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# WHO IS BENEFITING THE MOST FROM NAFTA? AN INTERVENTION TIME SERIES ANALYSIS

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Unlike previous studies on the North American Free Trade Agreement (NAFTA), which examined either trade or income effects by using forecasted trade values, this paper investigates the impact of NAFTA on both bilateral trade and income of each member country - US, Canada, and Mexico - by using historical data. This paper covers time series data before and after NAFTA was formed, from 1980 to 1999. We consider NAFTA as a prolonged impulse function in international trade activities among the three trading partners by employing an intervention-function model. Findings reveal that NAFTA increases bilateral trade between US-Canada and US-Mexico, and in terms of income, NAFTA benefits Canada the most "certainly". To substantiate these findings, Granger causality analysis is employed, which in turn supports our intervention-function results.

*Keywords*: NAFTA, Intervention-function Model, Time Series Analysis, Granger Causality
*JEL classification*: F15, O11, C10

## 1. INTRODUCTION

Unlike previous studies on the North American Free Trade Agreement (NAFTA), which examined either trade or income effects by using forecasted trade values, this paper investigates the impact of NAFTA on both bilateral trade and per capita income (as measured by the per capita gross domestic product - GDP) of each member country (US, Canada and Mexico) by using historical data. This paper covers time series data before and after NAFTA was formed, from 1980 to 1999. We consider NAFTA as a *prolonged impulse function* in international trade activities among the three trading partners by employing an intervention-function model.

An extensive body of research has been conducted on NAFTA and its impact on member countries. However, most of this research relied on forecasted values, employed

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applied general equilibrium models (AGE) - for economy-wide effects, or used simple gravity models - for trade effects. Most of those forecasted values of trade fell short from reality. For instance, Casario (1996) used Vector Autoregression (VAR) model to assess the impact of NAFTA on bilateral trade among member countries, and forecasted a decrease in US trade deficit with Canada and, more surprisingly, an increase in US trade surplus with Mexico. While in fact, US trade deficit with Canada and Mexico jumped to $36 billion and $23.12 billion in 1999, respectively.

In addition, the mainstream literature on NAFTA's economy-wide effects that mostly adopted AGE models (Brown *et al.* (1992), Cox and Harris (1992), Sobarzo (1992), and Markusen *et al*. (1995)) encompasses methodological concerns raised by many economists. These concerns are that AGE results reflect more about model structure and parameter specification than the consequences of NAFTA.

Other previous studies also assessed the impact of NAFTA on trade creation or diversion by employing gravity models. However, in a more recent work, Matyas (1997) argued against the use of regional dummy variable(s) to test the hypothesis that trading blocs significantly explain trade volumes. He showed that gravity models used to test regional blocs are mis-specified from an econometric point of view, which leads to incorrect interpretation of the dummy regional variable(s) and improper economic inference.

The contribution of this paper lies in the use of intervention-function model, which allows us to isolate the impact of NAFTA on both, bilateral trade and per capita income (i.e., per capita GDP) effects of all three member-countries. Also, the use of historical data from 1980 to 1999, though not enough time for more reliable inferences, still gives more robustness than the use of forecasted data. This 20-year period covers the year 1993 when NAFTA was signed, while isolating and eliminating the effect of the US-Canada Free Trade Agreement (FTA), which went into effect in 1989. Having said that, it is normal to note here that the US-Canada FTA of 1989 was extended in 1993 to include Mexico, forming the NAFTA bloc.

Although more time is needed before a clearer assessment of NAFTA's impact is made, still this paper attempts to shed light on this controversial topic. In fact, opponents and proponents of NAFTA are still debating about its trade and welfare outcomes. Nevertheless, this paper examines the impact of NAFTA on bilateral trade and GDP among member countries. It attempts to find out which country is benefiting the most from NAFTA, in terms of trade creation and income, respectively.

The rest of this paper is organized as follows: Section 2 reviews the streamline literature on NAFTA and its impact on trade and income. Section 3 discusses the methodology and the specification of the intervention-function model. Section 4 analyzes the findings. Finally, Section 5 provides a conclusion with policy implications of the results.

## 2. OVERVIEW

Although NAFTA is no longer a front-page topic, however, its controversial nature is still ailing among economists as well as politicians. The bulk of research that has been done on NAFTA dates back mainly between 1992 and 1995. A somehow comprehensive work on NAFTA (mainly pro-NAFTA) compiles the early AGE studies on the agreement (Lustig *et al*. (1992)). Both opponents and proponents of the 1993 agreement are still not satisfied with the empirical results mainly due to the insufficient time needed before getting a clearer view of the agreement's impact. Mixed results and contradicting claims regarding its economic benefits on the participating nations remain to be issues of debate.

For instance, Ensign (1997) reported that regarding the impact of NAFTA, the Brookings Institution found that NAFTA has significantly improved economies by creating more jobs; whereas reports of the Economic Policy Institute claimed that the agreement has caused more job and income losses. Similarly, Gagne (2000) documented in a recent paper that FTA and NAFTA had a mixed record, both in their working and impact.

Most of the empirical studies on assessing the NAFTA's impact employed static AGE models to predict the income effect of its member countries. Brown *et al.* (1992) examined the NAFTA's impact on all three national economies; Cox and Harris (1992) focused on Canada; Sobarzo (1992) focused on Mexico; and Markusen *et al*. (1995) analyzed the agreement's effect on the automobile industry - which accounts for a major portion of trade in North America. All these researchers predicted that the impact of NAFTA on Mexico's per capita income will be the biggest followed by a very small effect on the US economy. They also found that Canada will notice no increase beyond what it experiences as a result of its free trade agreement with the US, which went into effect in 1989. In the same context of NAFTA's effect on income, Panagariya (1996) postulated that because the US had little tariff preferences to grant to Mexico while the reverse was not true, the static welfare effect of NAFTA is likely to be positive on the former and negative on the latter.

Other studies explored the effects of NAFTA on trade. For instance, Casario (1996) estimated the effects of NAFTA on bilateral trade between the US and Canada and between the US and Mexico using a VAR model. She found trade creation results for all three countries (in particular, an increase in US exports) and an improvement in the US trade position with both Canada and Mexico. Other studies used gravity models to estimate the agreement's impact on trade flows; however, Matyas (1997) criticized the use of gravity models to test regional blocs. He argued that dealing with trading blocs as a dummy variable in gravity models would lead to an econometric specification error. The next section discusses the methodology along with the specification of the intervention-function model.

## 3. METHODOLOGY

This study assesses the impact of NAFTA on bilateral trade and per capita GDP (as a proxy for income) of each member country using historical data before and after NAFTA was formed. We consider NAFTA as a prolonged intervention in international-trade activities among three trading partners; therefore, the direct approach to estimate the impact of NAFTA is an intervention-function analysis.

There are three types of an intervention-function analysis: impulse function, gradually changing function, and prolonged impulse function (Ender (1995, p. 272)). *The impulse function* is characterized as a temporary intervention. The effect of this intervention may last several periods due to the autoregressive nature of time series data. *The gradually changing function* is the intervention that takes place gradually until it reaches its full force at the end. *The prolonged impulse function* is the intervention that prolongs for a long period of time. Since NAFTA is classified as a prolonged intervention starting since 1993, we apply the prolonged impulse function to analyze its impact on bilateral trade and GDP of its member countries.

The general form of prolonged impulse-function regression can be illustrated as follows:

$$y_t = a_0 + a_1 y_{t-1} + c_0 z_t + e_t , \tag{1}$$

where $z_t$ denotes the dummy of the prolonged intervention variable, NAFTA, which takes on the value of zero before NAFTA and 1 thereafter, the coefficient of $z_t$ indicates the impact of the NAFTA, and $e_t$ denotes a white-noise disturbance.

The specific form of the above function (1) varies depending on a data generating process, e.g., AR, MA, ARIMA, or ARCH.

Trade flows data for the US-Canada, US-Mexico, and Canada-Mexico are borrowed from the Direction of Trade Statistics (DOTS), while real GDP figures are collected from the International Financial Statistics (IFS) yearbook published by the International Monetary Fund. Exchange rates and GDP deflator figures are also borrowed from the IFS and are used to standardize the bilateral trade and GDP figures among all three countries.

## 4. EMPIRICAL ANALYSIS

We start the analysis by considering visually the plots of level and differenced series. Figures 1 and 2 illustrate the plots of level and differenced series of three bilateral-trade series, whereas Figures 3 and 4 show the plots of level and differenced series of three GDP series.

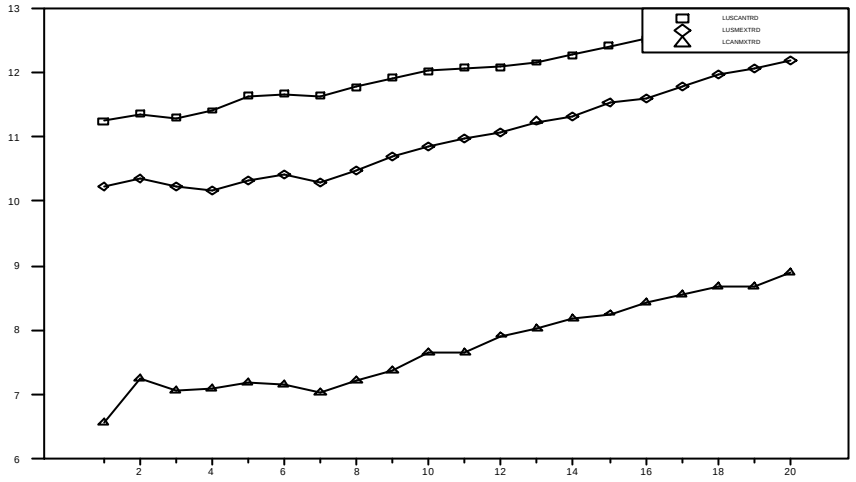


**Figure 1.** Plot of Level Trade Series

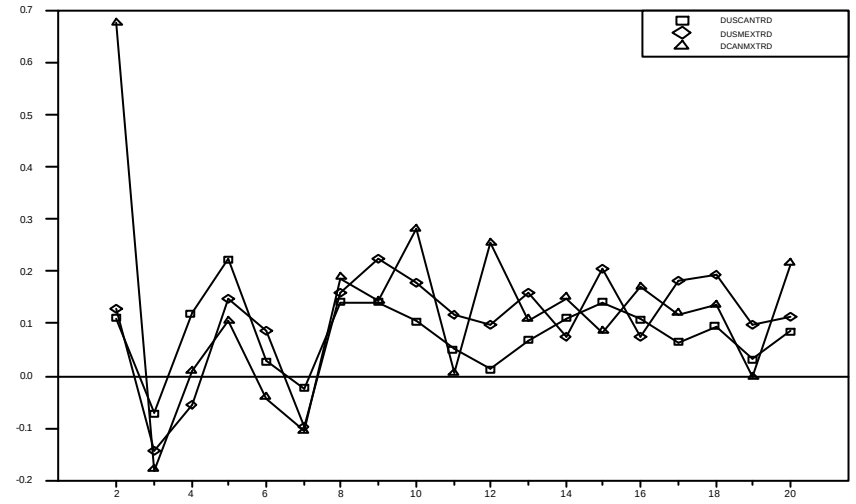


**Figure 2.** Plot of Differenced Trade Series

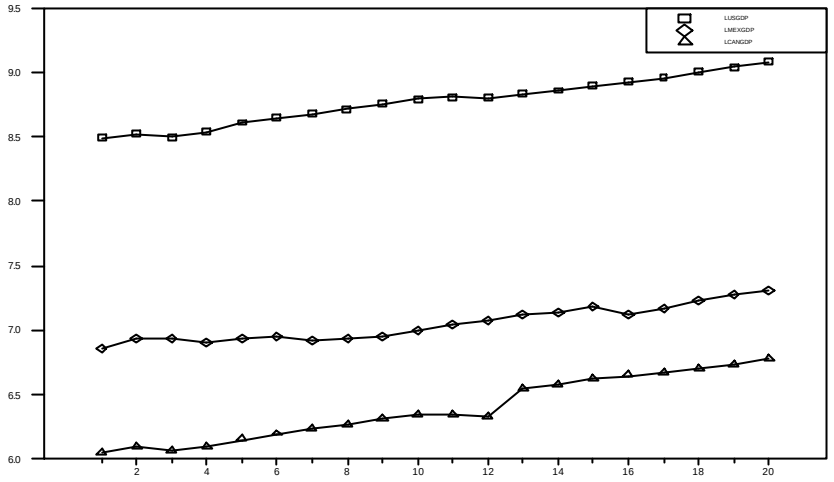


**Figure 3.** Plot of Level GDP Series

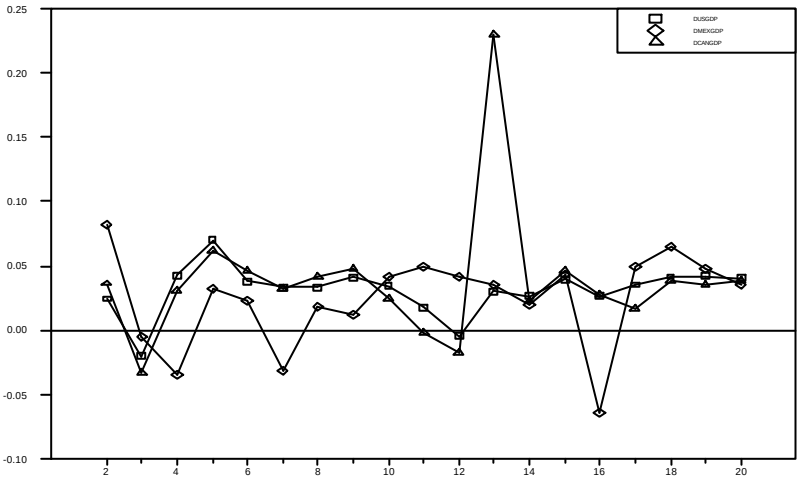


**Figure 4.** Plot of Differenced GDP Series

The plots of the level trade and GDP series in Figures 1 and 3 show the pattern of increasing slightly over time. The plots of the differenced series of trade and GDP in Figures 2 and 4 do not show substantial fluctuation over time. These suggest that all series exhibit neither a structural break nor volatility pattern. Canadian GDP seems to move downward slightly in 1991, but it increases moderately in 1992.

Consequently, we test whether each series has a unit root using the Dickey-Fuller (1979) unit roots test (see Table 1). From Table 1, we do not reject the null hypothesis that all level series contain a unit root. When we perform the test on the first-differenced series, we reject the null hypothesis of having a unit root. This indicates that all series contain a unit root.

**Table 1.** Dickey-Fuller Unit Roots Test

| Series | Level | First Difference |
|---|---|---|
| US GDP | 0.92 | -11.198*** |
| Canada GDP | 0.493 | -21.229*** |
| Mexico GDP | 1.014 | -17.780*** |
| US-Canada Trade | 1.378 | -11.827*** |
| US-Mexico Trade | 2.874 | -5.353*** |
| Canada-Mexico Trade | 2.353 | -19.56*** |

*Note:* *** indicate significance at 1%, based on Dickey-Fuller test.

Next, we move to investigate the data generating process that generates each series. Since the plots of series do not exhibit a volatility pattern, we use the Box-Jenkin (1976) methodology to test whether all series follow an ARIMA process. The results of the autocorrelation function (ACF) and partial autocorrelation function (PACF) indicate that each series was generated by the AR (1) process. Further, we move to investigate the impact of NAFTA on bilateral trade and GDP of each country using the intervention-function model (see Table 2).

**Table 2.** Results of the Intervention-Function Analysis

| PANEL A: TRADE | Intercept | Impact Effect |
|---|---|---|
| CAN-Mexico Trade | 1310.7 | 794.93 |
| | (2.28) | (1.32) |
| US-Canada Trade | 101544.4 | 44416.8** |
| | (5.34) | (2.24) |
| US-Mexico Trade | 38864.1 | 27962.2** |
| | (3.08) | (2.15) |

**Table 2.** (Continued)

| PANEL B: GDP | Intercept | Impact Effect |
|---|---|---|
| US GDP | 5238.2 | 405.65 |
| | (20.29) | (1.51) |
| Canada GDP | 457.93 | 25.39*** |
| | (10.90) | (5.80) |
| Mexico GDP | 1002.5 | 78.50 |
| | (18.56) | (1.36) |

*Notes:* All series were generated by AR (1) process. *t*-statistics are in parentheses. **(***) indicates significance at 5% (1%) level. The impact variable (z) takes on two values: 0 during 1980-1992 and 1 during 1993-1999. All series were tested at lag length of 1. Lag length was selected based on the results of Akaike Information Criterion (AIC) and Schwartz Bayesian Criterion (SBC).

Table 2 illustrates the impact of NAFTA on trade and GDP. Panel A shows the impact of NAFTA on three pairs of bilateral trade. The results show that the estimated coefficients of the intervention variable, NAFTA, are statistically significant (at 95 percent) on US-Canada trade series and on US-Mexico trade series. This suggests that, with 99 percent confidence, NAFTA increases bilateral trade between US-Canada and US-Mexico. Conversely, the estimated coefficient of NAFTA is not statistically significant on Canada-Mexico trade series, suggesting that NAFTA has no significant impact on trade between Canada and Mexico.

Panel B shows that the coefficient of NAFTA is statistically significant only on Canada's GDP. This implies that NAFTA has a positive and significant impact on Canada's GDP, thus benefiting Canada's income the most "certainly" (at 99 percent level of significance). We substantiate this finding using Granger-causality test (see Table 3).

**Table 3.** Results of Granger Causality Test

| PANEL A: USGDP, F-Tests, Dependent Variable USGDP | | |
|---|---|---|
| Variable | F-Statistic | Significance |
| USGDP | 1.2370 | 0.4484582 |
| USMEXTRD | 0.1171 | 0.9673621 |
| USCANTRD | 0.0472 | 0.9935644 |
| PANEL B: CANGDP, F-Tests, Dependent Variable CANGDP | | |
| Variable | F-Statistic | Significance |
| CANGDP | 12.1760 | 0.0337246 |
| USCANTRD | 11.8277 | 0.0351000 |
| CANMXTRD | 10.3971 | 0.0418693 |

**Table 3.** (Continued)

| PANEL C: MEXGDP, F-Tests, Dependent Variable MEXGDP | | |
|---|---|---|
| Variable | F-Statistic | Significance |
| MEXGDP | 3.0561 | 0.1928230 |
| USMEXTRD | 4.0381 | 0.1404193 |
| CANMXTRD | 7.2388 | 0.0678626 |

The causality analysis shows that, in Panel A, US-Mexico and US-Canada trade flows do not Granger-cause US's GDP. In Panel B, US-Canada trade and Canada-Mexico trade strongly Granger-cause Canada's GDP, which confirms the finding in Panel B of Table 2. Panel C suggests that Canada-Mexico trade marginally Granger-causes Mexico's GDP.

In summary, since NAFTA increases bilateral trade between US-Canada and US-Mexico but it does not increase trade flows between Canada-Mexico, we can probably say that, in terms of trade creation, NAFTA seems to benefit the US the most significantly, while in terms of GDP, NAFTA appears to benefit Canada the most certainly.

It may be useful here to note that by using the intervention model with bilateral trade flows and GDP, we are neither attempting to find out the benefits of the respective countries by *order* nor the *magnitude* of the impact of NAFTA as measured by the estimated coefficient (z) itself. Rather, we are simply isolating the impact of NAFTA to examine member countries' bilateral trade and GDP and see if they are significantly affected by NAFTA. In other terms, we are measuring the statistical significance of the intervention variable, NAFTA, on bilateral flows and GDP, separately.

## 5. CONCLUSION AND POLICY IMPLICATIONS

This paper examines the impact of NAFTA on both bilateral trade and GDP of the US, Canada, and Mexico for the period 1980-1999 by adopting an intervention-function model. This paper is differentiated from other previous studies in that it uses historical data and it assesses both trade and income by using a model that isolates the impact of NAFTA at a cut off year (1993) while examining its prolonged effect - *prolonged impulse function.*

Findings suggest that, in terms of trade, while all three countries experience some tendency for a net trade creation, NAFTA significantly increases bilateral trade flows between US-Canada and US-Mexico. For instance, NAFTA impacts the US trade with both Mexico and Canada, while Canada-Mexico bilateral trade is insignificantly affected by NAFTA. One possible explanation pertinent to the significant US bilateral trade finding is its consistence with Panagariya's (1996) argument that the US's tariffs were already relatively low during the pre-NAFTA period, but that was not the case with

Mexico. The NAFTA's mechanism is primarily built on lowering tariffs (gradually eliminating them) on most traded goods and services among all three countries. Therefore, the US (and perhaps Canada) would benefit more than Mexico for having access to a "newly" open market like Mexico.

Further results indicate that, in terms of income, NAFTA benefits Canada the most "certainly". In addition, Mexico's trade with NAFTA members has a statistically insignificant impact on Mexico's GDP. The high statistical significance of the Canada result implies that we are 99 percent certain that NAFTA has an impact on Canada's GDP. It may be helpful here to note that, in this case, the impact of joining NAFTA (on GDP or bilateral trade) is measured by itself and not as a ratio of GDP. Thus, a possible *descriptive* explanation of our results is that NAFTA's impact on Canada's GDP is probably due to the relatively large role of trade in Canada's economy (70 percent in 1999), in addition to Canada's large bilateral trade with both the US and Mexico as a share of its total trade (82 percent in 1999).

On the other hand, the US trade share of GDP is only 19 percent, and its NAFTA bilateral trade share of total trade is 32 percent. Mexico's trade portion of GDP is 57 percent, while its NAFTA bilateral trade percentage of total trade is 73 percent. When compared to the US and Canada, this may explain the weak link between NAFTA's bilateral trade and Mexico's GDP - 14 percent significance with the US trade and 6.7 percent with the Canada trade portion (see Table 3, Panel C). All above figures are from 1999.

In sum, the impact of NAFTA appears to be insignificant on the US's GDP perhaps due to its small share of trade relative to its large economy. While on the other hand, NAFTA's impact on Canada's GDP seems highly significant. This may be due to the relatively large role of trade (especially with the other members of NAFTA) in Canada's economy.

From a policy perspective, this study suggests that NAFTA seems to be trade creating in all three member countries, but most significantly in the US. Additionally, NAFTA appears to significantly spurring Canada's GDP. Surprisingly, the econometric results of this paper indicate that NAFTA has no significant impact on the US's GDP - as mentioned above, a plausible explanation could be due to the small (though increasing) "direct" role of trade in the US economy. Investigating the factors behind NAFTA's significant impact on Canada's GDP (and insignificant one on Mexico and the US) could be an interesting topic for future research.

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