

## The 2008 Legatum Prosperity Index Report

### Technical Appendix

*Legatum Institute*

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# 1. Introduction

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This Technical Appendix describes the construction of the Prosperity Index.

Section 2 sets out the general methodology used in the construction of both sub-indices using a top-down approach. The following sections describe the details specific to the Economic Competitiveness (EC, Section 3) and Comparative Liveability (CL, Section 4) sub-indices in turn.

## 2. General Methodology

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- For the purpose of this appendix, it is best to proceed with some terminology before exploring the methodological approach.
  - i. Sub-index refers to the overall performance of a country on 'Economic Competitiveness' or 'Comparative Liveability'.
  - ii. Indicators refer to the more basic components constituting a sub-index. Examples of indicators include 'Good governance' or 'Education'.
  - iii. Sub-indicators, drivers, or variables are the most basic components of each index. One or more of these variables constitute each indicator.
- A country's position in the overall index is based on its performance on two sub-indices: Economic Competitiveness and Comparative Liveability.
- Each sub-index is constructed in three stages.
  - First, we run regressions on current and historical data to identify a set of plausible drivers of economic growth, or subjective wellbeing.
  - Second, we use locally-weighted regression analysis to determine the importance of each driver – allowing for the possibility that different factors may be more or less important to countries at different levels of economic development.
  - Finally, we combine the importance weights derived above, with current data on each driver, to calculate three sets of scores for each country:
    - an overall score for each sub-index, which determines the country's rank on each sub-index;
    - scores for groups of variables that capture a country's performance along similar "indicator" dimensions (e.g. an "Innovation" score, comprised of a country's performance in patenting, research, and high technology exports); and
    - a score for each individual driver.
- We describe each stage in more detail below.
  - A. IDENTIFYING THE DRIVERS OF PROSPERITY
    - From a broad set of factors suggested by economic theory and existing literature in the area of economic growth and subjective wellbeing, the variables ultimately included in each sub-index were identified via regression analysis.
    - To allow for the possibility that different factors may drive or impede prosperity at different levels of development, the test for inclusion in the index was that the variable in question should be significantly correlated with growth or SWB in either:

- the full sample; or
- a locally-weighted (LOWESS) regression (described in greater detail in part B.) centered on some target level of GDP per capita.<sup>1</sup>

## B. DETERMINING THE DRIVERS' RELATIVE IMPORTANCE

- To determine the relative importance of each sub-indicator in driving prosperity, we use a modified form of locally weighted regression (LOWESS) to obtain weights that vary depending on the country's level of GDP.
  - The weight for each driver is derived from regressions including each variable individually, along with a standard set of controls.
  - At any given (target)<sup>2</sup> level of GDP per capita, we run a linear regression in which each country is weighted according to its proximity to the target level of GDP. This yields an estimate of importance (i.e. weight) of a given driver at that level of GDP.
  - The weight for each observation is given by the tri-cube weight function:  $W(u_i) = (1 - u_i^3)^3$  for  $0 \leq u_i \leq 1$ , and 0 otherwise, where  $u_i$  is the distance defined by  $\left| \frac{GDP_i - GDP_{target}}{GDP_q - GDP_{target}} \right|$ . Here,  $GDP_q$  is the GDP of the  $q$ th-nearest country to the target GDP level, and  $q$  is set at a constant fraction  $f$  of the sample size. See Cleveland and Devlin (1988).
  - Although the locally-weighted estimates always use a constant fraction of the available sample, the weighting means that they can be volatile when observations are sparse in the vicinity of the target GDP level. To address this, we also run a number of regressions on the entire sample, which include interaction terms between each variable and GDP per capita. The best-fitting full-sample model (without or without interaction terms) is selected according to Schwarz's Bayesian Information Criterion (Schwarz, 1978).
  - We then calculate the driver's weight at each level of GDP as a weighted average of the implied coefficient from the "prior" full-sample regression and the locally-weighted estimate, with the weights determined by the ratios of the coefficient variances. This leads to a moderation of imprecisely-estimated LOWESS coefficients towards the full sample mean (or trend line), and thus reduces spurious variation in the point estimates.
  - To avoid "double-counting" different drivers that may be capturing the same effects, the coefficients derived from the procedure just outlined are scaled down, by dividing them by the number of drivers (sub-indicators) in each indicator.

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<sup>1</sup> There are two exceptions to this, noted explicitly below.

<sup>2</sup> Used for LOWESS regressions, targets are incremental GDP values which operate similar to sliding windows, thereby including/excluding observations from the sample with each increment.

- In the body of the report, the weights presented are normalized by the standard deviation of the corresponding variable, so as to aid comparison.

#### C. CALCULATING THE SUB-INDEX SCORES

- Scores for each country are then calculated as weighted averages of the country's performance on each driver, with the weights depending on the coefficients derived from the regression procedure mentioned above.<sup>3</sup>
  - The raw sub-indicator weights for each country are simply the weights for that country's level of GDP per capita. If a country's GDP falls outside the bounds of the sample used to derive the weights, then the weights for the closest available GDP level are used.

To ensure that countries are not advantaged or disadvantaged in the sub-index by their level of development (for instance poorer countries will tend to achieve higher long-term growth rates), the resulting coefficients are further scaled so that their absolute values sum to one at each level of GDP.

- A country's performance on each variable is calculated as its distance from the best performing country in the sample (for that sub-indicator), on the basis of the most recent available data (usually 2006 or 2007). The best performing country will thus have a performance of zero, and all other countries will have negative scores, reflecting how far they fall short of this ideal. This ensures that countries for which a particular factor is not important (because its coefficient is zero at their level of GDP) are not disadvantaged.
- To maximize the Index's coverage, we include all countries where at least one sub-indicator is available for each indicator. Where countries are missing data on any of the remaining sub-indicators, these are imputed from a regression on a set of statistically significant predictors, consisting of (in order of preference):
  - the other variables in the same indicator;
  - GDP per capita; or
  - a constant-only regression.

#### D. CALCULATING THE INDICATOR SCORES

- The indicator scores displayed in the Prosperity Index Report are calculated in the same way as overall sub-index scores, except that:
  - the absolute value of weights within each indicator (c.f. sub-index for part C) are now constrained to sum to one within each indicator; and

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<sup>3</sup> Unfortunately, the LOWESS procedure makes it difficult to conduct formal tests of whether differences between country scores are "statistically significant." Such tests require knowledge of the covariance between the LOWESS coefficients at different levels of GDP. (Formally, they rely on the variance of the difference between the scores for countries  $i$  and  $j$ , which depends on the coefficient covariances:

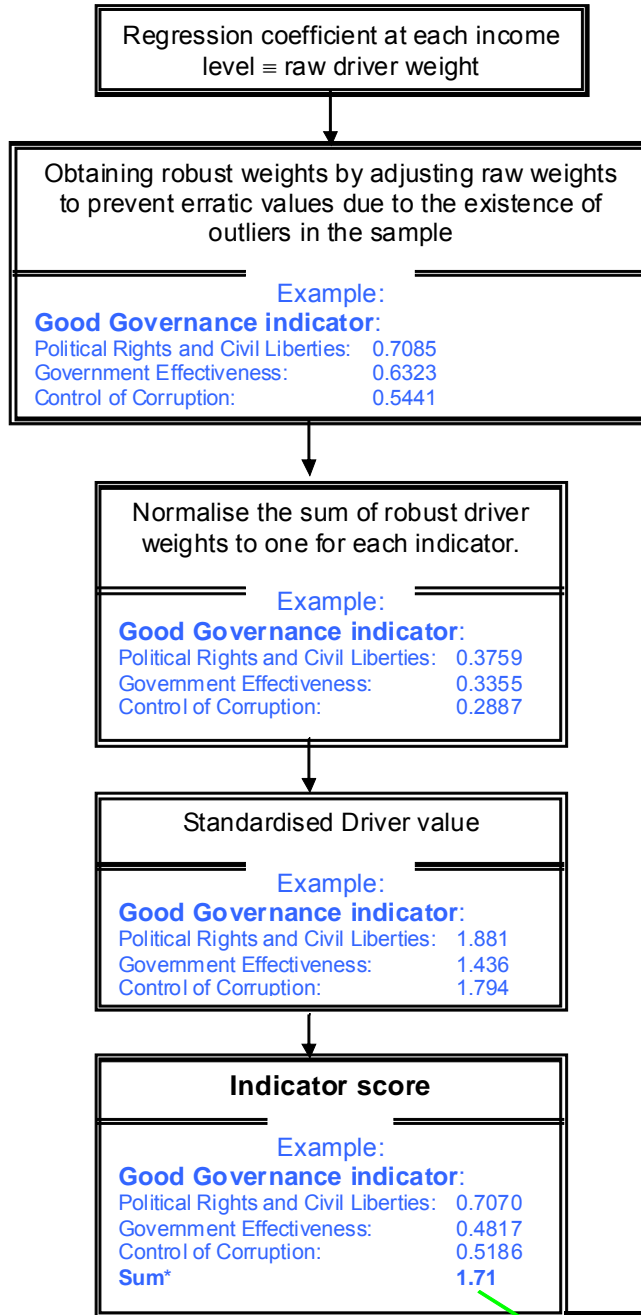
$Var(x_i\beta_i - x_j\beta_j) = x_i^2 Var(\beta_i) + x_j^2 Var(\beta_j) - 2x_i x_j Cov(\beta_i, \beta_j)$ .) This covariance should be high (especially for similar levels of GDP) but because the coefficients are obtained from separate regressions, its precise value is unknown, and ignoring it would be likely to significantly overstate the standard errors.

- to aid interpretation, a country's performance is expressed as its deviation from the mean performance of countries across the sample rather than from the best-performing country.

#### E. CALCULATING THE SUB-INDICATOR SCORES

- The sub-indicator scores displayed in the Prosperity Index Report are calculated in the same way as the indicator scores, except that:
  - the weights are now simply a multiple of 1 or -1, depending on the sign of the variable's effect (that is to say, the sub-indicators as displayed are unweighted); and
  - we do not calculate sub-indicator weights if the variable is missing for a given country.

**Technical Appendix diagram**  
**[Example: Australia; Income level 30,700 (\$US PPP)]**



\* This value is multiplied by 10 to give the score for indicator in table. Values are rounded to the closest whole number.

Prosperity Index		Invests productively			
Country	Rank	Score	...via growth in investec capital	...via good governance	...via competitive markets
Australia	6	19	18	17	1
Austria	9	15	19	19	-2
Finland	12	12	13	17	-4

### 3. The Economic Competitiveness Sub-Index

- This section sets out the details specific to the construction of the Economic Competitiveness sub-index.
- ♦ The weights for factors included in the Economic Competitiveness sub-index were derived from regressions on three separate data-sets: medium-term and long-term data for both rich and poor countries, and a panel data set available only for industrialized countries. The use of alternative data sets allows us both to take maximum advantage of the data available to us (some of which is only available for particular countries and time-frames). The main data set is the long-term data set. The medium-term data set is used for factors for which historical data are unavailable (e.g., the World Bank Governance Indicators). The panel data set is used for factors for which historical data are available for only a few countries (e.g., price levels).
- ♦ The details of the data sets, and the regressions run on each are outlined in the table below. In all cases, the bandwidth ( $f$ ) for the LOWESS regressions was set to 0.8, which seemed to give the best tradeoff between smoothing and fit.

DATA AND METHODOLOGY FOR ECONOMIC COMPETITIVENESS ANALYSIS					
Data Set	Data Coverage	Dependent Variable	Independent Variables (Included in All Regressions as Controls)	Independent Variables (Included Individually)	Regression Method
Medium Term	Period averages for 1999-2005	Annualised Growth in GDP per capita	Convergence Term Annualised Growth in Capital Per Worker Average Years of Secondary Education	Cost of Starting a Business Business Ownership R&D Researchers Patents High-Tech Exports* Trade Freedom Index* Foreign Trade & Investment* Regional Trade Agreements* Government Effectiveness Regulatory Quality	OLS
Long Term	Period averages for 1960-1995	Annualised Growth in GDP per worker	Convergence Term Annualised Growth in Capital Per Worker Secondary	Foreign Aid Natural Resource Exports	OLS

			Education Annualised Secondary Education Growth		
Panel	5-year averages for 1980-2000	Annualised Growth in GDP per worker	Convergence Term Annualised Growth in Capital Per worker  Average Years of Secondary Education	PPP to Exchange Rate Ratio  CPI to WPI Ratio	Fixed Effects

\* These regressions include Market Size as an additional control.

Zimbabwe is a clear outlier, and skews the regression results severely. It was consequently excluded from all regressions. Greece was excluded from regressions on the Business Ownership Rate for the same reason.

- ♦ The Capital and Secondary Education variables are included in regressions on all three data sets. However, we take the final weights from the Long-Term data, as this seems likely to better reflect their true influence on growth. Because these variables are included as controls in all the Long-Term equations, their weights are derived as the average of the coefficients obtained when including each of the other variables individually.
- ♦ More detailed descriptions of the data and sources, as well as selected regression results, are provided in the tables below.

DATA USED IN ECONOMIC COMPETITIVENESS ANALYSIS			
Indicator	Variable	Description/Source	Obs <sup>4</sup>
Dependent Variable	Growth	Growth in output per worker. (Source: Penn World Tables 6.1, 2002.)	
Control Variables only (omitted from score calculations)	Convergence Term	<ul style="list-style-type: none"> <li>• Deviation in Log Output per worker from US at the beginning of the sample period (for Medium and Long-Term data).</li> <li>• Lagged GDP per capita (for panel data)</li> </ul> (Source: Historical data from Penn World Tables v6.1. Current data from Euromonitor)	

<sup>4</sup> Number of observations available for regressions using the relevant independent variable.

	Market Size	GDP in constant international PPP dollars. (Source: World Development Indicators.)	
Capital	Capital	Capital stock per worker. Own estimations. Please refer to sub-section 3A for further details.	
Education	Secondary Education	Average years of secondary education completed (amongst labor force). Own estimations. Please refer to sub-section 3B for further details.	
	Secondary Education Growth	Growth in average years of secondary education completed. Derived from estimates of average secondary education. Own estimations. Please refer to sub-section 3B for further details.	
Innovation	High Technology Exports	Log of 1 plus High Technology Exports as a percentage of GDP (Source: World Development Indicators, based on UN ComTrade Data.)	27
	R&D Researchers	Log of Researchers Employed in R&D per million population. (Source: World Bank.)	37
	Patents	Log of Patent Applications filed by Office. (Source: WIPO.)	57
Entrepreneurship	Cost of Starting a Business	Log of 1 plus the Cost of Business Start-Up Procedures as a percentage of GNI per capita.	58
	Business Ownership Rate	Business Owners as a percentage of the Labour Force. (Source: COMPENDIA – Van Stel, 2005.)	20
Trade & Openness	Trade Freedom Index	Trade Freedom Index. (Source: Heritage)	58
	Foreign Trade & Investment	Imports + Exports + FDI as a proportion of GDP. (Source: World Development Indicators, and UNCTAD.)	58
	Regional Trade Integration	Number of Regional Trade Agreements notified to the WTO. (Source: WTO.)	57
Governance	Government	World Bank Governance Indicators Government Effectiveness Index. (Source:	58

	Effectiveness	World Bank.)	
	Regulatory Quality	World Bank Governance Indicators Regulatory Quality Index. (Source: World Bank.)	58
Dependence	Natural Resource Dependence	Natural Resource exports as a percentage of GDP. (Source: Historical data from Sachs and Warner, 1997. Current data from World Development Indicators.)	44
	Foreign Aid	Log of 1 plus foreign aid as a percentage of GDP. Source: Historical data from Sachs and Warner, 1997. Current data from World Development Indicators.)	44
Competitiveness	Domestic/International Price Ratio.	The residual from a regression of the PPP to Exchange Rate Ratio on GDP per capita. (Source: IMF.)	25
	Producer/Consumer Price Ratio	Ratio of the Consumer Price Index to the Wholesale Price Index (2000=1). (Source: World Development Indicators.)	25

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### Economic Growth Analysis

Dependent Variable: Average Annual Growth in GDP per worker

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Long-Term	Capital	.3484712*** (3.20)
	Secondary Education	.0036997* (1.76)
	Growth in Secondary Education	.2006599** (2.03)
	Natural Resource Dependence	-.0004516* (-1.77)
	Foreign Aid	-.001982** (-2.54)
Medium-Term	High Technology Exports (LOWESS: \$22,500 GDP per capita)	.0088851** (2.25)
	R&D Researchers	.0109745** (2.11)
	Patents	.0085331** (2.59)

	Trade Freedom Index	.0077123*	(1.72)
	Foreign Trade & Investment	.006403***	(3.42)
	Regional Trade Integration	.0071011**	(2.26)
	(LOWESS: \$10,000 GDP per capita)		
	Government Effectiveness	.0073216*	(1.94)
	Regulatory Quality	.0089749**	(2.61)
	(LOWESS: \$17,500 GDP per capita)		
	Cost of Starting a Business	-.0082055*	(-1.88)
	(LOWESS: \$1000 GDP per capita)		
	Business Ownership Rate	.0059572**	(2.80)
	(LOWESS: \$34,000 GDP per capita)		
Panel	Domestic/International Price Ratio	-.0047806***	(-3.38)
	Producer/Consumer Price Ratio	-.0070253***	(-4.29)

Normalized coefficients obtained from separate regressions including the relevant independent variable and a standard set of controls (a convergence term, capital per worker, and secondary education). Unless otherwise noted, coefficients are from regressions on all observed cases in full sample. When variables are not significant in the full sample regression, coefficients are obtained from a LOWESS regression for the specified level of GDP. Coefficients are generally significant over a range of GDP levels; for simplicity, we display the coefficient results only for a representative level.

\* indicates significance at the 10% level, \*\* indicates significance at the 5% level, \*\*\* indicates significance at the 1% level. Robust t-statistics in parentheses.

#### A. CALCULATING CAPITAL STOCK ESTIMATES

- o This section sets out the details specific to the calculation of national capital stock estimates.
- o Based on available data, we were able to produce physical capital stock estimates for a total of 156 developing and industrial countries. Physical capital stock is estimated from annual figures for gross fixed capital accumulation by the 'perpetual inventory' method pioneered by Goldsmith (1951).
- o The capital stock  $K_t$  is defined as the sum of past net investment flows in year  $t$ .

$$K_t = K_{t-1}(1 - \delta) + I_t,$$

where  $I_t$  is gross fixed capital formation (GFCF) and  $\delta$  is the annual depreciation rate, assumed to be 7% per year.

- The initial capital stock dataset is constructed with capital stock data to the most recent available year, and then extended to 2006 by the Perpetual Inventory method. The data are reported in 1996 international dollars (PPP).
- The principal sources for capital stock data are the Penn World Tables v. 6.1 and v. 5.6:

Heston, A., Summers R., Aten, B. (2002)

Summers, R. and A. Heston (1991)

Data coverage	To 2000.
Country coverage:	Angola; Argentina; Australia; Austria; Bangladesh; Barbados; Belgium; Benin; Bolivia; Botswana; Brazil; Burkina Faso; Burundi; Cameroon; Canada; Cape Verde; Central African Republic; Chad; Chile; China; Colombia; Comoros; Congo, Dem. Rep.; Congo, Rep.; Costa Rica; Cote d'Ivoire; Cyprus; Denmark; Dominica; Dominican Republic; Ecuador; Egypt; El Salvador; Ethiopia; Fiji; Finland; France; Gabon; Gambia; Germany; Ghana; Greece; Grenada; Guatemala; Guinea; Guinea-Bissau; Guyana; Haiti; Honduras; Hong Kong; Hungary; Iceland; India; Indonesia; Iran; Iraq; Ireland; Israel; Italy; Jamaica; Japan; Jordan; Kenya; Korea, Rep.; Lao PDR; Lesotho; Liberia; Luxembourg; Madagascar; Malawi; Malaysia; Mali; Malta; Mauritania; Mauritius; Mexico; Morocco; Mozambique; Namibia; Nepal; Netherlands; New Zealand; Nicaragua; Niger; Nigeria; Norway; Oman; Pakistan; Panama; Papua New Guinea; Paraguay; Peru; Philippines; Poland ; Portugal; Reunion; Romania; Rwanda; Samoa; Senegal; Seychelles; Sierra Leone; Singapore; South Africa; Spain; Sri Lanka; Suriname; Swaziland; Sweden; Switzerland; Syria; Tanzania; Thailand; Togo; Trinidad and Tobago; Tunisia; Turkey; Uganda; United Kingdom; United States; Uruguay; Vanuatu; Venezuela; Zambia; Zimbabwe.
Notes:	<p>Ratio of the Consumer Price Index to the PWT5.6 stock estimates were rebased from 1985 PPP prices to 1996 PPP prices using the conversion factors from PWT6.1 in the first instance, and from World Bank World Development Indicators in the second instance.</p> <p>The countries below were reported in PWT5.6 but had not been included in PWT6.1. These series were included by the following weights chosen according to country ranking in 1985 in PWT5.6:</p> <p>Algeria: Colombia and Malaysia; Bahrain: Guatemala and Trinidad and Tobago; Bahamas: Barbados and Lesotho; Belize: Guinea-Bissau and Cape Verde; Bulgaria: Philippines and Norway; Czech Rep: Denmark and Thailand; Iraq: Romania and Portugal; Kuwait: Singapore and Ecuador; Liberia: Lesotho and Bahamas; Malta: Togo and Benin; Mongolia: Trinidad and Tobago and Guatemala; Oman: Panama and Zimbabwe; Qatar: Trinidad and Tobago and Guatemala; Reunion: Angola and Mozambique; Samoa: Cape Verde and Belize; Saudi Arabia: Portugal and Colombia; Solomon Islands: Comoros and Sierra Leone; Somalia: Fiji and Ethiopia; Sudan: Uruguay and Sri Lanka; Swaziland: Lesotho and Bahamas; UAE: New Zealand and Peru; Vanuatu: Gambia and Comoros; Yemen: Guatemala and Cote d'Ivoire.</p>

- o Coverage for countries not included in PWT v.6.1 or v.5.6 was extended by the following sources:

Easterly, W. and S. Fischer (1995):

Data coverage	To 1990..
Country coverage:	Armenia; Azerbaijan; Belarus; Estonia; Georgia; Kazakhstan; Kyrgyzstan; Latvia; Lithuania; Moldova; Russian Federation; Tajikstan; Turkmenistan; Ukraine; Uzbekistan. Stock estimates are reported in constant 1973 Rubles.
Notes:	These series were first converted to constant 1973 local currency units (LCU) and then to constant 1973 PPP prices using conversion rates provided by Easterly and Fischer (1995).

Kubursi, Atif (1999):

Data coverage	To 1990..
Country coverage:	Armenia; Azerbaijan; Belarus; Estonia; Georgia; Kazakhstan; Kyrgyzstan; Latvia; Lithuania; Moldova; Russian Federation; Tajikstan; Turkmenistan; Ukraine; Uzbekistan. Stock estimates are reported in constant 1973 Rubles.
Notes:	These series were first converted to constant 1973 local currency units (LCU) and then to constant 1973 PPP prices using conversion rates provided by Easterly and Fischer (1995).

Data coverage	To 1989..
Country coverage:	Lebanon.
Notes:	Stock estimates are reported in current LCU and were converted to 1996 PPP prices using the PWT6.1 conversion rates.

Miketa, A., (2004):

Data coverage	To 2000..
Country coverage:	Albania; Algeria; Bahrain; Belize; Bosnia and Herzegovina; Bulgaria; Cambodia; Croatia; Czech Republic; Macedonia, FYR; Mongolia; Qatar; Saudi Arabia; Slovak Republic; Slovenia; Sudan; United Arab Emirates; Vietnam; Yemen.
Notes:	Stock estimates are reported in constant 2000 US dollars. These were first converted back into LCU using the market exchange rate and then into constant PPP prices using PPP conversion factors from PWT6.1 in the first instance, and from World Bank World Development Indicators in the second instance. The series were then weighted by the United States to ensure compatibility and consistency.

Nehru, V. and A. Dhareshwar, (1993):

Data coverage	To 1989..
Country coverage:	Kuwait.
Notes:	Stock estimates are reported in constant 1987 LCU and were converted to 1996 PPP prices using the conversion factors from PWT 6.1 in the first instance, and from World Bank World Development Indicators in the second instance.

Timmer, Marcel and Bart van Ark (2000):

Data coverage	To 1996..
Country coverage:	Taiwan.
Notes:	Stock estimates were converted and rebased from 1991 LCU to 1996 PPP prices using the conversion factor from PWT6.1.

- o A special effort was made to compile Gross Fixed Capital Formation series from 1960 onwards for as many countries as possible from International Monetary Fund (2007), International Financial Statistics and World Bank (2007) World Development Indicators. Where the time series were not complete, these were estimated by the growth rate for the previous year, or interpolated by geometric mean between available datapoints.
- o Data for Liberia, Samoa, Mongolia, and Qatar are not reported by IMF (2007) or WB (2007).

For Liberia, GFCF was calculated from UN Common Database to 1989 and interpolated between 1989-2000 and between 2000 and 2005 with UN data for 2000 and 2005 from [<http://data.un.org/CountryProfile.aspx?crName=Liberia>].

For Qatar, official GFCF data in current LCU from [[http://www.planning.gov.qa/Statistics\\_Dept/National-Accounts-25.pdf](http://www.planning.gov.qa/Statistics_Dept/National-Accounts-25.pdf)] was rebased and converted to 1996 PPP with PWT6.1 conversion factors.

However, we were unable to located GFCF estimates for Samoa, Mongolia and Qatar. For these countries, GFCF was calculated using the ratio for comparable country based on the capital stock ranking for the last available year: Samoa: as for Belize; Mongolia: as for Panama; and Qatar: as for Bolivia.

- o Workers are proxied for by the labour force aged 15-64. The labour force series are from PWT6.1 and were extended to 2006 with data from the World Bank (2007) World Development Indicators.
- o As the World Bank does not report data for Taiwan, PWT6.1 data for Taiwan were extended from 1990 to 2006 with labour force estimates.

These estimates were calculated by linear regression of PWT6.1 labour force data against the Taiwanese population aged 15-64, from the US Census Bureau, Population Division, International Database (2008) [<http://www.census.gov/ipc/www/idb/pyramids.html>].

There is some downward bias in the PWT6.1 compared to World Bank World Development Indicators figures, but the discrepancy is not too large. For instance, for the United States, the difference ranged from 0.05 to 0.02.

B. CALCULATING HUMAN CAPITAL STOCK ESTIMATES

- o This section sets out the details specific to the calculation of national human capital stock estimates.
- o We produced estimates of secondary educational attainment and average years of schooling for 153 developing and industrial countries.
- o We adapt the method employed by Barro and Lee (1993) to construct estimates for average years of schooling for the adult population aged 25 and over from the following formula:

$$(h_{2t} - h_{c2t}) \cdot DUR_{LS} + h_{c2t} \cdot DUR_{(LS+US)}$$

where  $h$  is the fraction of the population with secondary ( $_{2t}$ ) schooling,  $hc$  is the fraction of the population with completed schooling; and  $DUR$  is the number of years of schooling in lower secondary ( $_{LS}$ ) and upper secondary ( $_{US}$ ) levels.

- o The data on school duration (DUR) are from the World Bank (2007) and from UNESCO (2007), and take account of changes in school duration over time within countries.
- o The population with secondary ( $h_{2t}$ ) schooling is estimated in five-year intervals by the perpetual inventory method using actual census/survey observations on educational attainment as benchmarks.

Benchmarks for secondary educational attainment up to 1995.	Barro and Lee (1993, 1996)
Country coverage:	All countries
Exceptions:	American Samoa (1975, 1980, 1990); Aruba (1990); Austria (1990 – secondary only); Bahamas (1990); Belarus (1990); Bermuda (1970, 1990); British Virgin Islands (1990); Burundi (1990); Colombia (1995); Côte d'Ivoire (1990, 1995); Estonia (1990); Ethiopia (1995); Guadeloupe (1980); Guam (1970, 1980, 1990); Hong Kong (1995); Kazakhstan (1990); Kiribati (1980); Latvia (1990); Lithuania (1990); Luxembourg (1990); Macao (1970, 1990); Maldives (1990); Mauritania (1990); Moldova (1990); Monaco (1975); Mongolia (2000); Morocco (1970); Nepal (1970); Netherlands (1970, 1980, 1990); Oman (1995); Philippines (1970, 1975); Puerto Rico (1990, 1980, 1970); Qatar (1985); Russian Federation (1990); Samoa (1980, 1990); Tajikistan (1990); Tanzania (1990); Tonga (1985); Turkey (1995); Turks and Caicos (1970, 1980); Tuvalu (1990); US Virgin Islands (1980); United Arab Emirates (1975); United States (1995); Vanuatu (1980); Vietnam (1980, 1990); Zambia (1990).

- o For countries not covered by Barro and Lee (1993,1996) and listed above as exceptions, the following sources were used:

Benchmarks for secondary educational attainment.	UNESO (2002)
Country coverage:	All countries not covered by Barro and Lee (1993, 1996)
Exceptions:	Australia; Austria (secondary and tertiary); Belgium; Brazil; Canada; Chile; Czech Republic; Denmark; Finland; France; Germany; Greece; Indonesia; Ireland; Italy; Japan; Jordan; Korea, Rep.; Malaysia; Netherlands; New Zealand; Norway; Peru; Philippines; Portugal; Spain; Sri Lanka; Sweden; Switzerland; Thailand; Tunisia; United Kingdom; United States; Uruguay; Zimbabwe.

- Gaps in educational attainment that could not be filled in by the perpetual inventory method due to lack of enrollment data were filled in the following way:
  - if the existing series had 2 datapoints, by interpolation by geometric mean;
  - if 1 datapoint, by using the country ratio to a comparable country as proxy.
- Country comparability was guided by the literacy ranking for the corresponding year in the first instance, and by Human Development Index country ranking for the corresponding year in the second instance.
- For countries that did not have any census/survey observations, we use the most recent secondary educational attainment observation for a comparable country, as above.

Use of educational attainment data of comparable country:	Cambodia (1995) as for Zambia (based on literacy ranking); Lebanon (1995) as for Jamaica (based on HDI ranking as literacy rates are not available); Nigeria (1995) as for Egypt based on literacy ranking; Saudi Arabia (1990) as for El Salvador (based on literacy ranking); Ukraine (1995) as for Belarus (based on HDI ranking as literacy rates are not available); Uzbekistan (1995) as for Moldova (based on HDI ranking as literacy rates are not available); Yemen (1995) as for Liberia (based on literacy ranking).
Notes:	Completion ratios for these countries are calculated by the ratio of educational attainment to completion for the proxy country.

- Due to lack of data to calculate secondary ( $hc_{2t}$ ) completion ratios, we assume that the completion ratio for 2000, 2005, and 2006 are as for 1995. For the following countries, completion ratios are calculated by the ratio of educational attainment to completion for comparable countries (based on educational attainment ranking):

Use of completion ratio data of comparable country:	Belarus: Kazakhstan; Burundi: Congo, Dem. Rep.; Cambodia: Ghana; Granada: Croatia; Libya: Iraq; Qatar: Mexico; Samoa: Netherlands; Tanzania: Sierra Leone; Tonga: Swaziland; Ukraine: Belarus; United Arab Emirates: Colombia; Vanuatu: Swaziland; Vietnam: Congo, Dem. Rep.
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- Estimates of educational attainment were calculated by application of the perpetual inventory method used to construct flows of adult population.
- Flows of adult population are adjusted for the mortality rate and added to benchmark stocks (see Barro and Lee, 1993). The formula for secondary levels of schooling is as follows:

$$h_{2t} \equiv \frac{H_{2t}}{L_t} = \left[ 1 - \frac{L_{25t}}{L_t} \right] \cdot h_{2,t-5} + \left( \frac{L_{25t}}{L_t} \right) \cdot (SEC_{t-10} - HIGH_{t-5})$$

where  $L_t$  is the population aged 25 and over;  $L_{25t}$  is the population aged 25-29;  $SEC_{t-10}$  is the net secondary enrollment ratio; and  $HIGH_{t-5}$  is the gross tertiary enrollment ratio.

- Data on the population aged 25-29 and the population aged 25 and over are compiled from United Nations Population Division (2007) and from the United States Census Bureau (2008).
- Enrollment ratios (with the corresponding time lag and adjusted for the mortality rate) are added as flows to produce estimates of educational attainment in five-year intervals to 2006. Because data on school repetition is not readily available for all 156 countries, there is some upward bias in school enrollment estimates.
- For all countries, net secondary enrollment ratios are compiled from UNESCO (2002); and gross tertiary enrollment ratios are compiled from World Bank (2007) and from the United Nations Common Database (2008).

Due to the lack of historical data, net secondary enrollment ratios for 1990 and 1995 for Cambodia and Lebanon are as for 2000.

Secondary and tertiary enrollment rates for Taiwan are from DGBAS (2008).

- The schooling data for 2006 applies the enrollment ratios for 1995 and 2000 to population data corresponding to 2001 and 2006.

## 4. The Comparative Liveability Sub-Index

- This section sets out the details specific to the construction of the Comparative Liveability sub-index.
- ♦ The weights for factors included in the SWB sub-index were derived by regressing life satisfaction data on each variable individually, while controlling for income. In all cases, the bandwidth ( $f$ ) of the LOWESS regressions was set to 0.5, which seemed to give the best tradeoff between smoothing and fit.
- ♦ In all cases (both for testing the derivation of the weights, and for the construction of the scores). We used the most recently available data for each country.
- ♦ We could not calculate the weights on income directly from the LOWESS regressions due to the intractability of the resulting functional form. Instead, the weight on income is derived from a full sample regression imposing a log functional form (which seems a reasonable approximation to the LOWESS results).
- ♦ More detailed descriptions of the data and sources, as well as selected regression results, are provided in the tables below.

DATA USED IN COMPARATIVE LIVEABILITY ANALYSIS			
Indicator	Variable	Source	Obs
Dependent Variable	Life Satisfaction	Country average of responses to the World Values Survey question: "All things considered, how satisfied are you with your life as a whole these days?" Supplemented for some countries with similar data compiled by the World Happiness Database (Veenhoven)	
Political Life	Control of Corruption	World Bank Governance Indicators Control of Corruption Index. (Source: World Bank Governance Indicators.)	87
	Voice & Accountability	World Bank Governance Indicators Voice & Accountability Index. (Source: World Bank Governance Indicators.)	87
	Government Effectiveness	World Bank Governance Indicators Government Effectiveness Index. (Source: World Bank Governance Indicators.)	87
Equal Opportunity	Women in Parliament	Percentage of women in parliament. (Source: UN Human Development	84

		Report.)	
	Ratio of Female to Male Earnings	Ratio of Female to Male Earnings. (Source: UN Human Development Report.)	86
	Ability to "Get Ahead"	Average response to the question, "Can people in this country get ahead by working hard, or not?" (Source: Gallup World Poll.)	79
	Migration	Net Migration Rate per thousand inhabitants. (Source: UN)	85
Freedom of Choice	Freedom of Choice	Average response to the question "In your country, are you satisfied or dissatisfied with your freedom to choose what you do with your life?" (Source: Gallup World Poll.)	83
Leisure	Working Hours	Average working hours per week in manufacturing (Source: OECD.)	72
	Leisure Time	Average response to the question, "Approximately how many hours of your time yesterday was free time, where you could do what you wanted to do? (Source: Gallup.)	70
Income	Income	Log of GDP per capita, measured in 2000 \$US PPP. (Source: World Development Indicators, supplemented by IMF data for Taiwan.)	87
Health	Satisfaction with Health	Average response to the question, "Are you satisfied or dissatisfied with your personal health?" (Source: Gallup World Poll.)	84
	Health Adjusted Life Expectancy	Average life expectancy, adjusted for health. (Source: WHO.)	86
Jobs	Unemployment Rate	Log of 1 plus the unemployment rate. (Source: ILO, supplemented by data from the CIA World Factbook.)	84
Climate	Minimum Average Monthly	Average temperature in the coldest month of the year, weighted by	84

	Temperature	population. (Source: Temperature Data from the Climate Research Unit CL 2.0 database, weighted using the Gridded Population of the World v3 database.)	
	Maximum Average Monthly Temperature	Average temperature in the warmest month of the year, weighted by population. (Source: Temperature Data from the Climate Research Unit CL 2.0 database, weighted using the Gridded Population of the World v3 database.)	84
Environment	Ecosystem Services Product	Log of Ecosystem Services Product per capita (Source: Costanza et al., 1997).	84
	Environmental Satisfaction	Average response to the question, "In your country, are you satisfied or dissatisfied with efforts to preserve the environment?" (Source: Gallup World Poll.)	83
	Air Quality	Average response to the question, "In the city or area where you live, are you satisfied or dissatisfied with the quality of air?" (Source: Gallup World Poll.)	84
Family Life	Widow(hood) Rate	Percentage of the population reporting marital status: widowed. (Source: Gallup World Poll.)	81
	Divorce Rate	Percentage of the population reporting marital status: divorced. (Source: Gallup World Poll.)	81
	Social Support	Average response to the question, "If you were in trouble, do you have relatives or friends you can count on to help you whenever you need them, or not?" (Source: Gallup World Poll.)	83
Community Life	Social Trust	Average Response to the World Values Survey question "Generally, do you feel that other people can be trusted?" (Source: World Values Survey.)	73

	Volunteering	Percentage of WVS respondents who volunteered time for one or more groups. (Source: World Values Survey.)	83
	Community Involvement	Percentage of respondents involved (actively or inactively) in a community group or organisation, including: church or religious organization, sport or recreational organization, art, music or educational organization, labor union, political party, environmental organization, professional association, humanitarian or charitable organization, consumer organization. Aggregated data from two survey items: "Are you an active or inactive member in 1 or more group?" and "Do you belong to any group?" Most recent observation, if data on both survey items available. (Source: World Values Survey.)	69
	Charitable Giving	Average response to the question, "Have you done any of the following in the past month? How about donated money to a charity?". (Source: Gallup World Poll.)	83
Religious Life	Importance of God	Percentage of WVS respondents answering "Very Important" to the question "How important is God in your life?" (Source: World Values Survey.)	71
	Government Regulation of Religion	Government Regulation of Religion Index (Source: Grim and Finke (2006), via the Association of Religion Data Archive.)	87

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Comparative Liveability Analysis

Dependent Variable: Average Life Satisfaction

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Income	.7732208*** (7.97)
Control of Corruption	.5291714*** (2.75)

Voice & Accountability	.3099474*
	(1.86)
Government Effectiveness	.4849082**
	(2.24)
Women in Parliament	.3630417***
	(4.77)
Ratio of Male to Female Earnings (LOWESS: \$25,000 GDP per capita)	.2338352**
	(2.07)
Ability to "Get Ahead"	.5726754***
	(6.25)
Migration	.3000823**
	(2.47)
Freedom of Choice	.7046611***
	(7.12)
Working Hours (LOWESS: \$25,000 GDP per capita)	-.2289875**
	(-2.16)
Satisfaction with Health	.775425***
	(12.17)
Health Adjusted Life Expectancy	1.232244*
	(1.71)
Minimum Average Monthly Temperature	.8348511***
	(5.97)
Maximum Average Monthly Temperature	-.2565518***
	(-2.67)
Ecosystem Services Product	.2304189**
	(2.40)
Environmental Satisfaction	.5085027***
	(5.94)
Air Quality	.5650957***
	(7.61)
Widow(hood) Rate	-.6445417***
	(-7.68)
Divorce Rate	-.3805522***
	(-3.23)
Social Support	.3351777**
	(2.36)
Social Trust	.2993506***
	(3.13)
Volunteering	.3780014***
	(4.60)
Community Involvement	.4430115***

	(3.75)
Charitable Giving	.7181529***
	(7.04)
Importance of God	.3971453**
	(2.51)
Government Regulation of Religion	-.3162264***
	(-2.77)

Normalized coefficients obtained from separate regressions (each including the relevant independent variable and controlling for income). Unless otherwise noted, coefficients are from regressions on all observed cases in full sample. When variables are not significant in the full sample regression, coefficients are obtained from a LOWESS regression for the specified level of GDP. Coefficients are generally significant over a range of GDP levels; for simplicity, we display the coefficient results only for a representative level.

\* indicates significance at the 10% level, \*\* indicates significance at the 5% level, \*\*\* indicates significance at the 1% level. Robust t-statistics in parentheses.

- Although leisure was not significant in the full sample, or in the LOWESS regressions, it is significant in the sub-sample of countries with GDP per capita greater than \$17,000, as shown in the table below. We did not expect this indicator to be significant for poor countries, since at lower levels of income material concerns prevail as determinants of job satisfaction, and leisure time may be involuntary, as evidenced by research.

Comparative Liveability Analysis	
Dependent Variable: Average Life Satisfaction	
Leisure	.1358973*
	(1.82)

Normalized coefficient from a regression of SWB on Leisure and controlling for income, for the subsample of countries with GDP per capita greater than \$17,000. \* indicates significance at the 10% level. Robust t-statistic in parentheses.

- The unemployment rate variable was not significant in the full sample, or in the LOWESS regressions. It was included in the Prosperity Index because of the robust findings in the literature regarding the negative effects of unemployment on individuals. It can be shown to be significant for a sub-sample of countries (see table below).

Comparative Liveability Analysis	
Dependent Variable: Average Life Satisfaction	
Jobs	1.06635**
	(2.17)

Normalized coefficients obtained from a regression of SWB on Jobs and controlling for income, for the sub-sample of countries with GDP per capita greater than \$28,500. \* indicates significance at the 10% level, \*\* indicates significance at the 5% level, \*\*\* indicates significance at the 1% level. Robust t-statistics in parentheses.

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