

Understanding the Effects of Canadian International Food Aid on Production and Trade

Patrick D. Tagari *

Department of Economics
University of California, Berkeley

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Abstract

This research aims to quantify the relationship between different types of Canadian food aid, recipient country food production, and trade patterns between Canadian food aid recipients and Canada. This research analyzes panel data from 21 countries across 29 years using panel vector autoregressive estimation techniques. The main finding is that Canadian emergency food aid shipments have a small short-term, negative correlation with recipient country food production and with recipient country food imports from Canada. Non-emergency Canadian food aid shipments are not found to have any significant effects on recipient country production and trade patterns.

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1 Introduction

There is a historically charged debate surrounding the effects of food aid on the economies of the recipient and donor countries. In the past two centuries there has been an acceleration in world population growth that has introduced contemporary global issues regarding food security, production, and distribution. Producing and distributing enough food to ensure that the nutritional needs of the growing global population are met has become increasingly complicated. As developed economies leverage Green Revolution technology to exponentially increase food production, international food aid has become an important mechanism in international trade and developmental economics. Broadly, there are three main types of food aid as classified by the World Food Programme (WFP): emergency food aid, program food aid, and project food aid. Emergency food aid is categorized as food aid allocated to victims of disasters both natural and man made. Program food aid is aimed at specific at-risk groups with the goal to improve nutrition and development outcomes. Finally, project food aid is a direct transaction between donor and recipient governments in which the recipient government has control over the sale and allocation of the aid received depending on predetermined agreements between the donor and recipient governments. Canada has been a longstanding contributor to international food aid; according to the Organization for Economic Cooperation and Development's (OECD) statistics, Canada's contributions of food aid totaled the equivalent of 185.57 million U.S. dollars in 2017, making it the fourth largest contributor to international aid. As the global economy becomes more interconnected, the role of international trade takes on greater importance as developing countries seek to solidify their place among the existing global economic powers. However, there are numerous questions that arise regarding the economic effects of Canadian international food aid. Does Canadian food aid disincentivize producers in the recipient countries, leading to a reduction in food production in recipient countries? Does Canadian food aid lead to positive returns in trade between Canada and the recipient country? Or does Canadian food aid apply downward pressure on recipient production and restrict international markets for Canada?

This paper seeks to answer the following question: What is the impact of Canadian food aid on the production and trade of food products in the recipient country? In order to answer this question, a fixed-effects vector autoregression estimation technique is employed on extensive panel data to ascertain the dynamic effects of international food aid on food production and trade patterns. Foreshadowing the results, this research does not find significant results to assert a causal relationship between changes in food aid and production and trade, but offers insight into the trends of recipient country production and imports that occur after receipt of different types of food aid. Understanding the effects of international food aid will help educate policy makers' decisions on how best to implement international aid and promote the

global success of developing economies while protecting producers in both donor and recipient countries. Ideally, international aid can be structured to benefit both donor and recipient countries while mitigating any negative externalities.

The structure of this paper is as follows. Section 2 highlights various theoretical debates surrounding the economic effects of international food aid. Section 3 conducts a review of relevant literature. Section 4 is dedicated to the empirical methods of the analysis. Section 5 provides an explanation of the data. Section 6 gives the results of the empirical analysis and provides robustness checks. Section 7 discusses interpretations of the empirical results in addition to potential extensions and limitations. Section 8 offers concluding remarks. Section 9 includes all graphs and tables.

2 Debates Surrounding Food Aid

From the perspective of the Canadian producer, the effect of Canadian food aid on recipient country imports is crucial. Considering the “additionality principle” in which food aid is intended to add to the aggregate food availability in the recipient country, it is important that Canadian food aid does not simply substitute for food imports that the recipient country would purchase from Canada through commercial channels. Canadian food producers would suffer from a reduction in commercial demand from the recipient country and international competitors would have an advantage as the recipient country would have more capital to engage in trade with them.¹ A competing theory suggests that, due to an international regulation set by the Food and Agricultural Organization of the United Nations (FAO) called the “Usual Marketing Requirement (UMR)” the principle of additionality is upheld. The UMR stipulates that recipient countries continue a normal level of import engagement with the donor country with respect to the commodity in question. Recently, the World Trade Organization (WTO) reaffirmed that international food aid should “not be tied directly or indirectly to commercial exports.”² This requirement, however, is difficult for the United Nations to enforce and can lead to negative externalities faced by the producers in donor countries. As a result, it is questionable from a production perspective if food aid is a worthy investment that would bring increased returns as a result of lasting trade relationships or if it has negative returns based on food aid acting as a substitute for Canadian exports.³

Looking at recipient countries, there is the theoretical concern that international food aid will have adverse effects on producers. One argument made by Schultz (1960) states that foreign aid can be thought of as

1. Joachim Von Braun and Barbara Huddleston, “Implications of food aid for price policy in recipient countries,” *Agricultural Price Policy for Developing Countries*, 1988, 253.

2. World Trade Organization, “Ministerial Decision of 19 December 2015 : WT/MIN(15)/45 — WT/L/980” (2015).

3. Philip C Abbott and F Desmond McCarthy, “Welfare effects of tied food aid,” *Journal of Development Economics* 11, no. 1 (1982): 63–79.

an increase in domestic supply that leads to a reduction in price and disincentivizes domestic production.⁴ An alternate theory argues that countries who are recipients of food aid are not large enough economies to have effects on world prices and thus take prices as given. As a result, food aid can be thought of as a cash injection and does not have a depressive effect on commodity prices nor does it disincentivize production.⁵

3 Literature Review

There have been multiple studies, both empirical and theoretical, that have discussed the interdependent effects of international food aid on economic development, domestic and foreign production, and international trade patterns. Despite the depth of existing research attempting to clarify the effects of international food aid, a consensus has not been reached by modern economists. In this survey of relevant literature, the theoretical underpinnings of previous research are discussed in addition to previous methods of empirical analysis and the conclusions thereof.

3.1 Food Aid and Production

The most common starting point for much of the literature addressing the effects of international food aid is the foundational work done by American economist Theodore Schultz. He argues that international food aid acts as an exogenous injection to domestic food supply. Following basic theory, this creates downward pressure on domestic food prices in the recipient country and disincentivizes domestic production as producers can no longer sell at the higher, pre-aid infusion market price.⁶ In his theoretical work, Schultz assumes that international food aid does not violate the additionality principle. That is, the recipient country continues to import the same amount of food despite receipt of food aid. In other words, the UMR holds and international food aid has no effect on trade between the donor and recipient countries. Another underlying assumption Schultz makes is that recipient countries do not substitute away from specific food products received from aid when engaging in trade. This assumption strengthens his argument that food aid does not violate the additionality principle.⁷ In his study, Schultz exclusively considers United States program food aid, electing to exclude emergency aid from his study.

The Schultzian theory of the incentives tied to food aid became the foundational work upon which many later studies build. In Franklin Fisher's 1963 paper, he added to Schultz's argument by considering how price

4. Theodore W Schultz, "Value of US farm surpluses to underdeveloped countries," *Journal of Farm Economics* 42, no. 5 (1960): 1019–1030.

5. Sandeep Mohapatra et al., "Does food aid really discourage food production?," *Indian Journal of Agricultural Economics* 54, no. 2 (1999).

6. Schultz, "Value of US farm surpluses to underdeveloped countries."

7. Ibid.

elasticities play into the market dynamics of recipient countries.⁸ Other studies corroborate Schultz's findings regarding disincentivization that results from food aid. In particular, Maxwell and Singer in their 1979 paper find evidence that reinforces disincentivization theory. When the UMR holds, food aid is additional to usual import volumes, creating a surplus in recipient country supply and disincentivizing production.⁹ In subsequent research, Maxwell concludes that the level of production disincentivization is dependent on the type of government system in power in the recipient country.¹⁰ More recent research has been inconclusive in quantifying the effects of food aid on recipient production. Raymond Hopkins, in his 1992 country-level research, was unable to make strong conclusions on the production effects of food aid. Further, Barrett et. al. (1999) found that international food aid had little to no stimulation effect to recipient country production. Using vector autoregression with cereals as a proxy for food aid and production, their study found short-run evidence for Schultzian disincentivization.¹¹

A 1999 paper by Mohapatra et. al. takes the Schultzian view on price depression caused by increased domestic supply in the recipient country. The authors argue that depression of domestic food product prices relaxes balance of payment constraints on intermediate goods such as agricultural chemicals and equipment, leading to greater import volumes of these goods. Their findings point to upward pressure on food production quantities in recipient economies resulting from this change in balance of payments constraints while downward pressure on production results from traditional supply increases.¹² Their findings do not corroborate the Schultzian view of food production disincentivization in recipient economies, rather stating that the effect is ambiguous.

One of the only pieces of research that directly contradicts Schultz's theory is a 1990 World Bank report by Victor Lavy. The author argues that many countries, specifically those who receive more emergency food aid, do not produce the same goods as those received. Rather than substitutes, food aid goods are complementary and stimulate food production in recipient countries.¹³ Lavy uses a fixed-effects vector autoregression estimation technique to analyze the data on food aid and production.

8. Franklin M Fisher, "A theoretical analysis of the impact of food surplus disposal on agricultural production in recipient countries," *Journal of Farm Economics* 45, no. 4 (1963): 863–875.

9. Simon J Maxwell and Hans W Singer, "Food aid to developing countries: a survey," *World Development* 7, no. 3 (1979): 225–246.

10. Simon Maxwell, "The disincentive effect of food aid: a pragmatic approach," 1991,

11. Christopher B Barrett, Sandeep Mohapatra, and Donald L Snyder, "The dynamic effects of US food aid," *Economic Inquiry* 37, no. 4 (1999): 647–656.

12. Mohapatra et al., "Does food aid really discourage food production?"

13. Victor Lavy et al., "Does food aid depress food production? The disincentive dilemma in the African context.," *Policy, Research and External Affairs World Bank (USA)*, no. 460 (1990).

3.2 Food Aid and Trade

Another area of concern in regards to previous research done on food aid is its effect on trade. In particular, economists have long sought to understand if food aid violates the additionality principle and results in less imports from the donor country by the recipient country due to substitution away from trade with the donor country after accounting for the general trend of imports by the recipient country. A general decrease in imports by recipient countries from all trade partners is not a violation of the UMR. The preeminent empirical literature on this subject was done by Christopher Barrett. The research makes use of vector autoregression and impulse response functions, and finds a “J-curve” effect on the amount of food imported from the donor country by the recipient. In the short-run (less than 5 years) imports decrease substantially. In the long-run, food imports do not return to pre-shock levels for 20 years.¹⁴ Additional findings by Fitzpatrick & Storey (1989) and Saran & Konandreas (1991) point to the conclusion that food aid results in a displacement of imports, thus violating the additionality principle.¹⁵¹⁶

A 1992 study conducted by Roland Herrmann, Carlo Prinz, & Patricia Schenck finds that the impact food aid has on trade depends on the way in which the governments from recipient countries allocate the revenue received from monetizing food aid through the domestic market. Trade results depend on whether the recipient government elects to stimulate domestic supply or demand.¹⁷

3.3 Use of Vector Autoregression

This research builds on the model used by Barrett et. al. (1999). Barrett et. al. elected to analyze the dynamic relationship between food aid, production, and recipient country imports by using the vector autoregressive approach. The VAR model used by Barrett et. al. includes food aid, production, and imports as the main variables. They used five annual lags per variable and estimated the vector autoregression below using the seemingly unrelated regressions method. Vector autoregression is useful in analyzing interdependencies throughout multiple sets of time series data. The reduced form model used in their research is seen below, with F , P , and M representing non-emergency food aid, cereal production, and cereal imports respectively with the i and t being country and time indicators.¹⁸

14. Barrett, Mohapatra, and Snyder, “The dynamic effects of US food aid.”

15. Jim Fitzpatrick and Andy Storey, “Food aid and agricultural disincentives,” in *Development Perspectives for the 1990s* (Springer, 1991), 127–137.

16. Ram Saran and Panos Konandreas, “An additional resource? A global perspective on food aid flows in relation to development assistance,” 1991,

17. Roland Herrmann, Carlo Prinz, and Patricia Schenck, *A Relationship between Food Aid and Food Trade: Theoretical Analysis and Quantitative Results*, technical report (1992).

18. Barrett, Mohapatra, and Snyder, “The dynamic effects of US food aid.”

$$F_{it} = \mu_0 + \sum_{j=1}^5 \mu_j F_{it-j} + \sum_{j=1}^5 \delta_j M_{it-j} + \sum_{j=1}^5 \lambda_j P_{it-j} + \epsilon_{1it}$$

$$M_{it} = \gamma_0 + \sum_{j=1}^5 \gamma_j F_{it-j} + \sum_{j=1}^5 \theta_j M_{it-j} + \sum_{j=1}^5 \psi_j P_{it-j} + \epsilon_{2it}$$

$$P_{it} = \lambda_0 + \sum_{j=1}^5 \pi_j F_{it-j} + \sum_{j=1}^5 \nu_j M_{it-j} + \sum_{j=1}^5 \lambda_j P_{it-j} + \epsilon_{3it}$$

Other researchers, such as Lavy (1990) employ a similar method of vector autoregression in their research regarding the economic impacts of food aid. This paper builds on the above model used by Barrett et. al.

3.4 Main Contributions

This research fills previous gaps in the existing literature in the following ways. First, an updated, country-level data set is used in the empirical analysis. Second, this paper includes the type of food aid (emergency vs. non-emergency food aid) in its analysis. Third, the statistical significance of lag length is determined by iterative fitting of increasing lag lengths to vector autoregressive (VAR) models of the outcome variables and choosing the model with the lowest Akaike Information Criterion (AIC). Rather than imposing arbitrary lag lengths, this research varies the lag lengths of each variable based on the statistical significance of the lags. Finally, this analysis focuses on Canada as the donor country of interest rather than the United States as most studies focus on.

4 Estimation Techniques and Model Specification

4.1 Estimation Techniques

Since the data this research is focused on consists of multiple time series data sets, ordinary least squares (OLS) estimation will be biased and inefficient. This is due to serial correlation of the data and the estimated error terms; errors from one period are correlated to errors in an adjacent period. This results in standard errors that are either too large or too small depending on the nature of the serial correlation. As such, coefficient and standard error estimates that do not offer accurate information regarding the veracity of the model. In this research, the data suffers from positive serial correlation, meaning estimated standard errors using OLS will be too small.

In this research, the vector autoregressive model popularized by Holtz-Eakin et. al. (1988) and adjusted by Barrett et. al (1999) is extended in the following ways in order to analyze the interdependent effects of

Canadian international food aid on trade and production in the recipient countries.¹⁹ This study employs panel vector autoregression by including country specific fixed effects in order to account for time-invariant characteristics of each country that are not accounted for in the general autoregressive model. This choice is in place of aggregating aid and trade across a group of countries. This study does not make assumptions based on biological lags of food production since there are multiple types of food aid used in the analysis. Non-emergency food aid is planned in advance and lags can be estimated according to the time it takes to grow crops in addition to planned food aid delivery. However, since this study includes emergency food aid, the statistical significance of lag length is determined by iterative fitting of increasing lag lengths to the individual vector autoregressive (VAR) models of the outcome variables and choosing the model with the lowest Akaike Information Criterion (AIC).

4.2 Model Specification

The model used in this study extends the model proposed by Barrett et. al. (see section 3.3) by including country specific fixed effects in panel vector autoregression in the manner employed by Lavy (1990). The model used in this research is noted below and builds on the above model constructed by Barrett et. al. The addition of country specific fixed effects is intended to capture unobserved characteristics each country has that could affect the dependent variables: imports and production. For instance, precipitation, land use, and the political landscape of a certain country could affect cereals food production. Since this study uses panel data across different countries and time periods, incorporating country-specific effects can account for unobserved heterogeneity in the outcome variables.²⁰ This research also adds non-emergency food aid to the panel vector autoregression.

The variables used in the model are per capita domestic food production (P), per capita emergency cereal food aid received (E), per capita non-emergency cereal food aid received (NE_FA), and per capita cereal food imports from Canada (M). D represents the country specific dummy variable. The yearly time indicator is denoted by t with the last year being time T and the country specific indicator is denoted by i . The number of lags used is indicated by n . The number of countries is indicated by m . The fixed effects vector autoregressive model is shown below.

$$P_{it} = \sum_{j=1}^n \alpha_1 P_{it-j} + \sum_{j=1}^n \alpha_2 E_{it-j} + \sum_{j=1}^n \alpha_3 M_{it-j} + \sum_{j=1}^n \alpha_4 NE_FA_{it-j} + \sum_{k=1}^m \alpha_5 D_k + \epsilon_{1it}$$

19. Douglas Holtz-Eakin, Whitney Newey, and Harvey S Rosen, "Estimating vector autoregressions with panel data," *Econometrica: Journal of the Econometric Society*, 1988, 1371–1395.

20. Lavy et al., "Does food aid depress food production? The disincentive dilemma in the African context."

$$M_{it} = \sum_{j=1}^n \beta_1 P_{it-j} + \sum_{j=1}^n \beta_2 E_{it-j} + \sum_{j=1}^n \beta_3 M_{it-j} + \sum_{j=1}^n \beta_4 NEFA_{it-j} + \sum_{k=1}^m \beta_5 D_k + \epsilon_{2it}$$

Introduction of a country specific dummy variable means introducing a variable that does not vary over time to the model. A common practice for eliminating the stationarity problem that results from introducing fixed effects into a VAR model is to first difference the data.²¹ The differenced equations are shown below:

$$\begin{aligned} P_{it} - P_{it-1} &= \sum_{j=1}^n \alpha_1 (P_{it-j} - P_{it-j-1}) + \sum_{j=1}^n \alpha_2 (E_{it-j} - E_{it-j-1}) + \sum_{j=1}^n \alpha_3 (M_{it-j} - M_{it-j-1}) + \sum_{j=1}^n \alpha_4 (NEFA_{it-j} - NEFA_{it-j-1}) \\ &\quad + \epsilon_{1it} - \epsilon_{1it-1} \\ M_{it} - M_{it-1} &= \sum_{j=1}^n \alpha_1 (P_{it-j} - P_{it-j-1}) + \sum_{l=1}^n \alpha_2 (E_{it-l} - E_{it-l-1}) + \sum_{j=1}^n \alpha_3 (M_{it-j} - M_{it-j-1}) + \sum_{j=1}^n \alpha_4 (NEFA_{it-j} - NEFA_{it-j-1}) \\ &\quad + \epsilon_{2it} - \epsilon_{2it-1} \end{aligned}$$

The method of first differencing the original model introduces a problem of simultaneity into the model. The resolution proposed by Holtz-Eakin (1988) is the employment of instrumental variables. In order to use instrumental variables, the assumption is made that the error terms in each equation are uncorrelated with the lagged values of the dependent variables and the fixed effects.

This assumption is a defining portion of the estimation technique used by Holtz-Eakin (1988) and Lavy (1990) and is shown below:^{22,23}

$$E[P_{it}, \epsilon_{1t}] = E[M_{it}, \epsilon_{2t}] = E[D_i, \epsilon_{it}] = 0$$

The above assumption results in the instrument matrix that uses lagged dependent variables as the instruments:

$$[P_{it-2}, P_{it-3}, \dots, P_{it-n}, M_{it-2}, M_{it-3}, \dots, M_{it-n}]$$

The process of estimating panel VAR's is outlined in detail in Holtz-Eakin (1988). It employs a two-stage least squares estimation for each time period, then simultaneously estimates coefficients using generalized least squares on what Holtz-Eakin refers to as "stacked equations." The fixed effects vector autoregressions that resulted from the above model were used to estimate impulse response functions illustrated in Figures 5-8.

21. Holtz-Eakin, Newey, and Rosen, "Estimating vector autoregressions with panel data."

22. Ibid.

23. Lavy et al., "Does food aid depress food production? The disincentive dilemma in the African context."

5 Data

The macroeconomic data used in this study is consistent in terms of structure with the data used by previous researchers concerned with this topic. This paper, like many previous studies, uses cereals as a proxy for food. It is estimated that 90% of international food aid is made up of cereals.²⁴ Cereals, as defined by the Food and Agriculture Organization of the United Nations, include wheat, barley, maize, rye, oats, millet, sorghum, rice, buckwheat, alpiste/canary seed, fonio, quinoa, triticale, wheat flour, and the cereal component of blended foods. The recipient countries included in this research are the largest recipients of Canadian International Aid.²⁵ The data is yearly panel data tracking cereal food aid received (both emergency and non-emergency), cereal imports by the recipient countries, and cereal production in the food aid recipient countries. The data tracks 21 countries over 29 years.

Data tracking Canadian cereal production, recipient country cereal production, Canadian cereal exports, cereal imports by recipient country, and total Canadian cereal food aid is from FAOSTAT. Data tracking cereal food aid donated by Canada at a country level is provided by the World Food Programme. Country level population data is provided by the World Bank. Data regarding the monetary value of yearly Canadian food aid in U.S. dollars is from OECD. Precipitation and land usage data was sourced from the World Bank database.

Country specific cereals production, trade, and aid data was broken down by specific commodity and type of transaction. This data was aggregated to form a basket of cereals data which was then converted to a per-capita measurement based on the respective country's population. Data from FAOSTAT was in metric tons, whereas World Food Programme data was in U.S. tons. These units were converted to kilograms. The final data set is country level yearly per-capita kilograms of cereals production, imports, exports, emergency and non-emergency cereal food aid shipments. The final data set includes 21 countries that receive food aid from Canada and import the same goods over 29 years. Figures 1-3 provide a general visualization of broad trends in aggregate Canadian cereal food aid, exports, and production. Figure 4 shows preliminary impulse response functions that provide visualization for aggregate responses in Canadian cereal food exports and production that result from aggregate shocks in Canadian cereal food aid.

24. Barrett, Mohapatra, and Snyder, "The dynamic effects of US food aid."

25. Statistics Canada, "Statistical Report on International Assistance," 2017,

6 Results

6.1 Main Findings

The structural relationships between the variables in question are all important in understanding the dynamic macroeconomic effects both emergency and non-emergency food aid. This research is motivated to focus particularly on the effects Canadian emergency and non-emergency food aid has on recipient country production and trade patterns over time. The main question this paper is trying to answer is in regards to whether Canadian food aid boosts macroeconomic growth in recipient countries and leads to positive returns in trade between donor and recipient countries or if it applies downward pressure on recipient production and restricts international markets for Canada (the donor country).

Both fixed effects vector autoregression and fixed effects regression support findings that emergency food aid has a small negative relationship with recipient country production. While the results point to changing trends in the data after shocks to different types of food aid, a causal effect cannot be inferred (see section 7.2). Table 1 shows the regression results of the fixed effects regression analyzing the effects on recipient production. Additionally, Figure 5 shows the response of recipient country production to a one kilogram per capita shock in emergency food aid. These responses, however, are short lived. After a period of 2 years the response of emergency food aid deliveries on recipient production are negligible. After an initial negative response, food production in recipient countries remains relatively stable. The results in Table 1 point to an average decrease in production of 0.75 kilograms per capita given a 1 kilogram per capita increase in emergency food aid.

Additionally, this research finds no evidence to indicate that Canadian non-emergency food aid significantly impacts recipient country food production. Figure 6 shows the response of recipient country food production to a one kilogram per capita shock in non-emergency food aid. After an initial and insignificant period of stimulus, recipient country cereals production, on average, remains unchanged two years after the initial shock. There is no statistical evidence to support the notion that non-emergency food aid has a lasting impact on recipient production.

The findings of this paper are consistent with the majority of previous research in regards to the effects of international per capita food aid on recipient country per capita food trade patterns. Like Barrett et. al. (1999), this paper finds a subdued “J-Curve” effect on recipient country per capita food imports from the donor country (Canada) in the years following emergency food aid deliveries.²⁶ Both estimation techniques point to a negative relationship between the recipient country’s food imports from the donor country and emergency food aid shipments. This relationship, like that with production, is relatively short lived, with the

26. Barrett, Mohapatra, and Snyder, “The dynamic effects of US food aid.”

level of imports from Canada returning to baseline levels within 10 years. Figure 8 highlights the response of recipient country food imports from that results from a one kilogram per capita shock to emergency food aid from Canada. This, coupled with a statistically significant increase in recipient country consumption (and thus an increase in food imports from the rest of the world) points to a violation of the additionality principle and a breach of the Usual Marketing Requirements standard set by the United Nations.

Like the analysis focused on recipient country production, this research does not find any significant evidence that non-emergency food aid has an adverse effect on future trade patterns between Canada and recipient countries. Both estimation techniques yield insignificant results in regards to the effects Canadian non-emergency food aid shipments have on recipient country trade patterns.

6.2 Robustness Checks

In order to check the robustness of the estimation results, an alternate specification is used. Rather than using panel vector autoregression, a traditional regression model using time and entity fixed effects is used to estimate the effects of Canadian international food aid on trade and production. The same data is used in this estimation as in the panel vector autoregression. Per capita cereal emergency and non-emergency food aid received from Canada is represented by the variables E and NE_FA respectively. Per capita cereal food imports from Canada by the recipient country is represented by M , and per capita cereal food production in the recipient country is represented by P . Additionally, per capita cereal food consumption, denoted by C can be broken down into per capita cereal imports from the rest of the world TM and per capita cereal exports X . Additionally, a series of controls are added to the imports and the production models. For imports, the world price index for cereal foods is used ($Price_Index$) in addition to consumption. For the production function, controls for cereal food production as used in Wassie (2017) such as precipitation ($precipitation$) and percentage of total land used for agricultural purposes (ag_land).²⁷ The variable T_t represents time as a dummy variable. The variable D_i is the country-specific entity variable. The indicators t and i denote values from year t and country i respectively. Since the country variable is a binary variable, the model will have $i - 1$ country specific dummy variables. Similarly, since the year variable is binary variable, the model will have $t - 1$ year specific dummy variables. Additional controls include precipitation, the cereal food price index, and the percentage of total land used for agricultural purposes. The two outcome variables of interest are country level imports of Canadian cereal food products by food aid recipient countries and country level production of cereal food products. The alternate fixed effects models are shown below.

27. Solomon Bizuayehu Wassie, "Long run determinants of cereal production in Ethiopia: does CO2 emission matter?," *International Journal of Food and Agricultural Economics (IJFAEC)* 5, nos. 1128-2018-072 (2017): 109–119.

$$M_{it} = \alpha_1 E_{it} + \alpha_2 P_{it} + \alpha_3 C_{it} + \alpha_4 NE_FA_{it} + \alpha_5 Price_Index_{it} + \delta_i J_i + \gamma_t T_t + \epsilon_{it}$$

$$P_{it} = \beta_1 E_{it} + \beta_2 M_{it} + \beta_3 X_{it} + \beta_4 ag_land_{it} + \beta_5 precipitation_{it} + \beta_6 NE_FA_{it} + \beta_7 TM_{it} + \delta_i D_i + \gamma_t T_t + \epsilon_{it}$$

7 Discussion

7.1 Interpretation of the Results

The results of the empirical analysis, by and large, support broader theories espoused by previous researchers. The analysis points to the idea that Canadian emergency food aid deliveries do not have lasting negative impact on recipient country food production trends beyond an initial negative relationship. This follows Schultzian disincentivization theory in the short run; as emergency food aid represents an exogenous increase in recipient food supply, there are less incentives for domestic producers in the recipient country to continue producing at the same level. This effect, however, is short-lived. The findings of this research strengthen the argument against the idea that food aid has a lasting negative impact on recipient production. The lack of significant effects on recipient food production is consistent across both emergency and non-emergency food aid shipments from Canada. Non-emergency food aid has a less pronounced effect on recipient country food production. Most developing economies rely heavily on their agricultural sectors to bolster economic growth. If food aid, both emergency and program, do little to stimulate recipient agricultural production, that implies that there may be more substantial ways to provide aid to developing countries. Another theory states that, since producers know in advance that food aid is going to impact the local market, they take advantage of relaxed constraints on intermediate goods such as chemical fertilizers, pesticides, and other agricultural production equipment.²⁸

In line with much of the previous research done on this topic, this paper finds that there is a statistically significant, if small, negative relationship between emergency food aid shipments and the recipient country's per capita food imports from the donor country. While most previous research does not include multiple types of food aid, this paper finds there is a clear difference in the dynamic effect of food aid on trade patterns based on the type of food aid shipment. The correlation between emergency food aid with the recipient country's per capita imports from the donor country contradict the theory put forth by Schultz (1960) that food aid (of any kind) does not displace trade patterns between donor and recipient countries. This research finds that the recipient country trade response to Canadian emergency food aid points to a violation of the additionality principle; recipient countries imports have a negative relationship with Canadian emergency

28. Mohapatra et al., "Does food aid really discourage food production?"

food aid shipments. Rather, perhaps recipient countries tend to substitute emergency food aid shipments from Canada for commercial food imports from Canada. This is consistent with the findings of Barrett et. al. (1999) and Fitzpatrick et. al. (1990).

7.2 Limitations

One shortcoming involving this research and many analogous projects is the lack of complete data. The intrinsic goal of food aid (barring any political motivation) is to provide food insecure populations with access to basic nutrition. While the data used in this study follows international flows of cereal foods, there is limited data available to capture the efficacy of intranational food distribution systems in delivering international food aid to food insecure populations. Additionally, while Canada may be a large donor of food aid, the United States is the most significant contributor to international food aid. Canada is a small country and the results of this study apply directly to Canada and its trade relationship with other countries.

Further, there is limited availability of data on specific goods in the domestic markets of recipient countries. It is theoretically possible for an aggregate depression in domestic production or trade to result from international food aid while the opposite effect being true for individual goods within the domestic cereals market. While this study does account for macro-level trends in international food aid and trade, it does not delineate different types of goods that are categorized as cereals.

Additionally, this research only accounts for cereal foods traded on the commercial market. In many instances, countries in need of food aid (especially emergency food aid) have a non-insignificant portion of their economic dealings conducted in an underground economy, whose effects on and reactions to food aid are not captured by traditional statistics.

There is also a potential source of bias in the form of reverse causality in regards to the relationship between production and emergency food aid. It can be argued that emergency food aid is a reaction to problems in production that result from prolonged periods of disaster. The use of vector autoregression on the time series data accounts for autocorrelation while incorporating fixed effects makes the assumption that unobserved heterogeneity among countries is captured by the country indicator variable and absorbs the determinants of need for emergency food aid. This approach, however, does not fully solve the problem of reverse causality and further research should address this limitation.

Finally, food aid has historically been intensely political and subject to government influence in many ways. Arguments have been made that international food aid is used as a form of weaponized capitalism to foster international dependency on donor country goods. Recipient governments have (in some cases) the political authority to decide how to allocate food aid and shape its effects on domestic markets. One

shortcoming of this research is its lack of explanation for fundamental differences in the countries used in the analysis. It does not take into account the political, economic, or cultural differences between the countries used in the research.

7.3 Potential Extensions

There are several opportunities for additional research in regards to quantifying the effects of international food aid. As more complete data becomes available, the analysis could be done on specific goods rather than using cereals as a proxy for food aid, production, and trade. This would give better insight to the sensitivity of different goods to international food aid.

With the increased availability of micro-level data, analysis could be done on the effect food aid has on a household level. Analysis using more complete micro-level data could track the efficacy of food aid reaching those in need and give insight on an individual level on the effect food aid has on production and consumption patterns of the recipients. Additionally, as more detailed data becomes available with regards to the nutritional content of food aid deliveries on a good specific level, research could look into the effects of food aid in terms of nutritional content and its bearing on other economic indicators.

To account for differences in political and economic regimes in both donor and recipient countries, codifying certain characteristics of different countries and performing separate analysis on groups of similar countries could provide insight into additional determinants of the effects of international food aid. Several studies have grouped recipient countries based on geographical location, but not based on socioeconomic indicators such as political regime, openness to trade, social stability etc.

Finally, a potential extension could include use of multiple food aid donor countries as the dominating research in previous literature focuses on a single donor country and multiple recipients. Extending analysis to include multiple donor countries with the same recipients could provide more insight to the dynamic effects of different types of food aid in terms of production and trade patterns.

8 Conclusion

8.1 Policy Implications

Although econometric analysis of the effects of Canadian international food aid provides valuable insight into the dynamics of food aid and its implications on trade patterns, it is important to acknowledge that this research does not directly ask nor answer the most fundamental question regarding international food aid: is international food aid truly benefiting those who are food insecure and is it effective in helping developing

countries? This research, and other relevant studies in the field, assume an apolitical mechanism through which food aid is distributed within recipient countries. Essentially, a fundamental obstacle researchers face in answering the question posed by this paper is how to accurately account for differences in political motivation with regards to both donor and recipient countries. For instance, agribusiness lobbies in donor countries have incentives to promote additional international food aid to maintain certain conditions in domestic markets.

The results of this research suggest that Canadian policy makers may not want to base policy decisions on the negative impact food aid shipments from Canada could potentially have on recipient producers and markets, especially with regards to non-emergency food aid. On the other hand, this research suggests that food aid may not be the most effective way in boosting developing economies despite their reliance on agricultural growth and output. If anything, policy makers need to be cognisant of the potential negative change emergency food aid can have on trade patterns.

With a greater understanding of the effects of food aid, policy makers in donor countries beyond Canada can make more educated decisions about how best to provide aid to developing countries and countries in need of emergency relief. By decoupling political motivation and international aid, more educated decisions can be made on whether food aid is the most effective form of aid to recipient countries in need or if there are alternate channels through which donor countries can facilitate aid.

8.2 Final Remarks

Through analysis of extensive panel data of yearly Canadian shipments of emergency and non-emergency food aid using panel vector autoregression, impulse response functions, and fixed effects regression, this paper suggests that Canadian non-emergency food aid shipments have no significant effects on the kilograms per capita food production of the recipient country and food imports from Canada by the recipient country. Further, this research finds that Canadian emergency food aid shipments have a short-term negative relationship with both recipient country kilogram per capita food production and imports from Canada. However, there is not enough evidence to infer a causal relationship. In summary, this paper finds little evidence that non-emergency food aid affects recipient production or donor exports, rather that the bulk of the response in the trend of dependent variables comes from shocks in emergency food aid shipments.

9 Graphs and Tables

Figures 1-3: Data Visualizations

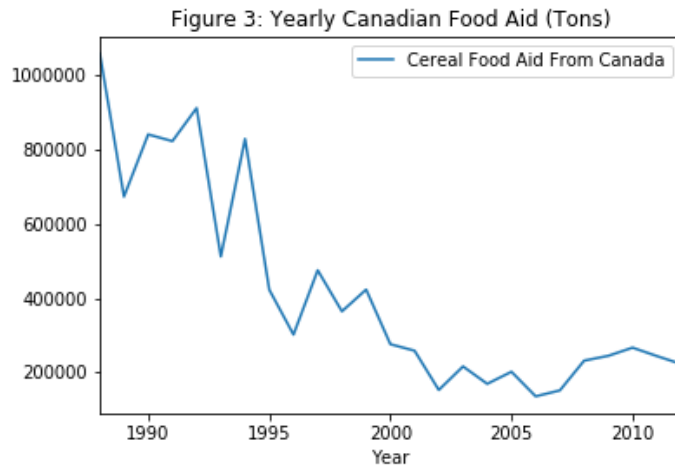
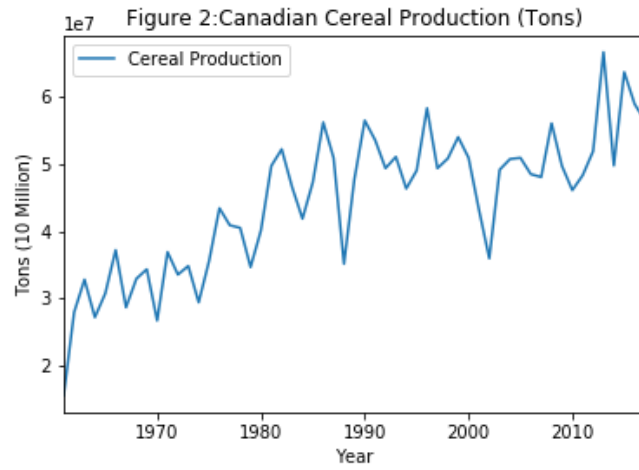
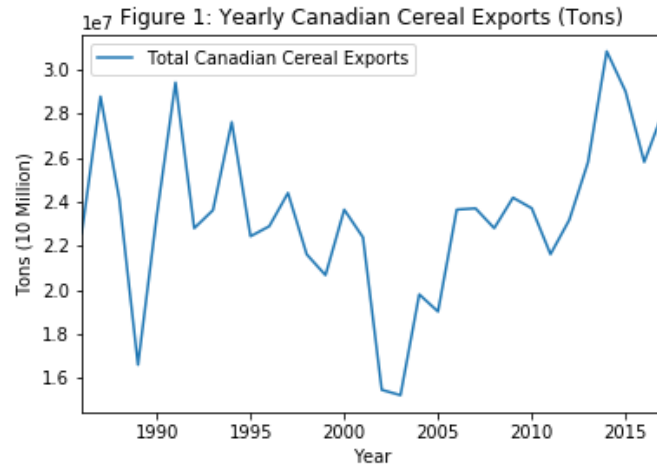


Figure 4: Impulse Response Functions Following A One Kilogram Per Capita

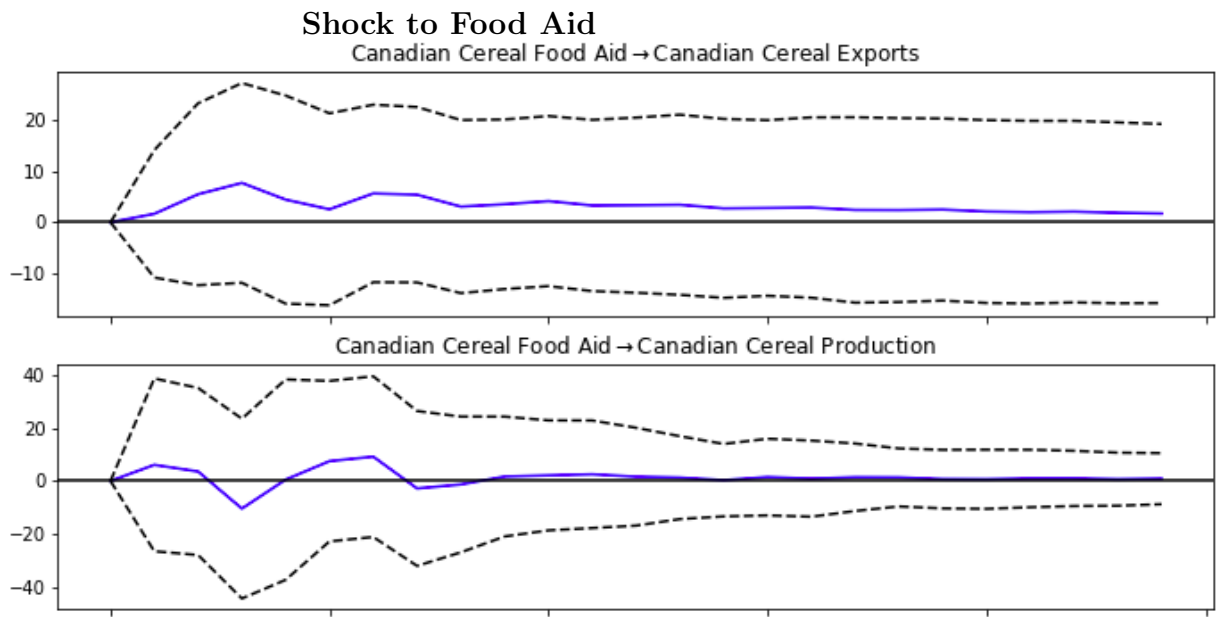


Figure 5: Recipient Country Production Response to a 1 Kilogram Per Capita Shock to Emergency Food Aid

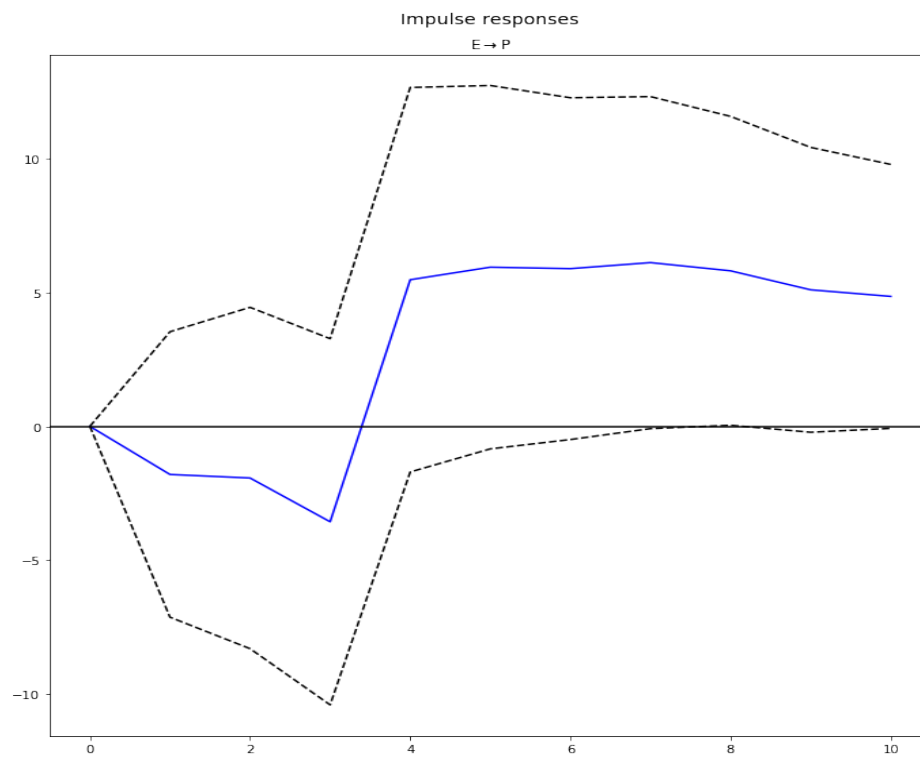


Figure 6: Recipient Country Production Response to a 1 Kilogram Per Capita Shock to Non-Emergency Food Aid

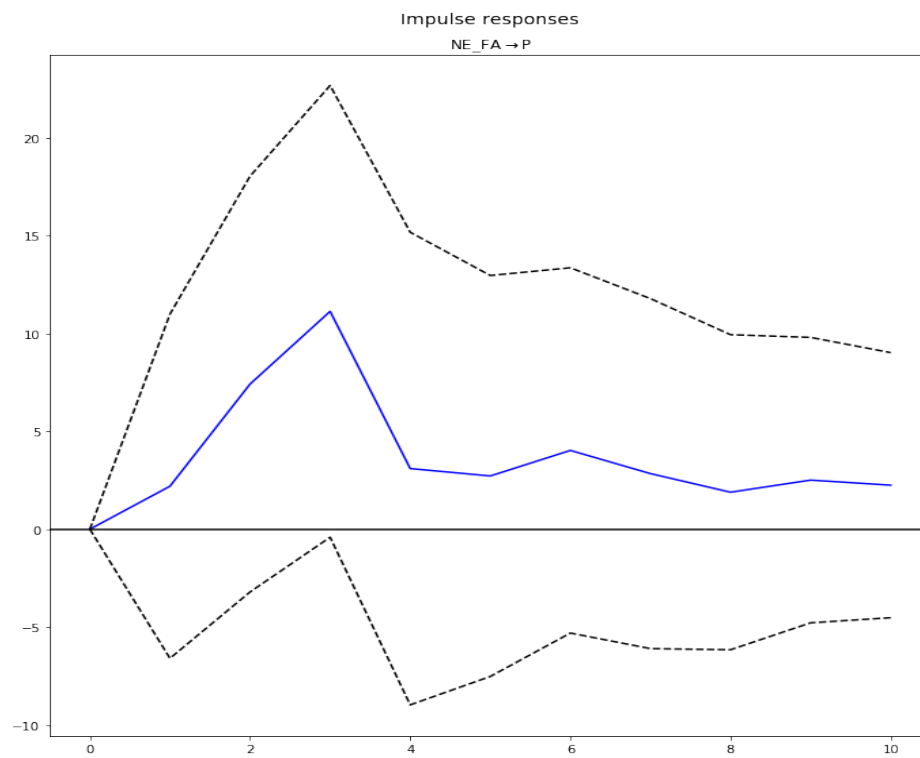


Figure 7: Recipient Country Imports from Canada Response to a 1 Kilogram Per Capita Shock to Non-Emergency Food Aid

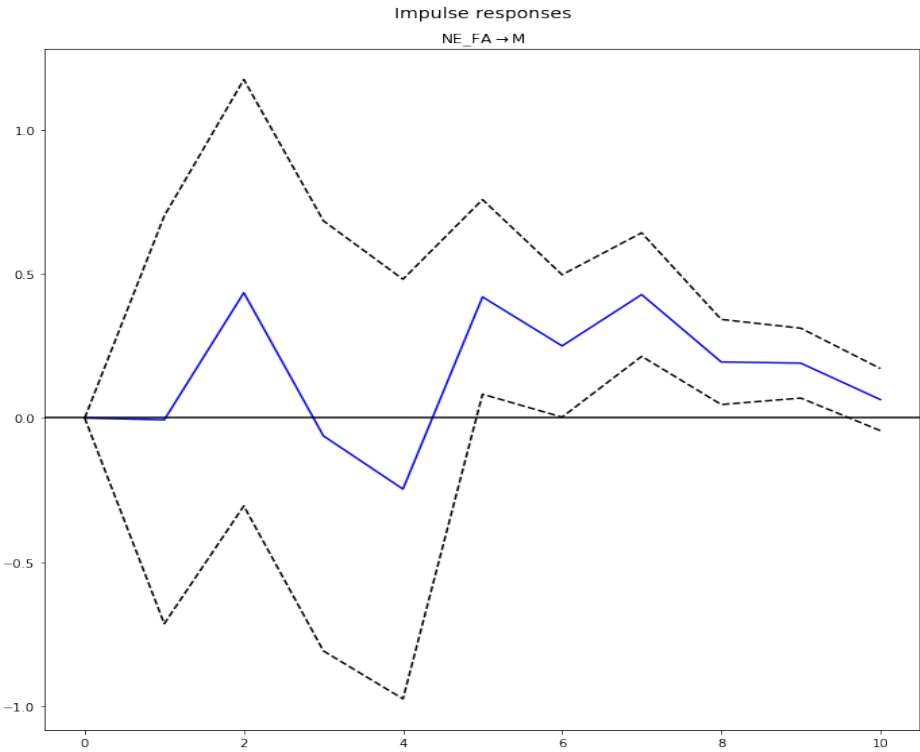


Figure 8: Recipient Country Imports from Canada Response to a 1 Kilogram Per Capita Shock to Emergency Food Aid

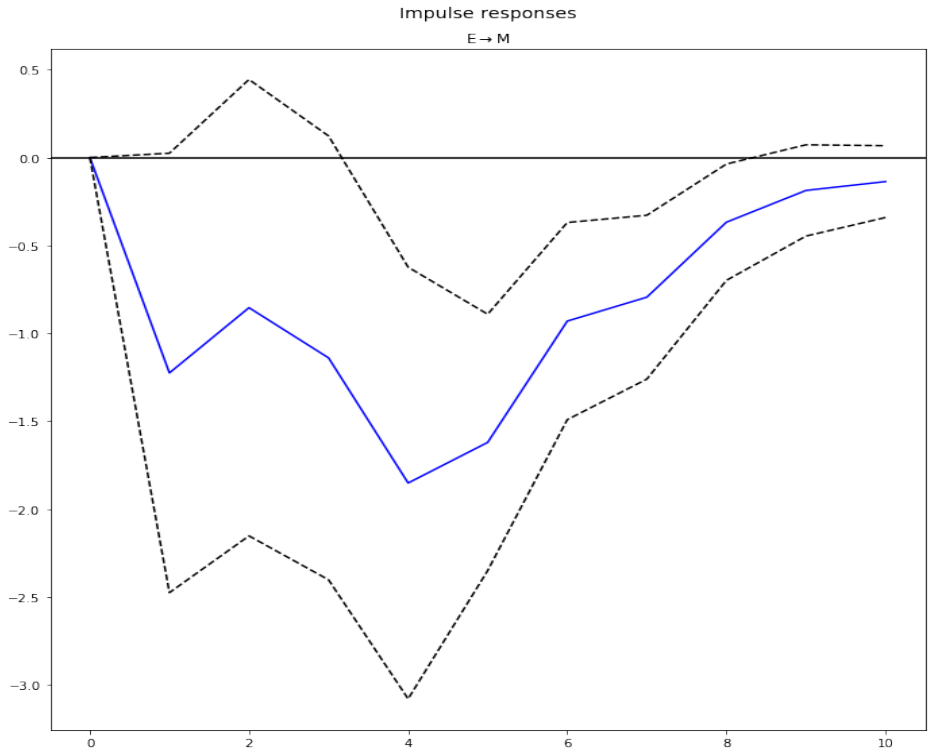


Table 1: Fixed Effect Regressions on Recipient Country Cereals Production

Dep. Variable:	P	R-squared:	0.7293			
Estimator:	PanelOLS	R-squared (Between):	0.7183			
No. Observations:	440	R-squared (Within):	0.1813			
Entities:	21	R-squared (Overall):	0.7293			
Time Periods:	29	Log-likelihood	-2572.5			
		F-statistic:	145.48			
		P-value	0.0000			
		P-value	0.0000			
		Distribution:	F(8,432)			
	Coefficient	Std. Err.	T-stat	P-value	Lower CI	Upper CI
ag_land	1.0082***	0.2062	4.8900	0.0000	0.6030	1.4134
X	-0.1074	0.1755	-0.6121	0.5408	-0.4524	0.2375
precipitation	0.0055**	0.0079	-0.6994	0.0447	0.0010	0.0100
E	-0.7467***	1.7952	-2.3277	0.0204	-3.6272	2.1338
NE_FA	7.6666	6.6000	1.1616	0.2460	-5.3055	20.639
M	-0.2046	0.3216	-0.6363	0.5249	-0.8367	0.4274
TM	-0.4362***	0.0495	-8.8209	0.0000	-0.5334	-0.3390

*p <0.1 **P<0.05 ***p<0.01

Table 2: Fixed Effect Regressions on Recipient Country Cereals Imports from Canada

Dep. Variable:	M	R-squared:	0.7210			
Estimator:	PanelOLS	R-squared (Between):	0.3620			
No. Observations:	440	R-squared (Within):	0.3160			
Entities:	21	R-squared (Overall):	0.7210			
Time periods :	29	Log-likelihood	-1752.2			
		F-statistic:	8.5176			
		P-value	0.0000			
		P-value	0.0000			
		Distribution:	F(7,433)			
	Coefficient	Std. Err.	T-stat	P-value	Lower CI	Upper CI
C	0.0449***	0.0142	3.1587	0.0017	0.0169	0.0728
E	-2.1800*	1.3639	-1.5983	0.0907	-4.8606	0.5007
NE_FA	0.6171	1.0220	0.6039	0.5462	-1.3915	2.6258
Price Index	0.0364***	0.0139	2.6123	0.0093	0.0090	0.0637
P	-0.0157***	0.0068	-2.2972	0.0221	-0.0291	-0.0023

*p < 0.1 **P < 0.05 ***p < 0.01

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