EMPIRICAL INVESTIGATION OF THE EFFECT OF NAFTA ON THE ECONOMY IN CANADA

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ABSTRACT

In this study, we investigate using statistical time series analysis the effect NAFTA may have had on some economic factors in Canada. These factors were GDP growth rate, unemployment rate, total export, export to and import from the US, and labor productivity. Results from the intervention time series analysis and the regression analysis with auto correlated errors did not show any significant relationship between NAFTA and any of the above economic variables. The only significant negative effect of NAFTA on total export was explained as being primarily due to the 2009 observation resulting from the 2008 great recession.

INTRODUCTION

In 1992, the United States, Canada, and Mexico signed the North American Free Trade Agreement (NAFTA), which took effect on January 1, 1994. Under this agreement, restrictions on trade among the three countries were phased out. One would expect this free trade agreement to benefit both import and export of the countries involved. However, it is not clear how effective NAFTA would be on other parts of the economy such as the GDP, unemployment and labor productivity. There have been many empirical studies in the literature on the effect of NAFTA on different aspects of the economy of Mexico. However, not many studies in the literature have addressed the effect of NAFTA on the economy in Canada. Studies done dealt mostly with the effect of NAFTA on trade. Proponents of NAFTA argued that the free trade agreement would have a positive impact on the economies of the three countries involved. On the other hand, the Nobel Prize economist Krugman has expressed the view that there has been zero effect of NAFTA on Canada (Contenta, 1996). The interest in this study is to determine if 22 years of NAFTA , has had any significant effect on the economy of Canada in terms of GDP, imports, exports, employment, and labor productivity. Time series analysis is used to determine if NAFTA has had significant effects on any of these macroeconomic variables.

LITERATURE REVIEW

Anderson (2009) reported on the regional and national effects of NAFTA in Canada. His analysis utilized an ordinary multiple regression not accounting for serial correlation in error that is likely to arise in time series data. The dependent variables were the logarithm of international trade with the US as well as both interprovincial and international trade with the US. The independent variables were the logarithms of GDP and GDP per capita, capital-labor ratios, land-labor ratios, tariff, exchange rate value, time t for trend and NAFTA as a dummy variable that is zero at or before 1994 and 1 after 1994. It was determined form this regression analysis that NAFTA had a significant positive effect on trade with the United States. In the provinces, NAFTA had a significant positive effect in Saskatchewan and Manitoba. Also, NAFTA had positive as well as negative effects on interprovincial trade.

Gould (1998) found that NAFTA had no statistically significant effect on international trade between Canada and the US as well as Canada and Mexico. Wall (2003) in a study of the effect of NAFTA on international trade between the US and three Canadian regions (western, central, and eastern), reported that over all Canada's imports from the US increased by 14% and export to the US were up 29%. By region, the increase in import and export was in the central region, 43% and 18%, respectively. The eastern region showed a decrease in export and import (9% and 13%, respectively) and there was no significant change for the western region.

Brox (2001) reported that NAFTA had a negative impact on the interprovincial trade in Canada. He estimated a reduction of 6.2%. On the other hand, there was evidence for increased trade with other countries. Thus, this increase in international trade may have been at the expense of interprovincial trade.

Caliendo and Parro (2015) extended the Ricardian model to include sectorial linkages, trade in intermediate goods, and sectorial heterogeneity in productivity and applied it to estimate the effect of tariff reduction under NAFTA on welfare and trade for Mexico, US, and Canada. It was found that welfare increased by 1.31% for Mexico and 0.08% for the US. On the other hand, welfare for Canada decreased by 0.06%. Trade for Mexico increased by 118%, 41% for the US, and 11% for Canada.

Dutt and Ghosh (2014) investigated the effect of NAFTA on the purchasing power parity (PPP) hypothesis in Mexico, Canada and the US using the Pedroni (2004) panel co-integration test. The PPP hypothesis states that under free trade and in the absence of non-tradable sectors and transportation costs, the prices of same goods should be the same in the three NAFTA countries. The analysis showed that PPP did not exist in these countries. This was explained as due perhaps to lack of free movement of labor among the countries even though there may have been free flow of trade among them.

Galbraith (2014) by examining estimates for gross household income, market, and disposable income, showed an evolution of income inequality since NAFTA in the US, Canada, and Mexico. Admittedly, this inequality may not have been due to NAFTA, but to other economic factors like the stock market boom in the 1990's and the mortgage-finance problem that lead to the recession of 2008.

Mejias and Vargas-Hernández (2001) reported that import and export between Canada and Mexico have increased under NAFTA. However, this increase has been leveling off. In other words the increase is occurring at a decreasing rate. Authors believe that Canada and Mexico would benefit by pursuing bilateral trade agreements, perhaps outside the NAFTA accord.

METHODS

In order to determine if NAFTA had any effect on different factors of the economy, two analytical procedures (intervention time series analysis, and auto-regression analysis) were utilized using the SAS software.

Intervention Analysis

The model by Box and Tiao (1975) is used to analyze for the effect of an intervention (NAFTA in this case) on a stationary time series response variable when the time (T) of the intervention is known. The intervention or NAFTA is entered in the model as a step function, S_t^T (0 before T=1994 and 1 at and after 1994). If the response due to the impact is felt b periods after

the intervention at time T, the impact of the intervention on the response variable can be specified in general as

$$wB^bS_t^T , \quad (1)$$

where, B is the shift operator, w is the impact coefficient and

$$S_t^T = \begin{cases} 0, & t < T \\ 1, & t \geq T \end{cases}$$

However, if the response due to the impact is gradual, the impact can be specified as

$$(wB^b/ (1-\delta))S_t^T \quad (2)$$

Where δ is between 0 and 1 (Wei, 2006).

For the purpose of this analysis, both (1) and (2) were used. The intervention model can be written as

$$y_t = \mu + x_t + wB^bS_t^T \quad (3)$$

or

$$y_t = \mu + x_t + (wB^b/ (1-\delta))S_t^T \quad (4)$$

where μ is the mean of the series x_t, y_t is the observed series and x_t is the series with no intervention. Of all the variables, only the unemployment mean was determined to be not significantly different from zero.

Auto-regression

The auto-regression model used in this analysis can be expressed as

$$y_t = a + cx_t + n_t \quad (5)$$

Where n_t is an auto-regressive process of the first order, $n_t = \theta n_{t-1} + e_t$ ($|\theta| < 1$) and e_t is random error. The order was determined using the Durbin-Watson statistic.

Here, $x_t = \begin{cases} 0, & t < 1994 \\ 1, & t \geq 1994 \end{cases}$

DATA

Data for unemployment rate, GDP rate, total export growth rate, labor productivity index (2010 =1), export to the US in millions of US dollars, and import from the US in millions of US dollars were from the Organization for Economic Co-operation and Development (OECD) and retrieved form the Federal Reserve Bank of St. Louis (https://fred.stlouisfed.org). Plots of the data over years are presented in the Appendix

RESULTS

In this analysis, different b values in Eqs. (3) and (4) were tried. In all cases w was not significant for any of the b values greater than 1. Hence, it was determined that there was no delayed effect of NAFTA. Also, there was no evidence from the model in (4) that there was a gradual effect. Hence, we report on the results of the model in (3) with b = 0 and T = 1994.

Using the standard time series diagnostic techniques, namely the dampening patterns of the auto regression, inverse auto regression, and partial auto regression of the time series, it was determined that the GDP rate and total export were stationary. On the other hand, the first difference of labor productivity, export to the US, import from the US, and unemployment were stationary.

All stationary series followed an auto regression of the first order AR(1). The AR(1) model gave a good fit to all of the dependent variables. Hence, x_t in the intervention model was assumed to be an AR(1).

Since the interest in this paper is to determine if NAFTA had any significant effect or association with each of the dependent variables, we present in Tables 1 and 2 the estimates W from (3) and c from (5) and their p values, indicating the level of significance.

It is seen from the W estimates of the intervention model in Eq. (3) and their corresponding p values that there were no significant associations between NAFTA and GDP, unemployment, labor productivity, import from the US, and export to the US. The W estimate was negative and significant for total export indicating a negative relationship of NAFTA with total export.

Results from Table 2 for the auto-regression model in Eq. (5) are the same as those in Table 1. Except for the negative association between NAFTA and export, there was no significant association between NAFTA and any of the other economic factors.

Table 1
Estimates of W in the intervention model of Eq. (3) with b =0. NAFTA is the independent variable (S_t) and GDP, unemployment, export, export to the US, import from the US, and labor productivity are the dependent variables (y_t)

Dependent Variables	W estimates	p values
GDP	-0.812	0.349
Unemployment	-0.779	0.337
Total Export	-6.007	0.0254
Labor Productivity	0.0099	0.276
Import from US	594.19	0.692
Export to US	1024.20	0.675

Table 2
Autoregressive analysis results of the model in Eq. (5). NAFTA is the independent variable (x_t) and GDP, unemployment, export, export to the US, import from the US, and labor productivity are the dependent variables (y_t)

Dependent Variables	c estimate	p value
GDP	-0.812	0.354
Unemployment	-0.783	0.395
Total Export	-6.000	0.029
Labor Productivity	0.0211	0.119
Import from US	1354	0.420
Export to US	2075	0.425

DISCUSSION

It is of interest to observe that NAFTA had no significant relationship with GDP, unemployment, labor productivity, or import and export between Canada and the US. There was a significant negative relationship between NAFTA and total export. The trend in total export over years (Figure 6), except for 2009, did not change noticeably after NAFTA. The big negative change came in 2009 due, no doubt, to the big recession in 2008. So it is likely that the significant negative association between NAFTA and export was due largly to the negative change in 2009. To verify this assertion, the 2009 observation was replaced by the average of 2008 and 2010. In this case the results gave W= -4.126 (p =0.116) and c = -4.134 (p=0.114), both not significant. When the observation of 2009 was deleted from the data set, the results from auto regression gave c= -4.19 (p=0.10), which is not significant.

Both analysis in Tables 1 and 2 showed a negative relationship between NAFTA and GDP and unemployment. However these were not significant. For GDP (Figure 3), there was no noticeable change in trend after NAFTA. However, in the case of unemployment (Figure 1) there was a definite negative trend after NAFTA came into effect in 1994. However, this did not seem to be significant perhaps due to the volatility effect.

There was a positive relationship between NAFTA and each of labor productivity, import from and export to the US (Tables 1 and 2). However, none of these associations are significant as seen from the p-values. It is seen from Figures 2, 4, and 5 that the trends were positive for import from the US, export to the US, and labor productivity. These trends started before NAFTA and continued after NAFTA. There was no indication of a change in trend after NAFTA. This would indicate as the analysis shows that NAFTA had no effect on these trends. One may conclude from this analysis that NAFTA has had no effect on these economic factors at the national level in Canada. This conclusion is in agreement with Krugman (1996). NAFTA may have had regional effects on trade as shown by some studies in the literature.

CONCLUSION

This study examined the effect of 22 years of NAFTA on the economy of Canada in terms of imports from and export to the US, total exports, employment, and labor productivity. Statistical analyses using the time series intervention analysis and the auto regression analysis did not show any significant relationship between NAFTA and any of the economic variables. NAFTA was significantly related to total export, but the significance was attributed primarily to the great recession of 2009, rather than to NAFTA. NAFTA showed a negative relationship with GDP growth rate and with

unemployment rate, but these were not significant. Also, NAFTA was positively related to import from and export to the US, and labor productivity. However, none of these relationships were significant.

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APPENDIX

Figure 1
Trend in unemployment rate over years

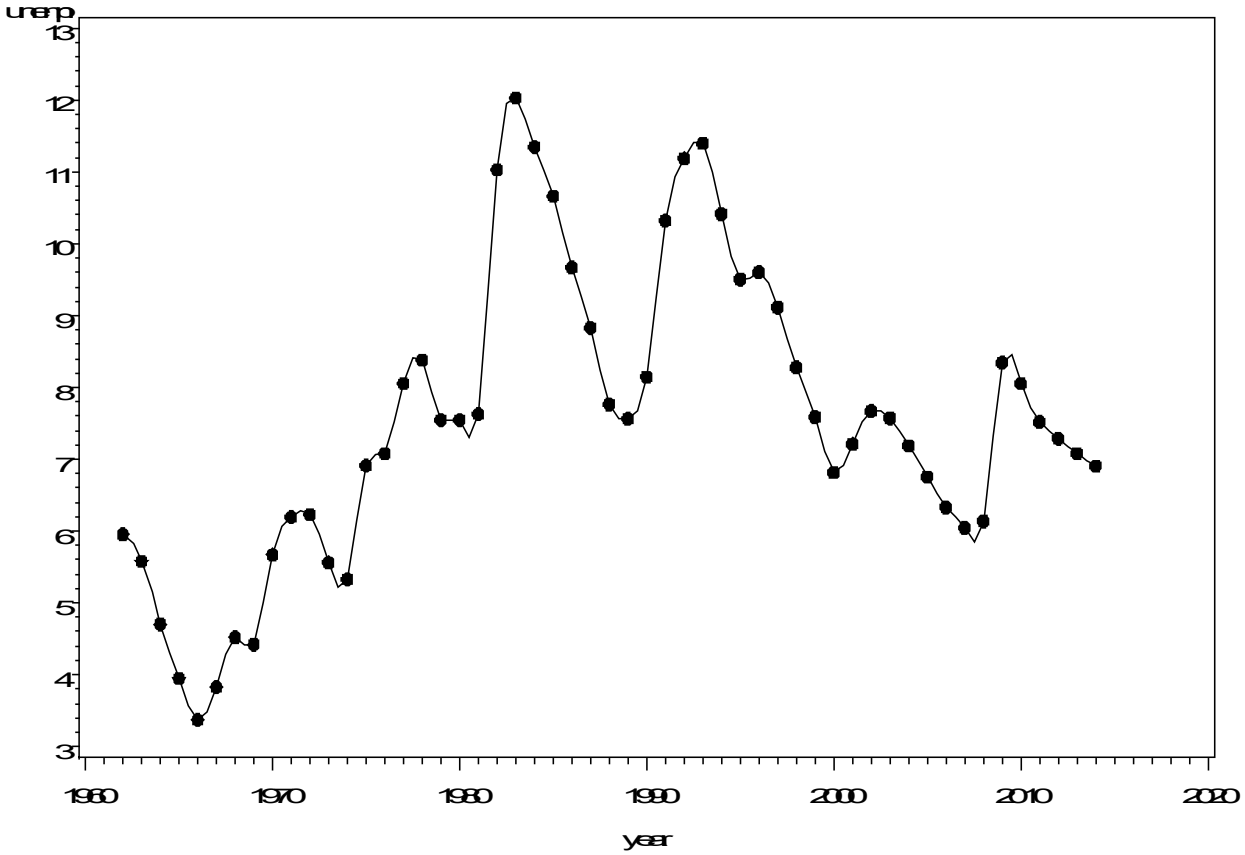

Figure 2
Trend in export to the US over years

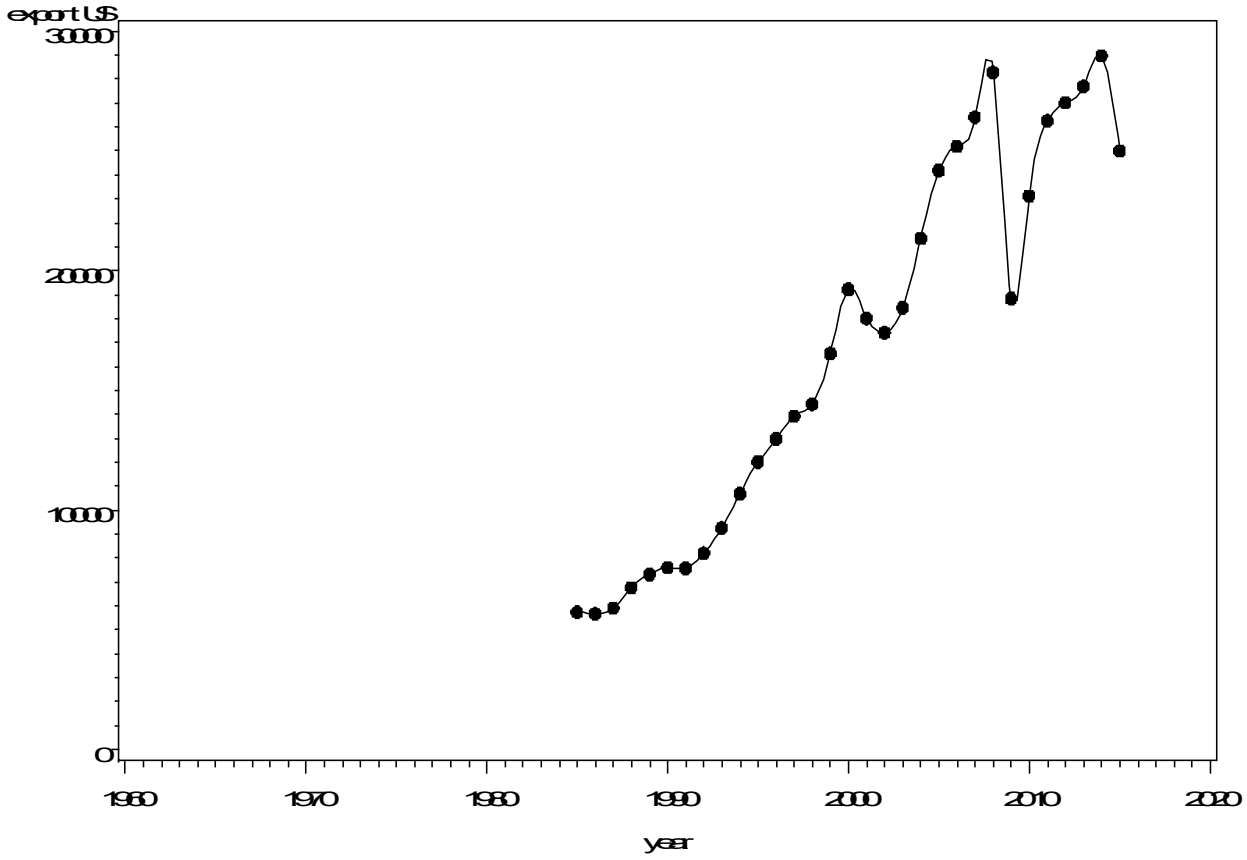

Figure 3

Trend in the gross domestic product (GDP) over years

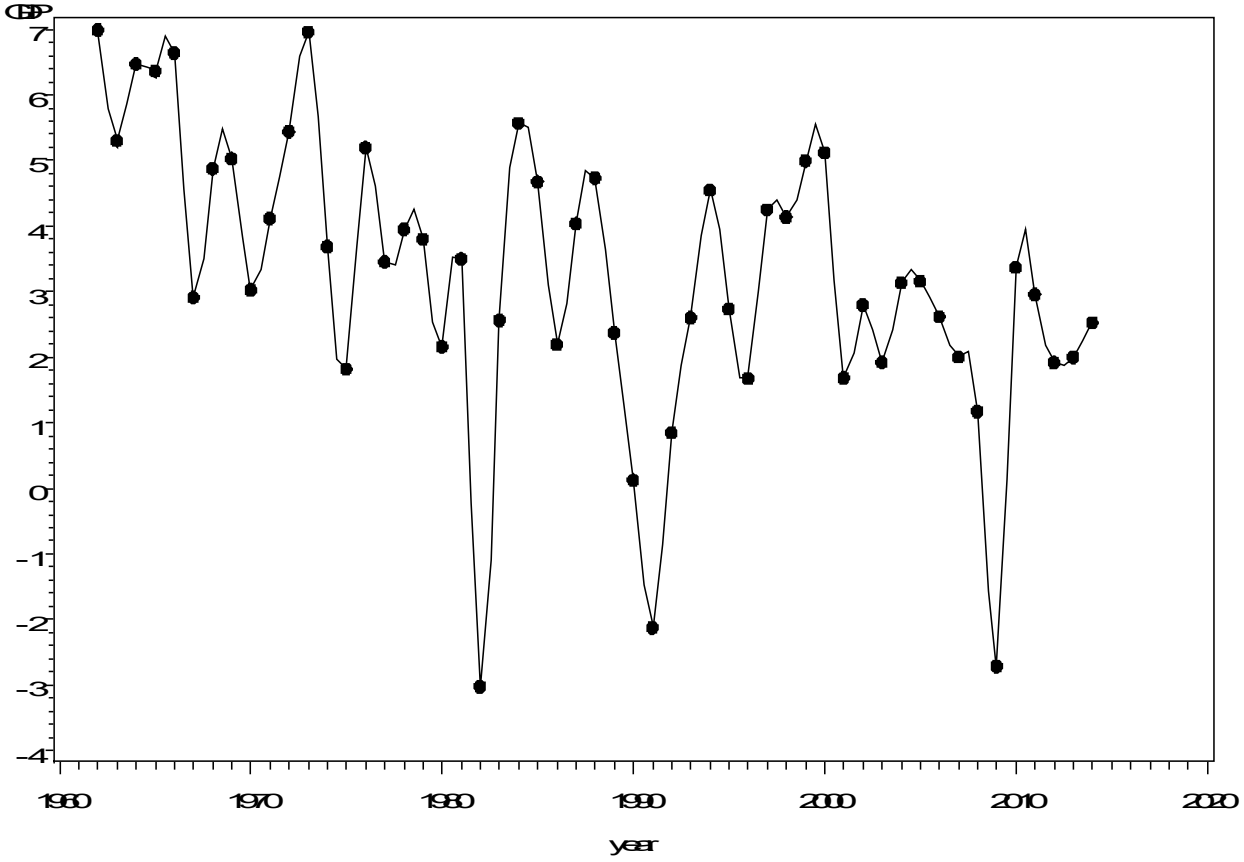

Figure 4

Trend in import from the US over years

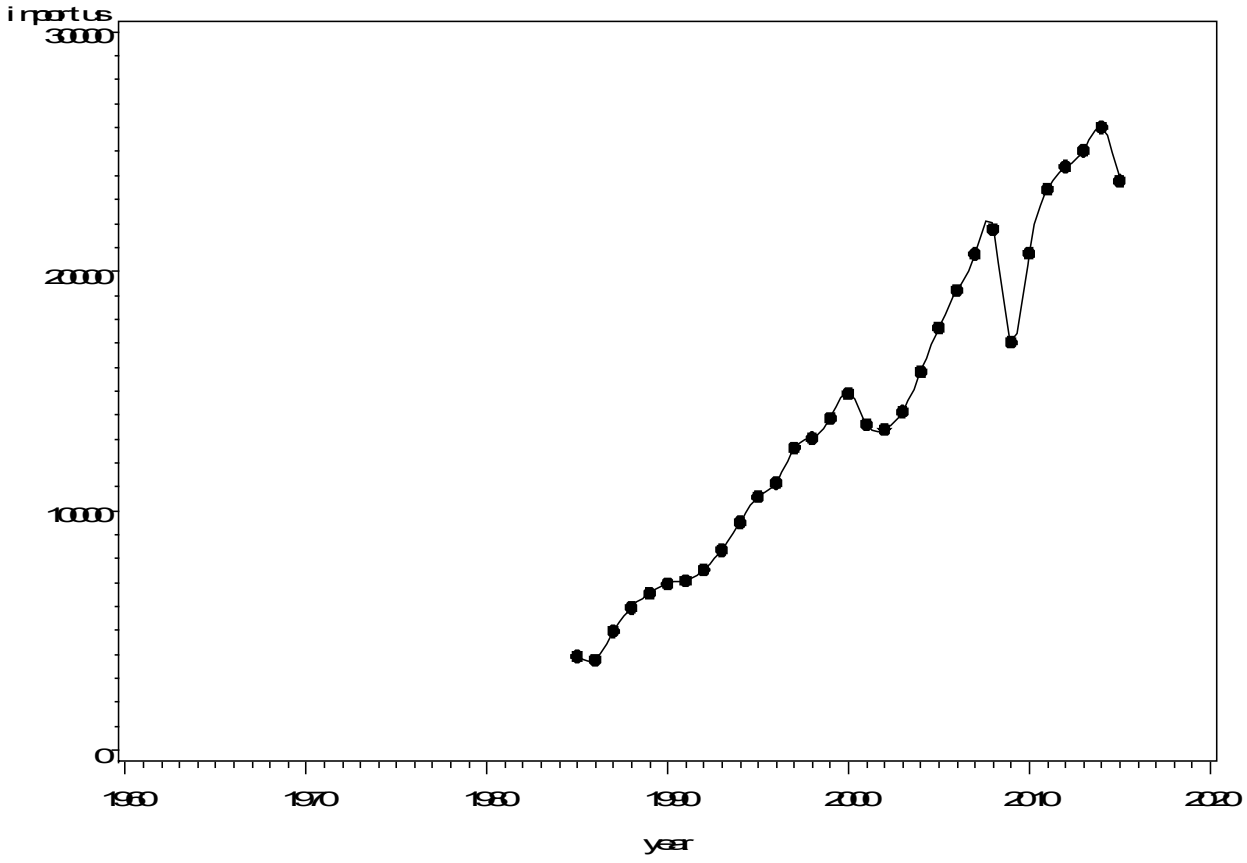

Figure 5

Trend in the labor productivity index over years

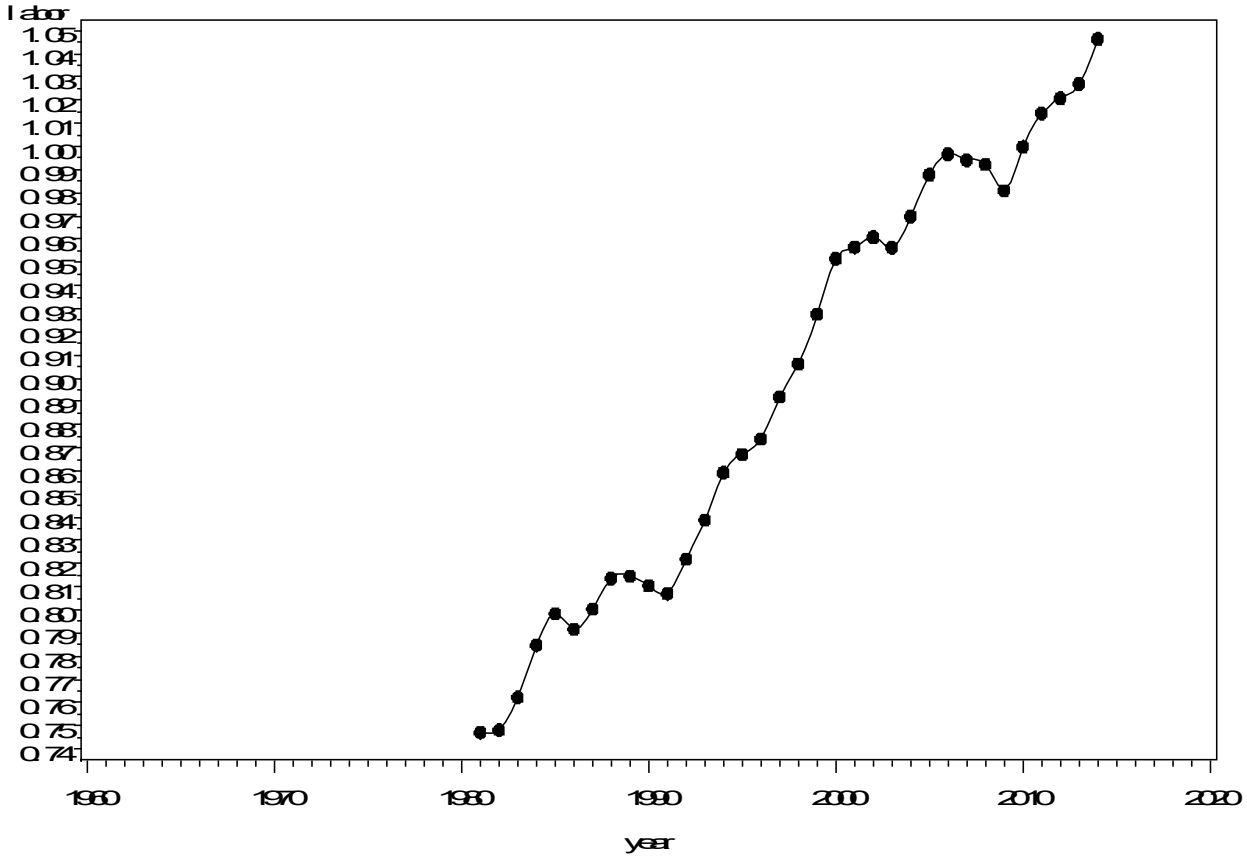

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Figure 6

Trend in total export over years