

The Economic Competitiveness of Countries: A Principal Factors Approach

Lonnie K. Stevans¹, James P. Neelankavil¹, Ronald Mendoza² & Savita Shankar²

¹ Zarb School of Business, Hofstra University, Hempstead, NY, United States

² W. SyCip Graduate School of Management, Asian Institute of Management, Manila, Philippines

Correspondence: Lonnie K. Stevans, Zarb School of Business, Department of IT/QM, Hofstra University, Hempstead, NY 11549, United States. Tel: 1-516-463-5375. E-mail: Lonnie.K.Stevans@hofstra.edu

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Abstract

Competition is a very important precondition which affects the effectiveness of development of national economy under the conditions of globalization. In classical economics, the competitiveness of countries is determined through production inputs. In the modern era of globalization, it appears that, besides quantifiable factors, qualitative influences or 'soft' factors such as political stability, government policies, quality of education, etc., are all important in determining competitiveness. The World Economic Forum's global competitiveness index and the IMD World Competitiveness Yearbook (WCY) are the two most widely used competitiveness indices. Using the same data as the WCY, Principal Components Analysis (PCA) is used in this analysis to develop indices of countries' competitiveness. The procedure deals with first transforming the original variables to a *new* set of uncorrelated variables called *Principal Components (PC)*. The new variables are linear combinations of the original variables, independent, and are derived in order of decreasing importance--the first PC accounts for as much as possible of the variation in the original data. We find that the WCY data collection methods could be simplified without compromising quality--which may encourage more countries to participate in the survey. Moreover, the approach developed in this study does not suffer from the same empirical limitations of past attempts to develop indices of the competitiveness of nations.

Keywords: Asian countries, competitiveness indices, economic competitiveness, Indices of developing countries Principal Components Analysis (PCA), Principal Components (PC), world competitiveness

1. Introduction

The Organization for Economic Cooperation and Development (OECD) defines a country's competitiveness as, "The degree to which a country can, under free and fair market condition, produces goods and services which meet the test of international markets, while simultaneously maintaining and expanding the real incomes of its people in the long term." The broad OECD definition sheds some light on the complexity of determining the competitiveness of countries.

Competition is a very important precondition which affects the effectiveness of development of national economy under the conditions of globalization. Economists argue that economic globalization has the potential of increasing economic welfare for all. In classical economics, the competitiveness of countries is determined through production inputs. Inputs such as labor, land, capital, and natural resources were the measures of competitiveness--mostly quantifiable factors that contributed to the gross domestic product of a country. In the modern era of globalization and the resulting interlink between countries and their economic interdependence, the classical theory of competitiveness is not applicable due to some dynamic shifts in recognizing competitiveness. It appears that, besides quantifiable factors, qualitative influences or 'soft' factors such as political stability, government policies, quality of education environmental conditions, institutional factors, cultural, and social issues are all equally important in determining competitiveness (Tan, 2004).

1.1 Countries' Competitiveness

Countries can achieve competitiveness through many factors including sustained economic growth, political stability, financial and banking infrastructure, strong exports, natural resources, sound government policy, educational system that builds human capital, and so on. Countries that have very few natural resources could

follow in the footsteps of Singapore, a country with few natural advantages. Singapore attained its development and achieved technological and economic competitiveness through development of a superior infrastructure and world-class transportation and materials handling facilities. Through the help of its government initiatives, Singapore has created an extremely attractive environment for multinational business on all levels (Sisodia, 1992). The role of the government and its policies were further demonstrated in a study of Russia's economic competitiveness. The study that analyzed Russia's comparative strengths in its macro and microeconomic competitiveness shows that for Russia to be economically competitive, especially in some key industries such as oil, information technology, outsourcing, and the food sector, it has improve its microeconomic climate and strengthen its institutions (Mills, Dukeov, and Fey, 2007). In a similar vein, research has shown that developing countries could be competitive if the government is strong and policy makers focus on initiatives to provide the necessary infrastructure to attract investments (Lall, 2001).

Countries strive for competitiveness to attract foreign direct investments (FDI) and also to attract skilled work force to their shores. Besides the quantifiable factors and the natural resources of a country, some qualitative variables are also important in achieving competitiveness. These include the political system of a country, its government policies, and its educational system. An additional factor that seems to determine country competitiveness is measure of tolerance. That is, acceptance of differences in terms of nationality, culture, and ethnicity. Das, DiRienzo, and Tiemann, using a world values survey, studied 62 countries on the relationship between tolerance and percentage of talented workers, economic development, and competitiveness. Their results suggest that more tolerant countries tend to attract more net migrants, have a greater concentration of talented workers, higher levels of economic development, and are more competitive (Das, DiRienzo, and Tiemann, 2008).

To assist countries in understanding their competitive position, The World Economic Forum's global competitiveness index and the IMD World Competitiveness Yearbook (WCY) are providers of two of the premier country competitiveness indices.

2. Literature Review

Although widely used by governments and companies, the World Forums' competitive index and IMD's WCY has been criticized on the grounds its complexity, difficulties in gathering reliable data, and for their large list of variables that go into developing the index (Zanakis and Becerra-Fernandez, 2005; Oral and Chabchoub, 1996). Because the list of variables run into the hundreds, countries, especially developing and smaller countries often finds it difficult respond to the survey instruments of the Word Forum and WCY.

Recognizing some of the deficiencies of existing competitiveness indices, researchers from time to time have tried to develop revised indices that are designed to provide more robust indices. A definite breakthrough in reducing variables to rank countries on their competitiveness was developed by Zanakis and Becerra-Fernandez (Zanakis and Becerra-Fernandez, 2005). Using data mining and multivariate statistical techniques along with knowledge discovery in databases (KDD) models Zanakis and Becerra-Fernandez identified important factors associated with a country's competitiveness. Their model identified 11 primary drivers of competitiveness including country risk ratings, level of computer usage, and level of gross domestic investment and so on. Similarly, Li and Ko, using an optimization model were able to reduce the WCY's variables to 14 attributes (Li and Ko, 2009). Previous researchers had tried reducing the variables through regression or neural network models, to induce rules for dynamic nations' competitiveness. Probably one of the better developed models in identifying a country's competitiveness rankings, Lin and Ko's model was used by countries to improve their competitiveness rankings.

In a different approach, Jesionwski, in his research of European countries, used two different measures to make comparison of the economic competitiveness – similarity (m) is used to measure the structural fitness of two economies and distance (d) between two economies is used to determine the differences between values of features characterizing two analytical objects (Jesionwski, 1996). Similarly, Tan in evaluating the competitiveness rankings of ASEAN countries with the methodology of the World Competitiveness Yearbook (WCY), based his rankings on standardized value (STD). Basically, he computed the average for each criteria (WCY has 122 criteria) for 10 countries (there are ten countries in the ASEAN group) following which the standard deviation is calculated. Next the STD value was computed by subtracting the 10 country average from each country's original value and then dividing the result by the standard deviation (Tan, 2004). Although a slight improvement over WCY's rankings, it did not provide an across the board measurement and that could be applied to all countries.

Other studies in the area of competitiveness have investigated issues either from a single factor approach across a limited number countries or focused on single countries. In a study comparing Turkey's competitiveness with the

commonwealth of independent states (CIS) countries Karaalp, H. Simay, (2011) found that Turkey was more competitive and had an advantage over the CIS countries. In a study dealing with the theoretical and empirical relations between living standard, quality of life, globalization and international competitiveness of EU and its neighboring countries, Olsson and Schuller found strong and positive correlations with the variables (Olsson, Michael and Schuller, (2012).

The single factor studies include, employee training across 33 countries (Cheung and Chan, 2012); export competitiveness for Baltic countries and India (Bruneckiene Paltanaviciene, 2012; Fetscherin and Pillania, 2012); entrepreneurial competitiveness for Lithuania, (Buracas, Zvirblis and Joksiene, 2012); tourism competitiveness for Romania and Bulgaria (Croitoru, 2011); Romanian economic competitiveness (Ioan, Felea Adrian, 2011); and the impact of state finances on a country's competitiveness (Vasiliauskaitė and Stankevičius, 2011). In an example of the single factor study, Bruneckiene and Paltanaviciene, based on theoretical analysis, developed an export competitiveness index just for the Baltic States allowing policy makers to identify the key factors to improve countries export competitiveness (Bruneckiene Paltanaviciene, 2012).

As shown here, attempts to improve the competitiveness indices have answered some of the complexities associated with WCY's competitiveness rankings. The studies mentioned here appear to answer some of the methodological and variable complexity issues, but have not addressed the issue from a macro as well execution point of view. An attempt is made here to develop a robust and comprehensive index that would correct some of the inherent problems with existing competitiveness indices and be more useful for countries and companies who make use of these indices. We have focused our attempts on WCY's index to develop an improved index system.

3. WCY Measure of Competitiveness

The IMD World Competitiveness Yearbook (WCY) is perhaps the most thorough report on nation competitiveness. It has been published since 1989 and is considered to be the best survey on national competitiveness--providing statistics/survey data that emphasize the competitiveness of countries' economies. The WCY study ranks nations according to their ability to attain economic prosperity. WCY defines a nation's competitiveness as, "a measurement of each nation's ability to create and maintain an environment that sustains more value creation for its enterprises and more prosperity for its people." As mentioned above, a country's competitiveness cannot be determined by GDP alone, because nations must also deal with political, social and cultural issues.

The WCY methodology involves dividing the national setting into four main competitiveness factors with twenty (20) sub-factors,

- Economic Performance,
 - Domestic Economy,
 - International Trade,
 - International Investment,
 - Employment,
 - Prices,
- Government Efficiency,
 - Public Finance,
 - Fiscal Policy,
 - Institutional Framework,
 - Business Legislation,
 - Societal Framework,
- Business Efficiency,
 - Productivity,
 - Labor Market,
 - Finance,
 - Management Practice,
 - Attitudes and Values,

- Infrastructure,
 - Basic Infrastructure,
 - Technological Infrastructure,
 - Scientific Infrastructure,
 - Health and Environment, and
 - Education.

Both quantifiable and qualitative issues are measured. There are 132 quantitative variables which represent a weight of two-thirds in the overall ranking and an additional 116 criteria are used from the WCY Executive Opinion Survey. The WCY assesses countries' economic performance by calculating a standardized score for each criterion using the available data and then using this score to rank the 59 economies based upon the 248 variables. Overall rankings, competitive factor, and sub-factor rankings are generated using this methodology.

While the WCY measure is simple to interpret and widely used to determine a country's competitiveness, it is lacking in its ability to encompass the relationships amongst the set of 248 *correlated* variables. Any developed measures that represent countries' competitiveness should be "optimal," in the sense that the indices be weighted averages with the weights determined by incorporating the inter-relationships among the 248 variables. In this study, due to the large number of missing values in the data, the initial list of 248 variables was reduced to 173. (Note 1) Simply put, our analysis will deal with the "factoring" of a cross-sectional/time-series dataset with 59 countries measured over 17 years (1995-2011), for a total of 1,003 observations.

4. Methodology and Results

4.1 Principal Components

Using the same data from the WCY, Principal Components Analysis (PCA) was used to develop indices of countries' competitiveness. The procedure deals with first transforming the original set of variables to a *new* set of uncorrelated variables called *Principal Components (PC)*. The new variables are linear combinations of the original variables and are derived in order decreasing importance—the first PC accounts for as much as possible of the variation in the original data.

One of the objectives here will be to determine if the first few components account for most of the variation in the data. If so, then the dimensionality of the study will be reduced from 173 to a smaller amount. For example, it is apparent that many of the WCY variables are highly correlated with each other—effectively "saying the same thing." Therefore, the first few components could be intuitively meaningful and may help the researcher better understand the data.

Let $\bar{X}' = (X_1, X_2, \dots, X_{173})$ be a 1 by 173 vector consisting of the WCY variables with mean equal to $\bar{\mu}$ and variance-covariance matrix Σ . The problem is to find a new set of 173 variables, $Y_1, Y_2, \dots, Y_{173}$, which are uncorrelated with each other and whose variances decrease from first to last. Each Y_j is a linear combination of the X_i ,

$$Y_j = a_{1j}X_1 + a_{2j}X_2 + \dots + a_{173j}X_{173} = \bar{a}'_j \bar{X}, \quad (1)$$

where $\bar{a}'_j$ is a vector of constants. In addition, the condition $\bar{a}'_j \bar{a}_j = 1$ ($\sum_{i=1}^{173} a_{ij}^2 = 1$) is imposed, so that the transformation is orthogonal and all distances are preserved.

4.2 Selection of Indices

The first PC is selected by choosing $\bar{a}_1$ such that Y_1 explains the most variation in the original data (X_i) as possible. The second PC is found by selecting $\bar{a}_2$ so that Y_2 explains the next highest variation in X_i and is *uncorrelated* with Y_1 . The remaining $Y_3, Y_4, \dots, Y_{248}$ are derived to have decreasing variance and are uncorrelated with all of the other components. As was done in the WCY study, all variables can be standardized to have zero mean and unit variance. (Note 2)

As mentioned previously, one of the objectives here is to "reduce the dimension" of the problem. Since it can be proven that for the first p components (Chatfield and Collins, 1980),

$$\frac{\sum_{j=1}^p Var(Y_j)}{\sum_{i=1}^{173} Var(X_i)}, \quad (2)$$

we can retain only the first p components ($p < 173$) that explain a significant portion of the variation in the original data. The best method of selecting these components is through the use of a “scree” plot, which is a graph of the eigenvalues (variances) of each component plotted against the component number (see Figure 1). From this plot, it may be seen that the line “drops-off” to zero after about the sixth eigenvalue, so we have retained six components which together explain about 63 percent of the variation in the original data.

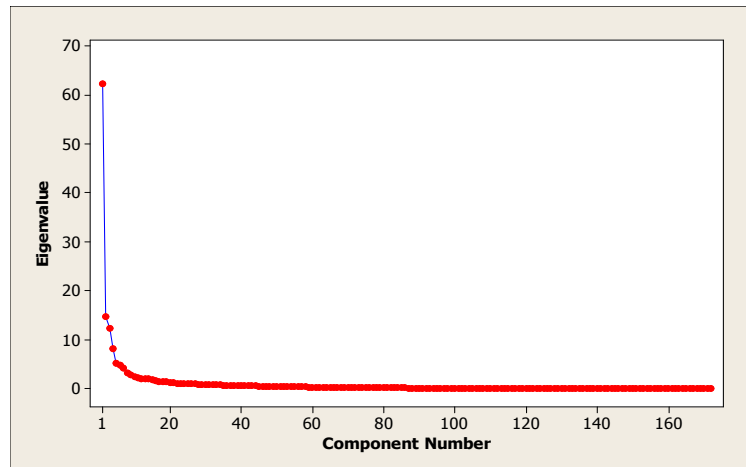


Figure 1. Scree Plot of Eigenvalues

4.3 Interpretations

The smaller set of components, $Y_1, Y_2, \dots, Y_6$, can be given meanings by examining what are known as the *loadings* or the correlations between each Y_j and the 173 variables, X_i . In other words, it may be possible to say that the first m components are measuring economic performance while the next n components are indices of government efficiency, etc. In Tables I thru 5, the correlations between each component (Components #1 - #5) and variable is presented (it is important to note that only correlations of .5 or above have been retained, since smaller correlations denote weaker linear relationships).

We interpret Component #1 (Table 1) as an “overall” competitiveness index, because it encompasses a large number of variables across all of the WCY competitiveness factors and categories. This index includes what is deemed necessary for countries to remain “competitive,” e.g., not only positive attitudes toward globalization and business formation, but also the existence of transparency in financial transactions and a high level of sustainable development.

Table 1. Overall Competitiveness Index

Competitiveness Factors	Category	Variable	Component #1
Business Efficiency	Attitudes and Values	av_atg	0.676
Business Efficiency	Attitudes and Values	av_esr	0.511
Business Efficiency	Attitudes and Values	av_fa	0.782
Business Efficiency	Attitudes and Values	av_ia	0.800
Business Efficiency	Attitudes and Values	av_nc	0.773
Business Efficiency	Attitudes and Values	av_vs	0.826
Business Efficiency	Finance	fin_corp_debt	0.541
Business Efficiency	Finance	fin_credit	0.860
Business Efficiency	Finance	fin_financial_services	0.656

Competitiveness Factors	Category	Variable	Component #1
Business Efficiency	Finance	fin_invest_risk	0.580
Business Efficiency	Finance	fin_regulation	0.657
Business Efficiency	Finance	fin_share_rights	0.844
Business Efficiency	Finance	fin_stock_markets	0.835
Business Efficiency	Finance	fin_tranparency	0.784
Business Efficiency	Finance	fin_vent_capital	0.837
Business Efficiency	Labor Market	lm_brain_drain	0.823
Business Efficiency	Labor Market	lm_ceo_compens	0.567
Business Efficiency	Labor Market	lm_compet_mgrs	0.868
Business Efficiency	Labor Market	lm_finance_skills	0.777
Business Efficiency	Labor Market	lm_foreign_skilled	0.643
Business Efficiency	Labor Market	lm_interna_exp	0.869
Business Efficiency	Labor Market	lm_labor_relations	0.892
Business Efficiency	Labor Market	lm_mfg_compens	0.520
Business Efficiency	Labor Market	lm_skilled_labor	0.833
Business Efficiency	Labor Market	lm_worker_motivation	0.918
Business Efficiency	Labor Market	lm_worker_training	0.905
Business Efficiency	Management Practices	mp_adaptable	0.685
Business Efficiency	Management Practices	mp_corp_boards	0.868
Business Efficiency	Management Practices	mp_credibility	0.872
Business Efficiency	Management Practices	mp_cust_satis	0.921
Business Efficiency	Management Practices	mp_entrepreneur	0.825
Business Efficiency	Management Practices	mp_ethics	0.755
Business Efficiency	Management Practices	mp_social_responsibility	0.890
Economic Performance	Domestic Economy	de_economy_resilience	0.642
Economic Performance	International Investment	ii_relocation_prod	0.709
Economic Performance	International Investment	ii_relocation_rd	0.752
Economic Performance	International Trade	it_exchange_rates	0.778
Government Efficiency	Business Legislation	bl_business_ease	0.614
Government Efficiency	Business Legislation	bl_comp_leg	0.901
Government Efficiency	Business Legislation	bl_customs	0.867
Government Efficiency	Business Legislation	bl_firm_creation	0.653
Government Efficiency	Business Legislation	bl_for_invest	0.807
Government Efficiency	Business Legislation	bl_immig_leg	0.735
Government Efficiency	Business Legislation	bl_invest_inc	0.819
Government Efficiency	Business Legislation	bl_labor_regs	0.740
Government Efficiency	Business Legislation	bl_parallel_econ	0.850
Government Efficiency	Business Legislation	bl_protect	0.811
Government Efficiency	Business Legislation	bl_pub_contracts	0.842
Government Efficiency	Business Legislation	bl_unemp_leg	0.706
Government Efficiency	Fiscal Policy	fp_eff_pers_tax_rate	0.531
Government Efficiency	Fiscal Policy	fp_real_corp_taxes	0.821
Government Efficiency	Fiscal Policy	fp_real_pers_taxes	0.712
Government Efficiency	Institutional Framework	if_bureaucracy	0.768
Government Efficiency	Institutional Framework	if_central_bank	0.829
Government Efficiency	Institutional Framework	if_corruption	0.742
Government Efficiency	Institutional Framework	if_cost_capital	0.839
Government Efficiency	Institutional Framework	if_credit_rating	0.711
Government Efficiency	Institutional Framework	if_govt_adapt	0.757
Government Efficiency	Institutional Framework	if_legal_reg_frame	0.817
Government Efficiency	Public Finance	pf_mgt_pub_fin	0.762
Government Efficiency	Public Finance	pf_tax_evasion	0.833
Government Efficiency	Societal Framework	sf_equal_opportunity	0.856
Government Efficiency	Societal Framework	sf_justice	0.848
Government Efficiency	Societal Framework	sf_polit_instability	0.792

Competitiveness Factors	Category	Variable	Component #1
Government Efficiency	Societal Framework	sf_security	0.875
Government Efficiency	Societal Framework	sf_social_cohesion	0.789
Infrastructure	Basic Infrastructure	bi_distrib	0.869
Infrastructure	Basic Infrastructure	bi_energy	0.660
Infrastructure	Basic Infrastructure	bi_maint_devel	0.857
Infrastructure	Basic Infrastructure	bi_quality_air	0.650
Infrastructure	Basic Infrastructure	bi_urbanization	0.884
Infrastructure	Basic Infrastructure	bi_water_trans	0.863
Infrastructure	Education	ed_educ_system	0.868
Infrastructure	Education	ed_higher_deg	0.521
Infrastructure	Education	ed_science	0.803
Infrastructure	Education	ed_univ_educ	0.786
Infrastructure	Health and Environment	hi_enviro_n_leg	0.842
Infrastructure	Health and Environment	hi_health_infrastructure	0.784
Infrastructure	Health and Environment	hi_health_problems	0.835
Infrastructure	Health and Environment	hi_pollution	0.743
Infrastructure	Health and Environment	hi_quality_of_life	0.869
Infrastructure	Health and Environment	hi_sustain_develop	0.738
Infrastructure	Scientific Infrastructure	si_intell_prop_rights	0.886
Infrastructure	Scientific Infrastructure	si_knowledge_transfer	0.910
Infrastructure	Technological Infrastructure	ti_computers_pc	0.687
Infrastructure	Technological Infrastructure	ti_cyber_security	0.610
Infrastructure	Technological Infrastructure	ti_devel_tech	0.887
Infrastructure	Technological Infrastructure	ti_engineers	0.814
Infrastructure	Technological Infrastructure	ti_internet_users	0.616
Infrastructure	Technological Infrastructure	ti_it_skills	0.765
Infrastructure	Technological Infrastructure	ti_tech_cooperation	0.944
Infrastructure	Technological Infrastructure	ti_tech_funding	0.874

Component #2 (Table 2) may be viewed as an index of “business attractiveness,” since it includes those variables that would just be needed for private industry to succeed, e.g., a pool of foreign, high-skilled workers, economic resiliency, cyber security, and an atmosphere of ease of business creation with little or no regulations—environmental or otherwise.

Table 2. Business Attractiveness Index

Competitiveness Factors	Category	Variable	Component #2
Business Efficiency	Attitudes and Values	av_atg	0.600
Business Efficiency	Attitudes and Values	av_cv	0.580
Business Efficiency	Attitudes and Values	av_esr	0.613
Business Efficiency	Finance	fin_corp_debt	0.605
Business Efficiency	Finance	fin_financial_services	0.626
Business Efficiency	Finance	fin_invest_risk	0.588
Business Efficiency	Finance	fin_regulation	0.639
Business Efficiency	Labor Market	lm_foreign_skilled	0.619
Business Efficiency	Management Practices	mp_adaptable	0.609
Economic Performance	Domestic Economy	de_economy_resilience	0.633
Government Efficiency	Business Legislation	bl_business_ease	0.595
Government Efficiency	Business Legislation	bl_firm_creation	0.631
Infrastructure	Basic Infrastructure	bi_energy	0.628
Infrastructure	Basic Infrastructure	bi_quality_air	0.660
Infrastructure	Health and Environment	hi_healthy_life_expect	0.524
Infrastructure	Technological Infrastructure	ti_cyber_security	0.577
Infrastructure	Technological Infrastructure	ti_mobile_telephones	0.529

The third component may be construed as a “development” index. It is important to note that every correlation is negative in Table 3--countries that experience “high” values of these variables also experience lower Component #3 index scores. (Note 3) Therefore, in this case, “lower” index scores would indicate more industrialized nations and “higher” scores would signify lesser developed nations.

Table 3. Development Index

Competitiveness Factors	Category	Variable	Component #3
Economic Performance	Domestic Economy	de_industry	-0.525
Economic Performance	Domestic Economy	de_ratio_capital	-0.598
Economic Performance	Domestic Economy	de_ratio_cons	-0.611
Economic Performance	Domestic Economy	de_ratio_govt_cons	-0.605
Economic Performance	Domestic Economy	de_services	-0.653
Infrastructure	Basic Infrastructure	bi_dep_ratio	-0.594
Infrastructure	Education	ed_sec_enroll	-0.569
Infrastructure	Health and Infrastructure	hi_hum_dev_index	-0.563
Infrastructure	Health and Infrastructure	hi_life_expect	-0.527
Infrastructure	Health and Infrastructure	hi_pub_health	-0.603
Labor Market	Employment	emp_industry	-0.577
Labor Market	Employment	emp_services	-0.609
Labor Market	Labor Market	lm_female_lf	-0.625
Labor Market	Labor Market	lm_lfpr	-0.681

Component #4 (Table 4) is an “agrarian” index because countries that have a relatively large agriculture sector and employment, a high illiteracy rate, and low compensation in the manufacturing sector will experience a higher value of this index.

Table 4. Agrarian Index

Competitiveness Factors	Category	Variable	Component #4
Economic Performance	Domestic Economy	de_agriculture	0.658
Infrastructure	Education	ed_illiteracy_rate	0.529
Labor Market	Employment	emp_agriculture	0.691
Labor Market	Labor Market	lm_mfg_compens	-0.538

Finally, the last component (#5) (Table 5), is a measure of economies with export-based sectors, since this index is inversely correlated with the level of exports as a percentage of GDP and the amount of trade relative to GDP. (Note 4) As before, both of these correlations are negative so nations that are more “export-based” will have lower values of this index relative to countries that have larger trade deficits.

Table 5. Export-Based Index

Competitiveness Factors	Category	Variable	Component #6
Economic Performance	International Trade	it_exports	-0.536
Economic Performance	International Trade	it_ratio_trade_gdp	-0.544

4.4 Ranking

Using the results above, a ranking may be achieved among the 59 nations used in this analysis (and the WCY study) for each of the five components. (Note 5) These rankings appear in Tables 6 thru 10. For each country, each index is averaged over the 17 years (1995-2011) and is denoted as the “mean” column in the tables (6 – 10). In addition, each table is sorted from the largest mean value to the smallest. (Note 6).

Table 6. Ranking of Countries Based Upon the Overall Competitiveness Index (Component #1)

Country	Mean	Standard Deviation
DENMARK	0.976	0.572
FINLAND	0.976	0.547
HONGKONG	0.932	0.533
SWITZERLAND	0.929	0.539
USA	0.837	0.521
NETHERLANDS	0.817	0.492
AUSTRIA	0.803	0.571
SWEDEN	0.787	0.517
CANADA	0.785	0.509
LUXEMBOURG	0.735	0.542

Table 7. Ranking of Countries Based Upon the Business Attractiveness Index (Component #2)

Country	Mean	Standard Deviation
BULGARIA	0.828	0.093
UAE	0.822	0.141
LITHUANIA	0.807	0.130
CROATIA	0.805	0.132
PERU	0.785	0.097
KAZAKHSTAN	0.750	0.125
UKRAINE	0.729	0.142
QATAR	0.664	0.142
ROMANIA	0.599	0.165
JORDAN	0.573	0.141

Table 8. Ranking of Countries Based Upon the Development Index (Component #3)

Country	Mean	Standard Deviation
INDIA	0.701	0.727
ARGENTINA	0.636	0.711
CHILE	0.635	0.760
TURKEY	0.539	0.844
CHINAM	0.520	0.792
THAILAND	0.461	0.759
BRAZIL	0.446	0.725
MEXICO	0.421	0.727
NEWZEALAND	0.348	0.917
PHILIPPINES	0.327	0.787

Table 9. Ranking of Countries Based Upon the Agrarian Index (Component #4)

Country	Mean	Standard Deviation
INDIA	2.491	0.840
INDONESIA	1.704	0.697
PHILIPPINES	1.659	0.721
CHINAM	1.594	0.654
TURKEY	1.440	0.777
COLOMBIA	1.312	0.673
BRAZIL	1.156	0.629
SLOVENIA	1.100	0.707
THAILAND	1.040	0.581
RUSSIA	0.944	0.525

Table 10. Ranking of Countries Based Upon the Export-Based Economic Index (Component #6)

Country	Mean	Standard Deviation
USA	1.497	1.108
CANADA	0.853	0.921
FRANCE	0.776	0.823
GREECE	0.718	0.695
AUSTRALIA	0.712	0.908
SWEDEN	0.660	0.960
GERMANY	0.593	0.891
ITALY	0.529	0.690
ISRAEL	0.514	0.926
SPAIN	0.506	0.700

5. Conclusion

The results of our analysis as produced some interesting findings. For starters, it appears that WCY data collection methods could be simplified without compromising the quality of the results. It is also assumed that the simpler data collection approach will draw more countries to participate in the survey. Moreover, the approach developed in this study does not suffer from the same empirical limitations of past attempts to develop indices of the competitiveness of nations. The following is a concise list of what has been accomplished in the WCY analysis,

1. The 20 sub-factors in the WCY study comprise more than 300 criteria, although each sub-factor does not necessarily have the same number of criteria (for example, it takes more criteria to assess Education than to evaluate Prices).
2. Each sub-factor, independently of the number of criteria it contains, has the same weight in the overall consolidation of results, which is 5% ($20 \times 5 = 100$).
3. Criteria can be hard data, which analyze competitiveness as it can be measured (e.g., GDP) or soft data, which analyze competitiveness as it can be perceived (e.g., availability of competent managers). Hard criteria represent a weight of 2/3 in the overall ranking whereas the survey data represent a weight of 1/3.
4. Some criteria are for background information only, which means that they are not used in calculating the overall competitiveness ranking (e.g. Population under 15).

Although sub-factors can be important in identifying and categorizing the data (as mentioned in #1 and #2, above), the focus should always be on the variables (criteria). Whether the sub-factors contain the same number of criteria or not, or whether each sub-factor is assigned the same weight, is not really essential to the problem. Empirically, the inter-relationships or correlations amongst the individual criteria contain the most information and in our study, it is these correlations that are used to derive the weighting scheme.

We see no statistical reason, *a priori*, for weighting the “hard” and “soft” data differently--the survey and measured variables should be analyzed together. In addition, “background data” may be just as relevant in predicting competitiveness as any other variable. (Note 7) As mentioned previously, in this study, we employed an empirical method known as principal components which optimally determines the weights given to each variable. The purpose here was to develop a “data-driven” competitive index by using a minimal amount of assumptions.

Furthermore, the revised personal component (PC) factor will help individual countries to concentrate on select areas to implement initiatives and policy shifts to improve their overall competitive rankings. For smaller countries that are in the developmental stage, this could be critical in attaining economic stability. For example, in a study of the Baltic countries Bruneckiene and Paltanaviciene concluded that if these countries could improve their export competitiveness it could stimulate the development of national economy (Bruneckiene and Paltanaviciene, 2012).

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Notes

Note 1. Please see Appendix I for a listing of the variables.

Note 2. This would be the same as using the correlation matrix rather than the variance-covariance matrix.

Note 3. "High" is in relation to the variable average (mean)—a negative correlation indicates that when one variable is above its mean, the other is below its mean (with high probability).

Note 4. It is important to note that there were six components retained as per the scree plot, but only five were used. This is because the fifth component was not correlated with any of the variables, so it was omitted from the analysis.

Note 5. Ibid.

Note 6. For purposes of brevity, just the top ten countries are identified in the Tables. All Tables will be made available upon request from the authors.

Note 7. For example, having a high proportion of workers who are out of the labor force (less than age 15 and greater than age 65) would certainly affect other economic variables and therefore a country's competitive ranking.

Appendix 1. Variable Descriptions

Variable	Explanation
av_atg	Attitudes toward globalization
av_cv	Corporate values
av_esr	Need for economic and social reforms
av_fa	Flexibility and adaptability
av_ia	Image abroad
av_nc	National culture
av_vs	Value system
fin_banking_assets	Banking assets as percentage of GDP
fin_corp_debt	Corporate debt does not restrain the ability of enterprises to compete (0-10)
fin_credit	Credit is easily available for business (0-10)
fin_financial_services	Banking and financial services support business activities efficiently (0-10)
fin_indx_currency_growth	Percentage change on index in national currency
fin_invest_risk	Overall Euromoney country risk (0-100)
fin_listed_companies	Number of listed domestic companies on stock market
fin_ratio_stock_mark_cap	Stock market capitalization percentage of GDP
fin_regulation	Finance and banking regulation is sufficiently effective (0-10)
fin_share_rights	Shareholders' rights are sufficiently implemented (0-10)
fin_stock_markets	Stock markets provide adequate financing to companies (0-10)
fin_transparency	Financial institutions' transparency is sufficiently implemented (0-10)
fin_vent_capital	Venture capital is easily available for business (0-10)
emp_agriculture	Agriculture employment (percent of total employment)
emp_industry	Industrial employment (percent of total employment)
emp_long_term_unemp	Long-term unemployment (percent of labor force)
emp_pub_sector	Public sector employment (percent of total employment)
emp_services	Services employment (percent of total employment)
emp_unemp_rate	Unemployment rate (percent of labor force)
emp_youth_unemp	Youth unemployment (percent of youth labor force under the age of 25)
lm_brain_drain	Brain drain does not hinder competitiveness (0-10)
lm_ceo_compens	Total base salary plus bonuses and long-term incentives, U.S.\$
lm_compet_mgrs	Competent senior managers are readily available (0-10)
lm_female_lf	Females as percentage of total labor force
lm_finance_skills	Finance skills are readily available (0-10)
lm_foreign_skilled	Foreign high-skilled are attracted to business environment (0-10)
lm_foreign_workers	Foreign workers as percentage of labor force
lm_interna_exp	International experience of senior managers is generally significant (0-10)
lm_labor_relations	Labor relations are generally productive (0-10)
lm_lfpr	Labor force as percentage of population
lm_mfg_compens	Total hourly compensation mfg. workers (wages+benefits)
lm_mfg_unit_labor_cost	Growth in unit labor cost manufacturing (%)
lm_part_time	Part-time employment as percentage of total employment
lm_skilled_labor	Skilled labor is readily available (0-10)
lm_worker_motivation	Worker motivation in companies is high (0-10)
lm_worker_training	Employee training is a high priority in companies (0-10)
lm_working_hours	Average number of working hours per year
mp_adaptable	Adaptability of companies to market changes is high (0-10)
mp_corp_boards	Corporate boards do supervise the management of companies effectively (0-10)
mp_credibility	Credibility of managers in society is strong (0-10)
mp_cust_satis	Customer satisfaction is emphasized in companies (0-10)

Variable	Explanation
mp_entrepreneur	Entrepreneurship of managers is widespread in business (0-10)
mp_ethics	Ethical practices are implemented in companies (0-10)
mp_social_responsibility	Social responsibility of business leaders is high (0-10)
pe_labor_product	Percentage change of GDP (PPP) per person employed per hour
de_agriculture	Agriculture production (percent of GDP)
de_economy_resilience	Resilience of the economy to economic cycles is strong (0-10)
de_industry	Industrial production (percent of GDP)
de_ratio_capital	Ratio of capital production to GDP
de_ratio_cons	Ratio of consumption to GDP
de_ratio_govt_cons	Ratio of government consumption to GDP
de_ratio_savings	Ratio of personal savings to GDP
de_real_gdp_grow	Percentage change based on national currency in constant prices
de_services	Value of Services (percent of GDP)
pr_cpi_inflation	CPI inflation rate
pr_office_rent	Total occupation cost (U.S.\$/Sq.M. per year)
ii_net_direct_invest	Investment flows abroad minus flows inward percentage of GDP
ii_relocation_prod	Relocation of production is not a threat to the future of your economy (0-10)
ii_relocation_rd	Relocation of R&D facilities not a threat to the future of your economy (0-10)
it_account_balance	Current account balance percentage of GDP
it_com_serv_balance	Balance of Commercial Services percentage of GDP
it_exchange_rates	Exchange rates support the competitiveness of enterprises (0-10)
it_exports	Exports of goods and services percentage of GDP
it_ratio_trade_gdp	Trade to GDP Ratio (Exports + Imports)/(2 * GDP)
it_terms_of_trade	Unit value of exports over unit value of imports (2000=100)
it_tourism	International tourism receipts as a percentage of GDP
bl_bus_starts	Number of days to start a business
bl_business_ease	Ease of doing business is supported by regulations (0-10)
bl_comp_leg	Competition legislation is efficient in preventing unfair competition (0-10)
bl_customs	Customs' authorities facilitate the efficient transit of goods (0-10)
bl_firm_creation	Creation of firms is supported by legislation (0-10)
bl_for_invest	Foreign investors are free to acquire control in domestic companies (0-10)
bl_govt_sub	Subsidies to private and public companies as a percentage of GDP
bl_immig_leg	Immigration laws do not prevent company from employing foreign labor (0-10)
bl_invest_inc	Investment incentives are attractive to foreign investors (0-10)
bl_labor_regs	Hiring/firing practices, minimum wages, etc. do not hinder business (0-10)
bl_parallel_econ	Black-market, unrecorded economy does not impair economic development (0-10)
bl_protect	Protectionism does not impair the conduct of your business (0-10)
bl_pub_contracts	Public sector contracts are sufficiently open to foreign bidders (0-10)
bl_unemp_leg	Unemployment legislation provides an incentive to look for work (0-10)
fp_corp_tax_rate	Maximum tax rate calculated on profit before tax
fp_eff_cap_prop_tax_rate	Effective capital and property tax rate (%)
fp_eff_pers_tax_rate	Effective personal income tax rate (%)
fp_real_corp_taxes	Real corporate taxes do not discourage entrepreneurial activity (0-10)
fp_real_pers_taxes	Real personal taxes do not discourage people from working (0-10)
fp_vat_tax_rate	Standard rate of VAT/GST
if_bureaucracy	Bureaucracy does not hinder business activity (0-10)
if_central_bank	Central bank policy has a positive impact on economic development (0-10)
if_corruption	Bribery and corruption do not exist (0-10)
if_cost_capital	Cost of capital encourages business development (0-10)
if_credit_rating	Rating on a scale of 0-100 assessed by the Institutional Investor Magazine
if_exch_rate_stability	Parity change from national currency to SDR, 2010/2008
if_govt_adapt	Adaptability of government policy to changes in the economy is high (0-10)
if_int_rate_spread	Lending rate minus deposit rate
if_legal_reg_frame	Legal and regulatory framework encourages competitiveness of enterprise (0-10)
if_real_short_rate	Real discount/bank rate (%)

Variable	Explanation
pf_govt_debt	Total government debt as a percentage of GDP
pf_govt_surp_def	Government surplus/deficit as percentage of GDP
pf_interest_payment	Interest payment on debt percentage of current revenue
pf_mgt_pub_fin	Management of public finances over next two years is likely to improve (0-10)
pf_tax_evasion	Tax evasion does not damage public finances (0-10)
sf_equal_opportunity	Equal opportunity legislation encourages economic development (0-10)
sf_female_positions	Female positions percentage of total legislators, senior officials and managers
sf_justice	Justice is fairly administered (0-10)
sf_polit_instability	The risk of political instability is very low (0-10)
sf_security	Personal security and private property rights are adequately protected (0-10)
sf_social_cohesion	Social cohesion is a priority for the government (0-10)
bi_air_trans	Number of passengers carried by main companies, thousands
bi_ala	Arable Land Area (Square meters per capita)
bi_dep_ratio	Population < 15 and > 64 years old divided by active population (15 - 64)
bi_distrib	The distribution infrastructure of goods and services is efficient (0-10)
bi_elec_cost	Cost of electricity (US \$ per kwh)
bi_energy	Energy infrastructure is adequate and efficient (0-10)
bi_energy_prod	Percentage of total requirements in tons of oil equivalent
bi_la	Land Area (Sq. Kil. 000s)
bi_maint_devel	Maintenance and development infrastructure planned and financed (0-10)
bi_population	Population
bi_quality_air	Quality of air transportation encourages business development (0-10)
bi_railroads	Density of the railroad network, km per square km
bi_roads	Density of the road network, km per square km
bi_urbanization	Urbanization of Cities Supports Business Development (0 - 10)
bi_water_trans	Water transportation (harbors, canals, etc.) meets business requirements (0-10)
ed_educ_system	The educational system meets the needs of a competitive economy (0-10)
ed_expend_pc	US\$ per capita
ed_higher_deg	Percentage of population attaining at least tertiary education for age 25-34
ed_illiteracy_rate	Adult (over 15 years) illiteracy rate as a percentage of population
ed_ratio_stu_tea_prim	Ratio of students to teaching staff Primary Education
ed_ratio_stu_tea_sec	Ratio of students to teaching staff Secondary Education
ed_science	Science in schools is sufficiently emphasized (0-10)
ed_sec_enroll	Percentage of relevant age group receiving full-time education
ed_univ_educ	University education meets the needs of a competitive economy (0-10)
hi_co2_emissions	CO2 industrial emissions in metric tons per one million U.S.\$ of GDP
hi_envirom_leg	Environmental laws do not hinder the competitiveness of business (0-10)
hi_health_infrastructure	Health infrastructure meets the needs of society (0-10)
hi_health_pc	Health expenditures (US \$ per capita)
hi_health_problems	Health problems do not have a significant impact on companies (0-10)
hi_healthy_life_expect	Average estimate of healthy life expectancy at birth (years)
hi_hum_dev_index	Combines economic, social, educational indicators
hi_infant_mortality	Under five mortality rate per 1000 live births
hi_life_expect	Average estimate of life expectancy at birth (years)
hi_paper_recycle	Paper and cardboard recycling rate (%)
hi_pollution	Pollution problems do not seriously affect your economy (0-10)
hi_pop_per_phys	Number of inhabitants per physician
hi_pub_health	Public health as percentage of total health expenditure
hi_quality_of_life	Quality of life is high (0-10)
hi_sustain_develop	Sustainable development is a priority in companies (0-10)
hi_waste_wat_treat	Percentage of population served by waste water treatment (%)
si_intell_prop_rights	Intellectual property rights are adequately enforced (0-10)
si_knowledge_transfer	Knowledge transfer highly developed between companies and universities (0-10)
si_patents	Number of patents per 100,000 population
si_r_and_d_business	R and D expenditures by business as percentage of GDP

Variable	Explanation
si_r_and_d_expend	R and D expenditures as percentage of GDP
si_science_degrees	Percentage of total university degrees in science and engineering
si_science_pubs	Scientific articles published by origin of author
ti_broadband_users	Number of subscribers per 1000 population
ti_computers_pc	Number of computers per 1000 population
ti_cyber_security	Cyber security is being adequately addressed by corporations (0-10)
ti_devel_tech	Development/application of technology supported by the legal environment (0-10)
ti_engineers	Qualified engineers are available in your labor market (0-10)
ti_high_tech_exports	High tech exports as percentage of manufactured exports
ti_internet_users	Number of internet users per 1000 population
ti_it_skills	Information technology skills are readily available (0-10)
ti_mobile_telephones	Number of subscribers per 1000 population
ti_tech_cooperation	Technological cooperation between companies is developed (0-10)
ti_tech_funding	Funding for technological development is readily available (0-10)
ti_telephone_lines	Number of main lines per 1000 population