INTERNATIONAL TRADE AND STRUCTURAL CHANGE[*]

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ABSTRACT

In light of the substantial movement towards trade liberalization during the postwar period, this paper attempts to determine if, and when, countries experienced statistically significant changes in the paths of their export-GDP and import-GDP ratios. We find that: (1) most trade ratios exhibited a structural break in their time paths; (2) postbreak trade exceeded prebreak trade for the majority of countries; (3) the coincidence in timing between the import and export breaks does not appear to be particularly strong, and; (4) there is little relation between the extent of changes in imports and the extent of changes in exports for most countries.

J.E.L. classifications: C22, F1
Keywords: international trade, structural change

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I. INTRODUCTION

The postwar period has been characterized by a series of steps that have led to increasing openness among countries. Sachs and Warner (1995) refer to the years between 1970 and 1995 as "the most remarkable institutional harmonization and economic integration among nations in world history" (pg 1). As Krugman (1995) states, "there is no question that the general profile of world protectionism since the early twentieth century has been the inverse of that of world trade" (page 338).

As Ben-David (1993) shows for the EEC, EFTA and between the United States and Canada, this relaxation of trade barriers has been accompanied by significant income convergence among the liberalizing countries. Furthermore, the income convergence did not come at the expense of the wealthier countries, but was instead the product of faster growth − in varying degrees − by the countries involved. Ben-David and Papell (1995) find that majority of these countries tended towards new, steeper, growth paths in the decades following the Second World War. In their examination of the link between trade reforms and output growth, Sachs and Warner (1995) find strong evidence in support of such a liberalization-growth link.

A crude examination of average import and export shares of output since World War II indicates that the increases in trade have been fairly widespread. If one splits the period between 1948 and 1993 in half, then roughly 70% of the four dozen countries examined below had higher trade shares after 1970 than they did prior to 1970.

Krugman (1995) cites a number of possible reasons for the post-WWII growth in trade. In light of the extensive postwar trade liberalization that has taken place, a portion of the increased trade reflects a return to pre-WWI levels − when the economies of the world were

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more integrated than they were during the interwar years. Krugman also highlights the increase in intra-trade (trade in similar goods between similar countries) that he attributes in part to technology improvements in the form of lower transportation costs and the advent of faster and cheaper communications technologies that facilitate long-range business relationships.

Rose (1991) explores a number of possible trade-enhancing factors in addition to tariff reductions and declines in transportation costs. He finds that increases in real output, increases in international reserves and reductions in tariff rates are significantly related to trade growth of small open economies, though, as Rose points out, only the latter effect, tariffs, is predicted by standard economic theory.

The focus of this paper is different. The goal here is not to provide an explanation for the growth in trade over the postwar period. Given that trade has grown for most countries since World War II, the first goal of this paper is to examine whether the trade-output shares evolved gradually over the postwar period, or whether trade in individual countries changed abruptly. We utilize sequential trend break tests to determine the existence of significant structural breaks in the trend processes of trade-output ratios. These tests are used to determine if, and when, countries display evidence of significant changes in these ratios.

To the extent that countries are characterized by structural breaks, then it is possible to show that the timing of these breaks occurs *after* the major postwar trade reforms had been implemented. In contrast with the evidence on output – which rose rapidly in the years following WWII and subsequently slowed down in recent decades (see Ben-David and Papell, 1997) – trade, which also began to rise after the war, was even higher (in the majority of instances) after the structural breaks than before.

The second, related, issue that we focus on is the common practice (in current growth-related empirical work) of lumping together imports and exports into a single measure of openness. In light of the major OPEC-related shocks to energy prices, and the subsequent effects on imports, we examine whether this lumping practice masks relevant information. Hence, the analysis below is conducted separately for imports and exports. The determination of the existence and the timing of trend breaks is useful in this regard as it facilitates a comparison of imports and exports and the extent of similarity (or lack thereof) in the time paths of each.

The next section describes the trend break test and details the results of its estimation on 48 countries (47 in the case of exports) between 1948 and 1993. In section three, these findings are then used in evaluating the behavior of trade in general, and of imports and exports in particular, since the Second World War. Section four concludes.

II. STRUCTURAL BREAKS

This section presents a statistical analysis of the structure of postwar trade. Formally, we test for structural change in the import-GDP and export-GDP ratios for the 48 countries for which we could find adequate data.[1] Our goal is to determine whether the evolution of trade shares has followed a stable process during the postwar period or, alternatively, whether – and when – the process has changed.

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[1] The time spans for the data are as large as 1948 through 1993 and no smaller than 1955 through 1988. The data comes from the IMF *International Financial Statistics*.

The literature on structural change is large and increasing. While earlier work often made restrictive assumptions such as stationary, non-trending, and/or iid data, recent work has relaxed these assumptions. Vogelsang (1994) develops a set of particularly non-restrictive tests which allow for unit roots, polynomial trends, and serial correlation. These features are important because the import-GDP and export-GDP ratios appear to have unit roots, are obviously trending in the majority of instances, and may be serially correlated. The Vogelsang Sup Wald (or SupF_t) test consists of estimating the following equation:

$$R_t = \mu + \beta_1 t + \beta_2 t^2 + \theta DU_t + \gamma_1 DT_t + \gamma_2 DT2_t + \sum_{j=1}^{k} c_j R_{t-j} + \varepsilon_t \qquad \textbf{(1)}$$

where R_t equals either the import-GDP ratio or the export-GDP ratio. The period at which the change in the parameters of the trend function occurs will be referred to as the time of break, or T_B. The break dummy variables have the following values: $DU_t = 1$ if $t > T_B$, 0 otherwise, $DT_t = t\text{-}T_B$ if $t > T_B$, 0 otherwise, and $DT2_t = (t\text{-}T_B)^2$ if $t > T_B$, 0 otherwise.

The exact specification of the test depends on what type of trending characterizes the data. If both a linear and a quadratic trend is allowed, Equation (1) is estimated as written. We call this specification Model I. For linear trending data, Model II imposes the restriction that $\beta_2 = \gamma_2 = 0$. For non-trending data, Model III, the restriction is $\beta_1 = \gamma_1 = \beta_2 = \gamma_2 = 0$. While tests for non-trending and linear trending data are more common, inclusion of the quadratic trend in Model I may be particularly appropriate for trade share data because it allows the import-GDP and export-GDP ratios to be rising at a decreasing rate.

The lagged values of the trade shares are included in Equation (1) to account for serial correlation. Since data dependent methods for selecting the value of the lag length k appear to be superior to making an *a priori* choice of a fixed k, we follow the procedure suggested by Campbell and Perron (1991) and Ng and Perron (1995). Start with an upper bound of k_{max} on k. If the last lag included in Equation (1) is significant, then the choice of k is k_{max}. If the lag is not significant, then k is reduced by one. This process continues until the last lag becomes significant and k is determined. If no lags are significant, then k is set to 0. k_{max} is initially set at 8 and the 10 percent value of the asymptotic normal distribution (1.6) is used to assess the significance of the last lag.

Equation (1) is estimated sequentially for each break year with 15 percent trimming, i.e., for $0.15T<T_B<0.85T$, where T is the number of observations.[2] For Model III, SupF_t is the maximum, over all possible trend breaks, of three times the standard F-statistic for testing $\theta=\gamma_1=\gamma_2=0$. For Model II, Sup$F_t$ is the maximum of two times the standard F-statistic for testing $\theta=\gamma_1=0$ and, for Model I, SupF_t is the maximum of the standard F-statistic for testing $\theta=0$. It is important to understand that the break years are determined endogenously, with no *ex ante* preference given to any particular year.[3]

The no-trend-break null is rejected in favor of the broken-trend alternative if the SupF_t statistic is greater than the appropriate critical value. Vogelsang tabulates critical values for both stationary and unit root series. We estimate three versions of Augmented-Dickey-Fuller tests, with a constant, a linear time trend, and a quadratic time trend. Using these tests, we can reject

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[2] Vogelsang reports critical values for both 1 and 15 percent trimming. The 15 percent trimming was used here because it has greater power to detect breaks near the middle of the sample.

[3] These tests allow for only a single break for each series. Tests which allow for multiple breaks, such as Bai and Perron (1995) have, to our knowledge, only been developed for stationary and non-trending data.

the unit root null in only about 10 percent of the cases (at the 5 percent significance level), and so use the unit root values.[4]   Since the unit root critical values are higher than the stationary critical values, we are erring on the conservative side if the data is actually stationary.

The structural change literature provides little guidance regarding which model to estimate. If the data is trending (either linear or quadratic), then estimating a model which does not contain the appropriate trend may fail to capture a significant break. On the other hand, the power to reject the no-trend-break null when there is a break is reduced when estimating a model which includes a trend which is not contained in the data (because the critical values increase with the inclusion of more trends).

We use the following model selection algorithm. First, the least restrictive Model I is estimated. If the no-trend-break null can be rejected (at the 10 percent or higher level), then the results are reported. If the Model I null cannot be rejected, then Model II is estimated and its results are reported if the no-trend-break null can be rejected. If the Model II null cannot be rejected, then Model III is estimated and, like before, the results are reported if the null is rejected. If the no-trend-break null cannot be rejected by any model, we report the results for Model I.[5]

The results of the Vogelsang SupF_t tests are reported in Table 1. For the import-GDP ratios, the no-trend-break null is rejected at the 10, 5, and 1 percent levels for 37, 28, and 23 of the 48 countries. For the export-GDP ratios, the null is rejected at the 10, 5, and 1 percent levels for 33, 30, and 19 of the 47 countries, respectively. Most of the rejections are for Model I,

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[4] We compute finite sample critical values — which incorporate both the exact number of observations and the data dependent method for selecting the value of the lag length — for these calculations.

[5] The choice of reporting Model I results in the latter case of countries with insignificant breaks is completely arbitrary, and the insignificant results are not used later.

reflecting the importance of including quadratic, as well as linear, trends. The large number of rejections constitutes strong evidence of a structural change in trade shares during the postwar period.

The experience of the United States provides a nice illustration of Models I (for imports) and III (for exports), which is provided in Figure 1. The actual trade shares are plotted together with the fitted values prior to, and following, the trend breaks. While the export case depicts a *level* change following 1972, U.S. imports appear to have begun to rise in the late sixties (possibly related to the implementation of the Kennedy Round agreements at that time), jumping substantially in 1973. These increases continued after 1973 – though at a diminishing rate – finally levelling off towards the late eighties.

III. TRADE BEHAVIOR IN THE POSTWAR PERIOD

Determination of the structural breaks in the previous section suggests a turning point for each country that is useful in a comparative analysis of trade behavior during the postwar period. Table 2 lists all of the countries with significant trend breaks for imports and exports. As reported above, over two-thirds of the countries in the sample exhibit significant trend breaks – 37 of 48 countries in the case of imports, and 33 of 47 in the case of exports.

Determination of the break years provides a natural partitioning of the postwar years for each country. The percent change in post-T_B to pre-T_B average import shares is listed in Table 2 with the countries sorted according to the percent changes. This is done for export shares as well.

As is evident from the results, approximately four-fifths of the countries that experienced significant breaks exhibited increases in their trade shares. This is true for both imports (29 of the 37 countries, or 78%) and exports (27 of the 33 countries, or 82%). The relatively high proportion of countries experiencing increases in both their import and export shares provides support for the notion that the global trend towards the liberalization of trade during the postwar period has borne fruit.

While the oil shock may have had a relatively large effect on imports, exports have increased as well. As might be expected, the most prevalent trend break year for imports was 1973, with 9 countries experiencing breaks that year, compared to 4 countries with 1973 export breaks. In general however, the trade increases appear to have begun after the implementation of the Kennedy Round in 1968.

As Preeg (1970) notes, although there were five earlier postwar multilateral conferences, the Kennedy Round was the most important in reducing formal trade barriers, culminating in average tariff reductions on industrial products of roughly 35 to 40 percent (with two-thirds of the cuts exceeding 50 percent). The Kennedy Round was later followed by a host of other bilateral and multilateral trade agreements as countries continued to remove obstacles to trade. By the time of the next GATT round, the Tokyo Round of the late seventies, the main emphasis had shifted to the removal of non-tariff barriers.

While there appears to have been a general increase in postwar trade, the differences in the timing of the import and export trend breaks raises the issue of lumping the two together into a common measure of openness. The remainder of this section addresses some of the differences in the behavior of the import and export shares.

Of the countries with significant trend breaks, 24 experienced significant breaks in *both* imports and exports (Table 3). Of the 24 countries, 10 have nearly identical break years while the remainder vary between their import and export break years.[6] In general, however, the correlation in the timing of the breaks is not particularly high, with a correlation coefficient of 0.33. Similarly, the relationship between the extent of the change in imports and the extent of the change in exports (that is, the correlation coefficient between the ratio of postbreak to prebreak import shares and the ratio of postbreak to prebreak export shares) is 0.28.

This lack of strong evidence that large increases in imports are linked with large increases in exports is highlighted by the fact that, of the 24 countries with significant breaks in both imports and exports, 7 of these have imports and exports going in different directions following their respective breaks.[7] In fact, Ireland, Denmark, and the Netherlands, three of the ten countries with similar (and significant) break years are characterized by lower postbreak import shares and higher postbreak export shares.

IV. CONCLUSION

The goal of this paper is to provide evidence on some general characteristics of international trade during the postwar years with the objective of identifying common postwar trade similarities and dissimilarities. Using sequential trend break tests, it is shown here that over

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[6] The ten countries with similar break years (*i.e.*, within two years of each other) are Morocco, the United States, Italy, Malta, Panama, Iceland, Switzerland, Jamaica, Denmark, and the Netherlands.

[7] These countries are Haiti, Myanmar, Iceland, Norway, Denmark, the Netherlands, and Japan.

two-thirds of the countries examined exhibit significant trend breaks in the paths of both their imports and their exports. In approximately 80% of these instances, it is shown that the postbreak trade shares exceed the prebreak shares. The trade increases occurred during a period of global trade liberalization, with none of the primary shifts (as indicated by the trend breaks) occurring prior to the implementation of the largest global attempt at comprehensive tariff reductions – the Kennedy Round of the GATT.

While the overall direction of postwar imports and exports in most countries tends to be the same, there is still something to be said for not lumping the two together in common openness measures, as the similarity of import and export paths of individual countries is not a particularly strong feature of the data. Not only is there little relationship in the timing of the import and export breaks, there is also little evidence of a link in the magnitude of the subsequent changes in these.

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Table 1 — Sequential Trend Break Tests

$$R_t = \mu + \beta_1 t + \beta_2 t^2 + \theta DU_t + \gamma_1 DT_t + \gamma_2 DT2_t + \sum_{j=1}^{k} c_j R_{t-j} + \varepsilon_t$$

	Import-Output Ratios				Export-Output Ratios			
	Country	Break Year	Model	SupF_T	Country	Break Year	Model	SupF_T
1	Algeria	1966	I	17.43	Australia	1964	I	13.79
2	Australia	1973	I	35.98 **	Austria	1964	I	23.27
3	Austria	1968	I	28.24 *	Bahrain	1975	I	50.86 ***
4	Barbados	1973	I	10.45	Bangladesh	1974	I	30.64 *
5	Belgium-Lux	1982	I	64.71 ***	Barbados	1975	I	15.30
6	Canada	1981	I	29.87 *	Belgium-Lux	1977	I	35.28 **
7	Cyprus	1984	I	18.06	Bhutan	1977	I	140.27 ***
8	Denmark	1980	II	23.57 ***	Canada	1983	I	22.41
9	Dominican Rep.	1984	III	22.19 **	Denmark	1978	II	23.29 *
10	Egypt	1973	I	29.23 *	Dominican Rep.	1981	I	11.93
11	Finland	1986	I	37.63 **	Finland	1981	I	53.44 ***
12	France	1967	I	112.78 ***	France	1971	I	43.23 ***
13	Ghana	1973	I	21.35	Gabon	1966	I	15.00
14	Greece	1971	I	22.13	Greece	1972	III	19.54 **
15	Guyana	1975	I	44.03 ***	Guyana	1981	I	32.11 **
16	Haiti	1968	I	138.60 ***	Haiti	1972	I	44.99 ***
17	Iceland	1974	II	23.96 *	Iceland	1974	I	33.01 **
18	India	1973	I	28.88 *	India	1986	III	17.63 *
19	Ireland	1978	I	51.82 ***	Ireland	1973	II	26.35 **
20	Italy	1973	I	122.50 ***	Italy	1975	I	170.36
21	Jamaica	1978	III	19.48 *	Jamaica	1976	III	18.71 **
22	Japan	1985	II	23.29 *	Japan	1977	I	35.90 **
23	Korea	1968	I	28.07 *	Malawi	1973	I	11.20
24	Malaysia	1985	I	17.35	Malaysia	1971	I	50.76 ***
25	Malta	1973	I	119.06 ***	Malta	1975	I	49.13 ***
26	Mauritius	1968	I	14.02	Mauritania	1973	I	15.56
27	Mexico	1981	I	16.61	Mexico	1981	I	46.63 ***
28	Morocco	1972	I	52.04 ***	Morocco	1973	I	48.81 ***
29	Myanamar	1968	I	58.31 ***	Myanamar	1976	I	66.54 ***
30	Netherlands	1985	I	46.69 ***	Nepal	1980	I	16.65
31	New Zealand	1973	II	34.60 ***	Netherlands	1985	I	75.61 ***
32	Nigeria	1980	I	52.49 ***	New Zealand	1983	I	25.64
33	Norway	1977	I	37.07 **	Norway	1985	I	88.35 ***
34	Pakistan	1977	III	21.52 **	Panama	1973	II	29.74 **
35	Panama	1973	I	43.11 ***	Paraguay	1982	I	53.68 ***
36	Paraguay	1963	I	16.50	Philippines	1982	I	7.61
37	Philippines	1979	I	18.36	Portugal	1979	I	31.58 **
38	Portugal	1985	I	41.40 ***	South Africa	1976	II	27.84 **
39	South Africa	1976	I	24.70	Sri Lanka	1969	I	22.52
40	Sri Lanka	1977	I	86.65 ***	Suriname	1973	I	67.23 ***
41	Sweden	1985	I	61.59 ***	Sweden	1974	I	57.31 ***
42	Switzerland	1977	I	38.37 ***	Switzerland	1975	I	39.98 ***
43	Thailand	1981	I	63.96 ***	Syria	1985	I	15.62
44	Trinidad & Tobago	1976	I	77.95 ***	Thailand	1968	I	52.34 ***
45	Turkey	1979	III	19.66 *	United Kingdom	1976	I	37.77 **
46	United Kingdom	1973	I	54.59 ***	United States	1972	III	28.00 ***
47	United States	1973	I	231.65 ***	Venezuela	1979	I	13.71
48	Venezuela	1976	I	48.43 ***				

***, **, and * denote statistical significance using unit root critical values at the 1, 5, and 10 percent levels. For Model I, these are 38.35, 31.29,

and 27.99, respectively. For Model II, the critical values are 30.36, 25.10, and 22.29, while for Model III they are 22.48, 17.88, and 15.78.

Table 2:   **Trend Breaks and Changes in Trade**

	Import-Output Shares				Export-Output Shares		
	Countries	**Break Year**	**Percent Change**[*]		**Country**	**Break Year**	**Percent Change**[*]
1	United States	1973	146.98%	1	Malta	1975	179.09%
2	Korea	1968	129.05%	2	Greece	1972	103.16%
3	Turkey	1979	124.06%	3	Ireland	1973	101.66%
4	France	1967	65.56%	4	Mexico	1981	74.80%
5	Pakistan	1977	58.49%	5	United States	1972	69.04%
6	Dominican Rep.	1984	52.95%	6	France	1971	65.29%
7	Belgium-Lux	1982	51.73%	7	Portugal	1979	65.13%
8	Haiti	1968	51.19%	8	Italy	1975	61.30%
9	Italy	1973	50.66%	9	Belgium-Lux	1977	55.38%
10	Portugal	1985	46.34%	10	Malaysia	1971	41.06%
11	Sri Lanka	1977	45.04%	11	Sweden	1974	38.56%
12	Thailand	1981	44.95%	12	India	1986	37.32%
13	Egypt	1973	42.33%	13	Morocco	1973	36.90%
14	Guyana	1975	41.85%	14	Norway	1985	30.27%
15	Austria	1968	41.74%	15	United Kingdom	1976	27.98%
16	Jamaica	1978	33.55%	16	Switzerland	1975	26.68%
17	Sweden	1985	31.03%	17	Thailand	1968	22.42%
18	Ireland	1978	26.17%	18	Myanmar	1976	20.53%
19	United Kingdom	1973	25.64%	19	Finland	1981	19.76%
20	Canada	1981	24.18%	20	Jamaica	1976	19.55%
21	Malta	1973	21.48%	21	Japan	1977	19.51%
22	India	1973	21.04%	22	Guyana	1981	18.21%
23	Morocco	1972	17.82%	23	Denmark	1978	14.92%
24	Switzerland	1977	16.61%	24	Panama	1973	13.53%
25	Panama	1973	15.71%	25	Netherlands	1985	9.31%
26	Venezuela	1976	11.32%	26	Iceland	1974	8.67%
27	Finland	1986	6.79%	27	Bahrain	1975	5.75%
28	Nigeria	1980	5.07%	28	S.Africa	1976	-1.70%
29	New Zealand	1973	0.90%	29	Paraguay	1982	-4.54%
30	Denmark	1980	-1.55%	30	Bhutan	1977	-4.91%
31	Iceland	1974	-1.86%	31	Haiti	1972	-6.45%
32	Netherlands	1985	-7.33%	32	Suriname	1973	-15.03%
33	Australia	1973	-13.92%	33	Bangladesh	1974	-69.36%
34	Norway	1977	-14.70%				
35	Japan	1985	-32.91%				
36	Trinidad and Tobago	1976	-37.24%				
37	Myanamar	1968	-69.52%				

[*] Column reflects the percent changes in postbreak to prebreak trade-output shares.

Table 3: **Countries with Both Significant Import
and Significant Export Trend Breaks**

		Import Shares		Export Shares	
	Countries	**Break Year**	**Percent Change**[*]	**Break Year**	**Percent Change**[*]
1	France	1967	65.56%	1971	65.29%
2	Haiti	1968	51.19%	1972	-6.45%
3	Myanamar	1968	-69.52%	1976	20.53%
4	Morocco	1972	17.82%	1973	36.90%
5	United States	1973	146.98%	1972	69.04%
6	United Kingdom	1973	25.64%	1976	27.98%
7	Italy	1973	50.66%	1975	61.30%
8	Malta	1973	21.48%	1975	179.09%
9	Panama	1973	15.71%	1973	13.53%
10	India	1973	21.04%	1986	37.32%
11	Iceland	1974	-1.86%	1974	8.67%
12	Guyana	1975	41.85%	1981	18.21%
13	Norway	1977	-14.70%	1985	30.27%
14	Switzerland	1977	16.61%	1975	26.68%
15	Ireland	1978	26.17%	1973	101.66%
16	Jamaica	1978	33.55%	1976	19.55%
17	Denmark	1980	-1.55%	1978	14.92%
18	Thailand	1981	44.95%	1968	22.42%
19	Belgium-Lux	1982	51.73%	1977	55.38%
20	Netherlands	1985	-7.33%	1985	9.31%
21	Sweden	1985	31.03%	1974	38.56%
22	Japan	1985	-32.91%	1977	19.51%
23	Portugal	1985	46.34%	1979	65.13%
24	Finland	1986	6.79%	1981	19.76%

[*] Column reflects the percent changes in postbreak to prebreak trade-output shares.

Figure 1

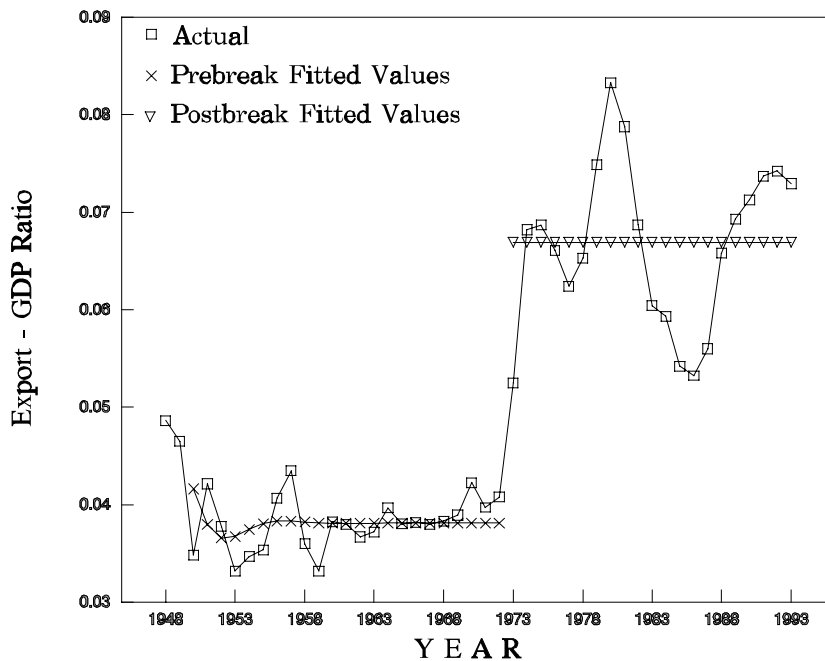## Imports: United States

Break Year: 1973, Model I
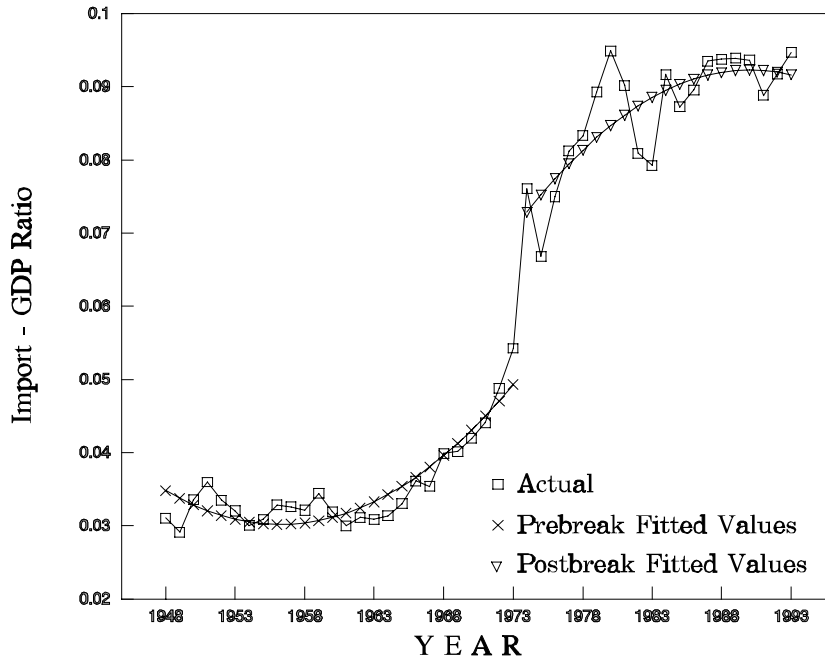
Panel A

Exports: United States

Break Year: 1972, Model III

Panel B