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Embrace or Not? An Empirical Study of the Impact of Globalization on the Country's Sustainability in the Case of NAFTA

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Received: 21 August 2018; Accepted: 24 September 2018; Published: 26 September 2018

Abstract: This paper investigates the international trade role in economic development and sustainability. Specifically, a trade agreement is one of the most popular ways for a country to participate in trade, therefore we aim to estimate the relationship between a free trade agreement (FTA) and economic development on a country level, using the North American Free Trade Agreement as an example. Sustainability on an industrial level is also discussed in parallel. To achieve this, a counterfactual analysis is used to generate the welfare with and without the trade agreement to draw inference on the sustainability analysis. We find that the FTA does facilitate a country's sustainability. However, it is less clear on an industrial level. This finding provides important evidence relating to a country's sustainable development and has broadened the study scope regarding the impact of participating in an FTA with regard to economic sustainability.

Keywords: international trade; sustainability; economic development; NAFTA; FTA

1. Introduction

With the proliferation of globalization, growth sustainability at the country level has become a major concern. This concern comes from the fact that exposure to the global market may pose a threat to the local economic development since the driving force for development may not be applied in this country. Specifically, there are three factors stimulating economic growth sustainability, resources such as relatively cheap labor, capital, and land cost which are critical to the economic development, efficiencies in areas such as the economic scales, comparative advantage, and specialization also serve to be an important element of development [1,2]. Lastly, innovation such as the diffusion of technology is the third element which drives the economic growth sustainability [3]. In the context of globalization, countries are closely connected, and the decision regarding who should provide resource usage and who should provide innovation really depends on their comparative advantage. In this case, the indigenous effort in innovation and resources will not be promoted as a country will sacrifice their own development and instead focus on a global production system. This phenomenon would hamper the country's own economic development [4–6]. However, others believe it is better for a country to adapt with the globalization and therefore pursue a sustainable development for both the global economy and individual economy due to better access to the global market and the greater number of technology sources available [7]. Moreover, trade can facilitate integration with resources and innovation [8,9]. The relationship between economic development and globalization is complex and ambiguous [10]. For example, studies vary in terms of the impact of trade restriction on the growth sustainability, they show the relationship is not straightforward, especially for the developing economy, and the trade resistance may indeed promote the economic development [11–13]. So far, whether embracing globalization is conducive to the economic growth is still uncharted.

The literature regarding the trade and economic development are twofold. Papers extensively investigate this effect by regressing a variety of cross-country growth factors on an independent variable such as trade openness or trade policy to capture the causal relationship between trade liberalization and growth [14–18]. However, the difficulties are; first, it is difficult to measure the openness, different researchers tend to use a different measurement, making the result inconclusive. Second, the ordinary least squares (OLS) method tends to underestimate the effect due to the endogeneity of growth, such as geographical characteristics, with different countries having their own endogenous factors [19–21]. Third, Rodriguez and Rodrik also showed that even allowing an instrument variable (IV) to account for the endogeneity, another issue of robustness arises due to the limited sample size of world country data [22]. In addition to this, existing papers mentioned above examine the relationship between trade and growth rigorously. However, this relationship has not been investigated extensively when it comes to the FTA effect on growth. Undeniably, an FTA is a principal channel through which the country participates in the international trade and is also critical to economic growth, which is one of the major reasons countries participate in it.

Moreover, recent years have seen a rise in the importance of FTAs along with a worldwide escalation in trade tension, see Appendix A. For instance, the USA now imposes tariffs on steel and aluminium imports from NAFTA member countries, resulting in retaliation from these countries [23]. The EU and the USA have also reconsidered their wider economic relationship in terms of tariff cuts on steel and aluminium [24]. Furthermore, concerns about a potential trade war still exist between the USA and China [25,26]. FTA's critical role in economic growth combined with its associated trade tension motivate us to understand whether FTAs improve welfare. Namely, whether FTAs are conducive to economic development and sustainability.

The effect of removing multilateral trade restrictions on growth is another strand of the literature. Tariff rate is a good representation of the trade barrier, and the current literature has not reached a consensus regarding the relationship between tariff rate and growth [15–17,20,27–29]. They fail to identify a strong effect and Rodriguez and Rodrik point out a limitation is that they tend to disregard the heterogeneity in both size and economic level [22]. Furthermore, Park argues that a country with a similar trade openness may experience a diverse economic growth, because it may also depend on the characteristics and openness of their corresponding trade partners [30].

In this paper, we study the FTA's role in economic development and sustainability in the case of the North American Free Trade Agreement (NAFTA). Particularly, we identify the relationship between FTA and economic development by comparing the current member countries' welfare and the potential welfare if the FTA no longer exists. NAFTA provides us with a great example to analyze the global trade impact on sustainability; firstly, NAFTA is one of the most politically contentious trade agreements, studying the role of NAFTA on a country's development and sustainability can provide representative insights regarding FTA and it serves as a compelling setting to study this effect. Secondly, this is an agreement between a developing country and developed countries; therefore, three critical driving forces mentioned above such as resources, technology, and efficiency are more likely to be diverse, which provides us with a great opportunity to analyze whether the country should prioritize indigenous development or embrace globalization to achieve a better and sustainable economy. Thirdly, unlike the conventional approach, by mainly focusing on three countries with more detailed data, our study does not suffer from the endogeneity issue or robustness concern prevalent in the current literature.

We find that the termination of NAFTA would be detrimental to all the member countries. We also find that Mexico would experience considerable losses whereas the USA would witness the smallest losses. Specifically, the welfare loss for the USA represents 7.5% of the total manufacturing output, the welfare loss for Canada represents 9.0% of total manufacturing output, and the welfare loss for Mexico accounts for 11.8% of the total manufacturing output. This finding is strong evidence that an FTA facilitates the economic development on a country level. Therefore, participating in an FTA ensures long-term sustainability since there is an adverse consequence among member countries in the absence of an FTA. In addition, the welfare impact on an industrial level varies, some industries will gain while others lose. Overall, we take the view that firms should embrace the international trade and prioritize the globalization process to boost their country's economy and sustainability.

This study contributes to the existing literature in several ways. Firstly, to the best of our knowledge, this study is one of the few to investigate the relationship between a Free Trade Agreement and a country's economic development and sustainability. We achieve this via the empirical estimation of the potential welfare for NAFTA members by assessing the withdrawing effect of NAFTA. Then, a country's potential welfare is used to compare with their current welfare to draw conclusions on an FTA's impact on sustainability, because an increase in welfare is essential for a country's overall sustainable development. Secondly, by investigating the welfare impact at a more disaggregated level, we can better understand the industrial-level welfare change in response to the trade shock. This analysis can provide valuable insights regarding the future design of trade agreements and implications to ensure sustainability on an industrial level. For example, by looking at the industries that are vulnerable to trade shock and the industries that benefit from trade shock, we can measure the consequence and design certain transfer payments to help those industries that are in difficulty recover. This can contribute to trade and economic development literature. Thirdly, this paper not only addresses the relationship between trade and economic development but also sheds light on whether a trade agreement is a building block or stumbling block towards multilateralism. Bhagwati introduced this phenomenon and pointed out that there are two kinds of effects [31]. First, an FTA can foster the integration between countries by including more countries in trade. This potentially facilitates further global trade liberalization in line with the goal of the World Trade Organization (WTO). On the other hand, an FTA can inhibit multilateral trade liberalization if this trade agreement focuses primarily on liberalizing between member countries and thus diverts trade from non-member countries to member countries. An FTA can do this by setting up entry barriers to prevent other globally low-cost producers from participating, resulting in discrimination and therefore a stumbling block towards multilateralism. As Krueger states, economists have not reached a consensus on how FTAs affect global trade liberalization [32]. We can gain insight into the merits of FTAs by looking at what the effects could be if NAFTA falls apart. Specifically, our counterfactual welfare estimation can be compared with the current welfare to suggest FTAs' compatibility with the WTO's goal of further multilateral liberalization [33]. We can achieve our goal to identify the trade agreement's role towards multilateralism. If our finding indicates that there will be a decline in the welfare level for the economy when NAFTA falls apart, it is equivalent to conclude that in the presence of an FTA, the trade creation effect outweighs the trade diversion effect, and the overall effect is beneficial to the economy. This provides evidence of the FTA's building-block role towards multilateralism since each country is better off by participating in an FTA.

The remainder of the paper is organized as follows: Section 2 gives an overview of the method and characterizes the data. Section 3 presents the result. Section 4 discusses the results. This paper concludes in Section 5.

2. Materials and Methods

2.1. Methodology

Whilst the existing studies have been limited, there has been some research related to the counterfactual analysis of withdrawing from trade agreements. Caliendo and Parro approach the same kind of questions in the context of MERCOSUR (this refers to the South American trade block including Argentina, Brazil, Paraguay, and Uruguay.) [34]. They quantify the counterfactual effect of MERCOSUR collapse on welfare, real wages, sectoral exports, and labor reallocation. We would also use the highly-disaggregated level data, adopt the welfare estimation strategy described by Romalis, and estimate the NAFTA effect on member countries in the welfare perspective [35]. A similar paper to that by Donaldson applied a general equilibrium model to estimate the welfare in the context of India's transportation costs, but they applied the Eaton and Kortum model instead [36,37].

Trade elasticities, import demand elasticity, and export supply elasticity, are calculated first because the interplay between them allows for identification of the impact of tariff changes on price and welfare. These parameters are essential to evaluate the welfare gains in the trade policy literature [38]. For simplicity and tractability, we employ the Armington assumption and a constant elasticity of substitution (CES) framework to derive the demand and supply elasticities [39]. In terms of econometric strategy, in addition to the fixed-effect estimators employed for deriving the elasticities, we also use a two-stage least squares (2SLS) for the supply elasticity calculation. The reason behind this is to control for the attenuation bias in the supply equation. This 2SLS strategy is also adopted from Romalis [35]. Nevertheless, we extend his paper by allowing differences in both demand and supply elasticities. With the comprehensive and disaggregate trade and tariff data, we can account for the heterogeneity in elasticities' estimates by breaking them down on a 2-digit industry level, which includes 16 industries.

With these parameters in hand, we can estimate the welfare impact of the withdrawal from NAFTA on all member countries. One country's aggregate price level is used to represent the welfare of a country under the Dixit-Stiglitz framework [40]. Hence, the welfare impact of withdrawing from NAFTA is generated by comparing the current and counterfactual aggregate price level for the USA, Canada, and Mexico, respectively. The industrial-level welfare can also be generated by aggregating the price changes of corresponding commodities. The challenge here is to calculate the counterfactual price level. When the NAFTA falls apart, there will be an increase in the tariff rate because the rate under NAFTA no longer applies. In this paper, we apply the most favored nation (MFN) rate as the benchmark counterfactual tariff rate for countries leaving NAFTA, while the preferential rate still holds for the remaining countries still in NAFTA. In terms of econometric strategy, to identify the new counterfactual aggregate price level, we employ an identical iterative process developed by Romalis to generate the counterfactual aggregate price level index [35].

2.2. Data Description

2.2.1. Tariff Rate Data

Tariff rates are available at the World Bank's Integrated Trade Solutions (WITS) (see: https://wits.worldbank.org) website Trade Analysis and Information System (TRAINS) database. The data is available from the years 1988 to 2016. To obtain the time series tariff rate, we extract each country's data in each year and append them together for our purpose. Tariff schedules including MFN rate (MFN rate: MFN tariffs are what countries impose on imports from all other members of the WTO, the rate should be unified) and preferential tariff (PRE) rate (PRE rate: The preferential rate is imposed only among certain trade agreement members as a preferential treatment). There are two ways of measuring these rates; the ad valorem equivalent (AVE) method has been used because it provides a more straightforward way to identify the total tariff associated with each product by simply multiplying the rate with the trade value. For the PRE rate, the partner code indicates different partners the importing country faces for each commodity each year. These partners consist of both country code and region code. For region code, by using the preference beneficiaries file available on the WITS website, we trace out all the member countries for each region and apply this tariff to all the member countries. For the rest of them, we match these country codes with the ISO Alpha-3 country codes, which are internationally recognized codes that designate for each country. Furthermore, a country code list is used to identify the partner country. When there is a preferential agreement rate for bilateral trading countries, we will refer to the PRE-AVE rate to assign the tariff rate between them to truly represent the tariff effect. In addition, occasionally there are some extremely high tariff rates occurring. For example, the maximum value that is shown in Table 1 is 800%. We control this by replacing the extreme values with the 99% percentile value, which results in a new "maximum" value of 35%.

For the counterfactual tariff rate, after withdrawing from NAFTA, we assume the withdrawing country could re-impose the tariff rates established prior to NAFTA, being the MFN rate, which is applied to all countries who are involved in World Trade Organization (WTO) but do not participate in a Preferential Trade Agreement (PTA). This rule forms the base for our counterfactual analysis, and we assume that after they withdraw from NAFTA the MFN rate will be re-imposed, and it is this rate that represents the counterfactual-level tariff rate.

Table 1 shows certain statistics regarding the tariff rate from the sample. The values are simply calculated by taking the average. The difference between the MFN rate and the actual rate captures the preferential treatment applied in the NAFTA countries. As can be seen from the table, the NAFTA member countries impose a much larger effect on the tariff rate. The standard deviation is also large, indicating there is a significant dispersion among each International Standard Industrial Classification code (ISIC) industry.

Table 1. Tariff rate statistics.

Variable	Mean	SD	Min	Max	p25	p50	p75	p99
MFN rate	6.560	13.04	0	800.3	1.450	5	8	35.00
Actual rate	0.0500	1.180	0	156.8	0	0	0	0

2.2.2. International Trade Data

International trade data for the world are categorized according to the Harmonized System. This consists of a six-digit code, with approximately 5000 products. The comprehensive annual trade data can be collected from The United Nations Commodity Trade Statistics Database (UN COMTRADE) (see: https://comtrade.un.org). It contains detailed annual trade data for around 200 countries or areas in the world from 1962 to the most recent year. The trade data provides years, reporter, partner countries with their corresponding ISO country codes, the supplementary quantities, and total trade values. We retrieve both the import and export trade flow data for each of the countries so that the Free on Board (FOB) price, where the importer assumes the liability for transportation, is generated from the import trade flow while the Cost, Insurance, and Freight (CIF) price is attained from the export trade flow. Additionally, we use the dataset from Caliendo, Feenstra, and Romalis' NBER datasets to obtain the international trade data [41]. We collect these latest datasets from 1989 to 2013 for each country in 6-digit Harmonized Coding System (HS) levels. This period has more complete data both for trade and tariff data. The panel structure is essential to control for countries' fixed effects, with 39,505,630 observations overall.

We further group the commodities into 16 aggregate levels to capture industry heterogeneity. This is done by referring the product concordance to match HS-6 code with the International Standard Industrial Classification code (ISIC) Revision 3, a classification standard to classify the economic activities, the ISIC table can be seen online (https://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=2). This allocates each of the goods to a corresponding industry at the ISIC-4-digit level. Then, according to the hierarchy of ISIC system form, there are a total of 17 industries, A to Q, with many sub-industries at the 2-digit level. Excluding services sectors which are normally non-tradable, it leaves 16 industries to trace (see Appendix B for detailed information on the 16 ISIC industries.). Further data including product concordance between ISIC and HS-6 and the share of export to Gross Domestic Product (GDP) are made available in WITS and the trade share of GDP can be obtained from World Bank Open Data.

2.3. Model

We assume a monopolistic competitive market. The commodity price simply equals its marginal cost multiplied by constant markups. Countries can levy a tariff rate on trading products, and different trading partners are subject to a different tariff rate, depending on the trade agreement. The representative consumer's utility for country j imports and consumes a range of variety k from exporting country i is expressed in the CES framework:

$$U_j = \left(\sum_i \int_0^K a(k)_{ij}^{\frac{1}{\sigma}} q(k)_{ij}^{\frac{\sigma-1}{\sigma}} dk \right)^{\frac{\sigma}{\sigma-1}} \tag{1}$$

σ is the elasticity of substitution, and $a(k)_{ij}$ is a preference shifter among the k goods, $q(k)_{ij}$ is the country j's quantity of good k imported from country i. A country j's total expenditure constraint is given by:

$$\sum_i \int_0^K q(k)_{ij} p(k)_{ij} = E_j \tag{2}$$

E_j is the total expenditure in country j, $p(k)_{ij}$ is the importing price from i to j. Solving the consumer's utility maximization problem subject to the expenditure constraint, Equation (2). We can obtain the Marshallian demand for commodity k:

$$q(k)_{ij} = a(k)_{ij} p(k)_{ij}^{-\sigma} E_j P_j^{\sigma-1} \tag{3}$$

The value of total trade is just to multiply quantity (3) with price to match our dataset:

$$V(k)_{ij} = a(k)_{ij} p(k)_{ij}^{1-\sigma} E_j P_j^{\sigma-1} \tag{4}$$

2.3.1. Empirical Strategy for Demand Elasticity

FOB price is used in the dataset, so we rewrite Equation (4) by including the transport cost and tariff rate in the importing goods' price:

$$V(k)_{ijt} = \frac{a(k)_{ij} p(k)_{it}^{1-\sigma_k} \tau(k)_{ijt}^{1-\sigma_k} g(k)_{ijt}^{1-\sigma_k} E_j}{P_{jt}^{1-\sigma_k}} \tag{5}$$

$V(k)_{ijt}$ is the trade value for commodity k between country i and j at time t. We take the log of trade Equation (5) and treat the country's price index P_{jt}, expenditure $E(k)_{it}$, commodity price $p(k)_{it}$ and transport costs $g(k)_{ijt}$ as fixed effects. Under a constant elasticity of substitution (CES) framework with Dixit-Stiglitz setting [40]. The demand elasticity can be generated by Equation (6):

$$lnV(k)_{ijt} = lna(k)_{ij} + (1-\sigma_k) lnp(k)_{it} + (1-\sigma_k) ln\tau(k)_{ijt} + (1-\sigma_k) lng(k)_{ijt} + lnE(k)_{jt} - (1-\sigma_k) lnP_{jt} \tag{6}$$

An identification issue is the measurement error in the price level, but the rich bilateral trade data enables us to pin down the demand elasticity, because FOB unit prices are assumed to be constant for each destination an exporter country sells to, and the price can be eliminated by a fixed-effect estimator.

Another challenge is that expenditure, preference shifter, and price-level data are not available at the HS-6 commodity level. We use the time variation in the panel data and treat the country's price index P_{jt}, expenditure $E(k)_{jt}$ as a constant within the country by including a set of fixed effects. The commodity price $p(k)_{it}$ is controlled by including the fixed effect D_{ikt}. Furthermore, transport costs $g(k)_{ijt}$ and preference shifter between two countries are absorbed by country-pair fixed effects. While ϵ_{ijt} is an error term and is assumed to be orthogonal to the tariff rate. We write Equation (6) to generate demand elasticity at an industrial level:

$$lnV(k)_{ijt} = D_{ikt} + D_{jkt} + D_{ijt} - \sigma ln\tau(k)_{ijt} + \epsilon_{ijt} \tag{7}$$

$V(k)_{ijt}$ is the trade value of good k from exporting country i to importing country j at time t. $\tau(k)_{ijt}$ is the ad-valorem tariff imposed by country j at time t. By running regressions for each ISIC industry separately, we can control for the fixed effect of good k. For the fixed effect D_{ikt}, D_{jkt}, and D_{ijt}, the econometric strategy is to employ a linear regression with a large set of dummy variables.

2.3.2. Empirical Strategy for Inverse Supply Elasticity

Industrial production is also characterized by an upward sloped supply curve, the equilibrium prices and trade volumes are then determined by both demand and supply curves. For supply elasticities, we will parameterize the inverse supply elasticity η_k for each ISIC industry and account for the fixed effects in the Equation (8):

$$lnp(k)_{it} = \eta_k lnq(k)_{it} + ln\hat{P}_{it} + D_{it} + D_{ik} + \epsilon_{ikt} \tag{8}$$

where $p(k)_{it}$ is the price of good k in exporting countries, $\hat{P}_{it}$ is the aggregate price index in country i. Two fixed effects are used, D_{it} is a country-by-year fixed effect, and D_{ik} is a country-by-product fixed effect. ϵ_{ikt} is a random supply shock.

For the supply elasticity, we use the supply trade data where CIF price is used. Commodity prices are not available in the data, so we divide total CIF value for each commodity by the quantity they export for each product k at time t to all importing countries. The new Equation (9) is then:

$$ln\frac{V(k)_{it}}{q(k)_{it}} = \eta_k lnq(k)_{it} + ln\hat{P}_{it} + D_{it} + D_{ik} + \epsilon_{ikt} \tag{9}$$

Econometric identification issue is an attenuation bias due to the fact the quantity of good supplied not only appears in the dependent variable but also shows in the independent variable. This means they are negatively correlated so that the elasticity of supply tends to be underestimated. To overcome this issue, we re-estimate the inverse supply elasticity using the tariff rate as an instrument; the tariff rate is exogenous to the error term in the sense that it is not related to the supplier's cost. The $q(k)_{it}$ in Equation (9) can be rewritten as $q(k)_{it} = \sum_j q(k)_{ijt}$. By substituting this into the Equation (9) and add and subtract the same value,

$$ln\frac{V(k)_{it}}{q(k)_{it}} = \eta_k[ln\sum_j q(k)_{ijt} - lnq(k)^S_{ijt} + lnq(k)^S_{ijt}] + ln\hat{P}_{it} + D_{it} + D_{ik} + \epsilon_{ikt}$$

And therefore, the model for estimation is:

$$ln\frac{V(k)_{it}}{q(k)_{it}} = \eta_k[-ln\frac{q(k)^S{}_{ijt}}{\sum_j q(k)_{ijt}} + lnq(k)^S_{ijt}] + ln\hat{P}_{it} + D_{it} + D_{ik} + \epsilon_{ikt} \tag{10}$$

$ln\frac{q(k)^S{}_{ijt}}{\sum_j q(k)_{ijt}}$ is just the share of country i's total product that is exported to country j. $lnq(k)^S_{ijt}$ is the same as $lnq(k)^D_{ijt}$. The $lnq(k)^D_{ijt}$ can be instrumented by the tariff rate which can be derived from Equation (3), we take the logarithm and derive:

$$lnq(k)^D_{ijt} = lna(k)_{ij} - \sigma_k lnp(k)_{it} - \sigma_k ln\tau(k)_{ijt} - \sigma_k lng(k)_{ijt} + (\sigma_k - 1)ln\hat{P}(k)_{jt} + lnE(k)_{jt}$$

For relevance, the quantity can be instrumented by the tariff rate because the quantity of country i export to country j is simply equal to country j import from country i. Hence, tariff can affect the quantity demanded without affecting the price level, and we can avoid inputting the quantity of good supply into the right-hand side of the Equation (9) and eliminate the attenuation bias.

2.3.3. Welfare Estimation

We use the aggregate price index from Equation (11), interpreting this as a welfare measure of a given country. This aggregate price index is the weighted aggregate of the Dixit-Stiglitz price index for each industry or commodity, where weights are Cobb-Douglass coefficients and are consumption shares of these commodities. We can achieve this price level by inputting the latest year trade data, demand elasticity, and each commodity consumption share of the total expenditure in country j.

$$\hat{P}_{jt} = \prod_k \left[\sum_i \left(c_{ijt} g_{ijt} \tau_{ijt}\right)^{1-\sigma_k} \right]^{\frac{a(k)_j}{1-\sigma_k}} \tag{11}$$

Simply inputting the new tariff rate and other available data into Equation (11) is subject to mistakes because, in a dynamic international trade context, the tariff change only captures the partial price index change. To elaborate, when the tariff changes, not only the commodity price but also the industry price index, as well as the aggregate price index, can be altered at the same time. More importantly, the new price indexes could also determine a new commodity price level. To capture this dynamic process, it is better to perform an iteration to finalize the equilibrium counterfactual prices and price indexes' level; four steps are included:

Step 1:

With the latest trade data and tariff rate for each HS-6 level commodity, we take the difference between the actual tariff rate and the MFN rate to represent the changes in tariff rates in a counterfactual scenario. We use the changes in the tariff rate to approximate an initial value impact on changes in the commodity's price level $dlnp(k)_{it}$, holding price level constant. The changes in commodity prices reflect only a partial effect because we hold the other parts fixed.

Step 2:

We further calculate the changes in country i's aggregate price index and changes in importing country's industry price index separately. Specifically, we use the Dixit-Stiglitz price index and differentiate it to get changes in industrial price index:

$$\hat{P}(k)_{jt} = \left(\left(\sum_i c_{ijt} g_{ijt} \tau_{ijt} \right)^{1-\sigma_k} \right)^{\frac{1}{1-\sigma_k}} \tag{12}$$

Step 3:

We plug in the new value for changes in commodity prices, changes in industrial and aggregate price indexes calculated above in Equation (12), holding income as fixed for now. New changes in commodity prices are generated in this way; they account not only for the tariff changes but also for the price index changes. Iterating steps 2 and 3 many times until all the variables $dlnp(k)_{it}$, $dln\hat{P}(k)_{jt}$, and $dln\hat{P}(k)_{it}$ converge to zero, which represents an equilibrium level of $p(k)_{it}$, $\hat{P}(k)_{jt}$, and $\hat{P}(k)_{it}$. The detailed derivation can be seen in Appendix C.

$$dlnp(k)_{it} = \frac{\eta_k}{1+\eta_k\sigma_k} \sum_j \left[-\phi(k)_{ijt}\sigma_k dln\tau(k)_{ijt} + \phi(k)_{ijt}(\sigma_k - 1) dln\hat{P}(k)_{jt} \right] + \frac{dln\hat{P}_{it}}{1+\eta_k\sigma_k} \tag{13}$$

Step 4:

We generate the new income for one country and plug in the new changes in income into Equation (13) to get the new commodity prices. Accordingly, the new price will cause new changes in the price index and changes in income via steps 2 to 4. By iterating steps 2 to 4 many times, we can finally pin down the equilibrium counterfactual value of all the variables of interest. The iteration steps are summarized below in Figure 1:

$$dlnp(k)_{it} = \frac{\eta_k}{1+\eta_k\sigma_k} \sum_j \left[-\phi(k)_{ijt}\sigma_k dln\tau(k)_{ijt} + \phi(k)_{ijt}(\sigma_k - 1) dln\hat{P}(k)_{jt} + \sum_j \phi(k)_{ijt} dlnY_{jt} + \frac{1}{\eta_k} dln\hat{P}_{it} \right] \tag{14}$$

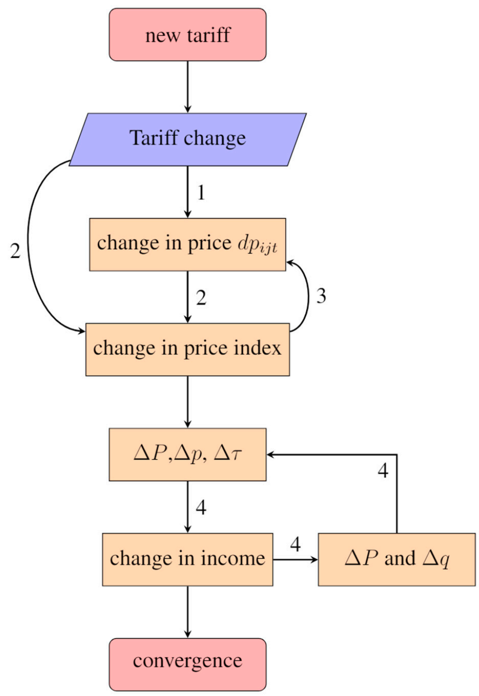

Figure 1. Iteration process.

3. Results

The demand and supply elasticities for welfare calculation purposes are summarized in Table 2. For demand elasticity, there is a large variation between sectors, in the range of 2 to 10.97. The median elasticity is around 4.7, which is close to the result of Head and Ries, Hertel, and Romalis [35,42,43]. High values of elasticities indicate that individuals are likely to substitute between goods from different sources, such as the mining industry, agricultural industry, and the hunting and fishing industries Some industries also exhibit a lower demand elasticity, such as the manufacturing of textiles, and manufacturing of food products and tobacco in which individuals are less likely to substitute between sources. For supply elasticity, the median inverse elasticity is 0.32; this means a 1% increase in the quantity imported in this industry is associated with a 0.32 percent increase in the export price. In this case, the supply curve is relatively elastic. Compared to Broda's result, their mean elasticity for supply is 0.85 while our estimation mean is about 0.3 [44]. One possible explanation is that a greater number of countries and more recent updated data have been used in our paper, whereas they estimate 15 non-WTO countries with a less disaggregated commodity code level (HS-4) during the period from 1994 to 2003. Soderbery discusses the potential source of bias given a smaller panel sample to estimate the supply elasticity [45].

Table 2. Demand and supply elasticities.

Industries	σ	η
1	10.51	0.21
2	10.97	0.33
3	2	0.34
4	2	0.30
5	2.07	0.44
6	6.79	0.17
7	8.60	0.32
8	2	0.40
9	3.28	0.25
10	2	0.35

Table 2. *Cont.*

Industries	σ	η
11	6.88	0.34
12	6.09	0.28
13	6.60	0.18
14	3.15	0.23
15	3.23	0.38
16	7.06	0.19

3.1. Country Level

Plugging in the demand and supply elasticities and the trade data into the model, we find that all the member countries experience losses. In Table 3, the greatest loss would be accrued by Mexico if the NAFTA was withdrawn, reflecting a manufacturing output loss of 11.8%, followed by Canada, reflecting a manufacturing output loss of 9.0%, whereas the lowest loss would be observed in the USA, reflecting a loss in the manufacturing output of 7.5%. Welfare is a good proxy for the economic development and sustainability of a country, for example, if there is a decrease in welfare, the persistence of sustainability cannot be achieved. Theoretically, by comparing the welfare change before and after the FTA effect, we can draw a conclusion regarding the FTA effect. From the result, we are convinced that trade liberalization through FTA plays an essential role in obtaining a sustainable economy. Namely, leaving FTA makes the member countries worse off; this also threatens the sustainability of the economy on a country level. Our finding is also consistent with the previous disintegration case. For example, Gros shows there are negative economic consequences associated with a lack of free trade; specifically, the disintegration of the former Soviet Union lead to one such undesirable result, where the GDP declined by half over a ten-year period [46].

Table 3. Changes in welfare.

Country	Welfare Change
United States	−7.5%
Canada	−9.0%
Mexico	−11.8%

3.2. Industry Level

In this section, we further investigate how the FTA would affect the economic sustainability at a more disaggregated level; therefore, we decompose the welfare into 16 industries for each member country. Not all industries suffer a loss due to the termination of NAFTA. Gains and losses occur simultaneously but the net effect is consistently negative. Indeed, there has been a substantial heterogeneity in gains or losses from trade, but on average the losses outweigh the gains.

It is clear to see from Table 4 that the industries that are most affected for the USA are the tanning and dressing of leather industry, agriculture, hunting and fishing, and the manufacture of paper and publishing. Specifically, the tanning and dressing of leather industry accounts for 52.7% losses in its total production. Canada also loses the most in the agricultural industry, paper publishing industry, and the manufacture of machinery and equipment industry. Similarly, the largest losses for Canada amount to 64.2% of its agriculture, hunting and fishing total output. In contrast, the most affected industry in Mexico is the manufacturing of motor vehicles and transport equipment, followed by the manufacturing of machinery and equipment, and the manufacture of basic and fabricated metals. The motor vehicles manufacturing industry accounts for 29.3% of the total export value. This industry's export share value is so significant that the major impact to this industry would be the main cause of aggregate welfare loss in Mexico.

4. Discussion

4.1. Discussions and Implications

Specifically, in the USA, it is clear to see from Table 4 that the most affected industries without FTA are the tanning and dressing of leather industry, agriculture, hunting and fishing, and the manufacture of paper and publishing industries. These are the industries that would have been less sustainable in the absence of FTA, so FTA indeed enhances the sustainability of these three industries, particularly. On the contrary, the mining and quarrying industry exhibits a significant positive welfare change of 34.34%, without FTA there is a considerable increase in this industry, indicating that the sustainability of this industry is threatened with FTA. In addition, the rest of the industries with small changes in absolute value suggest that industries are quite stable and sustainable regardless of the presence of an FTA or not.

Table 4. Welfare changes by countries and industries.

Industries	**△Welfare**		
	USA	Canada	Mexico
Agriculture of Hunting and Fishing	**−38.76**	**−64.16**	14.87
Mining and quarrying	34.34	10.82	4.72
Manu. of food products and tobacco	4.21	5.10	17.69
Manu. of textiles and wearing appeal	2.01	2.16	1.98
Tanning and dressing of leather	**−52.71**	−6.49	−6.46
Manu. of wood	−5.47	−8.46	−1.69
Manu. of paper and publishing	**−26.07**	**−22.93**	26.05
Manu. of coke, refined petroleum products and nuclear fuel	1.81	3.25	15.30
Manu. of chemicals and chemical products	−8.08	−5.61	−5.60
Manu. of rubber and plastics products	−9.15	−5.05	−3.40
Manu. of other non-metallic mineral products	3.86	4.72	5.07
Manu. of basic and fabricated metals	−4.41	−2.37	**−8.70**
Manu. of machinery and equipment not elsewhere classified (n.e.c.)	5.65	**−53.77**	**−9.70**
Manu. of electrical and computing machinery and apparatus n.e.c.	−1.92	−1.73	−2.00
Manu. of motor vehicles and transport equipment	−1.62	−1.65	**−42.70**
Manu. of furniture and recycling	4.29	5.38	2.12

Note: the value is expressed as percentage change. The three largest welfare impacts are denoted in bold style. Manu. means manufacture.

In Canada, we observe a similar pattern. The most affected industries without FTA are the manufacturing of machinery and equipment, agriculture of hunting and fishing, and manufacturing of paper and publishing. FTA in this sense strengthens the economic sustainability for these industries. Noticeably, the paper and publishing industry and agriculture of hunting and fishing industry also have a large impact on the USA. Agriculture accounts for approximately 39% in output for the USA and 64% for Canada, whereas the paper industry accounts for 26% and 23% respectively.

In Mexico, FTA facilitates the sustainability for the manufacture of motor vehicles and transport equipment the most, followed by the manufacture of machinery and equipment and the manufacture of basic and fabricated metals. However, we also witness some less sustainable industries in the presence of FTA, including the manufacture of paper and publishing, manufacture of food products and tobacco, and manufacture of coke, refined petroleum products, and nuclear fuel.

We could not give a conclusive argument regarding the impact of FTA on sustainability at the industrial level. Some of the industries see growth and improvement, a representative for sustainability, while other industries demonstrate welfare loss because of the FTA. Nevertheless, our industrial-level outcomes provide some auxiliary implications in terms of industry-specific trade policy. For example, in the USA, the industries suffering the most in the absence of FTA are the leather industry, agriculture, and the publishing industry. Cautious attention should be paid to those industries if the withdrawal of FTA occurs to prevent severe negative consequences. A possible solution is the facilitation of a transfer payment or unemployment program regarding those vulnerable trade industries. Eventually, the sustainable overall economic development can be guaranteed. Furthermore, despite the inconsistency at the industrial level, we still conclude that FTA can facilitate the economic sustainability at an aggregate level, though it is difficult to disentangle the FTA impact on a disaggregated level.

4.2. Contributions

In the context of international trade and globalization, this paper makes unique contributions. Firstly, this paper is one of the few to investigate the relationship between FTA and a country's economic development [30,47,48]. We find that trade integration such as participating in global production systems by forming an FTA enhances the economic sustainability of a country.

Secondly, the sustainability at an industrial level and trade policy recommendations have been discussed. We showed that although the FTA's impact on industry sustainability is inconclusive, we can draw many implications from our findings, especially the recommendation to achieve an industrial-level sustainability. We believe our discussion on industrial-level sustainability can be expanded and contribute to the economic development, growth, and regional sustainability.

Thirdly, this paper also sheds light on the debatable topic regarding whether a trade agreement is a building block or stumbling block towards multilateralism [31,32]. We find that in the case of NAFTA, a country's trade integration facilitates the economic development and improves the overall welfare. This result is particularly strong evidence for the merits of an FTA's role in globalization and how it achieves the goal of the WTO to promote a further global trade liberalization in the future [33]. We believe this can add value to the existing literature.

5. Conclusions

In this paper, we try to understand the trade role in economic sustainability, and find that using NAFTA as an example, an FTA enhances a country's economic sustainability since the welfare of withdrawing the FTA will be reduced. The sustainability at an industrial level is ambiguous, some industries are better off, and others are worse off. In addition, we acknowledge our weakness in that our model did not incorporate vertical specialization. As Yi argues, even with a relatively small change in the tariff rate level, ignoring the vertical specialization can bias our welfare analysis for both internal and external margins [49]. First, the reduction in tariff rates can lead to a magnifying effect on a commodity's price because each country specializing in a stage of the global production system or intermediate inputs tends to benefit, and the overall effect on the final goods is significant. Second, when tariff rates decrease, there are also more goods becoming vertically specialized than before. Our model, based on Armington specification, fails to incorporate the vertical specialization. One important impediment rests on the fact that "production sharing" provision is commonly applied within NAFTA, where the US is duty-free for domestic content. Hence, some of the intermediate inputs from the origin are not subject to the tariff. This makes it more difficult to consider the vertical specialization cumulative tariff effect. Finally, this paper shifts the emphasis onto a sustainable economy, however, the environmental sustainability is equally important; studies by Cherniwchan show that two-thirds of the emissions from the US manufacturing industry are the result of trade liberalization of NAFTA [50]. Further investigation is required to better understand the sustainability of NAFTA [51].

Author Contributions: In this study, H.W. conceived and designed the study framework; Q.W. provided data and methods; M.Z. analyzed the data. H.W. wrote the original draft. W.L. provided revised opinions.

Funding: This study was supported by the National Social Science Foundation of China (Grant no. 17CGJ002).

Acknowledgments: We deeply thank anonymous reviewers for their insightful suggestions and constructive comments. We are grateful to the editors for their patient work for our manuscript.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. Number of RTA's in Force

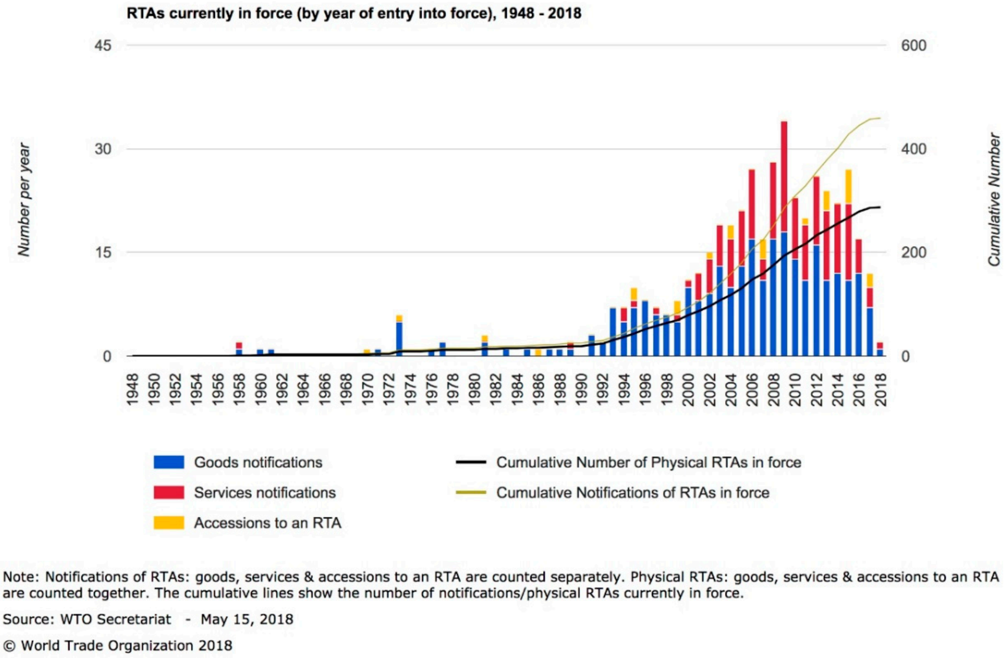

Figure A1. Number of RTA's in Force.

Appendix B. The Appendix Describes the ISIC Revision 3 Used in This Paper

01—Agriculture, hunting, and related service activities
02—Forestry, logging, and related service activities
05—Fishing, operation of fish hatcheries and fish farms; service activities incidental to fishing
10—Mining of coal and lignite; extraction of peat
11—Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying
12—Mining of uranium and thorium ores
13—Mining of metal ores
14—Other mining and quarrying
15—Manufacture of food products and beverages
16—Manufacture of tobacco products
17—Manufacture of textiles
18—Manufacture of wearing apparel; dressing and dyeing of fur
19—Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness, and footwear
20—Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
21—Manufacture of paper and paper products
22—Publishing, printing, and reproduction of recorded media
23—Manufacture of coke, refined petroleum products, and nuclear fuel
24—Manufacture of chemicals and chemical products
25—Manufacture of rubber and plastics products
26—Manufacture of other non-metallic mineral products
27—Manufacture of basic metals
28—Manufacture of fabricated metal products, except machinery and equipment
29—Manufacture of machinery and equipment n.e.c.
30—Manufacture of office, accounting and computing machinery
31—Manufacture of electrical machinery and apparatus n.e.c.
32—Manufacture of radio, television, and communication equipment and apparatus
33—Manufacture of medical, precision, and optical instruments, watches and clocks
34—Manufacture of motor vehicles, trailers, and semi-trailers
35—Manufacture of other transport equipment
36—Manufacture of furniture; manufacturing n.e.c.
37—Recycling

Appendix C. The Appendix Describes the Equation Derivation for Welfare Estimation

From the inverse supply elasticity Equation (8), we ignore fixed effects and supply shocks, and the inverse supply curve is:

$$lnp(k)_{it} = \eta_k ln \sum_j q^S(k)_{ijt} ln\hat{P}_{it} \tag{A1}$$

After totally differentiating the supply curve:

$$dlnp(k)_{it} = \eta_k \left[\sum_j \phi(k)_{ijt} dlnq^S(k)_{ijt} \right] + dln\hat{P}_{it} \tag{A2}$$

$\phi(k)_{ijt} = \frac{q(k)_{ijt}}{\sum_j q(k)_{ijt}}$ is the proportion of the output of country *i* that are shipped to country j.

Take logarithm of Equation (3) and totally differentiate:

$$dlnq^D(k)_{ijt} = dlna(k)_{ij} - \sigma_k dlnp(k)_{it} - \sigma_k dln\tau(k)_{ijt} + (\sigma_k - 1)dlnP_{jt} + dlnY_{jt} \tag{A3}$$

Substitute $dlnq^D(k)_{ijt}$ from Equation (17) for $dlnq^S(k)_{ijt}$ in Equation (12):

$$dlnp(k)_{it} = \frac{\eta_k}{1+\eta_k\sigma_k} [\sum_j -\phi(k)_{ijt}\sigma_{kdln\tau(k)ijt} + \sum_j \phi(k)_{ijt}(\sigma_k - 1)dln\hat{P}(k)_{jt} + \sum_j \phi(k)_{ijt} dlnY_{jt} + \frac{1}{\eta_k} dln\hat{P}_{it}]$$

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