Indices of Trade Partner Concentration for 183 Countries, 1980-2008[1]

Salvatore J. Babones
The University of Sydney
sbabones@sydney.edu.au

Robin M. Farabee-Siers
The University of Sydney

Abstract
Trade partner concentration can be used to operationalize important concepts like dependency and globalization, but it can be very time-consuming to calculate concentration indices. In research for which export, import, or total trade partner concentration would be useful as one among many variables but is not the primary variable of interest, potential users of concentration indices are likely to be deterred by the high level of commitment required to process the raw data. In addition, the expense of acquiring the raw data can be a deterrent to some scholars. To address these problems and broaden access to data we report seven indices of export, import, and trade partner concentration for all 183 countries for which data are readily available for the years 1980-2008. The raw data underlying the indices are drawn from the International Monetary Fund's Direction of Trade Statistics (DOTS) database. Details of data preparation and index construction are provided and basic characteristics of the resulting concentration indices described. The indices presented here are likely to find use in regression-based and time-trend studies of the structure and political economy of the contemporary world-system.

This paper and associated datasets describe export, import, and trade partner concentration data that are appropriate for use in quantitative macro-comparative research involving the analysis of the structure of the contemporary world-economy. Trade partner concentration is the degree to which a country engages in international trade with a limited number of partner countries. Export partner concentration is the degree to which a country relies on a limited number of partners as markets for its exports, while import partner concentration is the degree to which a country relies on a limited number of partners as sources for its imports. All three kinds of trade (export, import) partner concentration are ordinarily calculated in relation to a country's total international trade (exports, imports) with all partner countries.

Trade partner concentration was already being used as an indicator of the structure of the modern world-system well before the formalization of the world-systems perspective by Wallerstein (1974). Writing in the midst of World War II, Hirschman (1945) used trade partner concentration as an indicator of national economic and political vulnerability, with specific reference to the expansion of German economic imperialism in the run-up to World War II. He analyzed export and import partner concentration separately, noting that in most countries export partner concentration was higher. He also found that in those countries with the highest levels of trade concentration, export partner concentration was especially high relative to import partner concentration. He concluded emphatically that:

> The existing pattern of world trade tends to correlate dependence upon a few countries which in turn depend on a few products; it also brings about conditions in which the availability of alternative markets is seriously impaired. Under the condition of unchecked national sovereignties, this pattern therefore provides large opportunities for the exercise of economic pressures. (Hirschman 1945:111)

Three decades later, Galtung (1971) influentially used export partner concentration as an indicator of "feudal" relationships between countries. He considered feudal relationships to be a form of neocolonial imperialism in which poor countries were connected indirectly through their individual relationships with rich countries rather than directly with each other. Oddly (considering how close Galtung's arguments were to Hirschman's), Galtung did not cite Hirschman's well-known work (though he did cite Hirschman in another context).

Subsequently, beginning in the 1970s, a series of empirical studies by Chase-Dunn (1975), Rubinson (1977), and many others used export partner concentration as a primary or secondary indicator of dependency in poor countries. This dependency literature on export partner concentration extended into the 1980s and 1990s. More recently export partner concentration has been used in studies of growth (Kentor and Boswell 2003), inequality (Lee et al. 2007), and the environment (Shandra 2007). Import partner concentration has appeared in the literature much less frequently (e.g., Gasiorowski 1985; Ragin and Bradshaw 1992), but we include it in our calculations for completeness. A closely-related measure called "weighted export flow" has also recently been used extensively on the literature on dependency and ecologically unequal exchange (Jorgenson et al. 2009: 266-267). Throughout these literatures, high levels of dependency are generally associated with negative outcomes for poor countries.

The use of trade partner concentration variables in empirical research, however, has been hampered by high level of commitment required to process the raw data into usable indices. The International Monetary Fund (IMF) publishes directional partner-to-partner exports and imports data in its Direction of Trade Statistics (DOTS) database, but these data are expensive and the

data CDs are cumbersome to use. Moreover, these raw partner-to-partner trade data require extensive processing to turn them into trade concentration indices. These high costs are unlikely to deter researchers whose main objective is to study trade concentration levels, but they are very likely to deter researchers from using trade concentration indices as variables in wider analyses.

We address this problem by calculating and reporting complete export, import, and trade partner concentration series for all countries covered in the DOTS database for the years 1980-2008. We report seven different concentration measures for each series. The year 1980 was chosen as the start point both because it is widely viewed as the beginning of the current age or era of globalization (Babones 2007) and because the raw DOTS data are reported differently for years before and after 1980. Our series end in 2008 because that is the final year for which complete data were available in DOTS at the time the raw data were downloaded for analysis (March 2010). The advent of the global financial crisis (and the associated disruption to world trade) also makes 2008 a convenient statistical end point for the first phase of globalization.

Source Data and Country Coverage

The underlying data for this paper come from the IMF's DOTS database. We began our analyses using data for 1980-2005 from the 2008 DOTS database, later updating our series to include 2006-2008 data from the 2010 DOTS database. As a result, our full data series run from 1980-2008. Since our initial data collection used the 2006 DOTS database, our list of countries is based on the list of DOTS reporting countries at that time. A few small countries (East Timor, Eritrea, Montenegro) and several small French dependencies have been added since, but historical data are in any case lacking for these entities. Otherwise there were no major changes between the different editions of the DOTS database. Due to the data processing requirements involved, we have not recalculated our 1980-2005 figures using the more recent DOTS releases.

Our data thus represent only the 189 countries that were included in the IMF DOTS database as of 2008. These 189 countries or country-equivalents represent over 98% of the world's population in 2008. The only major trading country not included in the DOTS database is Taiwan. Taiwan data are reported only in hardcopy paper IMF publications and not in electronic IMF databases. Due to this inconvenience, Taiwan has been excluded from our analyses.

A major inconvenience of the raw IMF DOTS data (from the perspective of scholars who want to use the data in panel regression studies) is that it reports figures for countries as they existed at the time of reporting. As a result, many of the 189 countries included in the DOTS database are now defunct. There have been border changes, amalgamations of countries, and disintegrations of countries over time. In cleaning the DOTS data to create continuous series for further analysis, we have prioritized two main principles:

(1) As far as possible, the time series data actually included for any named entity should represent a constant geographical space over time
(2) As far as possible, the named entities included in our final database should correspond to the named entities that are currently included in major international datasets, particularly the World Bank's World Development Indicators

It was not always possible to follow these principles to the letter, but we have come as close as we were able, making necessary judgment calls along the way. Most countries have not changed

borders over the study period. Despite the relatively short time frame of 29 years, however, many countries have come into or out of existence.

The breakups of the Soviet Union, Yugoslavia, and Czechoslovakia resulted in the transformation of 3 old countries into 21 new countries. As a result, the Soviet Union is represented in the DOTS database from 1980-1991 and Czechoslovakia and Yugoslavia from 1980-1992. After these years, the data are recorded according to the 21 successor countries. All of these entities, however, are included as data rows for all years. This is consistent with the treatment in most international data sources on national income and other economic statistics. As a result, our concentration series include different potential partners at different times. For example, the Soviet Union was a major export destination for Poland, so Poland's exports would have become instantly more diversified in 1992 when that single county was replaced by 15 successor countries.

On the other hand, there were two cases of countries formed by merger over the study period. In 1990 East and West Germany combined to form the newly unified Germany and North and South Yemen combined to form the newly unified Yemen. German data today are reported in the World Bank's World Development Indicators as amalgamated data for unified Germany, even for years when East and West Germany had originally been distinct reporting entities. We have accordingly combined all data referring to either East or West Germany for any year into a single record for unified Germany. As a result, there is only one record for Germany in our data, which includes all data relating to any form of Germany (East, West, or unified). We followed an equivalent rule for North and South Yemen, for the same reasons.

A similar procedure was used to amalgamate data from Belgium, Luxembourg, and the combined reporting entity "Belgium-Luxembourg." In earlier years the DOTS data for Belgium and Luxembourg were combined. Over the years many countries (but not all at the same time) began separating out their imports from and exports to these two countries, until eventually all countries reported separately for Belgium and Luxembourg. Because of the impossibility of separating the data for earlier years (and the over-time transition from one reporting regime to the other) we have chosen to combine data for Belgium and Luxembourg for all years. We have gone this route in order to create a continuous series with no breaks for "Belgium" that can be used in cross-national panels. Given Luxembourg's very small footprint in international trade and the rarity with which it is used in cross-national comparative studies, we consider this a reasonable compromise. The alternative would have been to exclude Belgium entirely, since the shift in Belgium-Luxembourg from one to two reporting entities occurred at different times for different reporting partners.

As a result of the Germany, Yemen, and Belgium-Luxembourg amalgamations, our final working database included six fewer records than the original IMF data (East and West Germany, North and South Yemen, and Belgium and Luxembourg have all been eliminated). As a result, the data universe underlying our concentration series consists of 183 countries. The data themselves take the form of a matrix of flows of imports and exports from each country to each other country for each year. Thus, for each year there are 33,489 raw data entries (183 entries for each of 183 countries, with blanks where a country matches with itself) for each of exports and imports for each of the 29 study years. Since the DOTS data are reported by the constituent countries themselves, the recorded exports of Country A to Country B in the DOTS database do not always equal the recorded imports of Country B from Country A. We make no adjustment for this fact; we simply rely on the imports and exports as reported by each reporting country.

The DOTS data are expressed in terms of the U.S. dollar value of the goods traded (in millions). For the purpose of constructing concentration indices, the currency unit is irrelevant: since the currency appears in both the numerator and the denominator of the calculations, the unit ultimately cancels out. Thus the IMF's choice of exchange rates for converting the underlying national currency trade figures into U.S. dollars does not affect the concentration figures. Exports are expressed "f.o.b." (free on board) while import is expressed "c.i.f." (cost, insurance, freight), meaning that the exports figures represent the value of the exported while the imports figures represent the value of the goods imported plus the costs of freight and insurance. In other words, goods are in both cases valued in terms of their prices at the ports of the reporting countries.

The DOTS database does not include figures for total trade (imports plus exports). We have calculated total trade figures by summing the DOTS reported imports and exports figures for each country for each partner for each year. Once again, we rely on the figures reported by the reporting country. As a result, Country A's recorded trade with Country B may not equal Country B's recorded trade with Country A.

Index Construction

We computed seven measures of partner concentration. These will be described with reference to export partner concentration, but in each case the same logic applies (mutatis mutandis) for import and trade partner concentrations. The first measure, the percentage of a country's total exports that goes to its single largest export destination country, is the measure most commonly used in the sociology and dependency literatures. In particular, it is the measure used by Galtung (1971). We call this measure 1-CON, short for "top 1 partner CONcentration." In our view, however, the same logic that applies to dependency on a single export partner would also apply to dependency on a small number of export partners. Accordingly, we have computed 2-CON, 3-CON, 4-CON, and 5-CON measures as well (top two, three, four, and five partner concentrations, respectively). The 1-CON measure ranges from a theoretical low of less than 0.0055 (were a country's exports equally divided among all 182 potential partners) to a theoretical high of 1 (were a country's exports all concentrated with a single partner). Since the other CON measures include more partners, they have correspondingly higher minimum values.

Further extending this logic of using data from multiple partners, it is reasonable to suggest that concentration should matter the most when it represents concentration of exports into just one partner, a little less when it represents two partners, a little less for three partners, etc. Hirschman (1945) argued that the appropriate measure of inordinate power in trade partnership relationships was geometric mean concentration: the square root of the sum of the squares of the concentrations with each partner. Our HIRSCH series implement this equation. A particular advantage of the Hirschman index is that it uses all of the available data (including even that for the 182nd trading partner), weighting each partner according to its dominance. The Hirschman index ranges from a theoretical low of 0.0741 to a theoretical high of 1 when applied to 182 partners.

A final measure of concentration that is closely related to the Hirschman index is the Herfindahl (1950) index (cited in Hirschman 1964). The Herfindahl index is equal to the sum of the squares of the concentrations with each partner. It is equal to the Hirschman index before the final Hirschman step of taking the square root, or (equivalently) it is equal to the Hirschman

index squared. Our HERF series implement this equation. Like the Hirschman index, the Herfindahl index uses all of the available data weighting each partner according to its dominance. Since the Herfindahl index squares each concentration, the units of the Herfindahl index are notionally "concentration squared," an inconvenience that is rectified in the Hirschman index through taking the square root. The Herfindahl index ranges from a theoretical low of 0.0055 to a theoretical high of 1 when applied to 182 partners.

Equations for all seven indices, plus their theoretical minimum and maximum values, are presented in Table 1. Note that all seven indices would have a theoretical minimum of 0 if there were an infinite number of potential partners.

Table 1. Export Concentration Index Formulas (mutatis mutandis for Import and Trade Concentration Indices)

Index	Formula	Minimum	Maximum
1-CON	$Exports_{(1)}$ / Total_Exports	0.0055	1
2-CON	$SUM_{(i)=1 \text{ to } 2}[Exports_{(i)}]$ / Total_Exports	0.0110	1
3-CON	$SUM_{(i)=1 \text{ to } 3}[Exports_{(i)}]$ / Total_Exports	0.0165	1
4-CON	$SUM_{(i)=1 \text{ to } 4}[Exports_{(i)}]$ / Total_Exports	0.0220	1
5-CON	$SUM_{(i)=1 \text{ to } 5}[Exports_{(i)}]$ / Total_Exports	0.0275	1
HIRSCH	$SQRT(SUM_{(i)=1 \text{ to } 183}[Exports_{(i)}/ Total\_Exports]^2)$	0.0741	1
HERF	$SUM_{(i)=1 \text{ to } 183}[Exports_{(i)}/ Total\_Exports]^2$	0.0055	1

Note: (i) represents the i-th largest partner.

Hall and Tideman (1967) classically formulated six desirable properties of concentration indices. They find that the Hirschman index fulfills all six, while simple concentration measures fulfill only three out of six. Nonetheless, the situations in which simple concentration measures fall short are unlikely to arise in practice (e.g., when there is only one trading partner, or when trade with all partners is exactly equal). In all of the real-world analyses we have attempted, results found using any of the seven concentration indices are near identical. The indices themselves are correlated well over r = 0.95 for most panels of countries. The choice of index is not likely to affect empirical results in any meaningful way when studying broad panels of countries -- though it may make a real difference when studying concentration for any one country, as highlighted in the next section.

Concentration Series and Their Potential Uses

The export, import, and trade concentration series that result from carrying out these procedures are reported in the associated datasets.[2] Three spreadsheet workbooks are included, one each for export concentrations, import concentrations, and trade concentrations. The first spreadsheet in each workbook contains a country code cross-reference; this is identical for all three workbooks. The codes used are three-digit International Organization for Standardization (ISO) alphabetic

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[2] The datasets can be found in the University of Pittsburgh's World-Historical Dataverse, at http://dvn.iq.harvard.edu/dvn/dv/worldhistorical/faces/StudyListingPage.xhtml?mode=1&collectionId=3515 .

country codes. Note that the codes CSK (Czechoslovakia), SUN (Soviet Union / USSR), and YUF (Yugoslav Federation) are now defunct.

Following this are 29 annual spreadsheets containing concentration figures for all countries for the years 1980-2008 (inclusive). The first column contains total exports, imports, or trade (respectively) in millions of current U.S. dollars, summed from the raw DOTS data themselves. Following this are the seven concentration measures. Concentration figures are reported for any given country in any given year only if the country existed in that year and any export or import partner data were reported in the DOTS database. The dataset panel is constant from 1981-1991, after which the USSR (1992) and Yugoslavia (1993) break into their constituent republics. The only other changes are in 1995 and 1998, when Aruba and South Africa (respectively) enter the dataset. A summary of the panel changes over the full period 1980-2008 is presented in Table 2.

Table 2. Number of Countries Available by Year (with Explanatory Notes)

Years	Number	Notes
1999-2008	180	
1998	180	South Africa enters the data
1996-1997	179	
1995	179	Aruba enters the data
1994	178	
1993	178	Dissolution of Czechoslovakia and Yugoslavia
1992	172	Dissolution of USSR
1981-1991	159	
1980	129	Many countries missing

The largest constant panel that can be constructed over the period 1980-2008 is 127 countries. This panel includes the 129 countries reporting data for 1980, minus Czechoslovakia and Yugoslavia, which later drop from the data (coincidentally, USSR data happen to be missing for 1980, so they do not "drop out" later, since they were never there in the first place). Restricting the time frame to 1981-2008 permits the construction of a 156 country panel. Pragmatically speaking, this 156 country panel is likely to be the most desirable panel for analyzing trends over time. A breakdown of this panel by official World Bank region is reported in Table 3. The small number of countries from Europe & Central Asia is due to the fact that none of the Czechoslovakia/Yugoslavia/USSR successor states are included in the constant sample (this World Bank region consists entirely of post-Communist states). The small number of countries from South Asia is due to the fact that there are simply very few countries in the World Bank's South Asia region (in fact, only one country -- Bhutan -- is missing from the constant sample).

Table 3. Number of Countries Available by Region (156 Country Panel Reporting Data for the Period 1981-2008)

Region	Number of Countries
All Countries	156
Poor Countries	110
Rich Countries	46
East Asia & Pacific	17
Europe & Central Asia	5
Latin America & Caribbean	29
Middle East & North Africa	12
South Asia	7
Sub-Saharan Africa	40

We envisage several major uses for these datasets. First, we expect that researchers will use them to study trends in export, import, and trade concentration over time for individual countries, for groups of countries, and for the world as a whole. We strongly recommend that researchers studying concentration trends in individual countries use either the HIRSCH or HERF series. The 1-CON series may seem more straightforward, but 1-CON can mask important nuances in the structure of a country's trade. For example, one problem is that the identity of the one largest trading partner of a country may change from year to year. Another problem is that 1-CON can change dramatically when the universe of potential partners changes (as with the disappearance of the USSR from the data in 1992 and the appearance of South Africa in the data in 1998). Since the HIRSCH or HERF series combine data from all partners, the impact of such discontinuities is more muted in these series.

For researchers studying trends in average concentration levels across groups of countries (or the world as a whole) we strongly recommend weighting of the raw concentration figures. To facilitate weighting by total exports, imports, or trade themselves we have included these figures (as summed from the DOTS country partner data) alongside the concentration data. It might also be reasonable to weight the concentration figures by national income or (less likely) population. Weighting is necessary because of the dramatic differences in country size and the fact that the figures for the smallest and poorest economies can be highly volatile. In the absence of weighting, the appearance or disappearance of data for a single trading partner for a very small economy can result in a large swing in average concentration levels across a group of countries. For example, average unweighted concentration levels in South Asia display dramatic swings from year to year due to instability in the data for Afghanistan.

Second, we expect that researchers will use cross-sectional concentration data for particular years as variables in regression models. We recommend that in doing so researchers consider using averages of three or five years of concentration figures centered on their year of record. For example, a 1990 concentration figure might be represented by average concentration over 1989-1991. The annual concentration series we report reflect high levels of variability (and presumably error) in the underlying DOTS data. Period averages will tend to cancel out this potential source of error. Moreover, it is not prima facie obvious that the year represents the appropriate period of observation, what Chase-Dunn (1998: 321-322) called the "width of a time point." Our advice is that three or five year period averages will almost certainly produce more reliable regression results than the actually reported annual figures.

Third, we expect that researchers will use specific figures for individual countries in individual years, especially export partner concentration, to illustrate levels of dependency. Though we prefer the HIRSCH series, we suspect that for this purpose many scholars will prefer to use the 1-CON series. We caution, however, that 1-CON export partner concentration says nothing in itself about what country is the partner. Argentina, for example, has a relatively high level of 1-CON: nearly 20% of its total exports go to its single most important export partner. That partner, however, is Brazil, a country that is poorer than Argentina, not the United States or some other rich country. A high concentration should not be automatically associated with a neo-colonial relationship; researchers should dig deeper into the data before making any such claim about any particular case.

Illustrative Analysis: The Impact of NAFTA

The databases published alongside this paper have been optimized for use in cross-national panel studies, but they are equally useful for studying trends in trade concentration. As an illustration of the data, we examine trends in trade concentration in Canada, Mexico, and the United States before, during, and after the implementation of the North American Free Trade Agreement (NAFTA). The implementation of NAFTA brought Mexico into the preexisting Canadian-American free trade area and gave extraordinary protections to cross-border investors and business operators across all three countries. Canada, Mexico, and the United States signed the NAFTA treaty on December 17, 1992, with an implementation date of January 1, 1994.

Both Canada and Mexico are very dependent on the United States as a market for their exports. Since trade between Canada and the United States had already been liberalized before the implementation of NAFTA, NAFTA would be expected to have had very little effect on Canada's export dependence level: the Canada - United States Free Trade Agreement (CUSFTA) had already come into force on January 1, 1989. On the other hand, NAFTA might be expected to have had a major effect on Mexico's export dependence on the United States. The expansion of the cross-border *maquiladora* export industry in northern Mexico in the 1990s is consistent with this view.

Figure 1 tracks actual levels of top export partner concentration (1-CON) over time for both Canada and Mexico. Since the United States was the top export partner for both countries throughout this period, the 1-CON figures in practice represent exports to the United States. The trends depicted in Figure 1 suggest that the effect of NAFTA on trade dependence in Mexico was in fact modest. Mexican export partner concentration levels almost exactly track Canadian levels following the implementation of NAFTA in 1994. If Figure 1 suggests anything, it's that CUSFTA had a major impact on Canadian export dependence on the United States market. Canada's 1-CON level jumped from 0.74% to 0.82% between 1988 and 1993, around the time of the implementation of CUSFTA.

Figure 1. Trends in Canadian and Mexican Export Partner Concentration (1-CON) Compared with U.S. Import Partner Concentration (HIRSCH), 1980-2008
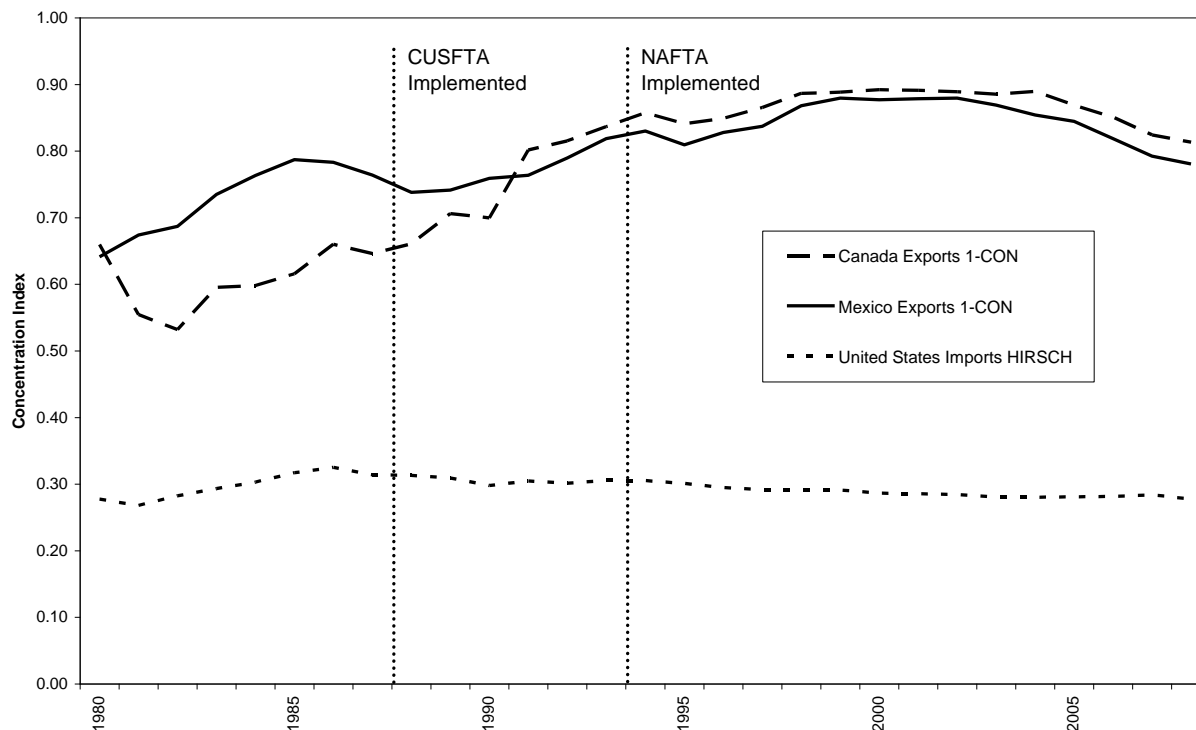
From the U.S. perspective, NAFTA also had little discernible effect. Figure 1 plots U.S. import partner concentration using the Hirschman index. The HIRSCH series is used because U.S. imports are widely dispersed among many partners. The U.S. HIRSCH index for imports never strays very far from its long-term average of 0.29, though the trend since the implementation of NAFTA has been slightly downward. Note that this stability in the U.S. HIRSCH index for imports is not due to any kind of built-in stability in the index itself. The Canadian HIRSCH for imports declined from 0.71 in 1980 to 0.55 in 2008, while the Mexican HIRSCH for imports fell from 0.67 to 0.53.

This simple example illustrates the usefulness of the databases presented here for constructing trade concentration series quickly and easily. Researchers who are studying trade concentration as such may prefer to go back to the original IMF data, since doing so will give them greater control over how they define partners and how they calculate dependency, but researchers using trade concentration data for substantive reasons are likely to prefer our pre-digested series. We also expect our series to be used by researchers estimating statistical models based on cross-national panel data. Where trade dependence is just one of a dozen or more variables under consideration, the marginal costs of collecting, cleaning, and compiling concentration figures may be prohibitive. The ready availability of the databases presented here will reduce the up-front cost of using dependency variables in panel analyses.

In making these trade partner concentration series publicly available we hope to spur renewed research into how the structure of trade has the potential to affect countries and the larger world-system in which they are embedded. Sixty-five years ago Hirschman concluded that

Germany strategically used trade structure as a tool of political domination over Eastern Europe in the run-up to World War II. Hirschman himself cited Adam Smith on the dangers of trade partner concentration, quoting at length a passage in which Smith warned of the dangers to the United Kingdom of its high concentration of trade with its American colonies (Smith 1999[1776]: 180-181; quoted in Hirschman 1945: 73-74). Trade partner concentration has been recognized as having potentially deleterious political and social implications for as long as there have been political and social sciences. It would be a shame if it were to drop off our agenda -- in this, the most data-rich era of all -- simply because of the inconvenience of computing the relevant indicators.

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