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GLOBAL TRADE AND PUBLIC HEALTH: THE CASE OF VIETNAM

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ABSTRACT

This paper explored the research question "Does a change in trade policies affect income for developing countries?" using the interrupted time-series method. To address the endogenous issue, the research used the fact that a group of developing countries joined the WTO (World Trade Organization) differently after its establishment. By looking at the time series of their income before and after the event, the paper checked whether there was a significant change in the countries' income. The country which joined the WTO was the intervention group, and all other countries (world) were the control group. The result of the econometric model in this paper rejected expectation of the benefits of the free trades on income and real GDP (Gross Domestic Product) growth in Vietnam. To some extent, it was consistent with the mixed result of free trades in the literature review.

TÓM TẮT

Bài báo này tìm hiểu câu hỏi nghiên cứu "Liệu sự thay đổi trong chính sách thương mại có ảnh hưởng đến thu nhập của các nước đang phát triển hay không?" bằng cách sử dụng phương pháp chuỗi thời gian gián đoạn. Để giải quyết vấn đề nội sinh, nghiên cứu sử dụng thực tế là một nhóm các nước đang phát triển gia nhập WTO (tổ chức thương mại thế giới) khác nhau sau khi thành lập. Bằng cách xem xét chuỗi thời gian của Thu nhập của họ trước và sau sự kiện, bài báo sẽ kiểm tra xem có sự thay đổi đáng kể trong Thu nhập của các quốc gia hay không. Quốc gia gia nhập WTO là nhóm can thiệp và tất cả các quốc gia khác (thế giới)

là nhóm kiểm soát. Kết quả của mô hình kinh tế lượng trong bài báo này đã bác bỏ kỳ vọng về lợi ích của giao dịch tự do đối với thu nhập và tăng trưởng GDP (Tổng sản phẩm trong nước) thực tế đối với Việt Nam. Ở một mức độ nào đó, nó phù hợp với kết quả hỗn hợp của các giao dịch tự do trong tổng quan tài liệu.

1. INTRODUCTION

We are well aware of the work of Adam Smith (Smith, 1950) [1] on the benefits of trade and specialization. When looking at the determinants of living standards, one cannot overlook the effect of international trade. There is a positive association between income growth and a country's openness to trade (Harrison, 1996) [2]. The problem is that trade share may be endogenous; A country with high income trades more (Rodrik et al., 1995) [3]. Therefore, using trade policies as an instrument for a trade share in the regression will not address the endogenous issue as a country adopts free trade policies and a free-market domestic policy, which correlates with factors omitted from the income regression (Frankel and Romer, 1999) [4].

Many types of research aim to address the ongoing debate on the link between trade and income: does trade cause growth, or does growth cause trade? Is there a correlation, and what is the direction?

A few notably such as Dowrick (1994) [5], found there is a significant positive correlation between trade openness and real GDP per worker using three different methods: ordinary least square, least-square dummy (fixed effects) and generalized least square (random effects) among a sample of 222 countries. Using a country's geographic characteristic as an instrument, Frankel and Romer (1999) [4] found an increase of trade to GDP by one percentage point raises Income per capita by one haft to two percent. However, Rodriguez and Rodrik (2000) [6] found little evidence that open trade policies such as lower policy-induced barriers to trade are significantly correlated with economic growth using OLS and IV.

In this paper, we would like to address this research question again, "Does a change in trade policies affect income for developing countries" using the interrupted time-series method. To address the endogenous issue above, We use the fact that a group of developing countries joins the WTO (world trade organization) differently after its establishment. By looking at the time series of their Income before and after the event, We would like to check whether there is a significant change in the countries' income. The country which joins the WTO will be the intervention group, and all other countries (world) will be the control group.

Besides the effect of global trade policies on Income per person of a country, the effect can also work for public health by transforming the government's capacity to monitor and protect public health (Shaffer et al., 2005) [7]. We expect it the WTO agreements will include policies on the important components of health,

such as medical commodities, intellectual property rights, and health service agreements (Bettcher et al., 2000) [8]. In addition, Rum (2000) [9] has shown a relationship between economic condition and health. The mortality rate has shown to have pro-cyclical fluctuation with GDP. Therefore, if there is evidence of global trade on income and GPD, it should affect public health. Through World Health Organization's bulletin, Bettcher and Yach (2000) call for an urgent need for well-documented evidence of the health ramifications of global trade agreements. Since then, there is no comprehensive work conducted on the issue.

Using the same econometric method and the event of global trade policy, the second research question for this paper is "Does changes in trade policies affect public health outcomes for developing countries".

2. MATERIALS AND METHODS

2.1 Data description

The income time-series of the intervening countries and the rest of the world were downloaded from The World Bank database. The official date joining WTO of the intervening countries is provided on the website of the WTO.

The World Bank database has limited time series data for public health. Using the same period covered, I first check the outcome of the infant mortality rate with changing global trade policies. Again, the intervention group is the countries joining WTO after 1995, and the control group is the world's infant mortality rate in the same period.

To summarize, WTO, developing from Uruguay round negotiation from 1986 to 1994, is an organization for trade opening established on Jan 1st, 1995, composed of 164 countries on July 29th, 2016.

There are two ways to look at the time-series involving the WTO joining event. The first event occurred in 1995, with most of the countries joining. Using this event, we don't have a control group and look at the change in the level and trend of this group of official country members before and after the event.

The second way to look at this event is to make use of the fact that about 18 developing countries join the free trade organization between 2000 and 2008. A few developing countries join after 2008, but we need at least eight years of income time-series, so the cutoff year is 2008. To show the approach, we only analyze Vietnam in this paper as the intervening country.

2.2 Econometric models and methods

Interrupted time series (ITS) is considered the strongest quasi-experimental research design today for observational data when we don't have a proper randomized experiment to estimate the precise effect of the variables of interest. Its strength includes the ability to control for secular trends in the series with a clear graphical presentation (Penfold and Zhang, 2013) [10].

3. RESULTS AND DISCUSSION

3.1 Effects on income per person

Again, using Vietnam's Income from 1984 to 2016 as the intervention group with the interrupted event of joining WTO in 2007, we compare it with the world's Income in the same

period as the control group with the assumption that the joining of Vietnam to WTO will not have any perceptible effect on the world income. Therefore, the world's income will be an excellent control group for our time series, protecting from threats to validity such as history, instrumentation, and maturation.

First, let's inspect the data, whether it is a suitable candidate for ITS analysis (Figure 1).

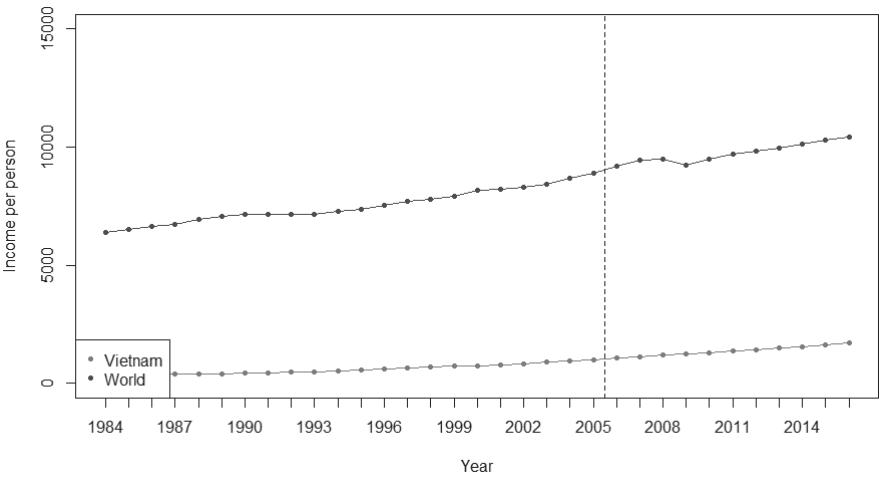

Figure 1. Vietnam income and the world income per person 1984-2016

There are no wild points in the series. It exhibits a linear trend with no co-intervention during the same period, so world' income is a fit candidate for the control group, and ITS can apply to Vietnam's income. The change in trade policies in 2007 has no discernable effect on Vietnam income, but we will test it further later using the proposed approach.

Start with a standard OLS regression with a time series specification, as this will form the basis for checks for autocorrelation. Our basic time series model is

$$Income_{jkt} = \beta_0 + \beta_1 time_t + \beta_2 group_k + \beta_3 group_k time_t + \beta_4 level_{jt} + \beta_5 trend_{jt} + \beta_6 level_{jt} group_k + \beta_7 trend_{jt} group_k + \epsilon_{jkt}$$

Where

$Group_k$: the intervention group or the country that joins WTO, such as Vietnam in this case

Status j: status after intervention or after 2007 in this case

Time t: from 1984 to 2016

Income: Real GDP (2000 dollars) per person

The coefficients of interest are: β_6 & β_7, our research question is based on the hypothesis that β_6 & β_7 are significantly different from zero.

3.2 Empirical results

Estimate the above model using OLS; we get the preliminary result (Table 1).

Table 1. Ouput of OLS regression estimation

```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  6234.575     46.695 133.518  < 2e-16 ***
time          112.511      3.406  33.037  < 2e-16 ***
vn          -5992.305     66.036 -90.743  < 2e-16 ***
vntime        -80.615      4.816 -16.738  < 2e-16 ***
level         311.607     85.970   3.625 0.000611 ***
trend           8.873     12.404   0.715 0.477283
vnlevel      -233.172    121.580  -1.918 0.060059 .
vntrend        24.643     17.542   1.405 0.165417
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 108.3 on 58 degrees of freedom
Multiple R-squared:  0.9993,    Adjusted R-squared:  0.9992
F-statistic: 1.163e+04 on 7 and 58 DF,  p-value: < 2.2e-16
```

However, we know that the results above are biased due to autocorrelation, so let's check for it uses the Durbin Watson test at eight lags (Table 2).

Table 2. Durbin Watson test check for autocorrelation

```
 lag Autocorrelation D-W Statistic p-value
   1       0.7137820     0.5494098   0.000
   2       0.3879477     1.1872748   0.000
   3       0.0372934     1.8850744   0.408
   4      -0.1158268     2.1898373   0.510
   5      -0.1928873     2.3412779   0.106
   6      -0.2015493     2.3559467   0.066
   7      -0.2341725     2.4029741   0.026
   8      -0.2391214     2.3041418   0.068
 Alternative hypothesis: rho[lag] != 0
```

We see that autocorrelation exists and is significant in the first two lags (Figure 2). Let's see the residuals from the OLS regression for further serial correlation analysis.

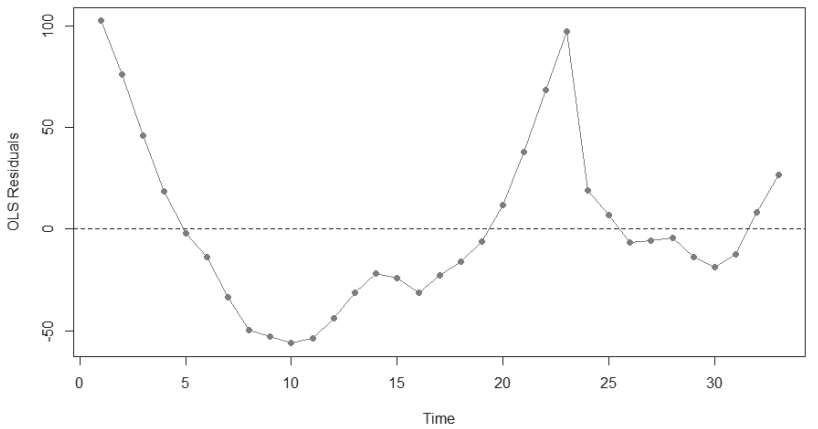

Figure 2. Autocorrelation check for OLS regression residuals

Serial correlation exhibits in this time series with consecutive error terms above and below zero. Let's look at the ACF and PACF graph for choosing the appropriate model to deal with these serially correlated errors.

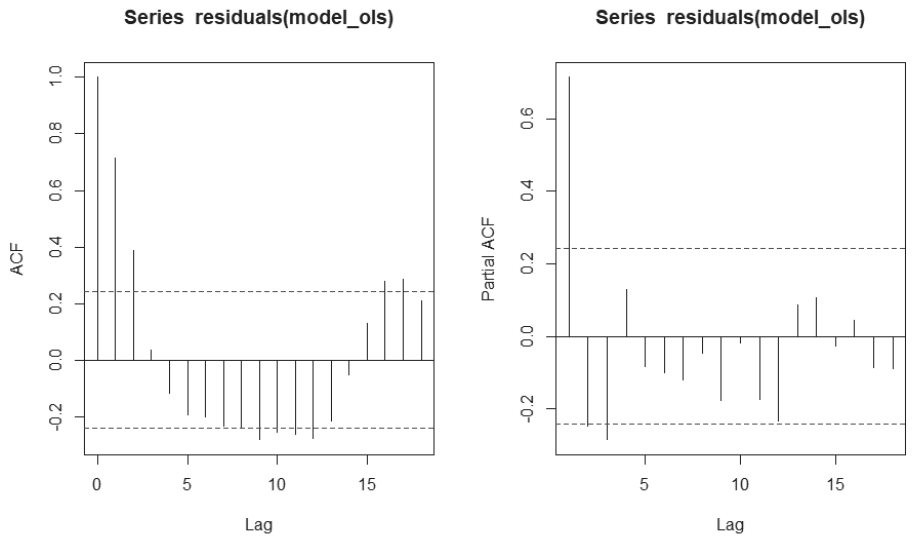

Figure 3. Autocorrelation check for OLS regression residuals using ACF and PACF

There is exponential decay in ACF and one significant lag in PACF, which suggests AR (1) model. Meanwhile, the DW test suggests AR (2) models. We will consider both models and pick the better one using AIC and SIB criteria. However, first, let's rerun the AR (1) model using the general least squares to obtain the result.

Table 3. Estimation of AR(1) model by generalized least squares

```
Coefficients:
               Value Std.Error   t-value p-value
(Intercept)  6208.107  95.35340  65.10630  0.0000
time          117.030   6.45460  18.13123  0.0000
vn          -5942.324 134.85008 -44.06615  0.0000
vntime        -85.465   9.12818  -9.36279  0.0000
level         179.581  81.75654   2.19654  0.0321
trend          10.431  19.07160   0.54692  0.5865
vnlevel      -168.552 115.62121  -1.45779  0.1503
vntrend        29.797  26.97132   1.10476  0.2738

 Correlation:
        (Intr) time   vn     vntime level  trend  vnlevl
time    -0.824
vn      -0.707  0.582
vntime   0.582 -0.707 -0.824
level    0.067 -0.174 -0.047  0.123
trend    0.393 -0.634 -0.278  0.448 -0.350
vnlevel -0.047  0.123  0.067 -0.174 -0.707  0.247
vntrend -0.278  0.448  0.393 -0.634  0.247 -0.707 -0.350

Standardized residuals:
       Min         Q1        Med         Q3        Max
-2.2338676 -0.6625374 -0.1154323  0.5107613  2.7267582

Residual standard error: 103.5039
Degrees of freedom: 66 total; 58 residual
```

Based on the p-value of 0,15 and 0,27 for the coefficients of vnlevel and vntrend, we don't find significant evidence to support the hypothesis that by joining the WTO, there will be a significant difference in income for Vietnam. The finding is in line with Rodriguez and Rodrik (2000) that open trade policies such as lower policy-induced barriers to trade are significantly correlated with economic growth using OLS and IV.

To check the appropriateness of the econometric model, we test another specification suggested by the Durbin-Watson criteria, which is AR (2). Run the likelihood-ratio test to check whether the parameters of the AR process for the errors are necessary and sufficient; we got the following comparison result between AR (1) and AR (2) specification.

Table 4. Likelihood-ratio test for AR(1) and AR(2)

	Model	df	AIC	BIC	logLik	Test	L.Ratio	p-value
model_p1	1	10	766.2623	788.1588	-373.1311			
model_p2	2	11	763.0539	787.1401	-370.5270	1 vs 2	5.208386	0.0225

Both AIC and BIC criteria suggest AR(2) is a better model (Table 4), so we rerun the generalized least squares to see any difference to our above conclusion. It turns out that we have the same conclusion, both coefficients of interest vnlevel and vntrend are insignificant, so we cannot reject the null hypothesis that joining WTO brings no difference to Vietnam's income (Table 5).

Table 5. Estimation of AR(2) model by generalized least squares

Coefficients:

	Value	Std.Error	t-value	p-value
(Intercept)	6212.205	82.37847	75.41054	0.0000
time	115.781	5.70181	20.30608	0.0000
vn	-5958.005	116.50075	-51.14134	0.0000
vntime	-83.867	8.06358	-10.40069	0.0000
level	154.680	78.29606	1.97558	0.0530
trend	19.637	18.35087	1.07006	0.2890
vnlevel	-144.496	110.72735	-1.30497	0.1971
vntrend	21.721	25.95205	0.83697	0.4060

Finally, let's put it all together in one summary graph for the above analysis.

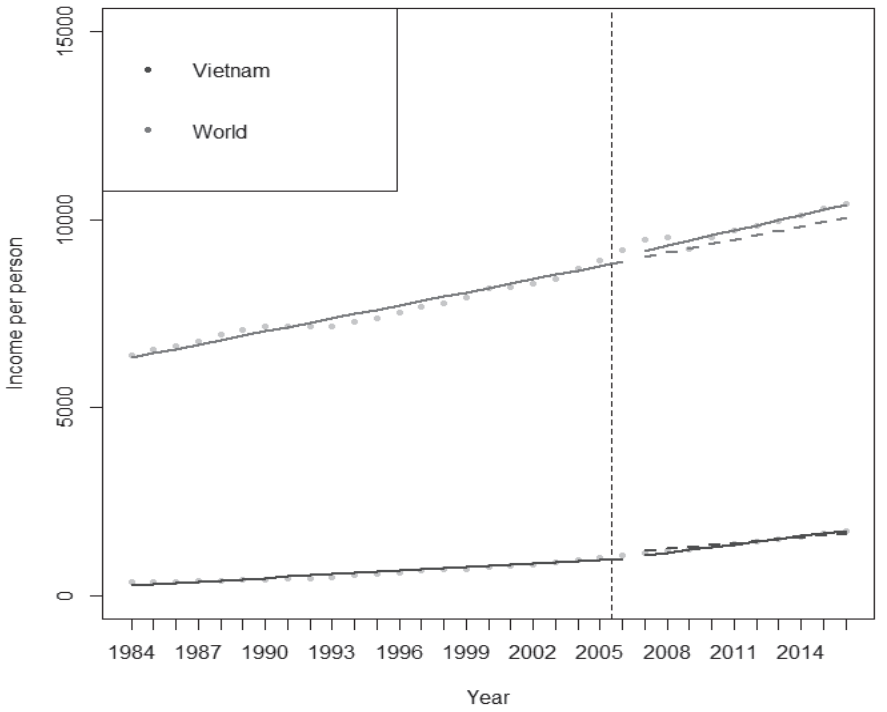

Figure 4. Real and trend of Vietnam income and the world income per person 1984-2016

Looking closely at the graph above, it seems like there is an increase in Vietnam's income trend after 2007. Still, we knew already that such an increase in trend compared to the counterfactual (the blue dash line) is not significant to conclude it is beneficial to join the WTO.

3.3 Robustness tests

Another explanation for a non-significant increase in income per capital could be that population growth is increasing faster than the increase in real GDP growth. To check the robustness of our conclusion, we repeat the interrupted time series model for just real GDP growth between Vietnam and the world without considering the population.

Using the same World Bank dataset in the same period for real GDP growth series, let look at the initial time series plot. There is a wild point after 2008 because of the global financial crisis. However, as the event affects both intervention and the control group, it should not change the ability to use the world as the control group.

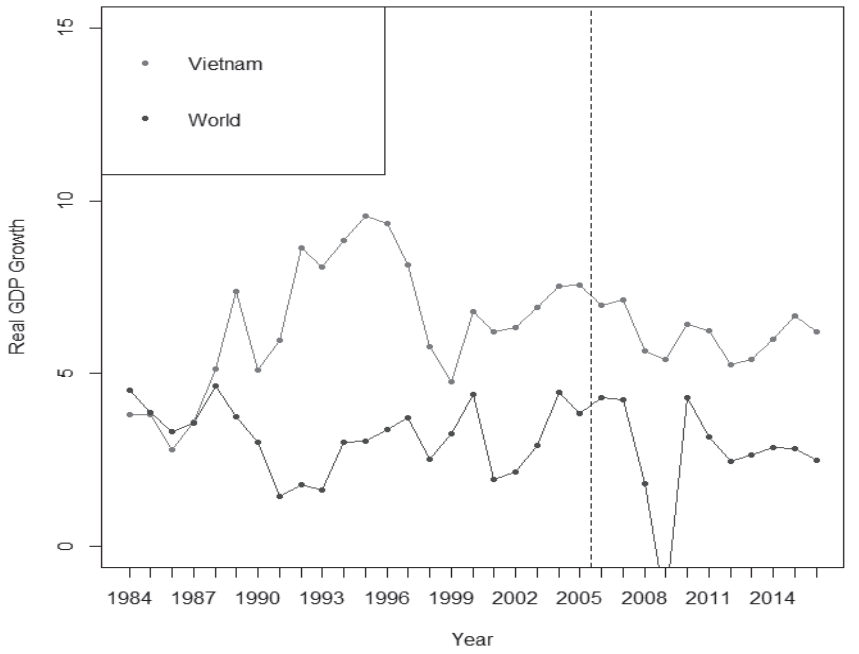

Figure 5. Vietnam and world real GDP growth series from 1984 to 2016

Both Durbin-Watson and ACF/PACF tests suggest AR(1) is a good specification to model GDP growth in this dataset (Table 6 and Figure 6).

Table 6. Durbin-Watson tests for autocorrelation in GDP growth series

lag	Autocorrelation	D-W Statistic	p-value
1	0.423528793	1.140155	0.000
2	0.111172643	1.749418	0.138
3	0.126689773	1.663588	0.088
4	-0.004572618	1.896967	0.724
5	-0.212000887	2.310435	0.134
6	-0.195184226	2.246081	0.182
7	-0.136667821	2.092730	0.326
8	-0.222799413	2.111938	0.222
9	-0.376503340	2.356882	0.030
10	-0.167143836	1.871413	0.598

Alternative hypothesis: rho[lag] != 0

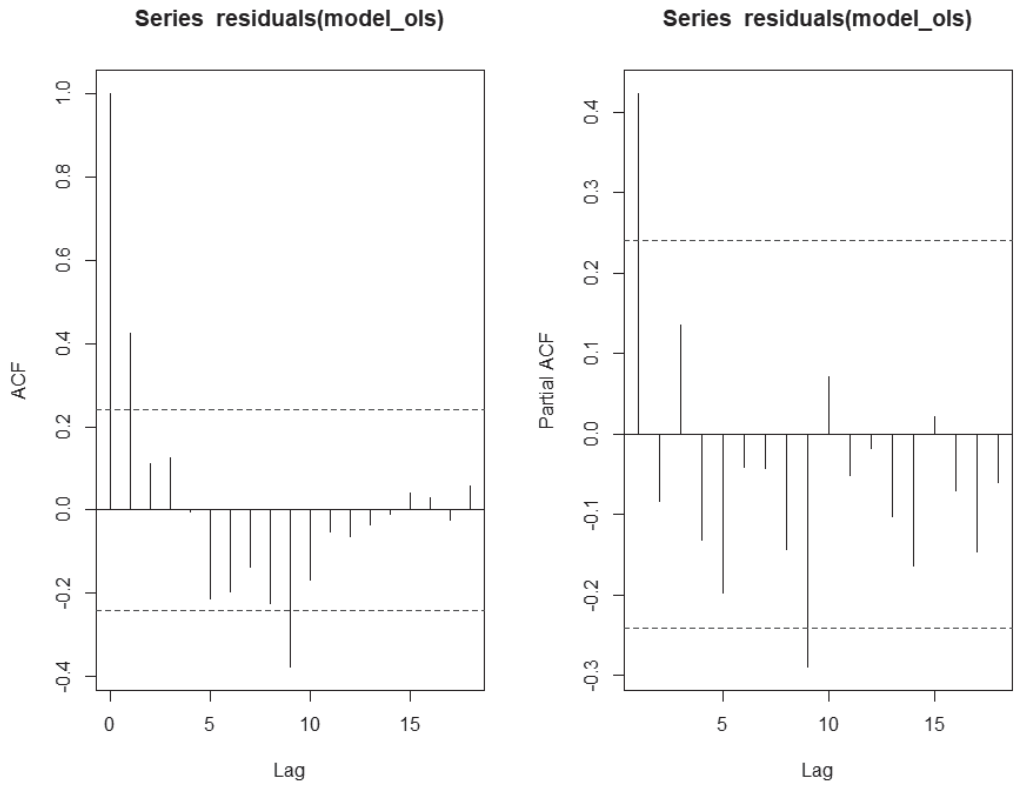

Figure 6. ACF/PACF tests for autocorrelation in GDP growth series

Hence, we run the general least square with AR (1) specification for the real GDP growth time series and obtain the following result (Table 7).

Table 7. Generalized least square with AR(1) specification for the real GDP growth time series

Coefficients:

	Value	Std.Error	t-value	p-value
(Intercept)	3.487488	0.8850134	3.940604	0.0002
time	-0.019758	0.0630491	-0.313375	0.7551
vn	1.335251	1.2515980	1.066837	0.2905
vntime	0.147678	0.0891649	1.656239	0.1031
level	-0.422703	1.2987529	-0.325468	0.7460
trend	0.010601	0.2117611	0.050059	0.9602
vnlevel	-0.569510	1.8367140	-0.310070	0.7576
vntrend	-0.233616	0.2994755	-0.780084	0.4385

Again, we cannot reject the null hypothesis that joining WTO will not bring about differences in real GDP growth for Vietnam. If we look at the graph below alone and do not use any control group, there is a change in level and trend in Vietnam's real GDP growth after

joining the WTO (Figure 7). It is worst for Vietnam to join as the real growth, reduce in both level and trend compared to the counterfactual (blue dash line). However, if we use the world's real GDP as the control group, such change is insignificant.

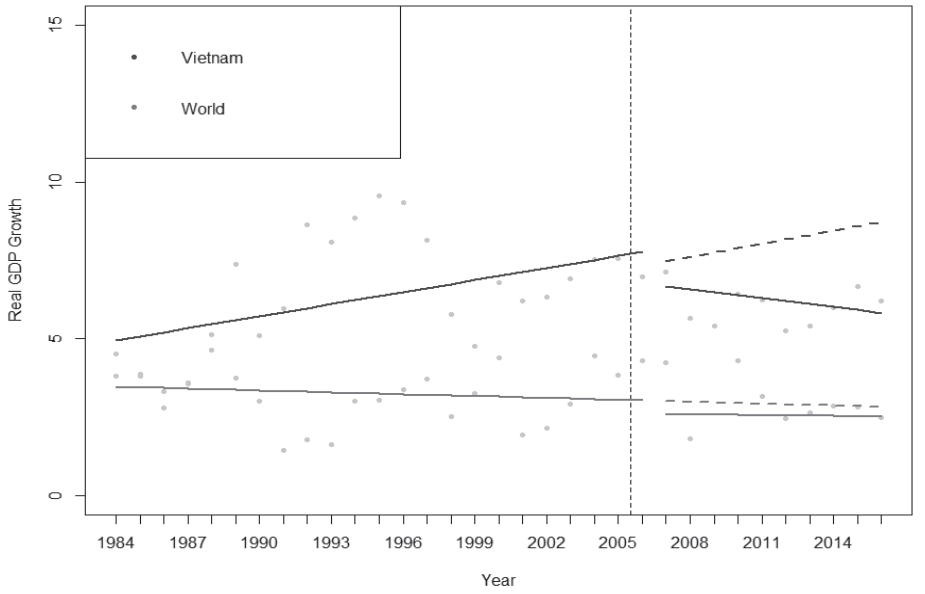

Figure 7. Level and trend in world and Vietnam's real GDP growth after joining WTO

3.4 Effects on infant mortality rate

Given the insignificant effect of joining WTO on income and GDP growth, let's see if it affects the infant mortality rate. We repeat the same time series econometric procedure, but with new dependent variables: infant mortality rate in this case.

First, let's see the initial situation for both Vietnam's infant mortality vs. the world's (Figure 8).

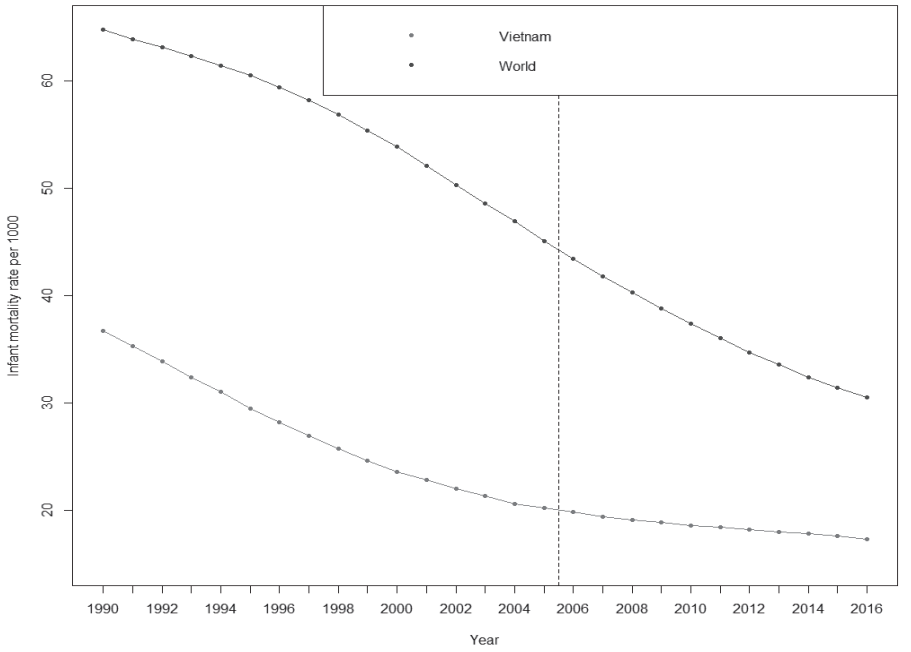

Figure 8. Vietnam's infant mortality rate per 1,000 vs the world's

Vietnam's infant mortality rate is lower than that of the world, and both have experienced a downward trend since 1990. It seems like the reduction rate in Vietnam is reduced compared to that of the world after 2007. After analyzing the residuals of both time series, both the Durbin-Watson test and ACF/PACF suggest a specification of AR (1). Run GLS with AR (1) specification, we get the result (Table 8).

Table 8. Generalized least squares estimation with AR (1) of infant mortality rate

Coefficients:

	Value	Std.Error	t-value	p-value
(Intercept)	66.59714	1.0611246	62.76090	0.0000
time	-1.34151	0.0684770	-19.59071	0.0000
vn	-29.30403	1.5006568	-19.52747	0.0000
vntime	0.28364	0.0968411	2.92896	0.0053
level	-0.35478	0.3498703	-1.01402	0.3159
trend	0.06658	0.1321846	0.50367	0.6169
vnlevel	0.19327	0.4947914	0.39061	0.6979
vntrend	0.77746	0.1869373	4.15891	0.0001

Again, the two variables of interest in vnlevel and vntrend suggest that there is no change in the level of infant mortality rate immediately after joining WTO, but the trend is significantly different with a p-value = 0.0001. After a major change in trade policy in 2007, compared to the reduction in the mortality rate of the world of 1.34 children per 1000 children

per year, Vietnam has a lower reduction rate of only 0.5 children per 1000 children per year (-1.34 + 0.067 + 0.78).

The result seems to contradict our first assumption that there will be a benefit to public health when Vietnam joins the WTO. However, the result showed that by increasing open trade, the reduction in infant mortality in Vietnam became slower than that of the world. But caution here is that the mortality in Vietnam is already low and has approached a stable level in recent years. So, the significantly different effect compared to the world could be the long-run trend. We need to see whether the effect repeats in other countries.

4. CONCLUSION AND SUGGESTIONS

The research question on the benefit of free trade is mixed. Some found it is significant, and some found there is not. Unfortunately, the result of the econometric model in this paper rejects our expectation of the benefits of the free trades on income and real GDP growth for Vietnam. To some extent, it is consistent with the mixed result of free trades in the literature review.

We got a significant difference in the infant mortality rate for Vietnam compared to the world after joining WTO, but note that the rate in Vietnam is already low and approach a stable level. The difference could be just the natural effect, but not trade policy. This result is not a generalization to other countries. We need to check other countries in the sample to understand better our research question about the benefits of free trade. By the way, that will be done in the next project.

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