated with preferential trade agreements. Similarly, including PTA_{ijt} may also lead to bias if the existence of bilateral agreements was correlated with unobserved factors in ϵ_{ijt}. We estimated robustness regressions excluding PTA_{ijt} and found similar results (table A.1).

[7] Endogeneity, or the correlation between observed variables and unobserved factors in the error term, is a common source of bias in gravity models of trade. As discussed in detail throughout this methodology section, the specification in equation (5) included a comprehensive set of fixed effects that controlled for common sources of endogeneity in standard gravity models. For example, this specification controlled for nondiscriminatory time-varying and time-invariant trade policies (via γ_{it} and δ_{jt}), fixed trade policies applied to specific trading partners (via φ_{ij}), and changes in bilateral trade policies enacted as part of a trade agreement, PTA_{ijt}. Changes in trade policies enacted outside of these three avenues, however, could still have biased the results.

and Tenreyro (2006) by estimating the gravity model using a Poisson Pseudo Maximum Likelihood (PPML) estimator. The PPML estimator is robust to heteroscedasticity of unknown form and expresses the dependent variable (i.e., poultry trade flows) in levels, which allowed for zero trade observations to be maintained. Thus, equations (4) and (5) can be re-expressed as follows:

$$X_{ijt} = \exp[C + \alpha(PTA_{ijt} * INTL_{ij}) + \beta(NTM_{jt} * INTL_{ij}) + \gamma_{it} + \delta_{jt} + \epsilon_{ijt}] \quad (6)$$

Where $C = \alpha(GRAV_{ij} * INTL_{ij})$ corresponds to the initial specification in equation (4) with bilateral gravity controls, whereas $C = \varphi_{ij}$ corresponds to the specification in equation (5) with directional, country-pair fixed effects. In both cases, the dependent variable was expressed in levels for the PPML estimation, and our main coefficient of interest was β that captured the effects of the different types of NTMs measured in this analysis.

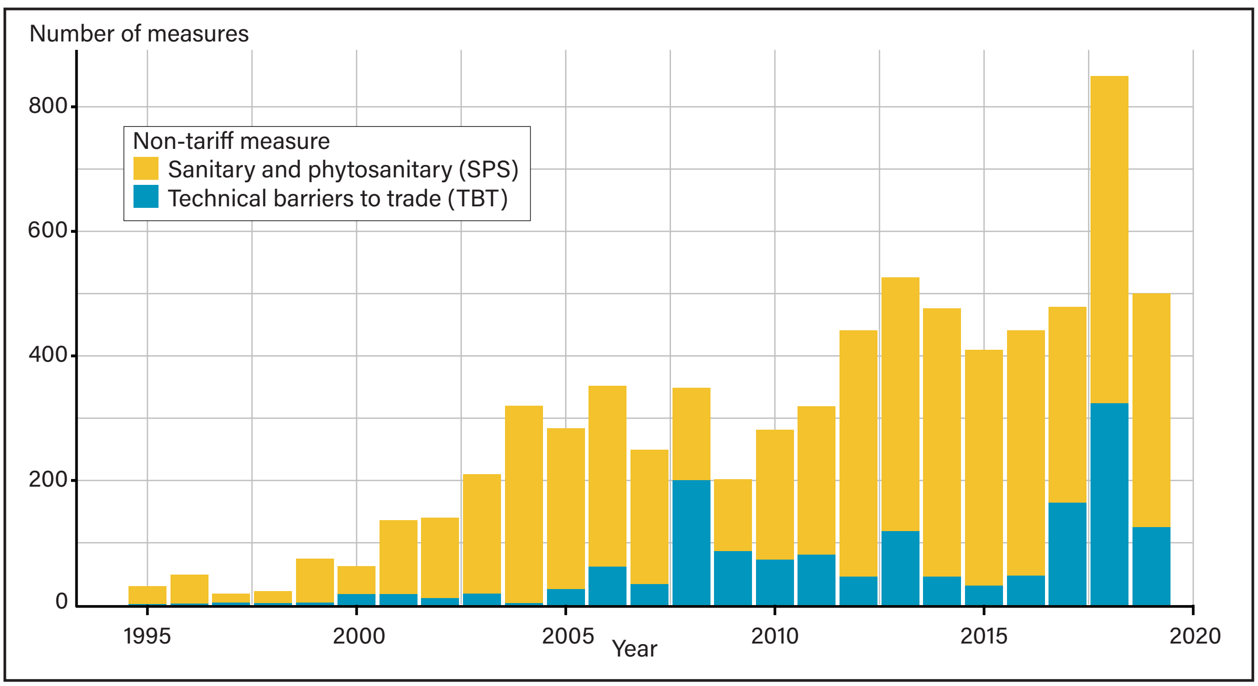
Results

Changing Composition of Poultry Nontariff Measures Over Time

We first analyzed the distribution of World Trade Organization (WTO) poultry-related nondiscriminatory nontariff measure (NTM) notifications over time. Figures 3 and 4 describe the frequency of chicken meat NTM notifications defined as initiated and in force, respectively, as reported in the WTO's Integrated Trade Intelligence Portal (I-TIP) database. Initiations note the year a measure was notified to the WTO as being in preparation while in force measures note the year when the WTO was notified that a measure was put into place.[8]

Figure 3

The number of poultry nontariff measure (NTM) initiations notified to the World Trade Organization (WTO)



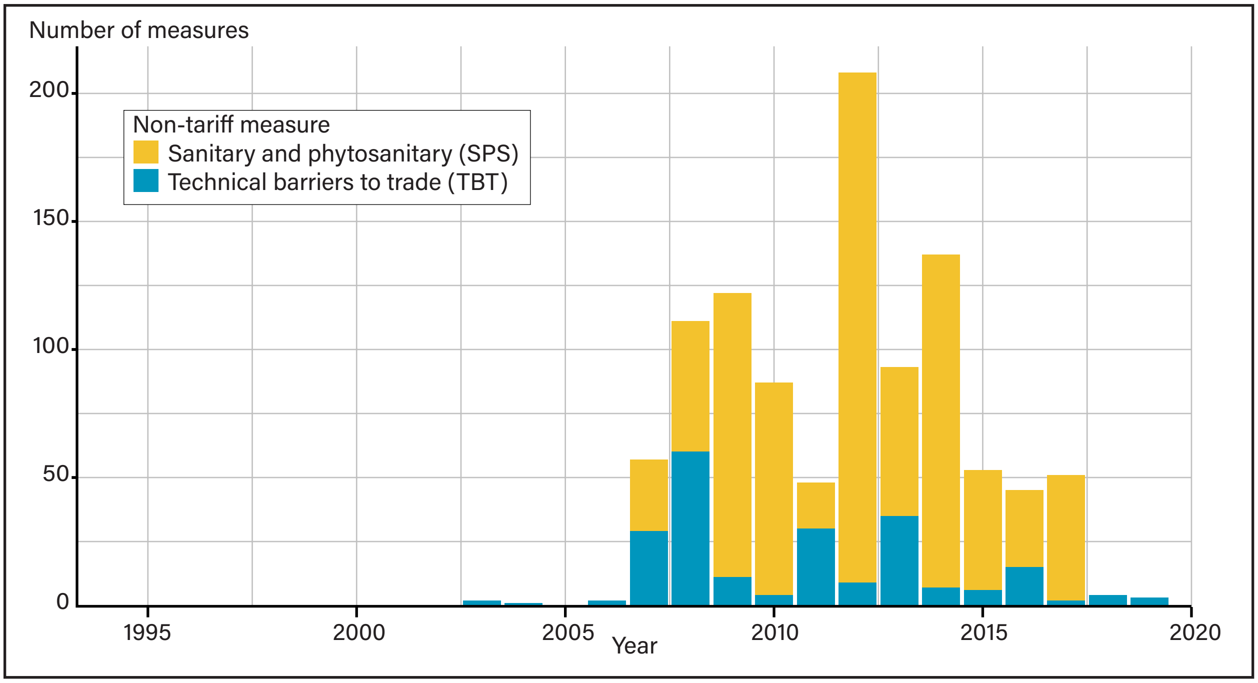
Note: WTO reported NTM notifications for years 1995 through 2019 related to Harmonized System codes 020711–14, which includes fresh, chilled, and frozen chicken meat and offal.

Source: USDA, Economic Research Service using World Trade Organization, Integrated Trade Intelligence Portal 2023 data.

[8] Entry-into-force notifications are not required for SPS and TBT measures. However, over time there has been increasing notifications by WTO members (WTO, 2023).

Figure 4

The number of poultry nontariff measures (NTM) placed in force notified to the World Trade Organization (WTO)



Note: WTO reported NTM notifications for years 1995 through 2019 related to Harmonized System codes 020711–14, which includes fresh, chilled, and frozen chicken meat and offal.

Source: USDA, Economic Research Service using World Trade Organization, Integrated Trade Intelligence Portal 2023 data.

Nondiscriminatory poultry NTM notifications have generally increased since the early 2000s. Focusing on the initiations illustrated in figure 3, NTM initiation notifications increased from a total of 30 in 1995 to 500 in 2019. Notifications peaked in 2018 when there were 849 poultry-related NTM initiations reported to the WTO. Notifications for poultry NTMs put into force (figure 4) were less frequent than NTM initiation notifications. For example, in this dataset, the first in force notification we observed was for two poultry-related TBT measures in 2003. In force notifications began to increase in 2007 when there were a combined 57 poultry NTMs, and these notifications peaked in 2012 with 208. Although in force NTM notifications appeared to have generally increased over time, such notifications were not required. Thus, applied NTMs may not have always received corresponding in force NTM notifications (WTO, 2023).

Table 2 summarizes the number of poultry-related NTM notifications by region and by type for the 1995–2019 period. The majority of SPS notifications were from importers located in the Europe-Eurasia region. Moreover, Europe-Eurasia represented 74 percent of SPS initiation notifications and 75 percent of SPS in force notifications contained in this dataset. Similarly, Europe-Eurasia represented 40 percent of TBT initiation notifications and 65 percent of in force TBT notifications.

Table 2
Number of poultry-related notifications by region and type, 1995–2019

	Sanitary and phytosanitary		Technical barriers to trade	
	Initiated	In force	Initiated	In force
Africa	99	4	144	7
Asia-Pacific	639	90	146	13
Europe-Eurasia	4,231	604	615	142
Latin America and the Caribbean	209	33	128	11
Middle East	173	53	350	1
North America	330	20	155	46
Total	**5,681**	**804**	**1,538**	**220**

Note: Includes nontariff measure notifications related to Harmonized System codes 020711–14, which covers fresh, chilled, and frozen chicken meat and offal. Some regions aggregated from regional groupings in Gurevich and Herman (2018), including Asia-Pacific = Pacific, Central Asia, East Asia, South Asia, and Southeast Asia; Europe-Eurasia = Europe and Eurasia; and Latin America and the Caribbean = the Caribbean, Central America, and South America. Regional groupings for Africa, the Middle East, and North America are maintained from Gurevich and Herman (2018).

Source: USDA, Economic Research Service using World Trade Organization, Integrated Trade Intelligence Portal 2023 data and Gurevich, T., and Herman, P., 2018, *The dynamic gravity dataset: 1948–2016*, (Working Paper 2018-02-A), United States International Trade Commission.

Aggregate Gravity Model Results

Table 3 reports the results from two different specifications of the gravity model. Columns 1–3 estimate the model specified in equation (6) using bilateral gravity control variables from USITC. The three standard gravity controls that are statistically significant across models (e.g., PTA, distance, and trading partner contiguity) all had the expected signs. Having an active PTA and sharing a border (contiguity) with a trading partner were both associated with increases in international poultry trade. At the same time, increased geographic distance between trading partners was associated with reduced international poultry trade.

Furthermore, as the model includes both domestic and international poultry trade, the international coefficient captured all poultry trade flows that cross an international border, which provided an estimate of the international border effect for poultry trade. As expected, the negative and significant international coefficient estimate indicated that crossing an international border was associated with a reduction in poultry trade relative to domestic trade. That is, international poultry trade was lower than intranational poultry trade, on average. In what follows, we allowed this poultry-specific, international border effect to vary based on the types of nondiscriminatory NTMs imposed on international poultry imports. The international indicator's interaction with the indicator for an NTM notification (SPS or TBT) captured the marginal effect of different types of NTM notifications on the international border effect.

The initial estimates in columns 1–3 suggest that WTO notifications for both types of NTMs are associated with statistically significant reductions (in absolute value) in the international border effect. Specifically, the SPS initiation or in force estimates in column 3 suggest that WTO SPS notifications, considering both initiation and in force notifications, are associated with a 33-percent reduction (in absolute value) in the average international border effect for poultry trade (from -7.626 to -5.12) (table 3). Similarly, the results in table 3's column 3 suggest that WTO TBT initiation or in force notifications are associated with 16-percent reductions (in absolute value) in the average international border effect for poultry trade (from -7.626 to -6.423). Thus, the initial results suggest that these nondiscriminatory WTO NTM notifications, on average, lowered the gap between international and domestic poultry trade.

Although table 3's columns 1–3 provide useful initial estimations using a common gravity model approach, columns 4–6 are the preferred specification due to their inclusion of more widespread bilateral controls. Specifically, columns 4–6 estimate the model given in equation (6) using asymmetric-pair fixed effects in place of the time-invariant bilateral gravity controls. As noted previously, the inclusion of directional pair fixed effects controlled for all of the previous time-invariant gravity controls (i.e., distance, contiguity, colonial ties, common language, and the international trade indicator) as well as any other unobserved, time-invariant bilateral characteristics which may have influenced poultry trade between trading partner pairs. Importantly, the international trade indicator was among the gravity controls incorporated into these asymmetric-pair fixed effects. The average international pair fixed effects estimate indicated that relative to domestic trade with a corresponding value of 0, crossing an international border has been associated with a reduction in poultry trade relative to domestic trade. The estimated poultry NTM notifications effects can be interpreted as marginal changes in this international border effect or the gap between international and domestic poultry trade.

The asymmetric-pair fixed effects results provide further evidence that WTO notifications for both types of NTMs were associated with statistically significant reductions in the international border effect for poultry trade. Specifically, the results in column 4 suggest that an SPS initiation notification is associated with a 6-percent reduction (in absolute value) in the average international border effect for poultry trade (from -9.23 to -8.70) (table 3). We estimated smaller effects of a TBT initiation notification that was associated with a 3-percent reduction (in absolute value) in the average international border effect for poultry trade.

These findings are consistent with previous research, which suggests that some NTMs for some products may be trade enhancing (e.g., Cadot et al., 2018; Gourdon et al., 2020). Specifically for poultry, SPS and TBT measures may be demand enhancing by signaling product attributes (e.g., safety, quality, etc.) to different consumer groups. Furthermore, it may be that new notifications spur temporary increases in trading activity in anticipation of future trade measures. It is also important to highlight that these estimates reflect averages across all SPS and TBT chicken meat WTO notifications. Thus, individual SPS or TBT measures, such as those raised as specific trade concerns, may still act as barriers to poultry trade. Moreover, these estimates are averages across all trading partners and may not be reflective of individual country pair experiences. For example, Arita et al. (2015) estimated that the EU's NTMs on poultry products had a strong trade-impeding effect on U.S. exports with an ad valorem equivalent effect of 95–102 percent.

Table 3
Gravity model estimates for the effects of nondiscriminatory World Trade Organization nontariff measure notifications on the value of poultry trade

	Gravity controls			Asymmetric FEs		
	(1)	(2)	(3)	(4)	(5)	(6)
	Initiated	In force	Either	Initiated	In force	Either
INTL	-7.489***	-5.334***	-7.626***			
	(0.870)	(0.776)	(0.870)			
SPS_x_INTL	2.670***	1.143***	2.506***	0.530***	0.260***	0.483***
	(0.467)	(0.169)	(0.454)	(0.171)	(0.0999)	(0.165)
TBT_x_INTL	0.871***	1.373***	1.203***	0.234***	0.231***	0.309***
	(0.237)	(0.325)	(0.266)	(0.0713)	(0.0601)	(0.0760)
agree_pta_x_INTL	0.706*	0.678*	0.717*	0.706**	0.731**	0.701**
	(0.383)	(0.370)	(0.384)	(0.313)	(0.319)	(0.311)
ln_dist	-1.491***	-1.653***	-1.476***			
	(0.289)	(0.302)	(0.287)			
contiguity_x_INTL	1.050***	0.946***	1.045***			
	(0.346)	(0.359)	(0.340)			
colony_ever_x_INTL	-0.720	-0.689	-0.711			
	(0.744)	(0.741)	(0.741)			
common_colonizer_x_INTL	-0.187	-0.285	-0.170			
	(0.409)	(0.423)	(0.401)			
common_language_x_INTL	-0.272	-0.379	-0.250			
	(0.284)	(0.274)	(0.290)			
Average international pair fixed effect				-9.228	-8.993	-9.236
N	195,036	195,036	195,036	60,378	60,378	60,378

FEs = Fixed effects. INTL = Indicator for international trade flow. SPS = Sanitary and phytosanitary measures. TBT = Technical barriers to trade. agree_pta = Indicator variable for existence of a preferential trade agreement. ln_dist.= Log value of distance between trading partners. N = Number of observations.

Note: Columns 1–3 include partner (exporter)-year and reporter (importer)-year fixed effects. Columns 4–6 include partner (exporter)-year and reporter (importer)-year and importer-exporter fixed effects. All regressions use a Poisson Pseudo Maximum Likelihood (PPML) estimator. Includes nontariff measure notifications related to Harmonized System codes 020711–14, which cover fresh, chilled, and frozen chicken meat and offal. *=p<0.1, **=p<0.05, ***=p<0.01, with standard errors in parentheses.

Source: USDA, Economic Research Service estimates using data from Trade Data Monitor, World Trade Organization, Integrated Trade Intelligence Portal and Gurevich, T., and Herman, P., 2018, *The dynamic gravity dataset: 1948–2016*, (Working Paper 2018-02-A), United States International Trade Commission.

As an added robustness check, we also ran these specifications using an indicator for lagged nondiscriminatory poultry NTM notifications by importers. Lagged measures are important because it may take exporters some time to adjust to new information about the NTM notification and, in some cases, find new markets for output. Overall, our estimates were broadly consistent with the results presented above.

Regional Heterogeneity on Nontariff Measures

We also investigated whether there were heterogeneous effects of WTO notifications on poultry trade. In the tables below, we present results from the following modified version of the specification in equation (6), which includes an additional interaction term for the region of the importer:

$$X_{ijt}^{REG} = \exp[\varphi_{ij}^{REG} + \alpha^{REG}(PTA_{ijt} * INTL_{ij}) + \beta^{REG}(NTM_{jt} * INTL_{ij} * REG_j) + \gamma_{it}^{REG} + \delta_{jt}^{REG} + \epsilon_{ijt}] \quad (7)$$

Where the *REG* superscript denotes that separate regressions were run for each region, REG_j is an indicator variable equal to 1 if the importing country *j* is a member of the specified region. The other variables are as defined in equation (6). We estimated separate models for Africa, Asia-Pacific, Europe-Eurasia, Latin America and the Caribbean, the Middle East, and North America.[9] In each case, we ran the regression on the full set of observations, with added interaction terms that allowed the poultry NTM notification effects for importers from the given region to vary from the rest of the world.

Table 4 presents regional results focusing on poultry NTM initiations notified to the WTO. Each column uses a different regional importer interaction term that is compared with a base category of all other regions. An estimate is missing when there is not enough region-specific variability to identify the effect (table 4). Overall, we found some evidence of regional heterogeneity in how SPS measures were associated with the value of poultry trade. For importers in Europe-Eurasia (table 4, column 3), we estimated that SPS notifications were associated with a 9-percent reduction (in absolute value) in the international border effect for poultry trade (from -9.24 to -8.45). This suggests that, on average, nondiscriminatory poultry SPS notifications are associated with a reduction in the gap between the value of international and domestic poultry trade in the region. However, for importers in other regions, we estimated that poultry SPS notifications were associated with increases (in absolute value) in the international border effect compared with the rest of the world. For example, the regional results for Africa (table 4, column 1) suggest that SPS notifications are associated with a 10-percent increase (in absolute value) in the international border effect for poultry trade (from -9.25 to -10.18).[10] We found no significant regional differences in the effects of TBT notifications on poultry trade.

[9] Some regions aggregated from regional groupings in Gurevich and Herman (2018), including Asia-Pacific = Pacific, Central Asia, East Asia, South Asia, and Southeast Asia; Europe-Eurasia = Europe and Eurasia; and Latin America and the Caribbean = the Caribbean, Central America, and South America. Regional groupings for Africa, the Middle East, and North America are maintained from Gurevich and Herman (2018).

[10] The overall SPS NTM notification effect for Africa is equal to the base SPS coefficient estimate (0.548) plus the Africa-specific SPS interaction term estimate (-1.485).

Table 4

Gravity model estimates for the regional effects of nondiscriminatory World Trade Organization nontariff measure initiation notifications on the value of poultry trade

	(1) Africa	(2) Asia-Pacific	(3) Europe-Eurasia	(4) Latin America and the Caribbean	(5) Middle East	(6) North America
SPS_x_INTL	0.548***	0.592***	-0.0268	0.626***	0.549***	0.531***
	(0.174)	(0.189)	(0.129)	(0.193)	(0.186)	(0.171)
SPS_x_INTL_x_R	-1.485***	-0.620***	0.791***	-0.569***	-0.422***	-0.963***
	(0.304)	(0.208)	(0.294)	(0.202)	(0.141)	(0.325)
TBT_x_INTL	0.231***	0.236***	0.393*	0.203***	0.234***	0.233***
	(0.0711)	(0.0725)	(0.215)	(0.0649)	(0.0717)	(0.0712)
TBT_x_INTL_x_R	0.348	-0.208	-0.194	0.425	-0.168	0.352
	(0.265)	(0.344)	(0.225)	(0.350)	(0.113)	(0.286)
agree_pta_x_INTL	0.708**	0.701**	0.713**	0.703**	0.709**	0.704**
	(0.315)	(0.317)	(0.316)	(0.316)	(0.315)	(0.312)
Average international pair fixed effect	-9.247	-9.216	-9.240	-9.257	-9.240	-9.205
N	60,378	60,378	60,378	60,378	60,378	60,378

FEs = Fixed effects. INTL = Indicator for international trade flow. SPS = Sanitary and phytosanitary measures. R = Region. TBT = Technical barriers to trade. agree_pta = Indicator variable for existence of a preferential trade agreement. N = Number of observations.

Note: All models include partner (exporter)-year and reporter (importer)-year and importer-exporter fixed effects and use a Poisson Pseudo Maximum Likelihood (PPML) estimator. Includes nontariff measure notifications related to Harmonized System codes 020711–14, which cover fresh, chilled, and frozen chicken meat and offal. Each column is labeled with the importer region interaction used. Some regions aggregated from regional groupings in Gurevich and Herman (2018), including Asia-Pacific = Pacific, Central Asia, East Asia, South Asia, and Southeast Asia; Europe-Eurasia = Europe and Eurasia; and Latin America and the Caribbean = the Caribbean, Central America, and South America. Regional groupings for Africa, the Middle East, and North America are maintained from Gurevich and Herman (2018). *=p<0.1, **=p<0.05, ***=p<0.01, with standard errors in parentheses.

Source: USDA, Economic Research Service estimates using data from Trade Data Monitor, World Trade Organization, Integrated Trade Intelligence Portal and Gurevich, T., and Herman, P., 2018, *The dynamic gravity dataset: 1948–2016,* (Working Paper 2018-02-A), United States International Trade Commission.

Investigating these patterns of heterogeneity can shed light on estimates of the average effect of NTM notifications on the value of poultry trade. For example, we estimated that SPS initiation notifications have been associated with a small reduction (in absolute value) in the international border effect for poultry trade (table 3). The results in table 4 highlight that this association appears to have been driven by importers in the Europe-Eurasia region. As discussed above, SPS measures may be trade enhancing when they provide specific signals about product attributes that consumers value (Cadot et al., 2018).

Table 5 presents regional results focusing on in force WTO NTM notifications. In force notifications are an important point of comparison because they represent a measure being actively applied rather than a notification that may or may not go into effect (i.e., WTO initiation notifications). We found different patterns of regional heterogeneity for in force notifications compared with initiations. For SPS measures, we found that in force notifications are associated with a 7-percent reduction and 3-percent increase (both in absolute value) in the international border effect for poultry trade among importers in the Middle East and Latin America and the Caribbean, respectively. Additionally, we found a less than a 1-percent increase (in absolute value) in the international border effect for North American importers and no significant regional differences in other regions. For TBT measures, we found that in force notifications were associated with a 5-percent reduction (in absolute value) in the international border effect for poultry importers in Africa.

Table 5

Gravity model estimates for the regional effects of nondiscriminatory World Trade Organization nontariff measure in force notifications on the value of poultry trade

	(1) Africa	(2) Asia-Pacific	(3) Europe-Eurasia	(4) Latin America and the Caribbean	(5) Middle East	(6) North America
SPS_x_INTL	0.261***	0.267***	0.00834	0.269***	0.255**	0.272**
	(0.1000)	(0.102)	(0.195)	(0.104)	(0.100)	(0.106)
SPS_x_INTL_x_R		-0.509	0.273	-0.551**	0.406***	-0.340*
		(0.442)	(0.226)	(0.230)	(0.155)	(0.203)
TBT_x_INTL	0.229***	0.231***	0.488***	0.233***	0.230***	0.227***
	(0.0625)	(0.0623)	(0.163)	(0.0607)	(0.0602)	(0.0621)
TBT_x_INTL_x_R	0.262***	0.289	-0.262	-0.600		0.309
	(0.0126)	(0.332)	(0.172)	(0.508)		(0.193)
agree_pta_x_INTL	0.734**	0.735**	0.733**	0.738**	0.734**	0.727**
	(0.320)	(0.320)	(0.322)	(0.322)	(0.320)	(0.321)
Average international pair fixed effect	-9.014	-9.011	-9.000	-9.018	-9.005	-8.997
N	60,378	60,378	60,378	60,378	60,378	60,378

FEs = Fixed effects. INTL = Indicator for international trade flow. SPS = Sanitary and phytosanitary measures. R = Region. TBT = Technical barriers to trade. agree_pta = Indicator variable for existence of a preferential trade agreement. N = Number of observations.

Note: All models include partner (exporter)-year and reporter (importer)-year and importer-exporter fixed effects and use a Poisson Pseudo Maximum Likelihood (PPML) estimator. Includes nontariff measure notifications related to Harmonized System codes 020711–14, which cover fresh, chilled, and frozen chicken meat and offal. Each column is labeled with the importer region interaction used. Some regions aggregated from regional groupings in Gurevich and Herman (2018), including Asia-Pacific = Pacific, Central Asia, East Asia, South Asia, and Southeast Asia; Europe-Eurasia = Europe and Eurasia; and Latin America and the Caribbean = the Caribbean, Central America, and South America. Regional groupings for Africa, the Middle East, and North America are maintained from Gurevich and Herman (2018). *=p<0.1, **=p<0.05, ***=p<0.01, with standard errors in parentheses.

Source: USDA, Economic Research Service estimates using data from Trade Data Monitor, World Trade Organization, Integrated Trade Intelligence Portal, and Gurevich, T., and Herman, P., 2018, *The dynamic gravity dataset: 1948–2016*, (Working Paper 2018-02-A), United States International Trade Commission.

In table A.2, we also estimated regional effects for a combined model that captured whether the importing country reported either a poultry NTM initiation or in force notification. The estimates mirrored the initiation notification effects in table 4. There could be several factors that have driven regional differences between initiation and in force notifications sent to the WTO. First, as mentioned above, there is no entry-into-force notification requirement for SPS and TBT measures, although both have become more common over time. However, there may continue to be regional differences in the likelihood of reporting such measures. Second, because an in force notification follows an initiation notification, it may be that producers and consumers have adjusted their behavior based on the initiation notification. Third, it could be that the two types of notifications are used differently. For example, initiation notifications could be used as a type of signaling about a country's trade posture with trading partners.

Conclusions

This report focused on estimating the effects of two main types of nondiscriminatory trade and nontariff measure (NTM) notifications to the World Trade Organization (WTO) on the value of poultry trade. The selected measures included sanitary and phytosanitary (SPS) and technical barriers to trade (TBT) measures when they were applied by importers to all trading partners. Using a gravity model approach combined with data on intra- and international poultry trade, this study estimated the average effect of different nondiscriminatory NTM notifications on global poultry trade and explored regional variation by importer market.

Overall, this report finds that, on average, nondiscriminatory poultry NTM initiations notified to the WTO have a positive effect on the value of international poultry trade relative to domestic poultry trade. It is important to highlight that this finding represents the average effect across all notified NTMs. In other words, these notifications represent many different types of measures, some that may be trade facilitating (e.g., measures harmonizing regulatory standards) and some that may be trade inhibiting (e.g., bans on imports). In aggregate, this finding suggests that the trade facilitation effect dominates, but this may not be the case for any individual NTM or country pair. Furthermore, this effect could be due to NTMs having differential effects on the quantity of poultry traded and the price of poultry. For example, if NTM notifications have a positive effect on the price of poultry and a negative effect on the quantity of poultry traded, then the price effect may outweigh the quantity effect if the price elasticity of import demand is inelastic. However, previous studies have generally found that demand for domestic poultry is inelastic, whereas demand for imported poultry products is elastic (Peterson & Orden, 2005).

This study also found that the effects of WTO notifications appear to vary by importer region. The results suggest that, for importers in the Europe-Eurasia region, nondiscriminatory poultry SPS initiation notifications are associated with a reduced gap between the value of international and domestic poultry trade. However, the corresponding estimate for Europe-Eurasia is insignificant when considering only SPS in force notifications. For importers in other regions, poultry SPS initiation notifications are associated with increases in the international-domestic poultry trade gap relative to the overall average effect. For TBT notifications, this report found that in force WTO notifications by importers in Africa are associated with increases in international poultry trade compared to domestic poultry trade. This supports the idea that the information content in SPS and TBT notifications and measures may be market specific. At the same time, regional heterogeneity could also be driven by market-specific demand and supply elasticities for poultry.

Using new developments in trade policy estimation, this study advances our understanding of nondiscriminatory trade measures as applied to poultry trade. However, we highlight several important caveats of these estimates. First, these estimates are in terms of the value of poultry trade rather than volume. Considering volume measures of poultry meat is difficult due to the measurement and aggregation of different poultry cuts (e.g., whole birds versus wings) across countries and regions. As a result, these estimates should be interpreted as considering price and quantity effects together. Second, this study focused on the effect of different NTM or trade measure notifications to the WTO. This means interpretations of the estimates are limited to the marginal effects of a notification action but not the implementation of the measure itself. Over time, nondiscriminatory NTMs may have different effects on the value of poultry trade as markets adjust to these different trade policies. Third, the estimates presented in this study do not evaluate the effects of specific NTM notifications or measures on individual countries. For example, bans on pathogen-reduction treatments have been shown to restrict the value of U.S. poultry exports to the European Union (Arita et al., 2015). Fourth, using alternate measures of NTM notifications (e.g., specific trade concerns) or intranational trade data may affect these estimates. Finally, this study does not identify the effects of any bilateral NTMs that may be implemented between trading partner pairs.

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Appendix

Table A.1

Gravity model estimates for the effects of nondiscriminatory World Trade Organization nontariff measure notifications on the value of poultry trade

	Gravity controls			Asymmetric FEs		
	(1)	(2)	(3)	(4)	(5)	(6)
	Initiated	In force	Either	Initiated	In force	Either
INTL	-6.753***	-4.660***	-6.873***			
	(0.707)	(0.664)	(0.711)			
SPS_x_INTL	2.621***	1.104***	2.457***	0.553***	0.267***	0.505***
	(0.465)	(0.166)	(0.453)	(0.172)	(0.100)	(0.166)
TBT_x_INTL	0.779***	1.192***	1.114***	0.238***	0.241***	0.315***
	(0.246)	(0.364)	(0.272)	(0.0727)	(0.0613)	(0.0777)
ln_dist	-1.621***	-1.781***	-1.608***			
	(0.254)	(0.270)	(0.252)			
contiguity_x_INTL	1.179***	1.050***	1.181***			
	(0.336)	(0.349)	(0.332)			
colony_ever_x_INTL	-0.676	-0.643	-0.667			
	(0.617)	(0.625)	(0.612)			
common_colonizer_x_INTL	-0.252	-0.318	-0.243			
	(0.403)	(0.422)	(0.396)			
common_language_x_INTL	-0.241	-0.322	-0.228			
	(0.289)	(0.279)	(0.295)			
Average international pair fixed effect				-8.982	-8.700	-8.991
N	195,036	195,036	195,036	60,378	60,378	60,378

FEs = Fixed effects. INTL = Indicator for international trade flow. SPS = Sanitary and phytosanitary measures. TBT = Technical barriers to trade.. ln_dist.= Log value of distance between trading partners. N = Number of observations.

Note: Columns 1–3 include partner (exporter)-year and reporter (importer)-year fixed effects. Columns 4–6 include partner (exporter)-year and reporter (importer)-year and importer-exporter fixed effects. All regressions use a Poisson Pseudo Maximum Likelihood (PPML) estimator. Includes nontariff measure notifications related to Harmonized System codes 020711–14, which cover fresh, chilled, and frozen chicken meat and offal. *=p<0.1, **=p<0.05, ***=p<0.01, with standard errors in parentheses.

Source: USDA, Economic Research Service estimates using data from Trade Data Monitor, World Trade Organization, Integrated Trade Intelligence Portal and Gurevich, T., and Herman, P., 2018, *The dynamic gravity dataset: 1948–2016*, (Working Paper 2018-02-A), United States International Trade Commission.

Table A.2

Gravity model estimates for the regional effects of nondiscriminatory World Trade Organization nontariff measure initiations or in force notifications on the value of poultry trade

	(1) Africa	(2) Asia	(3) Europe-Eurasia	(4) Latin America and the Caribbean	(5) Middle East	(6) North America
SPS_x_INTL	0.501***	0.540***	-0.0239	0.574***	0.502***	0.485***
	(0.167)	(0.183)	(0.129)	(0.187)	(0.179)	(0.165)
SPS_x_INTL_x_R	-1.446***	-0.574***	0.731**	-0.521***	-0.376***	-0.919***
	(0.297)	(0.202)	(0.288)	(0.199)	(0.131)	(0.326)
TBT_x_INTL	0.307***	0.312***	0.403*	0.279***	0.309***	0.309***
	(0.0758)	(0.0778)	(0.211)	(0.0702)	(0.0764)	(0.0759)
TBT_x_INTL_x_R	0.272	-0.251	-0.130	0.351	-0.242**	0.279
	(0.266)	(0.345)	(0.227)	(0.355)	(0.115)	(0.288)
agree_pta_x_INTL	0.704**	0.696**	0.711**	0.700**	0.704**	0.700**
	(0.313)	(0.315)	(0.315)	(0.315)	(0.313)	(0.311)
Average international pair fixed effect	-9.254	-9.221	-9.245	-9.263	-9.248	-9.213
N	60,378	60,378	60,378	60,378	60,378	60,378

FEs = Fixed effects. INTL = Indicator for international trade flow. SPS = Sanitary and phytosanitary measures. R = Region. TBT = Technical barriers to trade. agree_pta = Indicator variable for existence of a preferential trade agreement. N = Number of observations.

Note: All models include partner (exporter)-year and reporter (importer)-year and importer-exporter fixed effects and use a Poisson Pseudo Maximum Likelihood (PPML) estimator. Includes nontariff measure notifications related to Harmonized System codes 020711–14, which cover fresh, chilled, and frozen chicken meat and offal. Each column is labeled with the importer region interaction used. Some regions aggregated from regional groupings in Gurevich and Herman (2018), including Asia-Pacific = Pacific, Central Asia, East Asia, South Asia, and Southeast Asia; Europe-Eurasia = Europe and Eurasia; and Latin America and the Caribbean = the Caribbean, Central America, and South America. Regional groupings for Africa, the Middle East, and North America are maintained from Gurevich and Herman (2018). *=p<0.1, **=p<0.05, ***=p<0.01, with standard errors in parentheses.

Source: USDA, Economic Research Service estimates using data from Trade Data Monitor, World Trade Organization, Integrated Trade Intelligence Portal, and Gurevich, T., and Herman, P., 2018, *The dynamic gravity dataset: 1948–2016,* (Working Paper 2018-02-A), United States International Trade Commission.

Table A.3
Countries included in panel data specification

Africa	Asia-Pacific	Europe-Eurasia	Latin America and the Caribbean	Middle East	North America
Algeria	Australia	Albania	Antigua and Barbuda	Afghanistan	Canada
Angola	Bangladesh-Burma	Andorra	Argentina	Bahrain	Greenland
Benin	Bhutan	Armenia	Bahamas	Iran	Mexico
Botswana	Brunei Darussalam	Austria	Barbados	Iraq	Saint Pierre and Miquelon
Burkina Faso	Cambodia	Azerbaijan	Belize	Israel	United States
Burundi	China	Belarus	Bermuda	Jordan	
Cabo Verde	Cook Islands	Belgium	Bolivia	Kuwait	
Cameroon	Fiji	Bosnia and Herzegovina	Brazil	Lebanon	
Congo (Democratic Republic of the Congo)	Hong Kong	Bulgaria	British Virgin Islands	Oman	
Congo (Republic of Congo)	India	Croatia	Cayman Islands	Qatar	
Cote d'Ivoire	Indonesia	Cyprus	Chile	Saudi Arabia	
Egypt	Japan	Czech Republic	Colombia	Syria	
Eritrea	Kyrgyzstan	Denmark	Costa Rica	United Arab Emirates	
Eswatini	Laos	Estonia	Cuba	Yemen	
Ethiopia	Malaysia	Faroe Islands	Dominican Republic		
Gabon	Marshall Islands	Finland	Ecuador		
Gambia		France	El Salvador		
Ghana	Nauru	Georgia	Grenada		
Guinea	Nepal	Germany	Guatemala		
Guinea-Bissau	New Caledonia	Gibraltar	Guyana		
Kenya	New Zealand	Greece	Haiti		
Lesotho	North Korea	Hungary	Honduras		
Liberia	Pakistan	Iceland	Jamaica		
Libya	Philippines	Ireland	Nicaragua		
Madagascar	Singapore	Italy	Panama		
Malawi	South Korea	Kazakhstan	Paraguay		
Mali	Sri Lanka	Latvia	Peru		
Mauritius	Taiwan	Liechtenstein	Saint Lucia		
Mayotte	Tajikistan	Lithuania	Saint Vincent and the Grenadines		
Morocco	Thailand	Luxembourg	Suriname		
Mozambique	Turkmenistan	Malta	Trinidad and Tobago		
Namibia	Uzbekistan	Moldova	Turks and Caicos Islands		

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Africa	Asia-Pacific	Europe-Eurasia	Latin America and the Caribbean	Middle East	North America
Niger	Vietnam	Monaco	Uruguay		
Nigeria		Montenegro	Venezuela		
Reunion		Netherlands			
Rwanda		North Macedonia			
Sao Tome and Principe		Norway			
Senegal		Poland			
Sierra Leone		Portugal			
South Africa		Romania			
South Sudan		Russia			
Tanzania		Serbia			
Togo		Slovakia			
Tunisia		Slovenia			
Uganda		Spain			
Zambia		Sweden			
Zimbabwe		Switzerland			
		Turkey			
		Ukraine			
		United Kingdom			

Note: Some regions aggregated from regional groupings in Gurevich and Herman (2018), including Asia-Pacific = Pacific, Central Asia, East Asia, South Asia, and Southeast Asia; Europe-Eurasia = Europe and Eurasia; and Latin America and the Caribbean = the Caribbean, Central America, and South America. Regional groupings for Africa, the Middle East, and North America are maintained from Gurevich and Herman (2018).

Source: USDA, Economic Research Service using Gurevich, T., and Herman, P, 2018, *The dynamic gravity dataset: 1948–2016*, (Working Paper 2018-02-A), United States International Trade Commission.