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The Effect of Free Trade Agreements on the Intensive and Extensive Margins of Canadian Agri-Food Trade

Brendan McDougall *and Sylvanus Kwaku Afesorgbor †

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Abstract

We add to the empirical trade literature by testing the impacts of Canada's Free Trade Agreements (FTAs) on the intensive and extensive margins of agri-food trade. The agri-food sector is an important to the Canadian economy and export markets continue to be a source of growth. FTAs are designed to reduce trade barriers and increase trade amongst member nations. We use an augmented gravity model with disaggregated trade data from the UN Comtrade Database spanning from 1988-2018 to conduct our analysis. Our study observes trade stimulating effects for 11 of Canada's 14 FTAs. On the trade creating effect, we find that FTAs have heterogeneous impact on both the intensive and extensive margins. Agreements that reduce variable trade costs (such as tariffs) are not reduced to competitive levels have a negative intensive margin effect. Our study also concludes that time is a key indicator of trade growth along the extensive margin.

JEL: F21, F60, Q56

Keywords: Agri-food trade, extensive margins, intensive margins, gravity model, Canada

*Agriculture and Agri-Food Canada, Ottawa, Canada.

†Department of Food, Agricultural and Resource Economics, University of Guelph, Canada. Email: safesorg@uoguelph.ca We thank Rarkhal Sarke, Getu Hailu and all participants in the conference in Ottawa fro their useful comments. We are grateful to OMAFRA funding this project. The usual disclaimer applies.

1 Introduction

Free Trade Agreements (FTAs) continue to be an important part of the global trade systems as many countries use them to avoid the protectionist policies that hinder international trade. FTAs are particularly relevant for the agri-food sector as the sector faces higher trade barriers and is much more restricted in both developing and developed countries compared to manufactured products (Hoekman and Nicita, 2011). The degree to which FTAs stimulate agri-food trade has been well researched in studies such as Grant and Lambert (2008); Ghazalian (2017); Jayasinghe and Sarker (2008); Bureau and Jean (2013). On average FTAs are noted as trade creating according to Baier and Bergstrand (2007). Thus, it is not surprising we have seen substantial increase in the number of countries signing FTAs. Canada has also been involved in a number of FTAs. Canada's FTAs vary in terms of size, scope and enforcement date. FTAs vary in their ability to stimulate trade, both in terms of volume and variety. Heterogeneity in FTAs can be seen along the intensive (changes in volume or trade in previously traded goods) and the extensive margin (changes in variety or trade in new product categories).

Canada, being a small consuming economy with large agriculture production relies on exports to stimulate growth. FTAs lower risks and trade costs and thus helping Canadian exporters increase agri-food trade. Canada has, in force, 14 trade agreements and several more in negotiations as indicated in Figure 1. Although the conventional gravity model analysis using aggregate trade can identify agreements that reduce trade costs and stimulate trade. However this analysis cannot identify the different types of trade costs, be it fixed vs. variable. Agricultural exporters face tariff costs that vary with the number of units traded and regulatory/compliance costs that must be paid regardless of the number of units shipped. By breaking down aggregate trade data into intensive margin (IM) (trade in previously traded goods) and extensive margin (EM) (trade in newly traded goods) margins, we can better understand the types of costs that are being reduced as a result of the implementation of an FTA.

[Insert Figure 1 here]

FTA trade simulating effects are therefore dependent on how firms perceive risk, manage costs and find new consumers. Firms chose to export different products to different markets based on their production costs and elasticity of substitution of those products (Melitz, 2003; Chaney, 2008). Researchers such as Hummels and Klenow (2005) and Scoppola et al. (2018) decompose aggregate trade flows into intensive and extensive margins of trade. Evaluating the intensive and extensive margins provides information about the nature of trade growth and how firms perceive risk, opportunity and costs in a more coherent

way than aggregate data (Kehoe and Ruhl, 2013).

Evaluation of intensive and extensive margins has been employed in more modern trade papers to supplement analysis of aggregate trade data (Kehoe and Ruhl, 2013; Baier et al., 2014, 2019). Sub-sector analysis of agri-food trade has also been researched (Scoppola et al., 2018; Bureau and Jean, 2013; Grant and Boys, 2011; Hejazi et al., 2016). These papers have looked at FTA effects, intensive and extensive margin as well as agri-food trade and broader Canadian trade. However, to our knowledge, combining these research areas has not been completed. The Canadian agri-food sector accounted for 111.9 billion CAD in the Canadian economy, or 6.7% of GDP. [1] In 2016, agri-food exports provided 56 billion CAD to the Canadian economy. This is a gap in the literature that has significant ramifications for the Canadian agri-food export sector. Studying the impact of FTAs on the intensive and extensive margins of Canadian agri-food trade is an understudied area of the literature we address in this thesis.

FTAs are designed to lower barriers to trade which act as an additional cost to agri-food exporters (Ghazalian, 2017). Barriers can include tariffs and Tariff Rate Quotas (TRQs) which depend on the number of units shipped. Rules of origin, safeguards, regulatory compliance, Sanitary and Phyto-Sanitary (SPS) standards are fixed compliance costs and remain constant regardless of the number of units shipped. Firms must incur the cost of compliance before any units can be shipped Gallezot and Bureau (2004) describe these types of trade costs as the "cost of compliance." Other barriers can also include shipping costs and search or informational costs, which again firms incur before they ship any units.

Trade barriers and costs can be broken down into two general categories: variable and fixed. Variable costs are dependent on the number of units traded while fixed costs are incurred by firms regardless of trade volume. Analysis of aggregate trade cannot differentiate between these types of trade costs. Breaking aggregate trade into components that measure changes in volume and variety of products, intensive and extensive margins, can provide insight into what types of barriers, variable or fixed, have been reduced (or continue to exist) as a result of a FTA.

An example of this is the the recent Comprehensive Economic and Trade Agreement (CETA) between Canada and the European Union (EU). Under CETA, Canadian exporters now have an advantage over competitors in countries that do not have an FTA with the EU. [2] However, two years into the agreement, Canadian meat farmers (hogs and beef) have not seen the access they were promised. Mechanisms within CETA were supposed to prevent non-tariff barriers from stifling trade and ensure that parties abide by

[1] Overview of the Canadian Agriculture and Agri-Food System, 2017

[2] Quote can be found on Government of Canada website at URL: https://www.international.gc.ca/gac-amc/campaign-campagne/ceta-aecg/key_sectors-secteurs_cles.aspx?lang=eng

their commitment. Instead, with non-tariff barriers still in place, viable commercial access remains elusive.[3] Although there has been reduction in one form of trade cost, tariffs, the regulatory burden to Canadian exporters remains high. Through the intensive and extensive margin analysis in this thesis tease out these different trade costs in Canada's FTAs. [4]

Baier et al. (2019) emphasize the importance of studying heterogeneity amongst different FTAs. FTAs tend to vary in the quantity and quality of barrier reduction and thus their ability to stimulate trade. Agreement heterogeneity cannot be captured in the average FTA effect, such as those studied in Bureau and Jean (2013) and Baier and Bergstrand (2007). Increased knowledge of successes in past agreements can help improve the quality and trade stimulating ability of future agreements.

Upon completion of the Uruguay Round Agreement on Agriculture (URAA), agriculture and agri-food continue to have some of the highest barriers to trade in the world (Bureau et al., 2019). FTAs remain an effective way to reduce non-tariff barriers such as food safety regulations and technical standards, while promoting deeper integration (Grant and Lambert, 2008). With Canada being in negotiations and revisions of past and new agreements, policy makers need to know how these FTAs effect trade. By evaluating FTA effects along the intensive and extensive margins, researchers gain a more in-depth understanding of barrier reduction and provide valuable information to policy makers.

There is no study to our knowledge that attempts to investigate the Canada's FTA impacts on the intensive and extensive margins of agri-food trade. Close to the evaluating the impact of FTAs on Canadian trade are papers such as Sarker and Jayasinghe (2007), Ghazalian (2017), Ghazalian (2019). Sarker and Jayasinghe (2007) focus on different product categories within North American Free Trade Agreement (NAFTA) and (or) Canada United States Free Trade Agreement (CUSFTA). Their results also suggest that there has been a sustained increase in red meat, vegetables, grains, fruits, and sugar trade, however there is heterogeneous response between the different products. This could be due to differences in trade costs between products, similar to theory proposed in (Melitz, 2003) or differences in consumers elasticity of substitution in (Chaney, 2008). The differences in these products suggests that FTA impacts can have differing effects on products and agreements, both based on trade costs and preferences. Ghazalian (2019) conclude that Canadian beef exports expand significantly when tariff reductions are coupled with NTB reductions. Significant amount a heterogeneity exists between different export destination both in terms of tariff and NTBs border effects. For example, markets in the EU-15 and Switzerland have higher tariff and NTB measures for Canadian beef than countries in the NAFTA

[3] Canadian Agri-food Trade Alliance at URL: http://cafta.org/wp-content/uploads/2019/09/News-Release-CETA-2-years-later.pdf

[4] Analysis on the CETA agreement is not be conducted in this thesis as the agreement is too recent and insufficient data exists

bloc. This underlines the heterogeneity of trade restricting measures between partners and agreements (Baier et al., 2018).

Our paper makes contribution to the empirical FTA-trade literature different from the previous empirical papers in three specific ways. First, the focus on how FTAs impact agri-food trade along the intensive and extensive margins makes our different from Sarker and Jayasinghe (2007), Jayasinghe and Sarker (2008), Ghazalian (2017) and Ghazalian (2019) who also focused on Canadian FTAs. Additional information about the nature of costs derived from the analysis of intensive and extensive margins (Scoppola et al., 2018; Raimondi et al., 2019), help identify whether or not the FTAs are more effective in reducing fixed or variables (or both) trade costs. A similar study that also focuses on how FTAs affect agri-food trade along the extensive and intensive margins is Scoppola et al. (2018), however, their main focus was on the EU trade preferences granted developing countries. These trade preferences differ in term of their non-reciprocal nature compared to the reciprocal trade preferences between Canada and the rest of the world which is the focus of this paper.

Second, most of the previous empirical studies did not consider the heterogeneity of the FTAs especially for Canada as it has about 14 different FTAs with different countries. Table 1 indicates the different FTAs that Canada has over the period and the specific dates on which the agreements were signed. More specifically, studies such as Sarker and Jayasinghe (2007), Jayasinghe and Sarker (2008), Ghazalian (2017) and Ghazalian (2019) focused only NAFTA and (or) CUSFTA. Baier et al. (2019) emphasize that FTAs may have heterogeneous impact in promoting trade as they may differ in terms of objective, scope, coverage and the depth of economic integration. Thus, focusing on the different FTAs that Canada has signed provides the additional dimension to compare how other these FTAs compared with NAFTA in promoting Canadian exports. Especially, this may also form the basis to compare FTA with more developed economies compared with developing or emerging economies. In particular, for Canada and agri-food trade, Ghazalian (2019) finds that NTBs are significantly higher for Canadian beef in other countries compared to NAFTA countries.

2 Theoretical considerations

A contribution of this paper is to use theory from Melitz (2003) and Chaney (2008) to determine some of the trade costs (fixed and variable) encountered by Canadian agri-food exporters in different FTAs. Scoppola et al. (2018), Hejazi et al. (2018) and **?** test the relative size of trade cost reduction, for

example, a 10% tariff reduction. We do not do this type of analysis in our study. We evaluate the FTAs ability to lower different trade costs through empirical analysis of intensive and extensive margin and intuition drawn from theory. This chapter provides the theoretical underpinnings to why we may have heterogeneity across Canada's FTAs.[5].

Variable trade costs are incurred as the firm sells more units and are dependent on the number of units sold. An example would be a standard tariff. Reduction of a tariff increases the producers profitability of each good produced. Fixed costs are not dependent on output and must be paid regardless of the number of units sold. It is the compliance cost discussed in Gallezot and Bureau (2004) which are fixed regardless of the number of units exported. As discussed above, trade costs remain particularly high in agriculture (Grant and Boys, 2011; Jayasinghe and Sarker, 2008).

Following the intuition outlined in Scoppola et al. (2018) and Kehoe and Ruhl (2013), we can derive the following theoretical backing for our hypothesis tests. Extensive margins are primarily impacted by fixed trade costs such as NTB (Non-Tariff Barriers) and NTM (Non-Tariff Measures). NTBs and NTMs are generally associated fixed costs to trade. Intensive margins are primary impacted by variable trade costs such as tariffs and TRQs[6].

Lower variable costs refer to the cost associated with exporting each subsequent unit of output. Theory dictates that intensive margins are driven by variable costs when products have a low level of differentiation (Melitz, 2003) and (Chaney, 2008). This theory was reiterated and tested empirically in Scoppola et al. (2018). Melitz (2003) and Chaney (2008) dictate that lower trade costs can allow firms to cross their "profitability threshold" increasing the extensive margin. This is due to firm cost heterogeneity.

Based on our analytical framework, we can determine that countries who experienced negative coefficients for intensive margin likely did have lower variable costs as a result of the FTA. We searched for evidence of this within the FTAs themselves by searching the Government of Canada's 'Tariff Finder' tool. Table shows tariff rates to export into select FTA partner nations for select HS06 products. These HS06 codes were arbitrarily selected to represent the different product categories displayed in Table . We have selected 3 countries which our analysis determined had general negative intensive margin effects. These countries were Israel, Peru and Norway (an arbitrarily selected EFTA member). We display the MFN tariff rate which is the rate applied to all WTO member country as well as those applied to Canada. All

[5]Heterogeneity in FTAs effects is anticipated. This is due the consensus in past literature (Baier et al., 2018; Bureau and Jean, 2013; **?**)

[6]Extensive margins can also be impacted by reduction in fixed trade costs. However cost coefficients are sensitive to elasticity of substitution for different products. We do not differentiate between product substitutability for these products in our analytical framework.

the rates are for exports in 2017.

Bureau et al. (2019) contend that applied agricultural MFN Tariff rates are higher (or equal) to preferential tariff rates generated by FTAs. However, our research finds instances in which Canada's so called preferred tariff rate from an FTA is not lower than the Applied MFN rate applied to all WTO members. This means that the FTA does not give Canada a comparative advantage (at least in terms of tariffs) against any WTO members into these partner markets. The result is a lower intensive margin, as Canada is less competitive compared to its global partners. If the conclusion we are drawing here is true, product categories that have Canada has a comparative advantage in would have a positive (or zero) intensive margin effect.

In our research we find that there are some Canadian FTA partners who do not have notably different MFN and preferred tariff rates. We examine a select group of agri-food product categories (meat, dairy, fruits and vegetables, grains, oil seeds, sugars, alcohol and processed foods) and display there product specific rates, both MFN and preferred. These are shown in Table . Contrast this with the rates that are clearly preferential in Table . Agreements with similar rates include Israel, Peru and EFTA. We anticipate these countries have a negative intensive margin effect. Mexico (NAFTA), Colombia and Honduras have preferred rates and we anticipate them having a positive intensive margin effect.

While theory tells us that lower variable costs lead to higher intensive margins, fixed costs tend to affect the extensive margin (Melitz, 2003), (Chaney, 2008)). When entering a foreign market, firms must decide if they are going to comply with the regulatory and administration costs associated with entering that market regardless of the number of units sold. This makes these costs fixed. When fixed costs are high, firms cannot export new product categories, having a negative effect on extensive margins. If an FTA lowers fixed costs through standard harmonization and economic integration, more firms can enter the foreign market creating a positive impact on extensive margins (Scoppola et al., 2018).

There are many fixed costs associated with agri-food trade. Sanitary and Phytosanitary (SPS) measures refer to protection of domestic consumers from food that is deemed 'unsafe' for consumption. The WTO set basic standards for SPS measures in its 'Agreement on the Application of Sanitary and Phytosanitary Measures' [7]. However differences in regulatory regimes with respect to SPS can act as a trade barrier. A fixed trade cost like SPS measures can reduce the number of exporting firms and the extensive margin (Hejazi et al., 2018; **?**). FTAs which harmonize (or work to harmonize) SPS measures, theory tells us, has a positive impact on extensive margins.

[7] Find more information on the WTO and SPS at the following URL: *https://www.wto.org/english/tratop_e/sps_e/spsund_e.htm*

Another potential fixed cost trade barrier is technical barriers. Technical Barriers to trade refer to technical regulations, standards, and conformity assessment procedures that have the potential to create unnecessary obstacles to trade through higher trade costs.[8] Technical Barrier issues in Canadian agriculture include Pesticide and veterinary drug maximum residues limits, Agricultural biotechnology, Low-Level Presence (LLP)[9] regulations. Technical barriers can be difficult to identify and remove because of their inherently political nature. FTAs that successfully remove (or work to remove) Technical Barriers to trade lower firms' fixed export costs. This lowering of fixed costs also has a positive impact on the extensive margin.

We have done some basic descriptive analysis of the contents of Canada's different FTAs. This will lend insight into FTAs' ability to lower fixed trade costs like those discussed above. Table include an entry if there is a specific passage in the FTA to address the barrier. The table displays the part of the FTA that is being referenced. "SPS" column included an entry if the FTA contains a chapter that specifically discusses methods to address SPS measures. "Technical Barriers" column is filled if the FTA contains a chapter that specifically discusses methods to address Technical Barriers to trade. "Special Committee or Cooperation" names the chapter that discusses a working committee or coordination plan in place to work on addressing technical and or regulatory barriers. To be included in this column the FTA must state a commitment to "cooperation" to reduce regulatory, technical and other unaddressed barriers to trade. Exception column is includes any part of the FTA where agri-food products are exempt from trade stimulating policies outlined in the FTA.

Based on theory, if the intensive margin rises as the result of a FTA, then we know that variable costs to trade have been reduced. Firms now export more units of existing product categories. If extensive margins rise as a result of the an FTA, then we can say that either fixed costs or variable costs have been reduced. Reduction in fixed costs such as start-up infrastructure, search costs, SPS and other NTB, make it easier for firms to enter new markets in different product categories. Reduction in variable cost can also drive firms to export into new product segments as they reach their threshold profitability. This is due to the heterogeneity in firm cost structure described in Chaney (2008)

[Insert Figure 2 here]

[Insert Figure 3 here]

[8] Find more information on technical trade issues in agriculture at the following URL: *http://www.agr.gc.ca/eng/international-trade-of-agri-food-products/agri-food-trade-issues/technical-trade-issues-in-agriculture/?id=1384285632268*

[9] LLP refers to very low acceptable levels of contamination in an agriculture product. For example, what is an acceptable rate of GMO contaminated soybeans in the container of IP (Identity Preserved) soybeans?

Anecdotal evidence on the evolution of the extensive and intensive margins are provided in the Figures 2 and 3. The blue lines represent the average margins for FTA partners over the duration of the study while the red line represents all other countries which Canada has no FTAs with. FTAs tend to increase the extensive margin over time. The longer the FTA is in effect, the larger the extensive margin. This is consistent with empirical results from Baier et al. (2014) who argue that the majority of trade growth over time is felt in the extensive margin. On the their basis of this, we test the hypotheses that Canadian FTAs have positive effects on both the intensive and extensive margins of agri-food exports.

3 Empirical Strategy

3.1 Data

Data for this project was collected through the United Nation's Comtrade Database. The trade data is reported for 1,227 product categories. These product categories are defined using the Harmonized System (HS) Code Commodity Classification system and are disaggregated HS-06 level. They include raw commodity categories such as corn and soybeans as well as processed categories such as frozen beef cuts. Export trade flows are as reported by the importing country. The data ranges from 1988 to 2018 [10]. In order to calculate the intensive and extensive margin for each category, we need to know what the import value from the "rest of the world" (ROW) for each category. Further explanation is offered in the margin decomposition section.

In addition to the aggregate trade data, we also include gravity variable data. Gravity model variables such as distance, colonial ties etc. were compiled by the Centre d'Etudes Prospectives et d'Informations Internationale (CEPII). Other economic gravity model indicators such as GDP, population and GDP per capita were complied through the World Bank's online database. Our variable of interested is the different Canadian FTA effects. FTA enforcement data was compiled by using Mario Larch's Regional Trade Agreements Database" with reference to Egger and Larch (2008). This database includes all multilateral and bilateral trade agreements as notified to the World Trade Organization for the last 68 years from 1950 to 2017.

[10] All countries did not report data in all categories, in all years. Therefore, there are fewer reporting countries in 1988 than in 2017 due to countries voluntarily reporting. The number of reporters for each year can be seen in Table **??** in Appendix **??**. The data represents export trade with Canada reported by Canadian trade partners.[11] Only Canada's trade flows that were reported by their trade partner can used in this analysis. For example, if Canada reports exporting corn to Afghanistan in 1991, this observation would only be included if Afghanistan also reported its Canadian and world imports.

Comtrade data sets only report for product categories that have been traded. This means that there are no zero flow entries. As part of our data cleaning process, we add zero trade flow observations for years in which country-pairs report positive trade values in other years, otherwise we treat the county-product-year observations as missing observations. For example, if country j reports in year 1999 a positive trade value but not in 1998, we will generate zero trade flows for Canada and country j in year 1998.

3.2 Gravity model

The paper employs the gravity model according to Anderson and Van Wincoop (2003). The gravity model has dominated international trade literature as the main econometric approach for evaluating the ex-post effect of FTAs (Baier et al., 2014). In addition, it has become the conventional framework for analyzing the determinants of trade flow. It assumes that the trade flow between two countries is determined by supply potential (exporter GDP), market demand potential (importer GDP) and trade cost. One main advantage of the gravity model is that it delivers a tractable framework for trade policy analysis in a multi-country environment (Yotov et al., 2016). For instance, it helps to explain the variation in country pairs; trade flows in terms of the country's income, bilateral distance, and the presence of common language, common border, and FTAs (Baier and Bergstrand, 2007).

$$X_{ijt} = \frac{Y_i Y_j}{T_{ij}} \tag{1}$$

The specification of the gravity model started with the naive specification as in Equation 1, where X_{ijt} indicates trade between countries i and j. Y_i and Y_j represent country i and j's GDP respectively, T_{ij} represent the trade cost between the two countries. The trade cost is captured by a vector of variables including distance, the presence of border, colonial ties and common language while the trade policy variables include tariffs, the presence of FTAs and common currency, and whether both countries are members of WTO Estimation of this model using OLS requires conversion into a log linear form such as in Equation 3.

$$\ln X_{ijt} = \beta_0 + \beta_1 \ln Y_i + \beta_2 \ln Y_j + \beta_3 \ln T_{ij} + \epsilon_{ij} \tag{2}$$

The traditional gravity equation has evolved from only augmenting the determinants of trade with

bilateral accessibility variables, but also accounting for the relative position of the exporter and importer to the rest of the world, known as multilateral resistance terms (MRTs) in accordance with Anderson and Van Wincoop (2003). The MRTs are specific to the exporter and importer as specified in Equation 3. Econometrically, the MRTs are unobserved and thus we follow the Baier and Bergstrand (2007) by using; the time (α_t)), country ($\alpha_{i(j)}$) and dyadic fixed effects (α_{ij}) .

$$\ln X_{ijt} = \beta_0 + \beta_1 \ln Y_i + \beta_2 \ln Y_j + \beta_3 \ln T_{ij} + \alpha_{ij} + \alpha_i + \alpha_j + \alpha_t + \epsilon_{ij} \tag{3}$$

3.3 Hummels and Klenow (HK) Decomposition

Following the theory of the Hummels and Klenow (2005), we also decompose agri-food trade flow (X_{ij}) into intensive and extensive margins as indicated in Equations 4 and 5. Baier et al. (2014) indicate that trade cost affects bilateral trade flow between countries via both intensive and extensive margin. They also confirm that HK approach is the only tractable method for decomposing transparently the extensive and intensive margins of trade for a large set of countries.

$$EM_{ijt} = \frac{\sum_{m \epsilon M ijt} X^m_{wjt}}{\sum_{m \epsilon M wjt} X^m_{wjt}} \tag{4}$$

According to Hummels and Klenow (2005), extensive margin (EM) is a measure of the variety of products traded. It increases if the importing countries imports a larger set of products from the exporting country. Extensive margin can equal one if the importing country imports the same number of HS06 product categories in a given HS02 segment from Canada as it does from the ROW. Empirically, the EM measures the fraction of all products that are exported from Canada to a trading partner in a specific year weighted by the importance of that product relative to world exports to the trading partner as Equation 4.

$$IM_{ijt} = \frac{\sum_{m \epsilon M ijt} X^m_{ijt}}{\sum_{m \epsilon M ijt} X^m_{wjt}} \tag{5}$$

Similarly, the intensive margin (IM) represents trade in previously traded products. This is computed by measuring the market share of Canada's exports of specific product relative the rest of the world as in Equation 5. IM represents trade in previously traded products. IM increases as country exports levels grow as a percent of the importing countries trade in that product category. Intensive margin grows if it exports more of the product set that it previously exported. Although trade may be growing in a given product category, positive intensive margin effects will only be felt if exports are growing faster than

total imports from the world.

$$EM_{ijt} * IM_{ijt} = \frac{\sum_{m \epsilon Mijt} X^m_{ijt}}{\sum_{m \epsilon Mwjt} X^m_{wjt}} = \frac{X^m_{ijt}}{X^m_{wjt}} \tag{6}$$

Variables i and j are exporting and importing countries respectively while w is the world. m represents positively traded product categories (disaggregated on the HS06 level) that are included in subset $Mijt$ or $Mwjt$. $Mijt$ is a set of products sent from i to j while $Mwjt$ is a set of products imported by j from the world w. X^m represent export values (USD) of product category m. X^m_{ijt} is export value of product category m sent from i to j while X^m_{wjt} is the world exports of product category m to country j. By the definition of Hummels and Klenow (2005), the product of the intensive and extensive margins is equal to the percent of country i exports as a percent of the world to country j as indicated by Equation 6.

In the estimation of the aforementioned models, we resort use empirical tool of OLS, fixed effect (FE) and Poisson-Pseudo Maximum Likelihood (PPML) estimators. We use the OLS as the our baseline estimation in order to able to find out if our coefficients of the time-invariant variables such as distance, border, common language are plausible and consistent. We also use the FE estimators to control for time invariant heterogeneity in order to minimize any endogeneity resulting from omitted variable bias.

In the estimation of the gravity model, one main econometric concern has been the presence of zero flows. That is, when trade values between countries are too small such that they are rounded-up to zero or the countries do not actually trade among themselves for various reasons. Theoretically, zero flows may be due to existence of a fixed export cost and firm heterogeneity in productivity (Baier et al., 2014) . The problem of zeros is endemic when one is using trade flows at a higher level of disaggregation. This problem introduces a selection bias due to double logarithmic transformation of gravity model. Mathematically, the log of zero is undefined and thus the observations with zero trade values are automatically omitted. Thus, in a typical gravity model estimation, there is a self-selection of only countries that have positive trade values. Thus, following Silva and Tenreyro (2006), we estimate the gravity model in the presence of zero flows by estimating the gravity model where trade flow is measured at level, rather than using the logarithmic function.

4 Results and Discussions

Table 3 shows the average FTA effects for using OLS and PPML with FE. The average trade effect from FTA is positive for trade, IM and EM using OLS estimation. However, it differs in the PPML with FE estimation. Overall, under the OLS estimations, we find that Canadian FTA has positive and statistically significant. The coefficient of 0.595 indicates that all thing being equal, a Canadian FTA increases agri-food export by 62% ($e^{0.0595} - 1$). Breaking the effect into the margins, we find a positive effects of FTA for both the IM and EM under OLS.

[Insert Table 3 here]

Compared to PPML estimation,under which we control for both zero flows and fixed effects, a Canadian FTA has a positive effect for trade, but the effect is insignificant. Decomposing the trade effect into margins shows that a Canadian FTA has a positive and significant effect on EM in contrast to a negative and significant effect on the IM.

Turning to our control variables, our baseline (OLS) results indicate the standard gravity model variables such as income, population, common language, border, WTO have positive associations with export while trade discouraging variable like distance is negative. Although the results estimated in the OLS do not control for several econometric concerns, they are still consistent with theory and other comparable studies. Taking the border effect for example, indicates a large magnitude of 2.013. This is plausible as Canada's largest trading partner and only contiguous partner is the US which accounts for over 50% of Canada's agri-food exports.

[Insert Table 4 here]

The discrepancy when looking at effect of all FTA on IM and EM emphasizes the need to differentiate between FTAs. Thus, we evaluate each of Canada's FTAs separately in Table 4 in order to account for the heterogeniety in these FTAs. This results confirm the assertion of Baier et al. (2018) that FTAs have heterogeneous effects for trade, intensive and extensive margins as expected. NAFTA, Canada-Costa Rica, Canada-Israel, and Canada-Peru agreements are trade creating. The relative increases in exports are 67% for NAFTA, 59% for Canada-Costa Rica , 220% for Canada-Israel, and 62% for Canada-Peru. These results are largely consistent with Baier et al. (2019)'s analysis of aggregated trade. Baier et al.

(2019) find an increase of 94% for NAFTA, 63% for Canada-Costa Rica, 62% for Canada-Israel while Canada-Peru was not studied. These differences may be driven by the types of products studied. While our thesis focuses on agri-food products on an HS02 aggregation level, Baier et al. (2019) estimate all trade at the country level. Costa Rica, Mexico and USA are large agri-food producers compared to Israel. Isreal is more reliant on imports to supply its agri-food sector than Costa Rica, Mexico and USA. This could explain the discrepancy between our results and Baier et al. (2019).

Canada-Jordan, Canada-Chile, Canada-Colombia, Canada-Panama, Canada-Honduras, and Canada-Korea (South) have no significant trade creating effects. Baier et al. (2019) also find no significant result for Canada-Chile. Canada-EFTA agreement and coefficients actually have trade reducing effects, though this effect is only significant at a 10%. The implication is that a result of the implementation of an FTA, agri-food trade between the two countries had been reduced by 17% driven largely by reductions in the intensive margin.[12]. It is worth noting that Baier et al. (2019) also found several FTAs which estimating negative trade growth.

Extensive margins, whose effects are seen in column 3 of Table 4, are positively affected by most FTAs. Canada-Costa Rica, Canada-Israel, Canada-Chile, Canada-Honduras and Canada-Jordan agreements all have positive extensive margin effects. These partners saw an increase in the number of new import product categories. Categories increased 31% for Canada-Costa Rica, 246% for Canada-Israel, 44% for Canada-Chile, 59% for Canada-Honduras and 16% for Canada-Jordan. This relatively large number for Israel may be explained by the size of their economy and their desire for a large variety of agri-food products. NAFTA, EFTA and Canada-Panama, Canada-Colombia, Canada-Peru and Canada-Korea had no statistically significant effect. Agri-food was highly integrated in North America prior to the NAFTA agreement. This, accompanied with the CUSFTA (CanadaUS FTA) from 1987 may explain the high level of integration that existed prior to our study make it difficult to expand product variety and extensive margin.

Intensive margin effects also varied across agreements. Positive intensive margins were observed in NAFTA and Canada-Honduras. The increase in these agreements are 33% and 227% respectively. Canada-Costa Rica, Canada-Jordan, Canada-Panama and Canada-Colombia had no statistically significant intensive margin effect. Perhaps more interestingly, many agreements actually had negative intensive margin coefficients. Canada-Israel, Canada-EFTA, Canada-Chile, Canada-Peru and Canada-Korea all had negative intensive margin coefficient. Decrease in intensity of trade of previously traded goods were estimated to be 55% for Canada-Israel, 24% for Canada-EFTA, 45% for Canada-Chile, 23%

[12] Although the EFTA negative effect is not plausible, Baier et al. (2019) also similarly found that some FTAs can possibly have a negative effect.

for Canada-Peru and 38% for Canada-Korea.

Based on the Hummels and Klenow (2005) definition of intensive margin used to make these calculations, a lower intensive margin does not necessarily mean lower trade. Increasing exports from origin i and increasing exports from other origins w can create a lower intensive margin if exports from other countries are greater. In other words, $\sum_{m \epsilon Mijt} X^m_{ijt}$ may grow as a result of an FTA, however it is not larger than $\sum_{m \epsilon Mijt} X^m_{wjt}$, the effect will be negative. This may explain a positive trade effect coupled with a negative intensive margin. Alternatively, a reduction in the intensive margin can be dominated by increases in the extensive margin. In the case of Canada-Peru, it is possible given the definition of intensive margin to increase trade while decreasing the intensive margin. Although Canada may be exporting more goods to Peru as a result of its FTA, the USA (who also has an FTA with Peru) may be exporting more as a percent of Peru's total imports. This provides us with the result of a negative intensive margin and positive trade growth.

[Insert Table 4 here]

We also evaluate NAFTA effects for the USA and Mexico. Canada and the USA had signed the CUSFTA (Canadian US Free Trade Agreement) in 1989 and it served as the precursor to NAFTA. The result for different within the NAFTA bloc are therefore potentially different. In Table 5, we see positive trade effects with US trade increasing by 42% and Mexican trade increasing more that 245%, according to our estimation. Mexico experienced an increase in previously traded goods of 111% into Mexico while only 14% in the USA. In addition, there was no statistical difference in the number of products traded with Mexico while the USA experienced a 26% decline in varieties. The trade effects from the USA have dominated Mexico's in the NAFTA estimation coefficients since, from an economic weight perspective, the USA is much larger. There exsists some heterogeneity between those partners in the NAFTA bloc.

5 Robustness Analysis

As discussed above, there are many econometric concerns associated with estimating trade creating of FTAs using a gravity model. To remedy some of these concerns, we have employed PPML estimation and fixed effects for year, country and product (at the HS02 level) as in Scoppola et al. (2018). However, including the fixed effects cannot adequately solve for endogeneity concerns as such result of omission of MRT. In addition, we are unable to account for country-year varying fixed effects without losing our

variable of interest due to collinearity. Thus, we follow the approach of Baier and Bergstrand (2009) by using proxy to compute the MRT. This approach represents a way of teasing out multilateral trade resistance without using time-varying fixed effects. The proxy is a first-order log-linear Taylor expansion which yields an empirical reduced form equation as in Equation 7. The proxy is the simple average of multilateral relative to world trade costs (T_{ijt}), where T_{ijt} is replaced with observable trade costs such as distance, border, common language, colonial ties and WTO.

$$MRT_{ijt} = \frac{1}{N}[\sum_{i}^{N} \theta_{it} ln(T_{ijt}) + \sum_{j}^{N} \theta_{jt} ln(T_{ijt}) - \sum_{k=1}^{N} \sum_{m=1}^{N} \theta_{kt} \theta_{mt} ln(T_{kmt})] \tag{7}$$

The results from this estimation using the MRT proxy by Baier and Bergstrand (2009) are reported method in Table 6. There are some differentiation between the tresults where we controlled for MRT and previous results where which on fixed effects. Largely, some of the results are consistent and robust but there are differences especially in terms of the magnitude of the coefficients. Apart from this, there are also considerable differences for some of the FTAs. NAFTA has all positive values across margins. Although this is not consistent in Table 4, it is consistent with the results for the NAFTA-Mexico results in Table 5. Jordan has a negative intensive margin in MRT estimation. Colombia has trade creating effect. Honduras has contradiction in the trade creating effect but has a statistically zero effect in the PPML-FE model.

Typically, we can compile MRT effects for the different trade cost variables. However, our data set only includes exports from Canada, meaning there is only 1 origin country. The average effect is the same across all country pairs for distance, contiguity, colony, and common language. This causes collinearity and these coefficients are dropped during estimation. These variables are therefore not reported.

6 Conclusion

In this thesis, we evaluate the effects, at a disaggregated level, of Canadian FTAs on the intensive and extensive margins of agri-food trade. We find heterogeneous effects between different FTAs. Positive extensive margin effects are driven by reductions in variable trade costs such as tariffs that make Canadian exports competitive with other agri-food exporting countries. We find FTAs are heterogeneous in their ability to lower trade barriers and encourage trade, consistent with Baier et al. (2018). Our findings help us draw three conclusions. The first is that intensive margins are positively impacted by FTAs if they create variable cost regimes that are competitive

with other agri-food exporters. This is consistent with Scoppola et al. (2018) and Grant and Lambert (2008). The second is that extensive margins are positively impacted by lower fixed costs such as Sanitary and Phyto-sanitary Standards (SPS) and lower regulatory burdens. This was noted in Hejazi et al. (2018) and **?**. The third is that extensive margins are positively correlated with time. The longer the time horizon, the larger the extensive margin effect. This is consistent with findings in Baier et al. (2014) and Kehoe and Ruhl (2013).

Based on our results, Canada's FTAs have heterogeneous effects on on intensive margins. This is consistent with Baier et al. (2018). Agreements which positively impact are NAFTA and Honduras. There is some evidence that the agreement with Colombia and Jordan also have a positive impact. FTAs with Israel, the EFTA, Chile, Peru and South Korea all exhibit a negative value. This indicates that throughout the introduction of these agreements, Canada has become less competitive compared to its global partners for products that it was trading before the introduction of the FTA.

Similar to the intensive margin, FTAs have heterogeneous effects on on extensive margins, consistent with Baier et al. (2018) and Baier et al. (2019). FTAs with positive extensive margin effects are Costa Rica, Israel, Chile. Honnduras and South Korea exhibit some indication of positive extensive margin effects however the significance is low due to the low number of observations. There is also some evidence that the FTA with Peru positively effects extensive margins. In addition, when we break down the NAFTA agreement into trade with Mexico and USA, we find a positive effect for Mexico and negative effect for the USA. There are FTAs that have a negative effect on extensive margins however Jordan, EFTA, Colombia and Peru show little-to-no statistically significant impact.

The longest held FTAs have varying effects on the intensive margin. the FTA with Israel (1997) and Chile (1997) has a negative intensive margin effect while Costa Rica (2002) is statistically insignificant. The NAFTA (1994) agreement tends to have a large intensive margin impact for both the USA and Mexico. Where there is some agreement is along the extensive margin. All these FTAs (Mexico in NAFTA) have a positive and significant impact on the extensive margin. Only the NAFTA-USA has a negative coefficient for extensive margin. This may be driven by the Canada-US Free Trade Agreement (CUSFTA) from 1989 which the range of our data set does not allow us to test. The general pattern seems to be that extensive margins increase with FTAs overtime. This is consistent with Baier et al. (2014) who estimate that most of the trade growth from an FTA overtime happens along the extensive margin.

Similar to the answers the previous research questions, intensive and extensive margin effects are heterogeneous across agreements. Sometimes the positive dominates the negative and vice versa. Sometimes the two margins offset each other and cause an insignificant change in trade as a result of an FTA. In the case of NAFTA, the intensive margin effect is the large trade creating margin. For Costa Rica, Israel, South Korea and Peru, the trade creation seems to be generated by the extensive margin. The effects for Chile, EFTA and Colombia seem to have their trade creating effects offset to zero by the different directions of the intensive and extensive margin

generating by their respective FTAs. Based on our research, the only true way to have trade generation is to expand the intensive and extensive margins.

There are several implications for trade policy makers. Intensive and extensive margins are essentially two ways of expanding trade. Policy makers can pursue policies that expand the amount of previously traded goods primarily through reductions in variable trade costs such as tariffs and TRQs. Trade policy can expand the amount of newly traded products in domestic market through harmonization of standards and reduction in regulatory barriers. Policy makers must also be aware that it takes time for new entrants to enter the market and expand product variety. It takes time to integrate supply chains, alter production and find foreign consumers. Policy aimed at lowering and hastening these barrier for businesses help them expand the extensive margin more quickly. Evaluating the success of an FTA must not be reliant on overall agri-food trade. Evaluation should consider expansion in the intensive and extensive margins and how they are affected by heterogeneous reduction in different trade barriers.

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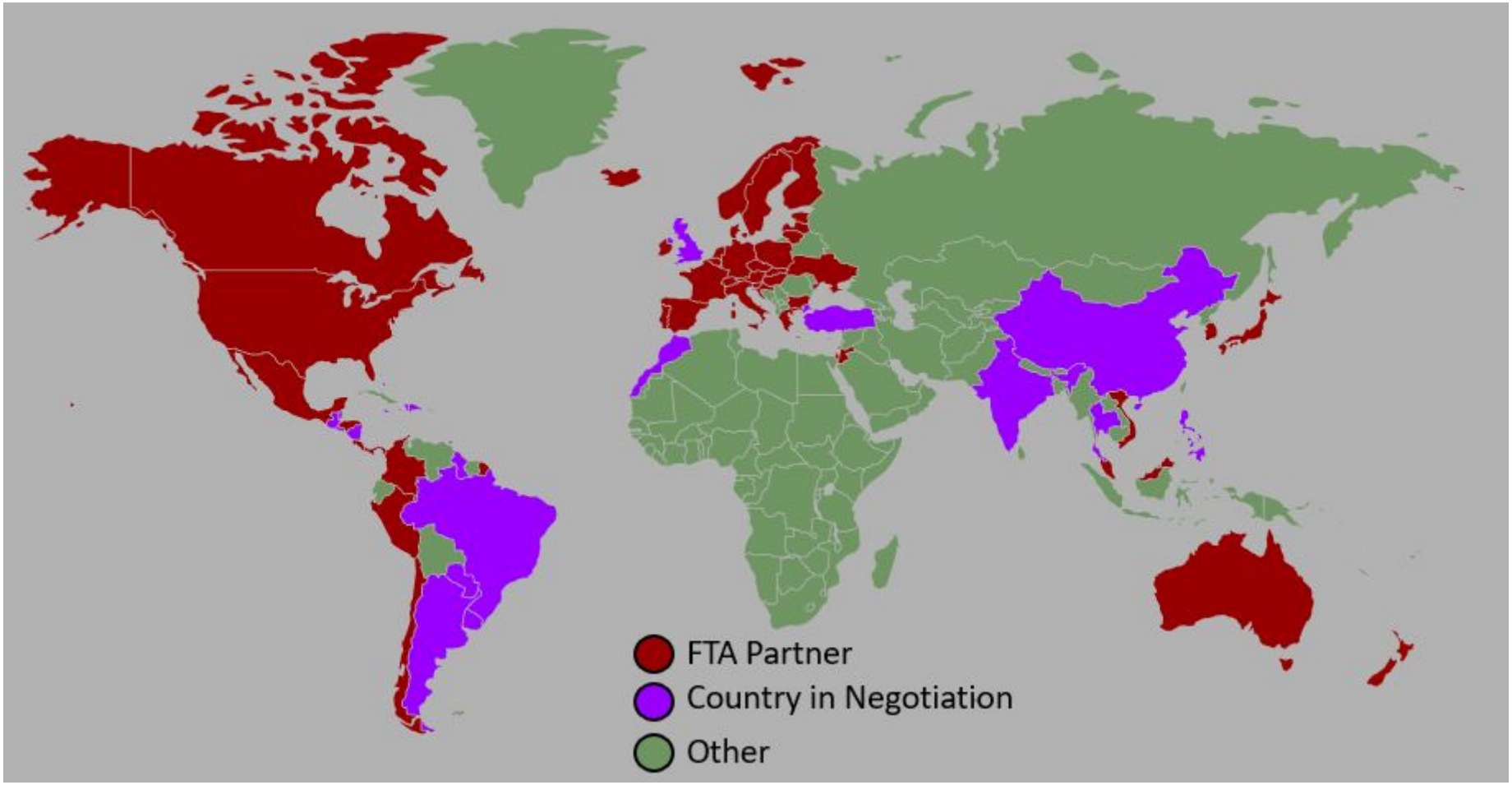

Figure 1: Canada's FTAs with Different Partners

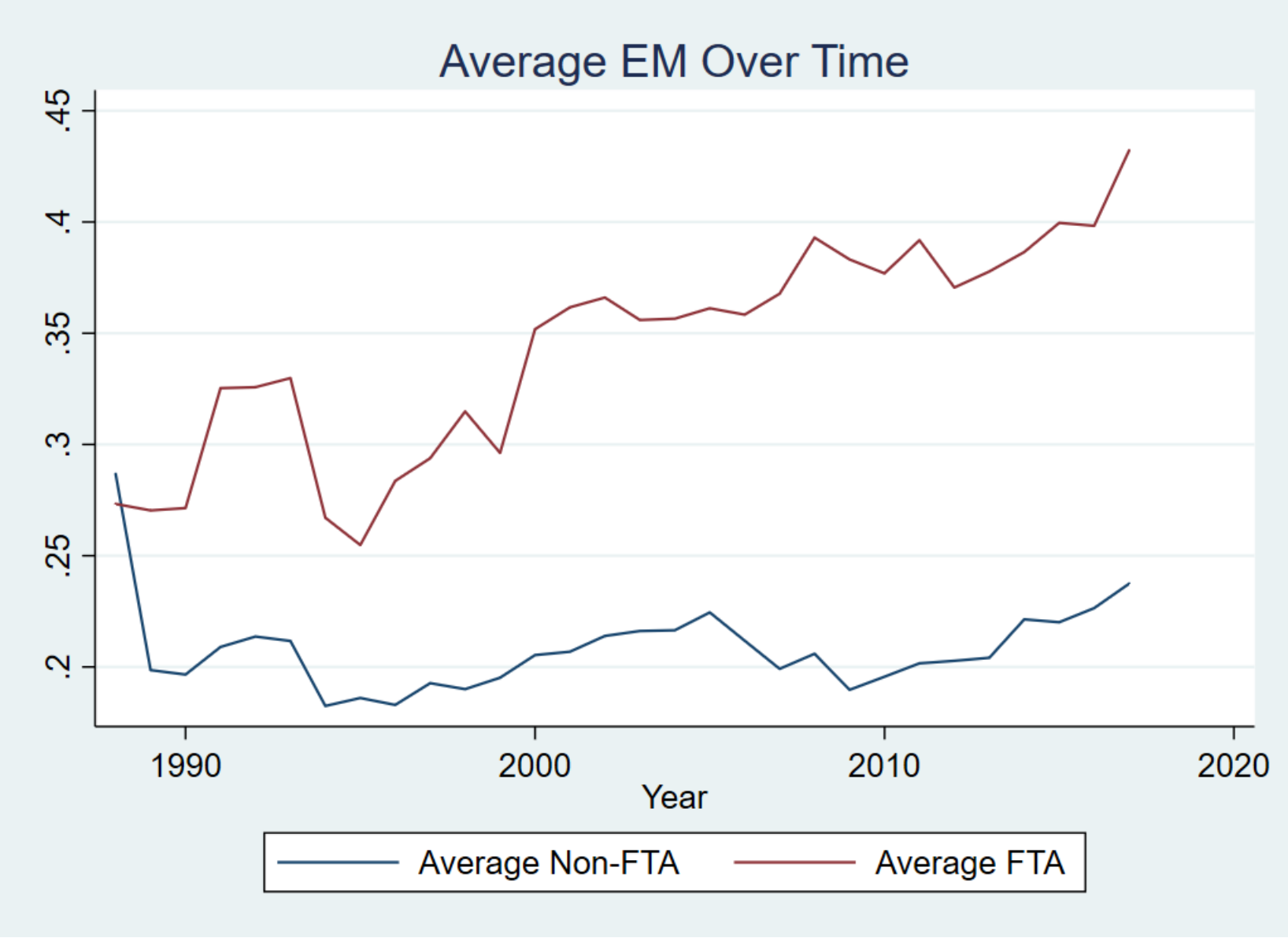

Figure 2: Canada's Extensive Margin of Agri-Food Trade, FTA vs Non-FTA Partners

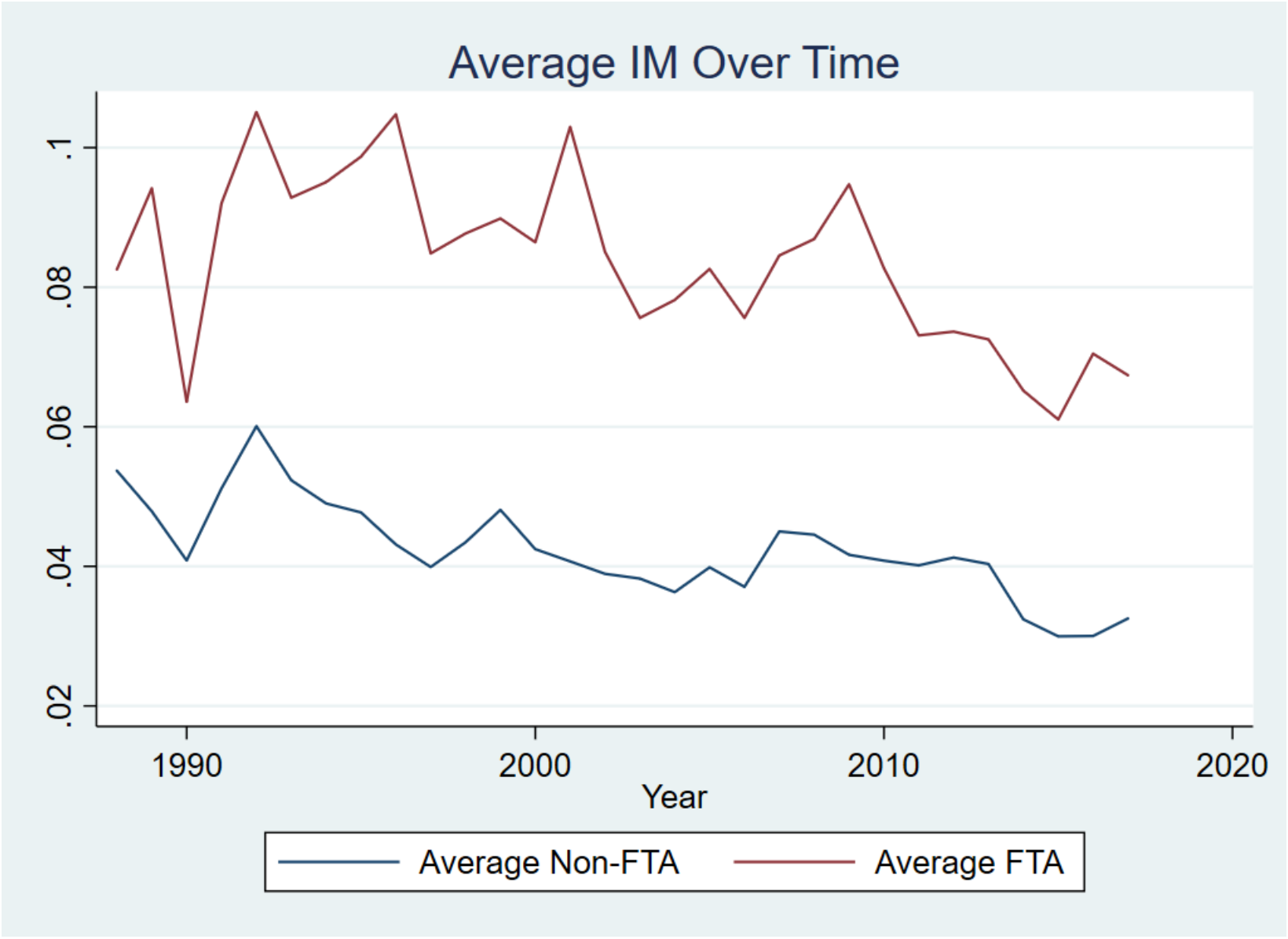

Figure 3: Canada's Intensive Margin of Agri-Food Trade, FTA vs Non-FTA Partners

Table 1: Canadian FTA Partners

Partner	Enforcement Date
Chile	July 5, 1997
Colombia	August 15, 2011
Costa Rica	November 1, 2002
Iceland	July 1, 2009
Liechtenstein	July 1, 2009
Norway	July 1, 2009
Switzerland	July 1, 2009
Honduras	October 1, 2014
Israel	January 1, 1997
South Korea	January 1, 2015
Jordan	October 1, 2012
Mexico	January 1, 1994
USA	January 1, 1994
Panama	April 1, 2013
Peru	August 1, 2009
Ukraine*	August 1, 2017
EU*	September 21, 2017
CPTPP*	December 30, 2018

Table 2: Canadian and MFN Export Tariff Rates into select FTA partners for select HS06 products

HS06 Selection	Israel		Peru		EFTA (Norway)	
	MFN	CAN	MFN	CAN	MFN	CAN
Bovine Carcasses	12%	12%	11%	11%	32.28	32.28
(0201.10.00.00)	+ 3.25 ILS/kg	+ 3.25 ILS/kg			KR/kg	KR/kg
Butter	0%	0%	0%	0%	0.2519	0.2519
(0405.10.00.00)					KR/kg	KR/kg
Apples	1.85 ILS/kg	1.85 ILS/kg	6%	0%	4.83	4.83
(0808.10.00.00)	up to 553%	up to 553%			KR/kg	KR/kg
Durum Seed	50%	0%	0%	0%	2.13	1.92
(1001.11.00.00)					KR/kg	KR/kg
Soybean Seed	0%	0%	0%	0%	0%	0%
(1201.10.01)						
Beet Sugar	0%	0%	0%	0%	1.41	1.41
(1201.12.00)					KR/kg	KR/kg
Wine, bottled (White)	12%	12%	6%	0%	0%	0%
(2204.21.31)	+1.35 ILS/L +	+1.35 ILS/L				
Processed Cereal	0%	0%	6%	0%	0%	0%
(1904.20.00)						

Notes: HS06 selections are proxies for different product segments Bovine Carcasses are a proxy for Animal Products. Butter for Dairy Products. Apples for Fruit, Vegetables, plants. Durum Seed for Cereals. Soybean seeds for Oilseeds, fats and oils. Beet Sugar for Sugar and Confectionery. Wine, bottled (White) for beverages and Tobacco. Processed Cereal for Other Agricultural Products. The number under the product categories represent the disaggregated HS product code. Rates can be found using "Canada Tariff Finder" at URL: *https://www.tariffinder.ca/en/getStarted*

Table 3: Basic OLS and PPML-FE results for Average FTA Effect

VARIABLES	ln (X)	Trade	ln (IM)	IM	ln (EM)	EM
ln (GDP_D)	0.638***		-0.0679***		0.189***	
	(0.0101)		(0.0084)		(0.0056)	
ln (POP_D)	0.0391***		0.0362***		-0.0963***	
	(0.0109)		(0.0092)		(0.0061)	
ln (Distance)	-0.479***		-0.436***		-0.316***	
	(0.0369)		(0.031)		(0.0206)	
Contiguous	2.013***		1.888***		(0.0282)	
	(0.146)		(0.122)		(0.0813)	
ComColony	0.293***		-0.708***		(0.0003)	
	-0.0991		-0.0832		-0.0553	
ComLang	0.305***		0.309***		0.388***	
	(0.0335)		(0.0281)		(0.0187)	
GATT/WTO	0.610***		0.175***		0.568***	
	-0.0624		-0.0523		-0.0348	
FTA	0.595***	0.0527	0.232***	-0.165***	0.155***	0.0996***
	(0.0575)	(0.073)	(0.0483)	-0.0499	(0.0321)	(0.0175)
Constant	-1.370***	20.28***	0.00742	-1.865***	-2.563***	-0.840***
	(0.347)	(0.0457)	(0.291)	-0.00984	(0.194)	(0.0034)
Observations	45,056	76,519	45,052	76,519	45,052	76,519
R-squared	0.236		0.027		0.059	
Year FE	NO	YES	NO	YES	NO	YES
Product-Country FE	NO	YES	NO	YES	NO	YES

Notes: Trade is aggregated at the HS02 level. Estimations that include Year and Product-country FE have all variables (with the exceptions of FTA) omitted due to collinearity. *** p<0.01, ** p<0.05, * p<0.1.

Table 4: PPML Estimation Results for Heterogeneous FTAs

VARIABLES	Trade	IM	EM
NAFTA	0.514***	0.288***	-0.139***
	(0.162)	(0.0816)	(0.0373)
CAN-Costa Rica	0.463***	0.102	0.267***
	(0.151)	(0.144)	(0.0538)
CAN-Jordan	-0.095	0.367*	0.146**
	(0.145)	(0.201)	(0.0602)
CAN-Israel	1.165***	-0.801**	1.242***
	(0.437)	(0.322)	(0.338)
CAN-EFTA	-0.184*	-0.268***	0.0284
	(0.103)	(0.0941)	(0.0297)
CAN- Chile	-0.279	-0.590***	0.363***
	(0.298)	(0.119)	(0.098)
CAN-Colombia	0.159	-0.0761	0.029
	(0.131)	(0.0813)	(0.0457)
CAN-Panama	0.0137	-1.359***	-0.625***
	(0.185)	(0.343)	(0.0974)
CAN-Peru	0.485***	-0.266**	-0.0451
	(0.169)	(0.127)	(0.0381)
CAN-Honduras	-0.00773	1.185***	0.463***
	(0.235)	(0.21)	(0.0737)
CAN-Korea	-0.246	-0.480***	0.0611
	(0.179)	(0.147)	(0.0421)
Constant	20.03***	-1.887***	-0.865***
	(0.0873)	(0.0102)	(0.00919)
Observations	76,519	76,519	76,519
Year FE	YES	YES	YES
Product-Country FE	YES	YES	YES

Notes: *** p<0.01, ** p<0.05, * p<0.1.

Table 5: PPML Estimation Results for NAFTA

VARIABLES	Trade	IM	EM
NAFTA	0.514***	0.316***	-0.139***
	(0.160)	(0.0570)	(0.0300)
NAFTA-USA	0.348**	0.138**	-0.304***
	(0.168)	(0.0689)	(0.0289)
NAFTA-MEX	1.239***	0.746***	0.108
	(0.338)	(0.233)	(0.0785)
Observations	76,519	76,519	76,519
Year FE	YES	YES	YES
Country-Product FE	YES	YES	YES

Notes: NAFTA-USA is equal to one if FTA is equal to one and country j is USA. NAFTA-MEX is equal to one if FTA is equal to one and country j is MEX. The generic NAFTA estimate is also listed. All estimates are evaluated separately causing slight variations in the NAFTA coefficient from those in Table preceding tables. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: PPML Results for MRT by FTA, Aggregated at HS02 Level

VARIABLES	Trade	IM	EM
NAFTA	0.989***	0.477***	0.362***
	(0.106)	(0.0906)	(0.0312)
CAN-Costa Rica	-0.132	0.571***	0.530***
	(0.369)	(0.118)	(0.0511)
CAN-Jordan	0.196	-0.363	-0.115
	(0.346)	(0.293)	(0.0905)
CAN-Israel	-4.354***	-1.436***	-0.612***
	(0.559)	(0.208)	(0.0624)
CAN-EFTA	0.496**	-0.375***	0.0285
	(0.222)	(0.0981)	(0.0329)
CAN-Chile	1.076***	0.291**	0.445***
	(0.226)	(0.138)	(0.0546)
CAN-Colombia	0.669**	0.329**	-0.0625
	(0.312)	(0.157)	(0.0676)
CAN-Panama	-1.024**	-1.460***	-0.991***
	(0.398)	(0.437)	(0.152)
CAN-Peru	1.556***	0.434**	0.0828
	(0.317)	(0.181)	(0.0629)
CAN-Honduras	-0.807**	0.598**	0.682***
	(0.333)	(0.288)	(0.132)
CAN-Korea	0.283	-0.430*	0.475***
	(0.191)	(0.227)	(0.0866)
Constant	27.77***	-39.79***	-30.54***
	(8.886)	(14.71)	(3.644)
Observations	95,338	95,338	95,338
R-squared	0.10	0.027	0.148
Year FE	YES	YES	YES
HS02 Pair FE	YES	YES	YES

Notes: Trade is aggregated to HS02 Level. Robust standard errors in parentheses. MRT variables omitted. Fixed effects not included. *** p<0.01, ** p<0.05, * p<0.1.