# AN INTERVENTION ANALYSIS OF A TRADE POLICY

## 1. Introduction

The traditional theory suggests that, in perfectly competitive markets, international trade always increases the welfare of trading partners by bringing about efficiency in resource allocation. It has further been argued that, in imperfectly competitive markets, trade liberalization will bring additional welfare gains by reducing the dead weight losses created by domestic monopolies and oligopolies by increasing competition and reducing price-marginal cost markups (Helpman and Krugman, 1989).

The welfare enhancing outcomes from theoretical models under perfect competition have led to the belief that any step toward perfect competition by relaxing existing trade barriers could be welfare enhancing. This is the stand taken by WTO, which urges its member countries to undertake policy reforms towards complete trade liberalization.

However, the theory of second best suggests that, in the presence of multiple distortions, a reduction in a distortion may actually reduce welfare. Although the impact of trade liberalization is itself being debated, there is a branch of studies that has devoted itself to the question of the proper form of a trade reform. On the welfare consequences of a trade reform, two basic results exist. The first one is called concertina rule (Hata, 1977 and Hata and Fukushima, 1979), which shows that the policy that reduces the highest tariff rate to the second highest level will improve welfare. The second result shows that uniform proportional tariff reduction raises welfare. However, there have been very sparse empirical studies to test these results. Most of the work in this area applies what is called an ex-ante approach, which looks for a set of policy prescriptions that yields welfare improvement. The models developed under this approach mostly make use of an explicit utility function. They either assume a representative consumer and develop an aggregate utility function for the whole country or develop a utility function at individual consumer/household level and use some weight to derive an

aggregate utility function. These utility functions are then optimized and necessary and sufficient conditions for utility maximization are produced. A positive welfare implication is concluded, if the necessary conditions are met under the proposed or new policy. However, the problem with the ex-ante approach is that it ignores the distributional issue at household level or the aggregation issue at national level. On the other hand, the so-called ex-post approach (Ohyama, 1972) looks for the indicators, which can be examined to see whether there has been a post-policy rise. However, Ohyama's model is also based on single representative consumer assumptions and ignores the distributional issue as some may gain from a policy while others may lose. Grinols and Wong (1991) have addressed the distributional issue inherent in Ohyama's by extending the model to the case of many consumers. But their model requires the welfare weight of individuals to be constant and reciprocal to marginal utilities of income. Such a problem has been avoided by Dixit and Norman (1980) and Dixit (1986). With the assumption of constant return to scale, no joint production, continuous demand, and holding of the Weymark condition, Dixit and Norman have derived conditions under which Pareto improvement is ensured by trade. However, their model derives the condition for Pareto improvement in terms of gains from a trade policy rather than a trade reform policy. Ju and Krishna (2000 and Aug. 2000), on the other hand, extending Ohyama's results and building on that of Dixit and Norman's, have derived sufficient conditions for welfare improving trade reform. Their model avoids the need for a welfare function and addresses the distributional issues arising from representative consumer assumptions. The main problems associated with the testing of their model, however, are two fold. First, the choice of any two periods, for the sake of welfare comparison, could be purely arbitrary as the impact on welfare, in any post-reform period, could be the cumulative effect of any policy change in a pre-reform period. Second, their model does not establish a theoretical link between the change in a trade policy and its impact on a country's welfare. So, the first objective of this paper is to fill a gap in trade literature by developing a simple and empirically testable model, which theoretically allows us to compare the mean value of the welfare indicator before and after a trade reform, thereby avoiding the need to choose two periods arbitrarily. The second objective of this paper is to establish a theoretical link between a trade reform policy and its impact on a country's welfare by introducing an intervention term in the welfare indicator and controlling the effect of all other factors that can affect the value of the welfare indicator.

To the best of our knowledge we are aware of only one study (Adhikari, 2003) so far, which evaluates the welfare impact of a trade policy at aggregate (national) level. This study uses gravity model variables plus a policy dummy in their welfare indicator and evaluates the impact of NAFTA on U.S. welfare. Our study takes a different approach and uses an intervention model, in which the mean welfare indicator values are compared over time to infer the welfare impact of a policy, and evaluates the impact of NAFTA on other member country's welfare, viz. Mexico's.

We outline the model in section -2, discuss the data sources in section -3, present the empirical results in section-4, and summarize the study in section-5.

## 2. The model

We develop an empirical model built on that of Ju and Krishna's. They derive the following condition for a trade reform to be welfare improving.

$$P^1 [ M(P^1, T^1) - M(P^0, T^0)] > 0, \quad (1)$$

where $P^1$ and $T^1$ are the vectors of import prices and tariff rates, respectively, after a trade reform. $P^0$ and $T^0$ are the vectors of import prices and tariff rates, respectively, before the reform, and $M(P^1,T^1)$ and $M(P^0, T^0)$ are the vectors of import bundles after and before the reform respectively. This condition ensures that the old import bundle be affordable at post-reform prices, which is a sufficient condition for a trade reform policy to result in a potential Pareto improvement.

### *2.1 The Empirical Model*

Let $Y^1 = P^{1'}M(P^1, u^1, V)$ and $Y^o = P^{1'}M(P^o, u^o, V)$ be the vectors of the values of net Mexican import from the U.S. after and before the formation of NAFTA respectively. Then the welfare improving condition (1) implies the following:

$$Y^1 - Y^o > 0 \quad (2)$$

That means, if the mean value of net Mexican imports from the U.S. after the formation of NAFTA is greater than that before NAFTA when both of the values are evaluated at post NAFTA prices, then the Mexican welfare has increased. However, such a comparison is inappropriate in time-series analysis. Since successive values of **Y** are serially correlated, some of the effects of the pre-NAFTA regime

could carry over to the post-NAFTA regime (post-intervention) date. For example, good understanding developed between the U. S. and Mexico before the intervention (NAFTA) regime could have encouraged both of the countries to liberalize their trade (e. g. to eliminate or lower tariff and quota barriers on their trade) with each other before the countries actually signed NAFTA agreement. The so-called Intervention Analysis allows for a formal test of a change in the mean of a time series. This model was first used by Enders (1995), Sanders, and Cauly to study the impact of the metal detector technology on the number of skyjacking incidents. For our purpose, we lay out the intervention model as following:

$$Y_t = a_0 + a_1 Y_{t-1} + c_0 Z_t + \varepsilon_t \qquad | a_1 | < 1, \qquad (3)$$

where, $Y_t$ = value of net Mexican imports from the U.S. in **t**th year evaluated at post-NAFTA prices;

$Y_{t-1}$ = one year lagged value of net Mexican imports from the U.S. evaluated at post-NAFTA prices;

$Z_t$ = an intervention (dummy) variable that takes a value of zero for the period prior to year 1993 (pre-NAFTA) and unity beginning the year 1993 (post-NAFTA);

$\varepsilon_t$ = a white-noise disturbance.

To explain the nature of the model we transform it as following:

$$(1-a_1L)\, Y_t = a_0 + c_0 Z_t + \varepsilon_t \qquad \text{or}$$

$$Y_t = a_0 / (1 - a_1L) + (c_0 Z_t) / (1 - a_1L) + \varepsilon_t / (1 - a_1L) \qquad (4)$$

For $t < 1993$, the value of $Z_t$ is zero. As such, the intercept term is $a_0$ and the mean of $Y_t$ series is $a_0 / (1 - a_1)$. Beginning in 1993, the intercept term jumps to a0 + c0 (since $Z_t = 1$ for $t \geq 1993$,); and the mean of $Y_t$ series is $(a_0+c_0)/(1-a_1)$. Thus, the mean effect of the intervention variable (implementation of NAFTA) is given by $c_0 / (1 - a_1)$. Therefore, to test if the long-run mean of $Y_t$ series for $t \geq 1993$ (with NAFTA) is greater than that for $t<1993$ one simply needs to test if $c_0$ is statistically positive. If it is found that $c_0 > 0$, it could be concluded that, as a result of NAFTA, the value of net Mexican imports from the U.S. evaluated at post-NAFTA prices has increased and, therefore, Mexican welfare has increased due to NAFTA.

## 3. The data

The data on Mexican import and export prices have directly been collected from the annual series of "International Financial Statistics" published by IMF (International Monetary Fund) and the data on Mexican imports from and export to the United States have been collected from different annual series of the IMF's publication "Direction of Trade". Since the $\mathbf{Y_t}$ (value of net Mexican imports from the United States evaluated at post NAFTA prices) series is not directly observable, we use some transformation techniques, which have been outlined in the appendix, to obtain the $\mathbf{Y_t}$ series. The data on all the variables in the model are annual and cover the years 1972-2001.

## 4. Empirical results

$$Y_t = \underset{(0.761365)}{88655.37} + \underset{(5.896601)}{0.755447\ Y_{t-1}} - \underset{(-0.479672)}{92422.85\ Z_t} \quad (5)$$

$R^2 = 0.600389$ $F = 20.28283$ Prob.(F-statistic) = 0.000004

The figures in the parentheses are corresponding t-values. The p-value associated with the F-statistic suggests that the model is significant. The coefficient of the intervention dummy ($Z_t$) is negative but statistically insignificant. So, we fail to reject the null hypothesis that intervention dummy has no effect on the net value of Mexican imports from the U.S. evaluated at post-NAFTA prices. This result suggests that the sufficient condition for welfare improvement is not met. Therefore, it cannot be determined if Mexican welfare has changed (increased or decreased) due to NAFTA.

## 5. Summary

We develop an intervention model built upon Ju and Krishna's sufficient condition for a trade reform policy to be welfare-improving. The sufficient condition requires that the mean value of net Mexican imports from the U.S. evaluated at post-NAFTA prices, represented by the variable $Y_t$, be increased after the formation of NAFTA. To compare the mean value of the $Y_t$, series before and after NAFTA, we introduce an intervention dummy taking a value of 1 for the years with NAFTA and zero otherwise and regress the $Y_t$ series on its one-period lagged values plus the intervention dummy. We

find that the coefficient of the dummy variable is negative but statistically insignificant, which shows that the mean value $Y_t$ series has not changed following the formation of NAFTA. This finding does not meet the sufficient condition for welfare-improvement. Consequently, we do not reject the hypothesis that Mexican welfare has not changed (increased or decreased) due to NAFTA.

Deergha Raj Adhikari

*University of Louisiana, Economics and Finance, Lafayette, Louisiana, USA*

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## ABSTRACT

We develop an intervention model based on Ju and Krishna's sufficient condition for a trade reform policy to be welfare improving. The welfare improving condition requires that the mean value of net imports of a country evaluated at post-intervention prices be higher than that before the intervention. To compare the two mean values we introduce an intervention dummy in the model. We apply this model to evaluate the impact of NAFTA on Mexican welfare. Our study finds that the intervention dummy is negative, but insignificant. This result fails to meet the sufficient condition for welfare improvement. Consequently, we do not reject the hypotheses that Mexican welfare has not changed (increased or decreased) due to NAFTA.


Key Words: NAFTA, revealed-preference, trade-reform, welfare, intervention-analysis

JEL Classification: F1


## RIASSUNTO

### *Analisi di interventi di politica commerciale*

Sviluppiamo un modello di analisi di interventi di politica commerciale basato sulla condizione di Ju e Krishna, condizione sufficiente a garantire che una politica di riforma commerciale migliori il benessere di un paese. Tale condizione richiede che il valore medio delle importazioni nette di un paese, valutate ai prezzi dopo l'intervento, sia più alto del valore delle importazioni valutate ai prezzi prima dell'intervento. Per confrontare i due valori medi introduciamo nel modello una variabile dummy per il giorno dell'intervento. Applichiamo questo modello per valutare l'impatto del NAFTA sul benessere del Messico. Lo studio trova che la dummy è negativa ma non significativa. Questo risultato sembra avvalorare l'ipotesi che il benessere del Messico non sia cambiato (aumentato o diminuito) a seguito del NAFTA.

## APPENDIX

Value of Net Mexican Import from the U.S. at Post-NAFTA Prices ($Y_t$)

The $Y_t$ series has been constructed as following:

$Y_t = P_{1995}NM_t$,

where, $P_{1995}$ is import price for the year 1995 and $NM_t$ is the real net import for the tth year. The $NM_t$ series has been constructed as following:

$$NM_t = P_{1995}(M_t - X_t)$$

$$= P_{1995}\left(\frac{P_t^I I_t}{P_{1995}^I} - \frac{P_t^E E_t}{P_{1995}^E}\right),$$

Where, $P_t^I I_t$ = Value of Mexican import from the U.S. at current import prices.

$P_t^E E_t$ = Value of Mexican export to the U.S. at current import prices.

$P_{1995}^I$ = Import price index for 1995.

$P_{1995}^E$ = Export price index for 1995.