

## **Is Economic Freedom One Dimensional ? A Factor Analysis of Some Common Measures of Economic Freedom**

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The present paper investigates whether popular measures of economic freedom used in regression analyses by development economists and others are one dimensional. Using the indices provided by the Fraser Institute, Heritage/Wall Street Journal, and Heritage and Freedom House, a principal component analysis indicates that all of the indices above perform about as well as the statistically best single index, and in every case the percentage of total variance explained could be improved by using several principal components. Because the components of the indices are orthogonal, this could be done without multicollinearity problems in regression equations. In sum, the results indicate that economic freedom is not one dimensional and that efforts to squeeze so much into a single index results in lost information and a mis-ranking of the economic freedom of many developing countries.

### **I. Introduction**

The notion of economic freedom is not new in economic theory. Adam Smith (1776), a member of the Scottish enlightenment, wrote clearly about how an individual who pursues his own interest promotes economic growth. The basic idea is that when the agents of the market are allowed to keep the results of their work the productive effort of the economy increases, and resources are put to their best use.

The concept of economic freedom provides a basis for arguing that differences in institutions explain differences in economic performance across nations. Several schools of thought, like neo-institutional economics and public choice, examine the link between economic freedom and economic performance. Examining economic freedom in a country means examining government regulations, black market activities, rent-seeking activities, and the enforcement of private property rights. These country characteristics are even used in econometric studies as proxies for economic freedom.<sup>1</sup>

The importance of this concept has given rise to several attempts to quantify economic freedom. Recently, three indices; the Fraser Institute index of Gwartney, Lawson, and Block (1996), the Freedom House index in the work edited by Messick (1996), and the Heritage

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1. See, for example, Barro (1997), Easton & Walker (1997), Grossman (1988), Laudau (1983), and Ram (1986).

Foundation-Wall Street Journal index of Johnson, Holmes, and Kirkpatrick (1998) have been developed to measure economic freedom. These indices provide a basis for freedom comparisons between countries and, increasingly, the indices are used as explanatory variables in regression models. A better understanding of these indices is important because of the great interest in economic freedom in fields such as development economics.

The purpose of this study is to look closely at the various indices of economic freedom and to determine whether something as complicated as economic freedom can be measured by a single index, and, if so, what the index should be. This study uses factor analysis to determine the factor structure underlying the items used to develop each index of economic freedom. Principal component analysis is also used to statistically determine the best single index for each of the studies. Each index is compared to the statistically best index to assess performance.

Our findings indicate that economic freedom is not one dimensional. We find four factors underlying the Fraser Institute index, and two factors underlying both the Freedom House and the Heritage/Wall Street Journal Indices. The principal component analysis indicates that performance of the Fraser Institute index could be greatly improved by using the first principal component as the index, but very little improvement in the Freedom House or the Heritage/Wall Street Journal Indices are possible using just the first principal component.

Pooling the data allows us to make some assessment of the relative performance of the measures. For the 54 countries in each of the studies for 1995, we find that information in the Fraser Institute index is sufficient to describe variation in the items used to construct the other two indices. The information in the Freedom House and Heritage/Wall Street Journal indices are not rich enough to explain variation in the Fraser Institute items. Unfortunately, the best single predictor is the first principal component derived from the Fraser Institute data, and not the Fraser Institute index. Our recommendation is that several principal components be used to measure economic freedom by development economists. The components are orthogonal so the inclusion of several in a regression model presents no multicollinearity problems.

## II. The Indices

Three indices are examined and compared in this study. The 1995 Fraser Institute (henceforth, FI) index, the 1998 Heritage Foundation/Wall Street Journal (henceforth, HWSJ) Index, and the 1995-6 Freedom House (henceforth, FH) Index. In each case the most recent year of the index is the subject of this study. The 1995 Heritage Foundation (henceforth, HF) Index is also examined so that the three indices can be compared for 1995. Having two years of data on the Heritage/WSJ index will allow us to examine the stability of that index over time.

*Fraser Institute.* The data used comes from a study by Gwartney, Lawson, and Block for the year 1995. They base their index on ratings for seventeen items for 116 countries.<sup>2</sup>

2. An updated index is available at the Fraser Institute Web site: <http://www.fraserinstitute.ca/>

The seventeen items are presented in Table 1A. FI's items are grouped into four categories; "Money and Inflation," "Government Operations and Regulations," "Taking and Discriminatory Taxation," and "Restraints on International Exchange."

**Table 1A Fraser Institute's Seventeen Items**

*Money and Inflation*

- A1-The average annual growth rate of the money supply during the last five years minus the annual growth rate of potential GDP.
- A2-The standard deviation of the inflation rate during the last five years.
- A3-Freedom of residents to own foreign money domestically.
- A4-Freedom of residents to maintain bank accounts abroad.

*Government Operations and Regulations*

- B1-Government general consumption expenditures as a share of GDP.
- B2-Government-operated enterprises as a share of the economy.
- B3-Price Controls -the extent that business are free to set their own prices.
- B4-Freedom to enter and compete in markets.
- B5-Equality of citizens under the law and access of citizens to a nondiscriminatory judiciary.
- B6-Freedom from government regulations and policies that cause negative real interest rates.

*Taking and Discriminatory Taxation*

- C1-Transfer and subsidies as a percent of GDP.
- C2-Top marginal tax rate (and income threshold at which it applies).
- C3-The use of conscripts to obtain military personnel.

*Restraints on International Exchange*

- D1-Taxes on international trade as a percent of exports plus imports.
- D2-Difference between the official exchange rate and the black market rate.
- D3-Actual size of the trade sector compared to the expected size.
- D4-Restrictions of the freedom of citizens to engage in capital transactions with foreigners.

The FI index is a weighted average of the scores on the seventeen items presented in Table 1A. Each item is weighted by the average score for that item. Each country's score is multiplied by the average for that item and then summed, and the sum is divided by the number of items (seventeen) to obtain the index. A higher score indicates more economic freedom.

The original FI data set for 1995 contained missing values for several items. In the subsequent analysis, we generated the missing values using a series of auxiliary regressions.<sup>3</sup> Consequently, our data set, indices, and rankings differ slightly from those originally published.

*The Heritage Foundation/Wall Street Journal*. The most recent volume contains indices for 154 countries for the year 1998. We also use data for 101 countries for 1995. Auxiliary regressions are used to impute missing values in the 1995 and 1998 data set.<sup>4</sup>

The HWSJ index is based on the simple average of ten items for each country. Each country is rated on a 1 to 5 scale (1 being most free, 5 being least free) for each of the following ten items; Trade policy, Taxation, Government intervention in the economy, Monetary policy, Capital flows and foreign investment, Banking, Wage and price controls, Property rights, Regulation, and the Black market. Countries with the lowest average score are considered to have the most economic freedom. A more detailed description of the components of the HWSJ can be found by an examination of Table 1B.

**Table 1B Heritage/Wall Street Journal's Ten Items**

E1. Trade Policy

- Average tariff rate
- Nontariff barriers
- Corruption in the customs office

E2. Taxation

- Top income tax rate
- Tax rate that applies to the average income level
- Top corporate tax rate
- Other taxes

E3. Government intervention in the economy

- Government consumption as a percentage of the economy
- Government ownership as a percentage of businesses and industries
- Economic output produced by the government

E4. Monetary policy

- Average inflation rate from 1985 to 1995
- Average inflation rate for 1996 (informational purposes only)

E5. Capital flows and foreign investment

- Foreign investment code

3. With  $R^2$  from 0.09 to 0.71. The average  $R^2$  was 0.52.

4. The range of the  $R^2$  for four missing variables in the 1995 data set was between 0.25 and 0.63. The  $R^2$  for the missing value of 1998 data was 0.17.

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- Restrictions on foreign ownership of business
- Restrictions on the industries and companies open to foreign investors
- Restrictions and performance requirements on foreign companies
- Foreigner ownership of land
- Restrictions on the repatriation of earnings
- Availability of local financing for foreign companies

E6. Banking

- Government ownership of banks
- Restrictions on the ability of foreign banks to open branches and subsidiaries
- Government influence over the allocation of credit
- Government regulations, such as deposit insurance
- Freedom to offer all types of financial services, such as buying and selling real estate, securities, and insurance policies

E7. Wage and price controls

- Minimum wage laws
- Freedom to set prices privately without government influence
- Government price controls
- The extent to which government price controls are used
- Government subsidies to businesses that affect prices

E8. Property rights

- Freedom from government influence over the judicial system
- Commercial code defining contracts
- Sanctioning of foreign arbitration of contract disputes
- Government expropriation of property
- Corruption within the judiciary
- Delays in receiving judicial decisions
- Legally granted and protected private property

E9. Regulation

- Licensing requirements to operate a business
- Ease of obtaining a business license
- Corruption within the bureaucracy
- Labor regulations, such as established work weeks, paid vacations, and maternity leave, as well as selected labor regulations
- Environmental, consumer safety, and worker health regulations
- Regulations that impose a burden on business

E10. Black market

- Smuggling
- Piracy of intellectual property on the black market
- Agricultural production supplied on the black market

Manufacturing supplied on the black market  
Services supplied on the black market  
Transportation supplied on the black market  
Labor supplied on the black market

*Freedom House Index.* The Freedom House Index examined is for 1995-96. A total of eighty-two countries are rated using six criteria: Freedom to hold property, Freedom to earn a living, Freedom to operate a business, Freedom to invest one's earnings, Freedom to trade internationally, and Freedom to participate in the market economy. A more detailed discussion of these categories is provided in Table 1C. For the first four items, countries are scored 0, 1, 2, or 3, with 3 being the most free. For the last two items, countries are scored 0, 1, or 2, with two being the most free. The index is based on the simple sum of these six scores. The highest possible score, indicating the most freedom, is 16. The lowest possible score is 0.

**Table 1C Freedom House's Six Items**

F1. Freedom to Hold Property

Is the right to property recognized by law? Is the right to intellectual property protected? Does the legal system give effect to the right to property? Are there restrictions on selling, exchanging, or devising property? Can individuals structure their property holdings among themselves as they choose?

F2. Freedom to Earn a Living

Can individuals form voluntary association to bargain over wages? Are unions state-controlled? Are wages controlled or freely set? Can individuals change jobs freely? Are there any vestiges of indentured servitude, debt peonage, or slavery?

F3. Freedom to Operate a Business

Can individuals freely join together to pursue mutual economic interests? Are the rules governing the formation of business enterprises so complex that large sectors of the population are foreclosed from forming businesses? Is entry into certain lines of commerce restricted? Are government contracts competitively let? Are raw materials, finished goods, services or other prices controlled?

F4. Freedom to Invest One's Earnings

Are interest rates regulated? Is credit allocated by the market or by government fiat? Are rates of return on investments controlled? Can individuals invest abroad? Can they hold foreign currency and securities? Is there an independent central bank or other institutional mechanism to protect citizens' savings loss through inflation?

F5. Freedom to Trade Internationally

Are there restrictive tariffs, quotas, or other barriers to importing goods from abroad? Are there export taxes or other impediments on the right to sell to foreigners? Are there limits on the right to enter or leave the country? Is foreign investment regulated? Are there exchange controls?

F6. Freedom to Participate in the Market Economy

Are racial or ethnic minorities or women foreclosed from certain occupations or from running certain types of businesses? Are there limits on minorities' or women's rights to hold or transfer property? Are the laws necessary for a market economy to function enforced? Is corruption so widespread as to interfere with normal market forces?

**III. Methods**

The data from which the freedom indices have been constructed will be examined by factor analysis and principal component analysis. Both methods allow large numbers of variables to be reduced to a few orthogonal constructs which should explain much of the variation in the original data. The following discussion is based on Comrey (1973) and Hair, Anderson, Tatham, and Black (1992).

Factor analysis and principal component analysis differ in the variance each seeks to explain. The total variation for each variable in the analysis can be partitioned into the sum of a common component, a specific or unique component, and an error component. Factor analysis extracts factors so as to explain as much of the common variance across all variables as possible. Principal component analysis extracts factors so as to explain as much of the total variance as possible. These two methods are distinguished by the diagonal elements of the correlation matrix. Factor analysis includes communalities along the main diagonal. These communalities are initial estimates of the common variation. The principal component method uses those along the main diagonal of the correlation matrix.

Maximum likelihood is the method of factor extraction for the common factor analysis. The number of factors extracted is determined by a combination of two methods. The first is the proportion of variance criterion. The second criterion is a chi-square test of the null hypothesis that there are no additional factors. The number of principal components reported is determined by a combination of the Cattell's scree test and the proportion of variance criterion. This combination of methods was concluded when 80% of the total variation had been extracted. This method was chosen to provide the best *single* index (the first principal component) to the indices provided by others and to save space.

There are several methods available for factor rotation. The VARIMAX procedure is probably the most common and it is the one chosen for use here. The aim of the VARIMAX procedure is to rotate the factor matrix to simplify the interpretation of the columns. Factors are rotated so that the loadings are very high or very low on a particular factor. These rotated factors should then be easier to identify and interpret than factors rotated by other methods.

The three indices discussed are constructed by either averaging or summing. Neither

averaging nor summing give any consideration to the correlations in the item scores which must certainly exist if all items measure economic freedom. Principal component analysis reduces the effects of the correlation problem and provides the single index explaining the largest percentage of the total variation in the data.

Principal component analysis is used to construct the best index because of the nature of the item scores upon which the indices are based. The items are chosen precisely because the investigating group believed they represented important components of economic freedom. Because these characteristics already represent a carefully chosen group, an ideal index should explain as much of the variation in these characteristics as possible. For this reason principal component analysis is used to construct our ideal indices.

#### IV. Results

*The Fraser Institute Index.* The first step in the analysis of the index is an examination of the correlation matrix. The correlation matrix for the seventeen items is presented in Table 2A. The seventeen items yield 136 correlation coefficients. Of these 136 correlations, only 31 are not significantly different from zero at the  $\alpha=.10$  level (based on a critical value of 0.1527). The correlations range, in absolute value, from a low of 0.00 to a high of 0.75.

**Table 2A Fraser Institute Correlation Matrix**

|    | A1     | A2     | A3     | A4     | B1     | B2     | B3     | B4     | B5     | B6     |
|----|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| A1 | 1.00   | 0.75   | - 0.04 | 0.09   | - 0.32 | 0.35   | 0.24   | 0.18   | 0.37   | 0.55   |
| A2 |        | 1.00   | 0.16   | 0.24   | - 0.27 | 0.34   | 0.35   | 0.27   | 0.41   | 0.70   |
| A3 |        |        | 1.00   | 0.75   | - 0.21 | 0.10   | 0.42   | 0.39   | 0.36   | 0.32   |
| A4 |        |        |        | 1.00   | - 0.19 | 0.27   | 0.48   | 0.50   | 0.36   | 0.42   |
| B1 |        |        |        |        | 1.00   | 0.19   | - 0.24 | - 0.27 | - 0.44 | - 0.22 |
| B2 |        |        |        |        |        | 1.00   | 0.41   | 0.42   | 0.20   | 0.45   |
| B3 |        |        |        |        |        |        | 1.00   | 0.62   | 0.53   | 0.56   |
| B4 |        |        |        |        |        |        |        | 1.00   | 0.65   | 0.39   |
| B5 |        |        |        |        |        |        |        |        | 1.00   | 0.47   |
| B6 |        |        |        |        |        |        |        |        |        | 1.00   |
| C1 | - 0.07 | - 0.21 | - 0.50 | - 0.37 | 0.44   | 0.16   | - 0.48 | - 0.53 | - 0.63 | - 0.26 |
| C2 | - 0.31 | - 0.12 | 0.16   | 0.21   | 0.23   | 0.19   | - 0.00 | 0.04   | - 0.20 | 0.04   |
| C3 | 0.15   | 0.17   | - 0.20 | - 0.17 | - 0.01 | 0.17   | - 0.09 | - 0.04 | 0.01   | 0.04   |
| D1 | 0.14   | 0.24   | 0.56   | 0.58   | - 0.29 | 0.01   | 0.44   | 0.51   | 0.45   | 0.28   |
| D2 | 0.36   | 0.36   | 0.43   | 0.48   | - 0.28 | 0.32   | 0.62   | 0.50   | 0.50   | 0.58   |
| D3 | 0.11   | 0.17   | 0.21   | 0.15   | - 0.14 | - 0.09 | 0.12   | 0.07   | 0.10   | 0.08   |
| D4 | 0.20   | 0.35   | 0.62   | 0.72   | - 0.20 | 0.33   | 0.66   | 0.68   | 0.54   | 0.48   |



**Table 2A (Continued)**

|    |      |      |      |        |        |        |        |  |  |  |
|----|------|------|------|--------|--------|--------|--------|--|--|--|
|    | C1   | C2   | C3   | D1     | D2     | D3     | D4     |  |  |  |
| C1 | 1.00 | 0.30 | 0.29 | - 0.51 | - 0.41 | - 0.07 | - 0.51 |  |  |  |
| C2 |      | 1.00 | 0.23 | - 0.06 | - 0.07 | - 0.00 | 0.10   |  |  |  |
| C3 |      |      | 1.00 | - 0.31 | - 0.11 | - 0.17 | - 0.05 |  |  |  |
| D1 |      |      |      | 1.00   | 0.48   | 0.27   | 0.52   |  |  |  |
| D2 |      |      |      |        | 1.00   | 0.21   | 0.51   |  |  |  |
| D3 |      |      |      |        |        | 1.00   | 0.17   |  |  |  |
| D4 |      |      |      |        |        |        | 1.00   |  |  |  |

Note: The critical value for significance at the  $\alpha=0.10$  is 0.1527 for the Fraser Institute sample.

An examination of the correlation matrix does indicate a few points worthy of note. The pairwise correlations category A entitled, “Money and Inflation,” exhibit an unusual pattern. Although the correlation between A1 and A2 is a high 0.75, and the correlation between A3 and A4 is also a high 0.75, the highest correlation across these two pairs of items is only 0.24. Even though these items are included in the same broad category, they seem to be measuring different things. Also, the ratings in the C category, “Taking and Discriminatory Taxation” do not seem to be as highly correlated as one would expect if they were all measuring the same thing. The highest correlation between any pair of “C” items is 0.30. These unusual correlation patterns may warn of some problems in aggregating this information into a single index. Factor analysis and principal component analysis can help to resolve this question.

The results from performing factor analysis on the seventeen items in the FI data are contained in Table 2B. Four factors are extracted. A chi-square test rejects the null hypothesis of no common factor in favor of the alternative, that at least one common factor is present, with a value of 1126.9 (with 136 degrees of freedom). Although naming the factors is not important for our ultimate goal, we do attempt to name the factors.

**Table 2B Fraser Institute Rotated Factor Matrix**

| Variable | FACTOR1   | FACTOR2   | FACTOR3   | FACTOR4   | $h^2$   | $\rho^2$ |
|----------|-----------|-----------|-----------|-----------|---------|----------|
| A1       | 0.11450   | 0.86070   | - 0.03902 | - 0.19569 | 0.79374 | 0.19515  |
| A2       | 0.20053   | 0.81643   | 0.15182   | - 0.14943 | 0.75215 | 0.34959  |
| A3       | 0.38867   | - 0.04226 | 0.77397   | 0.04242   | 0.75368 | 0.24183  |
| A4       | 0.47100   | 0.10346   | 0.72227   | 0.21186   | 0.79910 | 0.41994  |
| B1       | - 0.18560 | - 0.19349 | - 0.21551 | 0.50577   | 0.37414 | 0.00163  |
| B2       | 0.48671   | 0.43721   | - 0.16051 | 0.54160   | 0.74713 | 0.44522  |
| B3       | 0.71115   | 0.22109   | 0.22104   | - 0.01880 | 0.60383 | 0.39921  |
| B4       | 0.85718   | 0.08476   | 0.12027   | - 0.04906 | 0.75881 | 0.35572  |
| B5       | 0.66425   | 0.25516   | 0.14617   | - 0.38479 | 0.67576 | 0.21712  |
| B6       | 0.40583   | 0.64880   | 0.23946   | 0.01906   | 0.64334 | 0.48909  |

**Table 2B (Continued)**

| Variable                     | FACTOR1   | FACTOR2   | FACTOR3   | FACTOR4   | h <sup>2</sup> | ρ <sup>2</sup> |
|------------------------------|-----------|-----------|-----------|-----------|----------------|----------------|
| C1                           | - 0.54734 | 0.08698   | - 0.36462 | 0.60555   | 0.80679        | 0.01031        |
| C2                           | 0.02542   | - 0.13872 | 0.14321   | 0.57150   | 0.36702        | 0.14537        |
| C3                           | - 0.04593 | 0.23121   | - 0.26539 | 0.18617   | 0.16066        | 0.04470        |
| D1                           | 0.43453   | 0.04972   | 0.53757   | - 0.20236 | 0.52122        | 0.20040        |
| D2                           | 0.53260   | 0.32486   | 0.30487   | - 0.07425 | 0.48766        | 0.36789        |
| D3                           | - 0.00410 | 0.11425   | 0.28308   | - 0.08709 | 0.10079        | 0.05263        |
| D4                           | 0.68710   | 0.16341   | 0.48021   | 0.05917   | 0.73291        | 0.50223        |
| Sum of Squares-eigenvalue    | 3.79091   | 2.41859   | 2.27605   | 1.59314   | 10.07870       | -              |
| Percentage of Trace          | 37.6      | 24.0      | 22.6      | 15.8      | 100.0          | -              |
| Percentage of Total Variance | 22.3      | 14.2      | 13.4      | 9.4       | 59.3           |                |

The highest correlation with the first factor (0.86) is provided by item B4, “Freedom to enter and compete in markets.” Other items in the B category, “Government Operations and Regulations,” also load heavily on Factor 1. The correlation between Factor 1 and B3 is 0.71 and the correlation with B5 is 0.66. Factor 1 is also highly correlated (0.60) with D4, “Restrictions of the freedom of citizens to engage in capital transactions with foreigners.” The combined evidence leads us to name Factor 1, “Free Enterprise.”

The second factor is very highly correlated (0.86 and 0.82) with items A1 and A2, both of which concern inflation. This, along with a high correlation (0.65) on B6, “Freedom from government regulations and policies that cause negative real interest rates,” leads us to name this factor, “Stable Domestic Money.”

The third factor has very high correlations (0.77 and 0.72) with the third and fourth items in the “Money and Inflation” group. These two items concern the freedom to hold foreign currency and the freedom to maintain bank accounts abroad. We are thus led to name this factor, “International Monetary Freedom.”

The highest correlations with the fourth factor (0.61, 0.57, 0.54, and 0.51) are provided by items C1, C2, B2, and B1. These items address the top marginal tax rate, transfers and subsidies as a fraction of GDP, government operated enterprises as a share of the economy, and government general consumption expenditures as a share of GDP. We elect to name this factor, “Government Size.”

An interesting finding of this factor analysis is that the four items in section A entitled “Money and Inflation” loaded on different factors. A1 and A2 loaded heavily on Factor 2, but A3 and A4 loaded heavily on Factor 3. This is not surprising given the pairwise correlations noted earlier. This result indicates that what GLB label “Money and Inflation” is actually a composite itself, containing a domestic component and an international component.

These four factors together explain a great deal of the common variation in the scores for the seventeen items. Just how well these four factors perform can be seen by an examination of the final communality estimates contained in column 6 of Table 2B. These communalities are the sums of the squared correlations between the responses on each item and the factor score for each factor. The squared correlations represent the  $R^2$  for a simple regression between the item response and the factor score. Because the factors are uncorrelated, these squared correlations can be summed to indicate the proportion of the variance in the item response accounted for by all factors, combined. An examination of this column indicates that the four factors perform quite well. Eight of the communalities exceed .7, indicating that the factors explain more than seventy percent of the common variation in the responses to those items. Only five of the communalities are less than .5. The range is 0.80679 to 0.10079. The factors perform poorest in predicting responses to items D3, C3, and C2. Although these four factors account for much of the common variance, they do not perform nearly as well at predicting the total variance. Table 2B also indicates that even these four factors together explain only 59 percent of the total variance in the data.

How well is the FI index doing by comparison? Some indication of the relative performance of the FI Index is provided in column 7 of Table 2B. This column contains the squared correlations between the FI index and the responses to each of the seventeen items. This measure is the  $R^2$  that would result from a simple regression of the FI index against each of the item scores. These correlations are much lower than the communalities previously discussed. Only one value (for D4) exceeds .5. The range of the squared correlations is 0.00163 to 0.50223. In every case these squared correlations are below the communalities previously discussed. These results indicate that the FI index is not explaining much of the variation in the items from which it is derived. However, comparing the performance of the FI index to the performance of *four* factors is unfair.

To make a fair comparison the FI index should be compared to the best single index which can be constructed from the FI data. The best single index is the first principal component. The performance of the first principal component is compared to the FI index in Table 2C. The second column of the table again presents the squared correlations between the FI index and each of the seventeen item scores (column 6 from Table 2B). The third column of Table 2C presents the squared correlations between the first principal component and each of the seventeen item scores. This table compares the percentage of variation in each item score accounted for by the FI index to the percentage of variation in each item score accounted for by the "best" index (the first principal component). The table shows that the principal component performs substantially better than the FI index. The percentage of the total variance accounted for by the principal component exceeds that of the FI index for all but four of the seventeen items. Often, the amount of variation accounted for by the principal component exceeds that of the FI index by a considerable amount. Overall, the FI index accounts for 26.1 percent of the variance in all seventeen items. The principal component index accounts for 36.9 percent of the total variance, or over 41 percent more than the FI index.

**Table 2C Fraser Institute First Principal Component**

|                  | $\rho^2$ | $h^2$   |
|------------------|----------|---------|
| A1               | 0.19515  | 0.19342 |
| A2               | 0.34959  | 0.32668 |
| A3               | 0.24183  | 0.43535 |
| A4               | 0.41994  | 0.52425 |
| B1               | 0.00163  | 0.18580 |
| B2               | 0.44522  | 0.14470 |
| B3               | 0.39921  | 0.60731 |
| B4               | 0.35572  | 0.58057 |
| B5               | 0.21712  | 0.56784 |
| B6               | 0.48909  | 0.49341 |
| C1               | 0.01031  | 0.42992 |
| C2               | 0.14537  | 0.00328 |
| C3               | 0.04470  | 0.01589 |
| D1               | 0.20040  | 0.47006 |
| D2               | 0.36789  | 0.56397 |
| D3               | 0.05263  | 0.05692 |
| D4               | 0.50223  | 0.67254 |
| Percent of Total | 26.1     | 36.9    |

These percentages provide two insights if one assumes all seventeen items really are important to explain “economic freedom.” The first observation is that the performance of the FI index is greatly exceeded by the performance of the first principal component. The principal component explains over 41 percent of the variation in the items than the FI index. The second observation concerns the relatively poor performance of the principal component index. Even the best single index is only able to account for about 37 percent of the variation in these item scores. The seventeen items seem to defy being compressed into a single index. In doing so, much information is lost. A solution to this problem is found in the use of principal components. Each country’s FI index and the rank based on that index was obtained. The first principal component and each country’s rank based on the first component was also computed, along with the second through sixth principal components (these data are all available from the authors). These six components together explain 79 percent of the total variance in the FI data.

A comparison of the ranks provided by the FI index and the first principal component yields some surprising results (the correlation between the two is 0.770253). With the FI index, Hong Kong is ranked first and Denmark is forty-fourth. With the first principal component, Hong Kong is seventeenth and Denmark is first. The U.S. is ranked fourth using the FI index and eighth by the first principal component. The dramatic changes of the ranks of some countries is not surprising given the much greater explanatory power of the first principal component. According to Table 2C, the improved performance of the first principal component is due to its greater explanatory power regarding variations in “government

operations” and “restraints on international exchange.” Those countries whose ranks change by more than thirty places (FI rank, principal component rank) include developing areas such as Thailand (8, 39), Philippines (10, 54), Paraguay (17, 56), Belize (29, 61), Indonesia (31, 65), Dominican Rep. (53, 98), Bangladesh (66, 101), Haiti (70, 104), Nepal (71, 107), Uganda (76, 106), and Albania (105, 71). But one does not have to choose only the first principal component. All six principal components explain nearly 80 percent of the variance in the FI data, and, because they are orthogonal, the inclusion of the group in a regression model would present no multicollinearity problems.<sup>5</sup>

*Heritage Foundation Index-1995.* The correlation matrix for the ten items comprising the index is given in Table 3A. Of the forty-five pairwise correlations, only seven are *not* significantly different from zero at the  $\alpha=.10$  level (based on a critical value of 0.1636). The correlations range from a low of 0.00 to a high of 0.75. Most fall between 0.40 and 0.59.

**Table 3A Heritage Correlation Matrix, 1995**

|     | E1   | E2   | E3   | E4   | E5   | E6   | E7   | E8   | E9   | E10  |
|-----|------|------|------|------|------|------|------|------|------|------|
| E1  | 1.00 |      |      |      |      |      |      |      |      |      |
| E2  | 0.00 | 1.00 |      |      |      |      |      |      |      |      |
| E3  | 0.15 | 0.40 | 1.00 |      |      |      |      |      |      |      |
| E4  | 0.21 | 0.06 | 0.14 | 1.00 |      |      |      |      |      |      |
| E5  | 0.54 | 0.16 | 0.30 | 0.06 | 1.00 |      |      |      |      |      |
| E6  | 0.46 | 0.22 | 0.40 | 0.33 | 0.55 | 1.00 |      |      |      |      |
| E7  | 0.45 | 0.31 | 0.43 | 0.18 | 0.53 | 0.56 | 1.00 |      |      |      |
| E8  | 0.63 | 0.16 | 0.41 | 0.52 | 0.52 | 0.63 | 0.53 | 1.00 |      |      |
| E9  | 0.56 | 0.19 | 0.29 | 0.34 | 0.54 | 0.56 | 0.53 | 0.74 | 1.00 |      |
| E10 | 0.56 | 0.23 | 0.29 | 0.52 | 0.30 | 0.48 | 0.48 | 0.75 | 0.61 | 1.00 |

Note: The critical value for significance at the  $\alpha=0.10$  level is 0.1636 using the 1995 HWSJ data.

The rotated factor matrix is presented in Table 3B. Two factors are extracted and rotated using the VARIMAX method. A chi-square test rejects the null hypothesis of no common factor in favor of the alternative, that at least one common factor is present, with a value of 486.6 (with 45 degrees of freedom).

**Table 3B Heritage Rotated Factor Matrix, 1995**

| Variable | Factor1 | Factor2   | $h^2$   | $\rho^2$ |
|----------|---------|-----------|---------|----------|
| E1       | 0.58787 | 0.37519   | 0.48636 | 0.47680  |
| E2       | 0.22362 | 0.09632   | 0.05929 | 0.12746  |
| E3       | 0.39270 | 0.20659   | 0.19689 | 0.28847  |
| E4       | 0.06757 | 0.65798   | 0.43751 | 0.32217  |
| E5       | 0.85936 | - 0.00453 | 0.73851 | 0.39325  |

5. Scully (1991) and (1992).

**Table 3B (Continued)**

| Variable                     | Factor1 | Factor2 | $h^2$   | $\rho^2$ |
|------------------------------|---------|---------|---------|----------|
| E6                           | 0.64828 | 0.34252 | 0.53759 | 0.55284  |
| E7                           | 0.64418 | 0.25196 | 0.47845 | 0.48722  |
| E8                           | 0.60381 | 0.70249 | 0.85808 | 0.78895  |
| E9                           | 0.63555 | 0.48654 | 0.64065 | 0.62140  |
| E10                          | 0.37486 | 0.75945 | 0.71728 | 0.65353  |
| Sum of Squares - eigenvalue  | 3.03714 | 2.11347 | 5.15061 | 4.71209  |
| Percentage of Trace          | 59.0    | 41.0    | 100.0   | 91.5     |
| Percentage of Total Variance | 30.4    | 21.1    | 51.5    | 47.1     |

The first factor is very highly correlated (0.86) with item E5 which is “Capital Flows and Foreign Investment.” The second factor is most highly correlated with item E10 which is the “Black Market” category. These data seem to suggest that other, perhaps more obvious, ideas linked to economic freedom, such as “government intervention in the economy” or “regulation of business,” move together with these factors. The simple correlations do indicate that all ten items are highly correlated so that separation into distinct factors is not easy.

Table 3B also shows that these two factors together explain only 51 percent of the common variance in the ten items. The table shows that the Heritage Index, alone, explains 47 percent of the total variance. Clearly, the Heritage Index performs nearly as well as the two factors.

In Table 3C, we see that the best single index, or first principal component, accounts for 48 percent of the total variance in the data - only slightly better than the Heritage Index. Neither index explains as much as half of the total variance in the data. Perhaps more components are needed.

**Table 3C Heritage First Principal Component, 1995**

|    | $\rho^2$ | $h^2$   |
|----|----------|---------|
| E1 | 0.47680  | 0.50223 |
| E2 | 0.12746  | 0.10419 |
| E3 | 0.28847  | 0.26600 |
| E4 | 0.32217  | 0.22983 |
| E5 | 0.39325  | 0.46603 |
| E6 | 0.55284  | 0.60527 |
| E7 | 0.48722  | 0.54849 |
| E8 | 0.78895  | 0.79440 |

**Table 3C (Continued)**

|                  | $\rho^2$ | $h^2$   |
|------------------|----------|---------|
| E9               | 0.62140  | 0.66929 |
| E10              | 0.65353  | 0.61207 |
| Percent of Total | 47.12    | 47.98   |

Each country's Heritage index and the rank based on that index for 1995 were obtained. The first principal component and each country's rank based on the first component was computed, along with the second through the fourth principal components (all of these data are available from the authors). These four components together explain 79 percent of the total variance in the Heritage data.

A comparison of the ranks based on the Heritage index and the first principal component indicates close agreement, which is not surprising because of the close relationship between the Heritage index and the first principal component discussed above (the correlation between the two is 0.982612). Among those countries whose ranking differs by more than six places (HI rank, principal component rank) include many developing areas such as Jamaica (29, 39), Guatemala (48, 58), Kenya (48, 57), Guinea (67, 56), Mongolia (69, 59), Zimbabwe (74, 82), Mali (74, 84), Cameroon (74, 81), Albania (81, 72) and Belarus (89, 79).

*Heritage Foundation/Wall Street Journal Index-1998.* The correlation matrix for the ten items comprising the HWSJ index for 1998 is contained in Table 4A. Of the forty-five pairwise correlations, only two are not significantly different from zero at the  $\alpha=.10$  level (based on a critical value of 0.1325). The correlations range from a low of 0.05 to a high of 0.82, but most fall in the 0.40 to 0.69 range. The fact that the correlations are not all uniformly high suggests that the items are not all describing the same entity (a factor analysis provides more information).

**Table 4A Heritage/WSJ Correlation Matrix, 1998**

|     | E1   | E2   | E3   | E4   | E5   | E6   | E7   | E8   | E9   | E10  |
|-----|------|------|------|------|------|------|------|------|------|------|
| E1  | 1.00 |      |      |      |      |      |      |      |      |      |
| E2  | 0.16 | 1.00 |      |      |      |      |      |      |      |      |
| E3  | 0.40 | 0.30 | 1.00 |      |      |      |      |      |      |      |
| E4  | 0.21 | 0.05 | 0.22 | 1.00 |      |      |      |      |      |      |
| E5  | 0.56 | 0.20 | 0.53 | 0.27 | 1.00 |      |      |      |      |      |
| E6  | 0.57 | 0.29 | 0.46 | 0.31 | 0.69 | 1.00 |      |      |      |      |
| E7  | 0.51 | 0.25 | 0.50 | 0.25 | 0.68 | 0.71 | 1.00 |      |      |      |
| E8  | 0.64 | 0.23 | 0.47 | 0.55 | 0.63 | 0.66 | 0.62 | 1.00 |      |      |
| E9  | 0.57 | 0.27 | 0.45 | 0.41 | 0.57 | 0.59 | 0.61 | 0.76 | 1.00 |      |
| E10 | 0.62 | 0.11 | 0.34 | 0.51 | 0.53 | 0.61 | 0.60 | 0.82 | 0.67 | 1.00 |

Note: The critical value for significance at the  $\alpha=0.10$  level is 0.1325 using the HWSJ 1998 data.

The rotated factor matrix is presented in Table 4B. Two factors are extracted and rotated using VARIMAX. A chi-square test rejects the null hypothesis of no common factor in favor of the alternative, that at least one common factor is present, with a value of 919.9 (with 45 degrees of freedom).

**Table 4B Heritage/WSJ Rotated Factor Matrix, 1998**

| Variable                     | Factor1 | Factor2 | h <sup>2</sup> | ρ <sup>2</sup> |
|------------------------------|---------|---------|----------------|----------------|
| E1                           | 0.50759 | 0.48600 | 0.49384        | 0.53057        |
| E2                           | 0.32855 | 0.06181 | 0.11176        | 0.12918        |
| E3                           | 0.56178 | 0.22472 | 0.36610        | 0.38078        |
| E4                           | 0.07670 | 0.61180 | 0.38018        | 0.34321        |
| E5                           | 0.75831 | 0.32214 | 0.67880        | 0.58435        |
| E6                           | 0.74363 | 0.38075 | 0.69796        | 0.64434        |
| E7                           | 0.75929 | 0.33572 | 0.68922        | 0.59013        |
| E8                           | 0.47669 | 0.81882 | 0.89771        | 0.81195        |
| E9                           | 0.51101 | 0.61927 | 0.64463        | 0.66269        |
| E10                          | 0.39927 | 0.77611 | 0.76177        | 0.69516        |
| Sum of Squares-eigenvalue    | 3.03939 | 2.68258 | 5.72197        | 5.37236        |
| Percentage of Trace          | 53.1    | 46.9    | 100.0          | 93.9           |
| Percentage of Total Variance | 30.4    | 26.8    | 57.2           | 53.7           |

The first factor is most highly correlated with items seven, five, and six, in that order.<sup>6</sup> All of these correlations exceed 0.74. These high correlations are associated with wage and price controls, capital flows and foreign investment, and banking issues. The second factor has a very high correlation (0.82) with property rights and a high correlation (0.76) with black market activities.<sup>7</sup> These two factors are very similar to the factors discovered in the 1995 data.

The first factor explains 53.1 percent of the common variance and the second factor explains the remaining 46.9 percent. The HWSJ index explains 93.9 percent of the common variance. When the total variance is examined, all indices fare far worse. The two factors explain only 57.2 percent of the total variance in the ten items. The HWSJ index explains only 53.7 percent of the total variance. Nearly half of the total variance in the items is not accounted for by the HWSJ index.

The results for the first principal component are contained in Table 4C. The first

6. They also are correlated in the 1995 index, suggesting that these variables could represent the same dimension of economic freedom.

7. Again, these variables show correlation in the 95 index.



principle component explains 54.3 percent of the total variation in the ten items. This is only slightly better than the HWSJ index, but still leaves nearly half of the total variance unexplained. Once more, the data seem to defy condensation into a single index. Again, the use of principal components provides a solution.

**Table 4C Heritage/WSJ First Principal Component, 1998**

|                           | $\rho^2$ | $h^2$   |
|---------------------------|----------|---------|
| E1                        | 0.53057  | 0.54695 |
| E2                        | 0.12918  | 0.10799 |
| E3                        | 0.38078  | 0.38667 |
| E4                        | 0.34321  | 0.25373 |
| E5                        | 0.58435  | 0.63755 |
| E6                        | 0.64434  | 0.68438 |
| E7                        | 0.59013  | 0.65139 |
| E8                        | 0.81195  | 0.80274 |
| E9                        | 0.66269  | 0.68400 |
| E10                       | 0.69516  | 0.68271 |
| Percent of Total Variance | 53.72    | 54.38   |

Each country's HWSJ index and the rank based on that index for 1998 was obtained. The first principal component and each country's rank based on the first component was computed, along with the second through the fourth principal components (all of these data are available from the authors). These four components together explain 81 percent of the total variation in the HWSJ data for 1998, which is slightly more than for 1995.

A comparison of the ranks based on the HWSJ index and the first principal component indicates close agreement, similar to the results for 1995 (the correlation between the ranks for the two principal components for HWSJ95 and HWSJ98 is 0.93217). This close agreement is, again, not surprising because of the close relationship between the HWSJ index and the first principal component established earlier (the correlation between the two is 0.976326). The list of countries whose ranks differ (HWSJ rank, principal component rank) by more than 10 places includes developing countries Botswana (49, 59), Jordan (49, 60), Belize (53, 63), Guatemala (53, 68), Uganda (53, 38), Latvia (62, 54), Senegal (88, 100), Cambodia (96, 107), and Nepal (102, 112). Once again, economic freedom is over-rated by the published indices in many developing countries.

*Freedom House Index.* The correlation matrix for the six Freedom House items is given in Table 5A. All of the correlations are significantly different from zero at the  $\alpha=.10$  level (based on a critical value of 0.1816), and all but one of the correlations exceed 0.50. The six items are all highly correlated.

**Table 5A Freedom House Correlation Matrix**

|    | F1   | F2   | F3   | F4   | F5   | F6   |
|----|------|------|------|------|------|------|
| F1 | 1.00 | 0.70 | 0.64 | 0.79 | 0.53 | 0.74 |
| F2 |      | 1.00 | 0.66 | 0.64 | 0.58 | 0.73 |
| F3 |      |      | 1.00 | 0.77 | 0.64 | 0.59 |
| F4 |      |      |      | 1.00 | 0.63 | 0.58 |
| F5 |      |      |      |      | 1.00 | 0.46 |
| F6 |      |      |      |      |      | 1.00 |

Note: The critical value for significance at the  $\alpha=0.10$  is 0.1816 using the Freedom House data.

The results from the factor analysis are contained in Table 5B. Two factors are again extracted and rotated. A chi-square test rejects the null hypothesis of no common factor in favor of the alternative, that at least one common factor is present, with a value of 344.3 (with 15 degrees of freedom).

**Table 5B Freedom House Rotated Factor Matrix**

| Variable                     | FACTOR1 | FACTOR2 | $h^2$   | $\rho^2$ |
|------------------------------|---------|---------|---------|----------|
| F1                           | 0.64856 | 0.58425 | 0.76198 | 0.77976  |
| F2                           | 0.51416 | 0.62932 | 0.66040 | 0.74729  |
| F3                           | 0.72058 | 0.39787 | 0.67754 | 0.72889  |
| F4                           | 0.89064 | 0.32759 | 0.90055 | 0.79064  |
| F5                           | 0.61200 | 0.29850 | 0.46364 | 0.54398  |
| F6                           | 0.32057 | 0.89920 | 0.91133 | 0.63998  |
| Sum of Squares-Eigenvalue    | 2.47478 | 1.90068 | 4.37546 | 4.23054  |
| Percentage of Trace          | 56.6    | 43.4    | 100.0   | 96.7     |
| Percentage of Total Variance | 41.2    | 31.7    | 72.9    | 70.5     |

As Table 5B shows, all variables are highly correlated with both factors, but two correlations stand out. The fourth item, “Freedom to invest one’s earnings,” has a correlation of 0.89 with the first factor. The sixth item, “Freedom to participate in the market economy,” has a correlation of 0.90 with the second factor. These two items are closely associated with the two factors.

The first factor explains 56.6 percent of the common variance, and the second factor explains the remaining 43.4 percent. The FH index alone accounts for 96.7 percent of the common variance. The two factors combine to explain 73 percent of the total variance in the data. The FH index, alone, explains 70.5 percent.

Table 5C indicates how well the FH index performs when compared to the best index. The results show that the best single index explains 70.6 percent of the total variance, only slightly more than the FH index.

**Table 5C Freedom House First Principal Component**

|                  | $\rho^2$ | $h^2$   |
|------------------|----------|---------|
| F1               | 0.77976  | 0.76976 |
| F2               | 0.74729  | 0.73683 |
| F3               | 0.72889  | 0.73308 |
| F4               | 0.79064  | 0.77301 |
| F5               | 0.54398  | 0.56468 |
| F6               | 0.63998  | 0.65973 |
| Percent of Total | 70.51    | 70.62   |

Each country's Freedom House index and the rank based on that index for 1995-6 was obtained. The first principal component and each country's rank based on the first component was computed, along with the second principal component (these data are all available from the authors). These two components together explain 81 percent of the total variance in the Freedom House data for 1995-6.

As with the Heritage indices, the rank based on the Freedom House index and the rank based on the first principal component are in close agreement (the correlation between the two is 0.993656). This result is, again, not surprising because of the close relationship between the Freedom House index and the first principal component established earlier.

*Comparisons.* Comparing the performance of these indices is very difficult for a number of reasons. First, assessing how well each index measures economic freedom is impossible because each index is based upon and related to the data from which it came. If the data has little to do with economic freedom, the index derived from the data will have little to do with economic freedom. Thus, the indices cannot be compared in an absolute sense.

Even comparisons in a relative sense are problematic because each index is based on a different set of data. The FI index is based on 17 items, the HWSJ and HF indices are based on 10 items, and the FH index is based on 6 items. Explaining variance in 17 items cannot be easier than explaining variance in 6 items. Consequently, any comparison based on how well the indices describe their own data sets will be biased against the FI index and in favor of the FH index. Indeed, our results to this point have shown that the FH index explains the largest percentage of total variance in its 6 items, the HWSJ index explains the second largest percentage, and the FI index explains the lowest percentage. The fact that several countries are present in each index in 1995 holds the promise of some useful comparisons.

Some comparison between indices can be made by examining how well one index explains the variance in the others' items. This rough comparison is made possible because all three indices are available for 54 countries for 1995. Table 6 presents the correlations between the three indices and the three principal components for the 54 countries. We have already learned that the FH index and the HF index are related much more closely to their respective principal components than the FI index is to its principal component. Those relationships are apparent in the table. The correlation between the FH index and its principal component is 1.00, for HF the correlation is 0.98, and for FI the correlation is 0.70.

**Table 6 Correlations Between Indices**

|       | FHI    | HFI    | FII    | FHP    | HFP    | FIP  |
|-------|--------|--------|--------|--------|--------|------|
| FHI   | 1.00   |        |        |        |        |      |
| HWSJI | - 0.67 | 1.00   |        |        |        |      |
| GLBI  | 0.53   | - 0.71 | 1.00   |        |        |      |
| FHP   | 1.00   | - 0.67 | 0.51   | 1.00   |        |      |
| HWSJP | - 0.71 | 0.98   | - 0.66 | - 0.71 | 1.00   |      |
| GLBP  | 0.82   | - 0.77 | 0.70   | 0.82   | - 0.79 | 1.00 |

Obs.: FHI: Freedom House Index; HFI: Heritage Foundation Index; FII: Fraser Institute Index; FHP: Freedom House first principal component; HFP: Heritage Foundation first principal component; FIP: Fraser Institute first principal component.

The table also reveals that the correlation between the HF index and the FI index is the highest in absolute value (- 0.71), the correlation between HF and FH is next (- 0.67), and lowest is the correlation between FI and FH (0.53).

Although the simple correlations are interesting, more useful information about performance can be obtained by examining how well each index explains variance in the other two data sets. Information on how well each index and principal component explain variation in the 17 FI items is given in Table 7A. The last row in the table shows that there is little difference in the percentage of variance accounted for by each index. The FH index accounts for 24.74 percent, the HF index accounts for 22.11 percent, and the FI index accounts for 23.21 percent. Oddly, the FH index accounts for more variance in the FI data than the FI index. But the FI principal component performs much better than any other index or component, explaining 35.59 percent of the total variance in the 17 FI items.

**Table 7A Correlations with FI Items**

|    | FHI       | HFI       | FII       | FHP       | HFP       | FIP       |
|----|-----------|-----------|-----------|-----------|-----------|-----------|
| A1 | 0.39802   | - 0.58680 | 0.54306   | 0.38659   | - 0.52809 | 0.55947   |
| A2 | 0.38298   | - 0.58525 | 0.61310   | 0.36877   | - 0.52348 | 0.53215   |
| A3 | 0.32475   | - 0.30790 | 0.39578   | 0.31833   | - 0.32861 | 0.58664   |
| A4 | 0.48107   | - 0.47255 | 0.58525   | 0.47307   | - 0.46683 | 0.61125   |
| B1 | - 0.41715 | 0.32140   | - 0.03355 | - 0.42904 | 0.35173   | - 0.49895 |
| B2 | 0.35234   | - 0.50788 | 0.79310   | 0.34602   | - 0.46735 | 0.41347   |
| B3 | 0.78055   | - 0.60686 | 0.54927   | 0.78510   | - 0.65653 | 0.77484   |
| B4 | 0.70141   | - 0.56180 | 0.43472   | 0.70068   | - 0.60760 | 0.70809   |
| B5 | 0.65411   | - 0.47592 | 0.32945   | 0.65082   | - 0.49404 | 0.72773   |
| B6 | 0.45401   | - 0.47087 | 0.63409   | 0.44313   | - 0.45897 | 0.65924   |
| C1 | - 0.56510 | 0.29793   | 0.10627   | - 0.56600 | 0.36533   | - 0.57748 |
| C2 | - 0.28147 | 0.12337   | 0.21058   | - 0.28063 | 0.14712   | - 0.28210 |
| C3 | - 0.04227 | 0.01001   | 0.19867   | - 0.04420 | 0.06877   | - 0.14248 |

**Table 7A (Continued)**

|          | FHI     | HFI       | FII     | FHP     | HFP       | FIP     |
|----------|---------|-----------|---------|---------|-----------|---------|
| D1       | 0.51779 | - 0.54747 | 0.40972 | 0.50405 | - 0.56796 | 0.69487 |
| D2       | 0.69246 | - 0.62713 | 0.65603 | 0.67658 | - 0.65315 | 0.84284 |
| D3       | 0.03983 | - 0.27830 | 0.21107 | 0.02380 | - 0.25116 | 0.16112 |
| D4       | 0.61745 | - 0.62086 | 0.63805 | 0.61530 | - 0.63470 | 0.77304 |
| $\rho^2$ | 24.74   | 22.11     | 23.21   | 24.32   | 22.65     | 35.59   |

Table 7B shows how well the indices and principal components account for the variance in the 10 items of the HF data set. The largest percentage of the variance in the HF data set (38.97 percent) is, unsurprisingly, explained by the HF index. As for the other two indices, the FH index accounts for 22.78 percent of the variance, and the FI index accounts for 18.88 percent. The FH index performs somewhat better than the FI index. But the FI principal component explains 28.05 percent of the variance, which is much more than either the FH index or the FH principal component.

**Table 7B Correlation with HF Items**

|          | FHI       | HFI     | FII       | FHP       | HFP       | FIP       |
|----------|-----------|---------|-----------|-----------|-----------|-----------|
| E1       | - 0.62327 | 0.70782 | - 0.35233 | - 0.62346 | 0.73080   | - 0.70336 |
| E2       | 0.22780   | 0.02476 | 0.23790   | 0.23485   | - 0.02864 | 0.20209   |
| E3       | - 0.05684 | 0.37894 | - 0.39308 | - 0.04992 | 0.31706   | - 0.02405 |
| E4       | - 0.25695 | 0.59791 | - 0.55588 | - 0.24326 | 0.48719   | - 0.41655 |
| E5       | - 0.43070 | 0.40562 | 0.22842   | - 0.43150 | 0.51602   | - 0.48633 |
| E6       | - 0.42507 | 0.61116 | - 0.29025 | - 0.42664 | 0.67697   | - 0.41853 |
| E7       | - 0.44846 | 0.53751 | - 0.46957 | - 0.45042 | 0.61071   | - 0.47837 |
| E8       | - 0.65654 | 0.89937 | - 0.63374 | - 0.64746 | 0.89325   | - 0.73278 |
| E9       | - 0.62915 | 0.77364 | - 0.39811 | - 0.62625 | 0.81622   | - 0.65132 |
| E10      | - 0.61175 | 0.81210 | - 0.57150 | 0.60762   | 0.77101   | - 0.70228 |
| $\rho^2$ | 22.78     | 38.97   | 18.88     | 22.57     | 40.29     | 28.05     |

Table 7C shows how well the indices account for the 6 items comprising the FH index. The FH index accounts for 56.98 percent of the variation, the HF index accounts for 26.79 percent of the variation, and the FI index accounts for 17.35 percent of the variation. In this instance, the FI index is defeated by the HF index. However, the FI principal component accounts for 29.23 percent of the variation. This is virtually the same percentage of variance explained as with the HF principal component.

**Table 7C Correlation with FH Items**

|          | FHI     | HFI       | FII     | FHP     | HFP       | FIP     |
|----------|---------|-----------|---------|---------|-----------|---------|
| F1       | 0.77652 | - 0.73543 | 0.57719 | 0.76316 | - 0.73171 | 0.75578 |
| F2       | 0.79006 | - 0.4578  | 0.25595 | 0.77993 | - 0.50262 | 0.61482 |
| F3       | 0.78502 | - 0.45223 | 0.35147 | 0.79216 | - 0.49951 | 0.58369 |
| F4       | 0.85405 | - 0.59615 | 0.64497 | 0.8375  | - 0.61227 | 0.75088 |
| F5       | 0.61059 | - 0.33662 | 0.22391 | 0.63176 | - 0.37882 | 0.48856 |
| F6       | 0.68800 | - 0.42841 | 0.22883 | 0.7117  | - 0.46527 | 0.48238 |
| $\rho^2$ | 56.98   | 26.79     | 17.35   | 57.09   | 29.54     | 29.23   |

The results in Tables 7A, 7B, and 7C lead to some interesting conclusions. If the principal component is used, both HF and FI explain the FH data equally well. The best index obtained from the FI data explains over 28 percent of the variation in the HF data, but the best index obtained from the HF data set explains only 22.7 percent of the variation in the FI data. The best FH index performs slightly better than the best HF index on the FI data, explaining 24.3 percent of the variation. For the HF data set, the best FI index explains 28.0 percent of the variation, and the FH index explains only 22.6 percent of the variation.

The conclusions from these results are, (1) if indices are compared the FI index performs relatively poorly, (2) the FI principal component performs better than is possible with the other indices or their principal components, and (3) FI is the richest data set of the three, but FI is not making the best use of its data.

## V. Conclusions

This paper has investigated the issue of whether what some call economic freedom is one dimensional. The findings, based on the Fraser Institute 1995 data, the Heritage/Wall Street Journal 1998 data set, the Heritage 1995 data set, and the Freedom House 1995-6 data set suggest that there are several aspects to economic freedom. A factor analysis finds four factors in the FI data, and two factors in each of the other three data sets. Even when combined, these factors usually explain less than half of the total variance in the data.

Principal component analysis is used to find the statistically best single index. Our results indicate that all of the indices except the FI index are performing about as well as the best index. The explanatory power of the FI index could be substantially improved by moving in the direction of the first principal component. In every case the percentage of the total variance explained could be increased substantially by using several principal components. We find that about 80 percent of the total variance could be explained by using six principal components with the FI data and two principal components with each of the other three data sets.

Some overlap in the countries studied in 1995 allows the three indices to be compared. Our results suggest that the performance of the FI index is inferior to the other two indices. However, if the best index from the FI index is used the performance equals or exceeds the best possible with the other data sets. This result is undoubtedly due to the relative richness of the FI data.

Finally, our results indicate that economic freedom is not one dimensional and that efforts to squeeze so much information into a single index will result in much lost information. Our suggestion is that several principal components be used as measures of aspects of economic freedom.

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