CHAPTER 1.1

The Growth Competitiveness Index: Measuring Technological Advancement and the Stages of Development

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A central objective of the *Global Competitiveness Report* is to assess the capacity of the world's economies to achieve sustained economic growth. We do this by analyzing the extent to which individual national economies have the structures, institutions, and policies in place for economic growth over the medium term, roughly a perspective of five years. These structural, institutional, and policy features of national economies are summarized in the Growth Competitiveness Index (GCI). We do not try to predict short-term business cycles, though we discuss short-term issues, especially as they affect the longer-term prospects for economic growth.

Economists' knowledge of the processes and policies that underpin economic growth has advanced tremendously over the past decade. With the increasing availability of cross-country macroeconomic data, the rapid evolution in theoretical and statistical methods, and the increasing sophistication of survey tools—including the Executive Opinion Survey that is conducted annually in preparation of this *Report*—economists have vastly increased their ability to test theories of economic growth. At least some of the ideological battles of the past are receding in the face of improved evidence.[1]

Of course, our knowledge remains imperfect. We do not know the exact mechanisms through which growth occurs, nor are we able to forecast future growth rates with absolute precision. Economic crises sometimes emerge somewhat out of the blue, as with Japan's decade long recession and the East Asian crisis in 1997. Research into the subject of economic growth is ongoing, and thus our understanding of the relevant technological, institutional, geographical, and societal factors improves with every year that passes. As a result, we are constantly updating the framework used in the Growth Competitiveness Index. This year's GCI is no exception.

This chapter on growth competitiveness contains two distinct sections. The first provides an outline of current knowledge concerning economic growth and the results for this year's GCI. The second proceeds in greater detail, describing the new GCI methodology and logic used in the construction of this year's Index.

ECONOMIC GROWTH AND GROWTH COMPETITIVENESS: THE FUNDAMENTALS

An overview of economic growth

Economists have identified three inter-related mechanisms involved in economic growth. The first is the efficient allocation of resources, based on market competition and a sophisticated division of labor. Adam Smith identified this factor already in 1776, and observed that international trade plays an enormously important role in achieving an efficient division of labor. The second mechanism is capital accumulation. When national saving is converted into increasing capital per worker, the output per worker also tends to rise. Economists have come to appreciate that productive capital includes not just the plant and equipment of business sector, but also the human capital that results from investments in education, health, and on-the-job training. The third mechanism in economic growth is technological advance. Improvements in technology (both new goods and better ways of producing goods) can be achieved by creating a truly new technology, or by adopting (and adapting) a technology that has been developed abroad. The first process is called *technological innovation*; the second, *technological diffusion*.

All three mechanisms—division of labor, capital accumulation, and technological advance—are important, but technological advance is probably the most fundamental of the three in modern history. Without technological advance, the benefits of an improved division of labor, or a higher rate of capital accumulation, push the economy to a higher standard of living but not to continuously high economic growth. For example, as capital is accumulated, the rate of return on new investment tends to fall over time unless the capital accumulation is accompanied by technological change, which creates new profitable investment opportunities. Thus, the Soviet Union accumulated capital at a high rate, but because civilian technology was nearly moribund, the rate of return to new investments fell to close to 0 by the 1980s, contributing to the collapse of the system.

Technological advance, on the other hand, has been self-perpetuating in the high-income countries. Each new technological innovation triggers yet further innovation, in a kind of chain reaction that fuels long-term economic growth. Thus, in the science-based, technologically advanced economies, economic growth has continued for nearly two centuries without running out of dynamism, or even slowing down.

There are, of course, volumes to be written about how the structural characteristics and economic policies of each economy affect economic growth. The division of labor is affected by trade policies, state versus private ownership, the legal system, and so forth. Capital accumulation is affected by the confidence in property rights, the rates of taxation, the faith in the judicial system, and the extent of macroeconomic stability or instability. Technological diffusion and innovation are affected by intellectual property rights, the size of the potential market for a new invention, government support for scientific research, the state of the higher education, and many other factors.

Economists have increasingly returned to another idea of Adam Smith's as well: that physical geography plays an important role in determining economic growth. When a poorer economy is close to a richer economy, the poorer neighbor can often benefit by absorbing technologies and capital from the richer neighbor. Economic growth then spreads "within the neighborhood" of the richer economy. A more distant economy, by contrast, may be less able to benefit from capital inflows and technological diffusion. Climatic factors can also affect long-term development, because of the effects of climate on disease, food productivity, and other sectors of the economy.

By virtue of their distinctive histories, geography, and social conditions, countries are at widely varying levels of income, technological sophistication, capacity to innovate, and overall capacity to achieve sustained economic growth. But perhaps the most significant global division today from the view of long-term economic growth is the one between countries that are able to achieve technological innovation at a high rate and those that are not. The main innovators in the world, as measured, for example, by the rate at which they patent new products and processes, are few in number. The United States and Canada, Western Europe, Japan, and a handful of other economies (Israel, Korea, Singapore, and Taiwan) account for the vast bulk of new patents each year. In 2000, these countries accounted for barely 15 percent of the world's population, but fully 99 percent of the patents issued for new inventions by the US Patent Office.

The world's technological divide was first incorporated into the growth competitiveness framework in last year's *Report* when our colleague Andrew Warner constructed the economic creativity index to distinguish empirically between growth stimulated by innovation and growth fueled by technology transfer. (An update on economic creativity by Dr Warner is included in Chapter 2.3 of this *Report*. Another chapter on innovation by Michael E Porter and Scott Stern appears as Chapter 2.2.) This year we build on the distinction between innovation and technology transfer by using the term *core economy* for a country that is a technological innovator; all the rest are said to be *non-core economies*. This classification system allows us to distinguish statistically how various factors affect growth at different stages of development. (The methodology section in the second half of this chapter describes exactly how this framework applies to our growth competitiveness calculations.) As an empirical matter, we define the core group as all economies that achieve

at least 15 patents per million population. The economies meeting this core criterion in 2000 are listed in Box 1. The core economies are, typically, the richest countries and typically have achieved sustained economic growth over the course of many years, indeed decades. Their economic growth is powered, fundamentally, by their capacity to innovate. The competition among the core economies is closely related to their relative capacities to innovate and to win new global markets for their technologically advanced products.

Box 1: Core innovators as of 2000

Countries with more than 15 US utility patents registered per million population in 2000.

Australia	Hong Kong SAR	New Zealand
Austria	Iceland	Norway
Belgium	Ireland	Singapore
Canada	Israel	Sweden
Denmark	Italy	Switzerland
Finland	Japan	Taiwan
France	Korea	United Kingdom
Germany	Netherlands	United States

We certainly don't want to be misunderstood by our use of terms. The use of *core* and *non-core* is not meant as a value judgment in any way, nor as a slight or insult to the non-innovating regions. It is meant only as a useful shorthand to describe the critical division in today's world economy between the innovating and non-innovating economies. The economic dynamics have been very different in these two groups of countries, and we highlight those differences in this *Report*. We also hope that the description will help more countries to develop the means for higher rates of technological innovation within their own economies.

The non-core economies often achieve very high rates of growth, indeed the world's very highest rates, by rapidly absorbing the advanced technologies and capital of the core economies. This process of "catch-up growth" has been extremely important for many developing countries. But we should highlight the fact that catch-up growth has its inherent limits. As a non-core economy narrows the income gap with the technological leaders, its ability to narrow the gap still further tends to diminish, or even disappear. In order to close the income gap fully, the non-core economy must become a technological innovator—in other words, it must become part of the core economy itself.

Globalization has generated new opportunities for countries, but also new challenges. By raising the mobility of financial capital, skilled workers, and new technologies, economies now have the capacity to grow at supercharged annual rates if they can become attractive magnets for investment and technological diffusion. But at the same time, globalization punishes the laggard economies far more harshly than in the past. When the business environment is poor, skilled workers and capital simply "pack up their bags" and leave for a more promising location. Thus, lawless governments impose a particularly high economic cost on their countries. Unfortunately, some of the losers today are suffering not for their sins, but for their poor geographical inheritance. Some distant locations (such as landlocked countries in Latin American, Africa, and Asia) are experiencing high rates of brain drain and capital outflow because their remoteness raises transport costs and diminishes the incentives for investment. Even here, however, investments in infrastructure (such as better roads and airports, and better Internet connectivity) can compensate for some of the inherent difficulties.

The most successful of the non-core economies in recent years have achieved fast growth by attracting high levels of foreign direct investment (FDI) from the high-tech multinational firms of the core economies. This FDI brings with it new technology, capital, export markets, and organizational know-how, all in one process. Thus, China, Singapore, Hong Kong, and more recently Ireland, Mexico, and Poland, have all achieved FDI-led growth at very rapid rates. Much of this FDI has been export oriented. The multinational firm has invested in these non-core economies not so much for the local market (though that can be important) but rather because it sees the economy as an export platform for the world market. Thus, the regions that have benefited most from this kind of FDI are those that have good access to global shipping lanes (eg, coastal regions) or land proximity to major markets (Mexico, Poland).

The boundaries between core and non-core economies are clearly not rigid. A technologically laggard country can become an innovator, but the breakthrough from non-core to core economy is not a simple one, and most places in the world have not accomplished the transition. That is, of course, why the group of core economies remains so small as a share of the world's population. Yet countries such as Iceland, Ireland, Hong Kong SAR, Korea, Singapore, and Taiwan have all achieved a breakthrough in innovative capacity, and have thereby become part of the "core" of the world economy (see Table 1). They are all growing rapidly based largely on their technological prowess. One of our goals in this *Report* is to identify some of the key factors that allow an economy to

Table 1: Core technology-innovating economies in the 1980s and in 2000

country	Average Annual US Utility Patents Granted per Million Population in 1980s*	1980s rank	US Utility Patents Granted per Million Population in 2000*	2000 rank
1980s Core technology innovators				
Switzerland	189.6	1	182.1	4
United States	165.8	2	308.7	1
Japan	101.2	3	246.6	2
Sweden	94.3	4	177.2	5
Germany	85.1	5	123.6	7
Netherlands	51.9	6	78.1	11
Canada	50.3	7	111.2	9
United Kingdom	43.2	8	60.6	16
France	43.0	9	64.4	14
Israel	42.1	10	135.0	6
Austria	40.3	11	62.1	15
Finland	37.0	12	119.4	8
Denmark	31.7	13	82.3	10
Belgium	26.4	14	67.8	13
Norway	22.6	15	55.1	18
Australia	21.4	16	36.7	20
Italy	16.4	17	29.7	22
New Zealand	15.2	18	28.0	23
1980s Non-core economies that became core innovators by 2000				
Taiwan	12.8	19	210.3	3
Iceland	9.0	21	61.6	17
Ireland	8.8	22	32.4	21
Hong Kong SAR	5.4	23	26.3	24
Singapore	2.4	26	54.3	19
Korea	1.3	28	70.1	12

*Note that Luxembourg averaged 71.7 US patents per million population in the 1980s and achieved 91.8 per million population in 2000 but is not included in our analysis.

become an innovator, in order to help more countries achieve the transition to innovation. These factors include: sizeable investments in higher education, a good information technology base, high levels of government spending on research and development, and effective intellectual property laws that promote research and development.

Another objective of this *Report* is to estimate as accurately as possible the different roles of technology at different stages of development. Each country's specific challenges posed by globalization depend importantly on its stage of economic and technological development. A very poor country with rudimentary levels of health and education will generally not be competing on the basis of technological innovation. Rather, the goal for that country will be to attract capital investment and discourage capital flight, and to use the proceeds of economic growth to invest in improved health, education, and infrastructure. For a country somewhat higher up the development ladder, the main goal is likely to be to speed up the process of technological diffusion into the country, in part by attracting high-tech foreign direct investments. For the most advanced of the non-core economies, the goal is likely to be the transition from technological diffusion to technological innovation—in other words, the transition from being a non-core economy to being a core economy. Among the most advanced countries, the main competition is in high-tech markets. Success in high-tech innovation depends on scientific prowess, the translation of science into technology, and the commercialization of that technology, often through start-up businesses.

Just as the challenges of growth differ according to the stage of economic development, we have found that the explanatory power of our Growth Competitiveness Index is improved if we allow for different weightings of factors depending on the stage of development. For the core countries, for example, the weight accorded to technological indicators (relative to other factors) should be higher than for non-core economies. Similarly, the importance of innovation relative to diffusion is higher for the core economies than for the non-core economies. We verify through regression analysis that, as the stage of economic development changes, the relative importance of various sub-components of the GCI also changes.

Finally, it is important to say a bit about the macroeconomic environment. Government monetary and fiscal policies, and stability of financial institutions, have important effects on short-term economic dynamics as well as on the long-term capacity to grow. The key macroeconomic factors in long-term growth are budget balance, modest taxation, high rates of national saving, stability in the financial system, and a realistic level of the exchange rate that preserves the competitiveness of the export sector. When one or more of these macroeconomic factors is jeopardized (for example, by large budget deficits or a banking crisis), the short-term consequences can be stunning. Banking crises in Latin America and Asia during the 1990s resulted in a collapse of GNP of 5 percent or more in a single year in many countries. The medium-term growth prospects are also implicated, though less dramatically, since macroeconomic instability seriously damages capital accumulation and the efficient division of labor. Although the short-term macroeconomic convulsions are often highest in the minds of investors or businessmen planning this year's strategy, our concern remains focused on the medium-term implications of the macroeconomic environment.

The Growth Competitiveness Index 2001–2002

Results

The overall Growth Competitiveness Index (GCI) aims to measure the capacity of the national economy to achieve sustained economic growth over the medium term, controlling for the current level of economic development.

Using data from recent years' Executive Opinion Survey, and building on other economic research by ourselves and colleagues at the Center for International Development at Harvard University—especially Andrew Warner, who has played a leading role in this *Report*'s intellectual development—the GCI 2001 focuses on three pillars of growth: technology, public institutions, and the macroeconomic environment, each with its own index. This is slightly modified from last year's Growth Index, which focused on economic creativity (similar to this year's technology index), finance (closely linked to the new macroeconomic environment index); and internationalization (which is somewhat related to both the technology and macroeconomic indexes). We also, for the first time, present a unified Index that distinguishes between growth factors affecting the world's core innovator economies and those affecting the non-core technological adapters.

Despite the revisions in methodology and labeling, the reader should be aware that many of last year's underlying variables are still included in this year's overall Growth Index. Many have been re-categorized, however, and several have also been dropped in light of new evidence regarding the role of various factors at different stages of development. Broadly speaking, the technology index measures the capacity for innovation and diffusion of technology. The public institutions subindex mainly measures the role of politics and the bureaucracy in supporting market-based economic activity and the division of labor. The macroeconomic environment index measures variables related to capital accumulation and the efficiency of the division of labor.

This year's results are presented in Tables 2 and 3. Table 2 focuses on the overall rankings, comparing this year's placings to last year's for the 58 countries included in both GCIs. Table 3 presents the results for the technology, public institutions, and macroeconomic environment indexes that, together, form the overall GCI. As explained in more detail below, these component indexes are constructed and weighted somewhat differently for the core and non-core economies.

When looking at Table 2, the reader should note that, given the updates in this year's GCR methodology as well as the expanded coverage of 17 new countries, a precise comparison between this year's and last year's results is not recommended. The reader should also note that, due to its perennially small yield in our Executive Opinion Survey,

Table 2: Growth Competitiveness Index rankings and 2000 comparisons

country	GCI 2001 rank	GCI 2001 score	GCI 2001 rank among GCR 2000 countries	GCI 2000 rank
Finland	1	6.03	1	5
United States	2	5.95	2	1
Canada	3	5.87	3	6
Singapore	4	5.84	4	2
Australia	5	5.74	5	11
Norway	6	5.64	6	15
Taiwan	7	5.59	7	10
Netherlands	8	5.56	8	3
Sweden	9	5.55	9	12
New Zealand	10	5.53	10	19
Ireland	11	5.52	11	4
United Kingdom	12	5.51	12	8
Hong Kong SAR	13	5.47	13	7
Denmark	14	5.44	14	13
Switzerland	15	5.43	15	9
Iceland	16	5.40	16	23
Germany	17	5.39	17	14
Austria	18	5.33	18	17
Belgium	19	5.31	19	16
France	20	5.29	20	21
Japan	21	5.25	21	20
Spain	22	5.17	22	26
Korea	23	5.13	23	28
Israel	24	5.01	24	18
Portugal	25	4.92	25	22
Italy	26	4.90	26	29
Chile	27	4.90	27	27
Hungary	28	4.87	28	25
Estonia	29	4.87	—	—
Malaysia	30	4.83	29	24
Slovenia	31	4.70	—	—
Mauritius	32	4.60	30	35
Thailand	33	4.53	31	30
South Africa	34	4.50	32	32
Costa Rica	35	4.49	33	37
Greece	36	4.46	34	33
Czech Republic	37	4.41	35	31
Trinidad and Tobago	38	4.40	—	—
China	39	4.40	36	40
Slovak Republic	40	4.36	37	38
Poland	41	4.30	38	34
Mexico	42	4.29	39	42
Lithuania	43	4.27	—	—
Brazil	44	4.26	40	45
Jordan	45	4.24	41	46
Uruguay	46	4.22	—	—
Latvia	47	4.19	—	—
Philippines	48	4.16	42	36
Argentina	49	4.11	43	44
Dominican Republic	50	4.10	—	—
Egypt	51	4.03	44	41
Jamaica	52	3.92	—	—
Panama	53	3.88	—	—
Turkey	54	3.86	45	39
Peru	55	3.85	46	47
Romania	56	3.84	—	—
India	57	3.84	47	48
El Salvador	58	3.84	48	49
Bulgaria	59	3.82	49	57
Vietnam	60	3.77	50	52
Sri Lanka	61	3.74	—	—
Venezuela	62	3.70	51	53
Russia	63	3.70	52	54
Indonesia	64	3.69	53	43
Colombia	65	3.68	54	51
Guatemala	66	3.44	—	—
Bolivia	67	3.42	55	50
Ecuador	68	3.36	56	58
Ukraine	69	3.26	57	56
Honduras	70	3.11	—	—
Bangladesh	71	3.04	—	—
Paraguay	72	3.01	—	—
Nicaragua	73	3.01	—	—
Nigeria	74	2.99	—	—
Zimbabwe	75	2.81	58	55

Table 3: Growth Competitiveness Index component indexes

TECHNOLOGY		
Country	Rank	Score
United States	1	6.42
Canada	2	6.37
Finland	3	6.35
Taiwan	4	6.19
Australia	5	6.05
Sweden	6	5.81
Norway	7	5.77
Estonia	8	5.68
Korea	9	5.66
United Kingdom	10	5.56
New Zealand	11	5.55
Denmark	12	5.54
Belgium	13	5.54
Netherlands	14	5.54
Germany	15	5.49
Austria	16	5.45
France	17	5.44
Singapore *	18	5.44
Iceland	19	5.41
Czech Republic	20	5.39
Hungary	21	5.39
Malaysia	22	5.36
Japan	23	5.28
Switzerland	24	5.27
Portugal	25	5.27
Israel	26	5.27
Spain	27	5.23
Ireland *	28	5.20
Slovak Republic	29	5.18
Slovenia	30	5.18
Italy	31	5.01
Costa Rica	32	4.97
Hong Kong SAR *	33	4.93
Latvia	34	4.83
Poland	35	4.75
Mexico	36	4.70
Mauritius	37	4.67
Greece	38	4.62
Thailand	39	4.54
Philippines	40	4.53
Lithuania	41	4.46
Chile	42	4.45
Jamaica	43	4.43
Dominican Republic	44	4.42
Uruguay	45	4.40
South Africa	46	4.39
Romania	47	4.33
Argentina	48	4.33
Brazil	49	4.33
Bulgaria	50	4.32
Turkey	51	4.28
Trinidad and Tobago	52	4.10
China	53	4.05
Jordan	54	3.99
Venezuela	55	3.98
Colombia	56	3.92
Panama	57	3.89
El Salvador	58	3.86
Sri Lanka	59	3.82
Russia	60	3.78
Indonesia	61	3.76
Peru	62	3.71
Ukraine	63	3.68
Egypt	64	3.59
Vietnam	65	3.56
India	66	3.54
Bolivia	67	3.52
Guatemala	68	3.38
Ecuador	69	3.33
Honduras	70	3.29
Nicaragua	71	3.21
Zimbabwe	72	3.20
Paraguay	73	2.98
Bangladesh	74	2.83
Nigeria	75	2.44

PUBLIC INSTITUTIONS		
Country	Rank	Score
Finland	1	6.59
Iceland	2	6.56
Denmark	3	6.42
New Zealand	4	6.33
Netherlands	5	6.29
Singapore	6	6.27
Sweden	7	6.19
Australia	8	6.17
United Kingdom	9	6.14
Hong Kong SAR	10	6.01
Canada	11	6.01
United States	12	6.01
Switzerland	13	5.99
Israel	14	5.98
Austria	15	5.98
Norway	16	5.95
Germany	17	5.93
Ireland	18	5.87
Japan	19	5.76
France	20	5.72
Chile	21	5.69
Belgium	22	5.67
Spain	23	5.47
Taiwan	24	5.30
Portugal	25	5.25
Hungary	26	5.20
Italy	27	5.05
Jordan	28	5.04
Estonia	29	4.99
Slovenia	30	4.90
Uruguay	31	4.89
Mauritius	32	4.79
Egypt	33	4.76
Lithuania	34	4.70
South Africa	35	4.69
Trinidad and Tobago	36	4.63
Costa Rica	37	4.56
Slovak Republic	38	4.54
Malaysia	39	4.53
Greece	40	4.50
Poland	41	4.40
Thailand	42	4.36
Jamaica	43	4.30
Korea	44	4.25
Peru	45	4.24
Turkey	46	4.21
Brazil	47	4.21
Latvia	48	4.18
India	49	4.11
China	50	4.10
Bulgaria	51	4.07
Romania	52	4.06
Czech Republic	53	4.04
Dominican Republic	54	4.02
Argentina	55	4.01
Mexico	56	3.99
Colombia	57	3.85
Sri Lanka	58	3.84
Panama	59	3.83
El Salvador	60	3.79
Russia	61	3.68
Bolivia	62	3.67
Vietnam	63	3.58
Philippines	64	3.53
Venezuela	65	3.40
Indonesia	66	3.35
Nicaragua	67	3.33
Ecuador	68	3.30
Zimbabwe	69	3.30
Guatemala	70	3.22
Ukraine	71	3.15
Honduras	72	3.01
Nigeria	73	2.84
Paraguay	74	2.75
Bangladesh	75	2.48

MACROECONOMIC ENVIRONMENT		
Country	Rank	Score
Singapore	1	5.52
Ireland	2	5.20
Switzerland	3	5.18
Hong Kong SAR	4	5.12
Norway	5	5.08
China	6	5.04
United States	7	4.97
Korea	8	4.94
Netherlands	9	4.88
Finland	10	4.82
Spain	11	4.82
United Kingdom	12	4.81
Canada	13	4.74
New Zealand	14	4.70
Taiwan	15	4.69
Thailand	16	4.68
Australia	17	4.68
Japan	18	4.66
Germany	19	4.65
Malaysia	20	4.59
Chile	21	4.56
France	22	4.54
Italy	23	4.53
Belgium	24	4.48
Trinidad and Tobago	25	4.48
Austria	26	4.46
South Africa	27	4.43
Philippines	28	4.42
Sweden	29	4.40
Mauritius	30	4.34
Denmark	31	4.28
Greece	32	4.26
Brazil	33	4.24
Iceland	34	4.24
Portugal	35	4.24
Mexico	36	4.18
Vietnam	37	4.15
Hungary	38	4.04
Slovenia	39	4.02
Argentina	40	3.99
Indonesia	41	3.96
Costa Rica	42	3.94
Estonia	43	3.94
Panama	44	3.92
India	45	3.88
Dominican Republic	46	3.87
El Salvador	47	3.87
Bangladesh	48	3.81
Czech Republic	49	3.81
Poland	50	3.75
Egypt	51	3.74
Guatemala	52	3.73
Venezuela	53	3.73
Jordan	54	3.69
Nigeria	55	3.68
Lithuania	56	3.66
Russia	57	3.64
Peru	58	3.62
Latvia	59	3.58
Sri Lanka	60	3.56
Israel	61	3.55
Ecuador	62	3.45
Uruguay	63	3.38
Slovak Republic	64	3.35
Paraguay	65	3.31
Colombia	66	3.29
Romania	67	3.14
Turkey	68	3.10
Bulgaria	69	3.09
Bolivia	70	3.08
Jamaica	71	3.05
Honduras	72	3.02
Ukraine	73	2.95
Nicaragua	74	2.48
Zimbabwe	75	1.93

* = When calculated as core economy. See Table 6B for values when calculated as non-core.

Luxembourg is not included in this year's rankings, so all 2000 rankings below third place have been scaled up one spot relative to their published order in the *Global Competitiveness Report 2000*.

Although the GCI sample has been expanded and its methodology modified, there is a high correlation between the rankings for last year and this year.[ii] In our view, this has two main explanations. First, despite changes in our growth competitiveness methodology in recent years, our Index is robustly capturing the key underlying elements affecting medium-run economic growth. Second, the consistency in rankings suggests that the underlying processes affecting growth have themselves been changing only gradually over the past three to five years. *We urge appropriate caution in the interpretation of the rankings.* An index like this cannot finely distinguish between the growth prospects of countries that are very similarly ranked. The trends throughout Table 2 are informative, but one should not over-interpret a movement of a few slots in the ranking.

Nonetheless, reading through the GCI rankings, the most obvious changes have taken place in the top spots, where Finland, for the first time, ranks first in the world. This is a notable achievement for a small open economy that underwent a deep recession after the Soviet Union collapsed a decade ago. It also serves as evidence of how quickly an economy's prospects can be transformed by strong political institutions, a focus on technology (especially the prowess of Nokia and the rest of the ICT sector), and sound macroeconomic management. The United States, currently at risk of a recession but still the world's largest market, technological leader, and engine of economic growth, has slipped to second spot—an interesting yet marginal overall change. The United States is still, of course, the overwhelming powerhouse of the world economy in the high-tech industries. Canada, the sixth-ranked economy in the 2000 GCI, rounds out the top three places, having moved up mainly due to this year's weight accorded to tertiary education as a key factor in technological innovation.

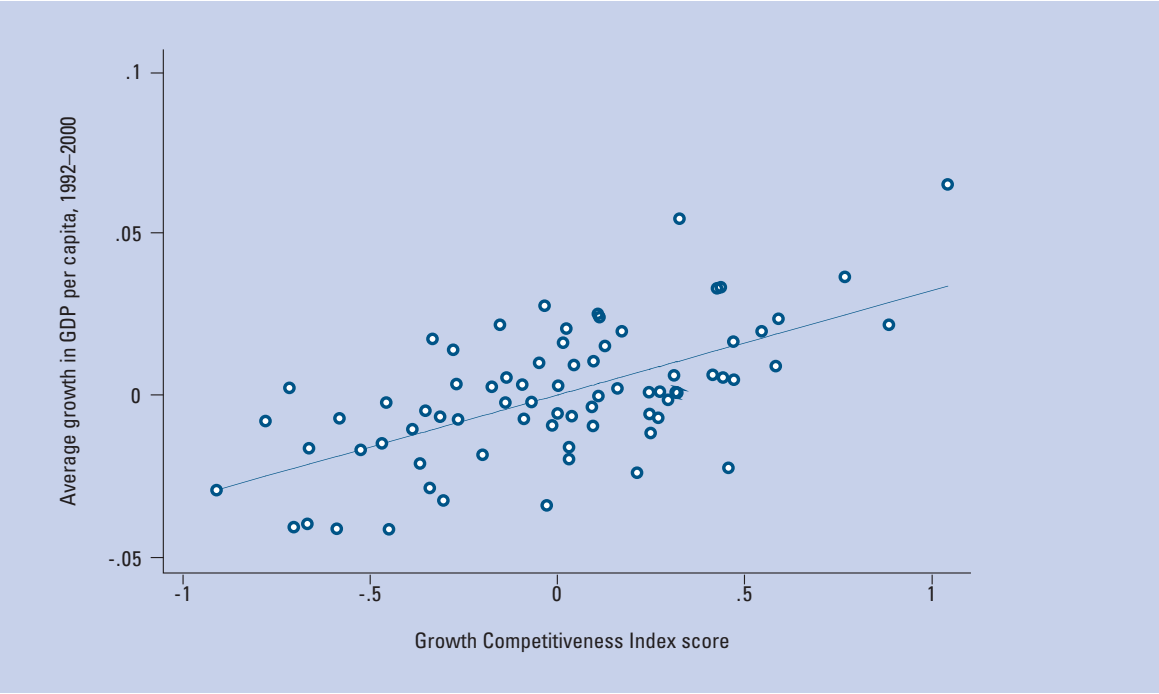
Singapore, the second ranked economy in the 2000 GCI, has dropped two spots to fourth, due more to the increased weight on innovation in this year's Index than to shifts in the local economy. Similarly Ireland and Hong Kong SAR, still strong economies with impressive growth prospects, have dropped from 5th to 11th and 8th to 13th, respectively, because of evidence that they will need to become more innovative to maintain their current high growth rates into the future. These three fast-growing economies have each been highly successful in pursuing technology-diffusing, manufacturing-based export growth strategies. They have concurrently expanded their local scientific and innovation capacities so that each now easily surpasses our 15 patents per million population criterion for the technological core. Yet despite their fast-pace growth and their development of local innovative capacities, they have not yet fully transformed their source of growth from diffusion to innovation. They appear to be, in a sense, between non-core and core economy status. In our final GCI rankings, we calculated their scores as both core and non-core economies, and then averaged the two. If we were to have calculated each solely as non-core economies, each would have had a higher overall ranking.[iii]

Norway marks another interesting shift in the rankings—this year up from 15th to 6th—having invested heavily in developing its information and communications technology (ICT) capacity, not unrelated to its Scandinavian neighbors' strength in this regard, while its government has concurrently enjoyed enviable macroeconomic conditions thanks to natural resource abundance and high oil prices. New Zealand has also scored a dramatic jump in the rankings, from 19th to 10th, reflecting its consistently stable macroeconomic and institutional environment and also its growing technological capacity that receives increased attention in this year's methodology. Iceland's move seven spots up, from 23rd to 16th, reflects the positive growth prospects for another country with one of the world's most advanced ICT infrastructures.

At the middle and lower ends of the rankings of countries covered in both this and last year's GCRs, results are more stable, with few countries experiencing dramatic shifts. For instance, Chile and South Africa are unchanged at 27th and 32nd spots respectively. Notable exceptions include Turkey, which was surveyed during the height of its economic crisis in the early months of 2001 and dropped six spots on the rankings. Even more dramatic was the drop for Indonesia, a country that has experienced ongoing political uncertainty while flirting with the prospect of major turmoil over the past year. It dropped 10 places, from 43rd to 53rd. Meanwhile, Mauritius climbed five spots from 35th to 30th, Jordan moved up from 46th to 41st, and Bulgaria jumped an impressive 8 places from 57th to 49th. Interestingly, Argentina has barely shifted since last year, improving one place from 44th to 43rd. Argentina is a bit of a paradox, of course. Many features of its economy are satisfactory, yet the economy remains trapped with an overvalued currency and unimpressive technological dynamics. Argentina may be a quintessential case of an economy that was fairly sophisticated 40 years ago but failed to develop its technological capacity.

On a less optimistic note, there is year-to-year consistency at the very bottom of the rankings, with three of the final four spots among the 58 countries covered in 2000 still occupied by Ecuador, Ukraine, and Zimbabwe, all countries facing ongoing macroeconomic disorder with

Figure 1: Partial regression results of GCI versus 1992–2000 GDP per capita growth, controlling for initial GDP level*



*More precisely, growth here is measured as the average annual change in the GDP GAP with the United States from 1992 to 2000 (1995 to 2000 for transition economies), as explained in the methodology section of this chapter.

little positive growth prospect in sight. Joining Ukraine toward the bottom of list, Russia continues to suffer the consequences of decades of economic mismanagement under Soviet rule and the haphazard process of economic change since 1991. Although it has moved up two slots, it remains very low, and this year is in the 52nd position.

Looking at the 17 countries added to this year's expanded GCI sample, one finds some interesting results. The top-scoring new entrant is Estonia, ranking 29th overall and well ahead of its Baltic neighbors Lithuania at 43rd and Latvia at 47th. The Caribbean economies of Trinidad and Tobago and Jamaica also provide noteworthy results, ranking 38th and 52nd respectively. Romania, a new addition at 56th, comes slightly behind. The members of the largest geographic group of new additions to the GCR—Latin American economies—have their economic difficulties reflected in generally low rankings. Honduras at 70th, Paraguay at 72nd, and Nicaragua at 73rd occupy three of the bottom six rankings. Guatemala, at 66th, is not far ahead. The relative bright spots among the newly included Latin American countries are found in Uruguay (46th), the Dominican Republic (50th) and Panama (53rd). Interspersed among these rankings are Latin American economies included in previous years' *Reports*: El Salvador (58th), Venezuela (62nd), Colombia (65th), and Bolivia (67th).

The Growth Competitiveness Index and economic growth

The goal of the GCI is to capture important factors in economic growth over roughly a five-year perspective. Of course, we cannot test the GCI for 2001 based on future growth, so instead we examine whether the GCI helps to account for patterns of growth during the recent past and then extrapolate into the future. Specifically, we examine the relationship between the GCI and economic growth from 1992 to 2000. The basic test equation explains annual economic growth over this period as a function of the country's GCI score and its initial level of income in 1992 (on the grounds that poorer countries, all other things equal, will tend to grow faster). As shown in Figure 1, the GCI has a strong relationship with recent economic growth, controlling for initial income level. (The same test reveals, as expected, that countries that began the 1990s relatively poorer achieved faster average growth over the period than their wealthier counterparts.) Of course, the real proof of the pudding for the GCI will be whether the Index helps account for future rather than past growth!

Interpreting the Growth Competitiveness Index

Although changes in the GCI rankings are informative, several points need to be established in order to ensure proper interpretation of the Index. First, as mentioned, the underlying methodology of the Index has been updated since last year, so year-to-year comparisons are not exact. Second, as also outlined above, the growth prospects of an economy depend not only on the GCI score but also on the level of per capita income. The catch-up effect is not included within the GCI itself, so a poor country with a low GCI might still have good growth prospects because it has room to "catch up" relative to a richer country with a somewhat higher GCI score.

Third, GCI rankings should not be confused with GCI scores. The difference in growth prospects for economies, say, five spots apart from one another on the rankings are not the same at all points on the GCI distribution. For instance, Finland's top GCI score of 6.03 is roughly 0.3 greater than Australia's 5th place score, whereas New Zealand's 10th place score of 5.53 is only 0.1 greater than Switzerland's 15th ranked value of 5.43. In an even tighter bunching, Panama's 53rd place score of 3.88 is barely different from El Salvador's value five slots lower at 3.84.

Fourth, the maximum possible score on the GCI is 7; the lowest is 1. All component variables, whether taken from the GCR Executive Opinion Survey or from hard data sources, have been re-based so that the "top" score is always equal to 7 and the "lowest" score is always to 1. Based on our statistical analysis, for two economies at the same level of per capita income, an increase of one point in GCI score (on the 1-to-7 scale) is linked, on average, to a rise of the growth rate of slightly more than 3 percentage points per annum. Conversely, the GCI implies that two economies with similar scores but different starting income levels will have different growth rates. For example, an economy with GDP per capita of $10,000 and a GCI score of 5 is predicted to grow, on average, nearly 2 percentage points faster per year than an economy with GDP per capita of $20,000 and the same GCI score of 5.

Fifth, although we and our colleagues at the Center for International Development at Harvard have spent a great amount of time studying such important growth factors as climate and proximity to markets, these geographical factors are not directly included in the GCI. Geographical factors do appear indirectly, because they affect industrial structure and other economic variables that are included in the Index. We want to stress, however, the importance and relative neglect of these geographical factors. The Baltic countries, for instance, with their seaport access and proximity to Western European markets, have an intrinsic advantage—independent of their policies—over land-locked economies in South America or economies such as Nigeria that have ample ocean access but no major export markets nearby. Similarly, Mexico has an intrinsic growth advantage over Argentina, and Poland over Romania. At the same time, New Zealand has very strong institutional, macroeconomic, and technological prospects for growth, as evidenced by its top-10 ranking on this year's Index, but it is located thousands of miles from most major markets, with the minor exception of Australia. We hope in future studies to incorporate these factors more directly in the GCI.

Sixth, there are fundamental limitations to the statistical analysis of medium-term growth. Regression tools allow us to capture and estimate the effects of numerous factors across a wide range of economies, but the range of countries with available data is inherently small and the period available for analysis is unfortunately short. Individual countries have specific characteristics that will inevitably be missed in our cross-sectional research, which relies on averages and trends. Also, our unit of analysis—the national economy—is blunt. The economies in our sample range from small and homogeneous societies such as Iceland, with a population of fewer than 300,000, to the massive and diverse countries of India and China, each with more than one billion people and an incredible internal diversity. The GCI does not account for these internal variations in growth prospects.

Finally, one must be sure not to confuse the last places on the GCI ranking with the worst growth prospects in the world. There are more than 150 countries around the world with populations of greater than one million. In this study we cover only 74 of those plus Iceland. We do not yet include the other 75 economies due to problems in collecting data, problems that are often highly related to the lack of economic development and growth competitiveness. The countries that occupy the last few spots of the GCI are far from lost causes—they merely represent the economies with the most policy work to do among our sample of countries. They also represent the countries with the greatest opportunity for "catch-up" growth as described above. Nigeria, for example, as the most populous country in Africa, stands truly at the dawn of a new economic and political era and, despite its fragile policy environment, could make great strides in economic development with good domestic policies and international help. Rather than seeing a low score on the ranking as cause for despair, we would instead hope that policymakers and business leaders will view the information contained in this report as a useful means to identify policy priorities and, in the future, to benchmark the success of new initiatives. Indeed, regardless of national income level, we aim for the information contained in the GCI to help policymakers and private-sector representatives in every country identify their national priorities as they seek to enhance their citizens' levels of economic welfare.

A brief comment on the United States

With the United States in slowdown, all eyes are on the country for clues about economic prospects in the coming few years. Will the United States go into a deep and prolonged slump, as Japan did after the bursting of its financial bubble in the early 1990s? Will it recover fairly quickly and resume its dynamic growth of the second half of the 1990s? Although we are reluctant to make short-term forecasts, especially given the purposes of the GCI, we stress that the underlying competitiveness of the United States economy remains very strong, auguring well over a five-year perspective. Of course, there are some notable blemishes that merit our attention.

The United States is in a slowdown now related to the end of a huge wave of investment in ICT capital stock. There are three reasons for the slowdown. First, after an enormous building period in information technology, companies are taking a breather in their ICT investments. They have no need to keep accumulating IT equipment as rapidly as they did in the second half of the 1990s. Second, the roll out of high bandwidth applications is certainly proceeding more slowly than expected just a few years ago. Third, the United States experienced a financial bubble when optimism about the IT revolution led to a euphoric overpricing of the technology sector. The risks of the US bubble have been evident for years, even before the stock market crash of 2000–2001. In mid-1998, the *Global Competitiveness Report* warned about the apparent overvaluation of the stock market.[iv] The worry was repeated in the 1999 GCR, when we wrote, "Everybody with sufficient stock market holdings feels rich and very clever. . . . Our best guess is that they will feel a little less clever in a year's time,"[v] a view that was vindicated by the subsequent end of the bubble beginning in the spring of 2000.

Does the bursting of the bubble undermine the case for the competitiveness of the United States? Not really, if we take a view over five or more years. The dynamism of the US economy remains tremendous. The flexibility of labor markets, ease of startups, technological prowess, and fiscal balance are all very strong. The financial sector appears to be sound, even after the collapse of the bubble, though undoubtedly there will be a stream of bad news as some heavily indebted enterprises go under. It seems unlikely to us that the United States will therefore enter into a prolonged slump of the sort that afflicted Japan in the 1990s. It is notable that Japan's competitiveness ranking has always been much lower than that of the United States in the past five years, and continues to be much lower in this year's *Report*.

The United States does have its relative weaknesses, however. Although the United States ranks second overall, this is a reflection of extraordinary strength in technology, combined with notably lower scores on the other two GCI component indexes. On the macroeconomic environment index, it rates seventh, somewhat behind the top countries of Singapore and Ireland. On the public institutions index, it ranks even lower, placing 12th, with a score roughly comparable with those of Hong Kong SAR and Israel. On more specific points, the dollar is surely overvalued relative to the euro. The rule of law is not as strong as Americans sometimes assume, as evidenced by 11th place ranking on the US corruption subindex and 17th place ranking on its measure of contracts and law. The low placing on the latter measure is due to poor scores on Executive Opinion Survey questions relating to government neutrality in public contracts and policy (18th overall) and a 22nd place ranking on the business costs imposed by organized crime. Note that this latter ranking is roughly the same as last year's, when the United States scored 25th on the same question.

Perhaps most notably, and somewhat notoriously, the United States is an unequal society, with huge perceived (and likely quite real) discrepancies between services enjoyed by the rich and the poor. In our Executive Opinion Survey question that asks about the difference in health care availability for the rich and poor, the United States scores 27th, behind Estonia and just ahead of Malaysia. In a parallel question that asks about discrepancies in schools available for rich versus poor children, the United States ranks even worse at 43rd, after Russia and barely above Uruguay. These Survey results highlight the inequalities in the United States when compared with inequalities in other countries, especially those in Western Europe, where the social welfare state is far more inclusive and therefore the quality of public services compared with private services also considered to be quite high. It is notable that Finland, the top country in this year's GCI, ranks best in the world on the measure of perceived educational equality and third on the measure of health care equality. Thus, Finland has achieved a technologically sophisticated economy with a high degree of social equality as well.

METHODOLOGY BEHIND THE GROWTH COMPETITIVENESS INDEX

As outlined in the previous section, because of the different growth trajectories that economies typically face at different levels of development, a fundamental issue must be considered when assessing growth competitiveness around the world: Different growth factors play different roles at different stages of development.[vi] Our research has suggested that public institutions, for instance, play a more crucial role at low and middle levels of development than they do at high levels, where economies tend to have less variation in institutional quality and a satisfactory threshold of organizational efficiency has already been met. Likewise, once overall macroeconomic stability is achieved, including sustainable fiscal balances and a healthy banking system with broad access to credit, "increased" stability becomes difficult to measure and its benefits become less pronounced.

Technology plays a key role in all stages of development. But again, the means through which technological progress occurs, and the conditions conducive to its advance, will vary at different levels of development. At low levels of development, growth competitiveness is achieved mainly through the effective exploitation of land, primary commodities, and unskilled labor. As economies move from low- to middle-income status, competitiveness is increasingly achieved by harnessing global technologies to local production. Foreign direct investment, joint ventures, and outsourcing arrangements help to integrate the national economy into international production systems, thereby facilitating the improvement of technologies and the inflows of foreign capital that support economic growth. The transition from middle-income to high-income status involves a transition from a technology-importing economy to a technology-generating economy, from technological adoption to innovation. At high levels of income, global competitiveness depends on innovation, high rates of social learning, and rapid adaptability to new technologies.

By adding 17 countries to our analysis since last year's GCR, we have significantly expanded our competitiveness research capacity. Most of the economies added to the GCR are middle-income developing countries, so including them provides more information about economic growth in the non-core economies. We should reiterate that the inherently backward-looking nature of empirical economic research poses a fundamental limitation in projecting future growth rates. The patterns that typified growth in the 1990s are not exactly the same as those that characterized growth in the 1960s or even the 1970s, and one can never fully predict what future technological innovations or revolutions will transform economic dynamics around the world. Despite these limitations, we *have* found growth trends from the past decade that are strikingly clear and thus not likely to change dramatically over the coming five years. These are the trends that inform our analysis and give rise to the growth forecast represented by the GCI.

The steps of our methodology in uncovering and determining relative weights for these trends are as follows:

1. First, for our 1990s economic analysis, we divided our sample of 75 economies into core and non-core groups based on an objective measure of their level of technological sophistication: the 1980s average annual number of utility patents registered in the United States per million population. This variable has strengths and weaknesses as a general indicator of technology, but it does help to provide a clear grouping of the economies that were registering technological advances—at an international standard—at the beginning of the 1990s. By this criterion, we identified 18 core economies with more than 15 US utility patents granted per million population in the 1980s. These were Switzerland, the United States, Japan, Sweden, Germany, the Netherlands, Canada, the United Kingdom, France, Israel, Austria, Finland, Denmark, Belgium, Norway, Australia, Italy, and New Zealand. Table 1 lists the economies included in the 1980s core and also those that achieved the core criterion by 2000 and were hence counted as core economies in calculations for this year's GCI.

2. As a second step, we calculated the 1992 and 2000 levels of Gross Domestic Product (GDP) per capita, measured at purchasing power parity (PPP), for all 75 countries in our sample, with the exception of the former Eastern Bloc transition economies, for which we calculated 1995 levels. We then calculated the ratio of each country's GDP per capita PPP to US GDP per capita PPP in both 1992 (1995 for the transition economies) and 2000, and calculated the average annual change in the ratio over that period as our measure of economic growth. As a shorthand, we call this ratio to US GDP the *GDP GAP*. We chose 1992 as a starting point, since it marks the end of the last major industrialized world recession and removes business cycle fluctuations that might otherwise distort the analysis of growth rates. For the transition economies, we selected 1995 in order to avoid incorporating the general negative growth that occurred during the first years of those economies' post-communism adjustment period.

3. Third, drawing on the economic growth literature and our own research at CID, we constructed more than a dozen subindexes to test their links with economic growth (as defined above). The indexes were typically comprised of both "hard" and "soft" data, the latter coming from the results of the Executive Opinion Survey. Using these subindexes, and testing them in a variety of specifications, we created indexes for three broad factors that were linked to economic growth in the 1990s: the quality of public institutions, the macroeconomic environment, and technology. As we have already stressed, these three factors are interwoven—strong institutions, for example, are needed for technological development to occur; a sophisticated technology base will contribute greatly to macroeconomic stability—but they do each have close and statistically distinct relationships with recent trends in economic growth. Measurements for each of these three pillars of growth, as well as their weightings in the GCI, are given below.

4. We then combined the component indexes into the overall GCI. For the core economies, our statistical analysis suggested we should place extra emphasis on the role of innovation and technology. Accordingly, the weightings for the core economies were as follows:

Core GCI = 1/2 technology index
+ 1/4 public institutions index
+ 1/4 macroeconomic environment index.

Meanwhile, for the non-core economies, our statistical analysis suggested a more balanced weighting between technology, institutions, and macroeconomic conditions. We therefore calculated GCI values for these countries as a simple average of the three component indexes:

Non-core GCI = 1/3 technology index
+ 1/3 public institutions index
+ 1/3 macroeconomic environment index.

As noted above, for Ireland, Singapore, and Hong Kong SAR—economies in transition from non-core to core status—we averaged their core GCI and non-core GCI scores to calculate an overall score.

Fourth, we examined the relationship between the GCI and growth during 1992 to 2000 using the following growth equation:

Average Annual Change in GAP = $ß_0 + ß_1 \times GCI + ß_2 \times$ natural log (percentage GDP GAP in 1992)[vii]

The results of this regression equation were displayed in Figure 1.[viii] We now turn to a more detailed discussion of the subcomponents of the overall Index.

Technology

Capturing the various processes of technological development forms a central challenge of our competitiveness research. Constructing measures that are precise enough to represent trends in specific countries yet broad enough to allow global comparability is a long-term research endeavor in which we are still in the early stages. Nonetheless, in the preparation of this year's *Report* we have investigated and developed technology indicators that provide a crucial advance in the evolution of global competitiveness comparisons. Since the core and non-core technology economies follow distinctly different processes of technological development, we have developed respective measures of technology that are used in competitiveness calculations for each group.

Technology in the core economies

For the core economies, the technology index is a simple average of an innovation subindex and an information and communication technology (ICT) subindex, both of which are comprised of hard and soft data. (The reader should note that the innovation subindex presented here is different from the "innovative capacity index" constructed by Michael E Porter and Scott Stern in Chapter 2.2 of this *Report*. That measure seeks to explain the underlying factors that contribute to innovation as measured by patents. The innovation subindex here seeks to explain the elements of innovation, such as patents, that are linked measurably to growth.) Using a simple linear transformation, the hard data were converted to a 1-to-7 scale so that they could be easily merged with the Executive Opinion Survey questions, most of which have possible responses on a range of 1 to 7, with 1 being the low score and 7 the high score.[ix] The precise composition of the technology index is outlined in Box 2.

Box 2: Technology index components

Technological core economies

core technology index = 1/2 innovation subindex
+ 1/2 ICT subindex.

Technological non-core economies

non-core technology index = 1/8 innovation subindex
+ 3/8 technology transfer subindex
+ 1/2 ICT subindex.

1. Innovation subindex

innovation subindex = 1/4 Survey data + 3/4 hard data.

innovation Survey questions

3.01 What is your country's position in technology relative to world leaders?
3.02 Does continuous innovation play a major role in generating revenue for your business?
3.06 How much do companies in your country spend on R&D relative to other countries?
3.09 What is the extent of business collaboration in R&D with local universities?

innovation hard data

3.16 US Utility Patents Granted per million population in 2000
3.19 Gross Tertiary Enrollment Rate in 1997*

2. Technology transfer subindex

technology transfer subindex = 1/2 technology transfer Survey question
+ 1/2 technology-in-trade residual.

3.04 Is foreign direct investment in your country an important source of new technology?
3.23 Technology-in-trade residual in 1999*

* Or latest available year.

3. Information and communication technology subindex

ICT subindex = 1/3 ICT Survey data + 2/3 ICT hard data

ICT Survey questions

4.03 How extensive is Internet access in schools?
4.07 Is competition among ISPs sufficient to ensure high quality, infrequent interruptions and low prices?
4.08 Is ICT an overall priority for the government?
4.09 Are government programs successful in promoting the use of ICT?
4.11 Are laws relating to ICT (electronic commerce, digital signatures, consumer protection) well developed and enforced?

ICT hard data

4.13 Number of mobile telephone users per capita
4.14 Number of Internet users per capita
4.15 Number of Internet hosts per capita
4.16 Number of telephone mainlines per capita
4.17 Number of personal computers per capita

Innovation subindex

When considering economic growth, a measure of innovation is central to measuring levels of technological sophistication in the core economies. Innovation is a product of many factors, but foremost among these are skilled human resources, well-developed market incentive structures for science, and intensive interaction between scientific and business sectors. The innovation measure aims to capture many of these processes through the use of hard and Survey data. On the hard side, we include two variables: US utility patents granted per million population and gross tertiary enrollment rates.

Patents are not a perfect measure of innovation, since they do not distinguish between very minor innovations that are simply technological refinements and major innovations that revolutionize a field. However, on average they present a very useful measure of innovation intensity in an economy and, to some extent, of the frequency with which innovations are taken to market rather than simply left in a laboratory. Tertiary education enrollment rates form a similarly broad but useful measure. They do not tell us the specific skill composition of a workforce, nor the precise number of product and process innovators in an economy, but they do provide a sound indication of a country's capacity to develop new technology and products at all levels of its economy. In fact, when performing statistical tests in which different variables were assessed in terms of their relationship with 1990s growth in the core economies, tertiary enrollment rates were found to be the variable most closely linked to high growth in the 1990s. We hence placed a greater weighting on it (3/4) than on patents (1/4) in the construction of the hard data portion of the innovation subindex.

The Survey questions incorporated in the innovation subindex form broad indicators of technological sophistication and product development. As shown in Box 2, the innovation subindex blends the hard data score with average country Survey scores from questions on the overall level of technology in the economy, the role of continuous innovation in generating revenue, company R&D spending relative to international peers, and private sector R&D collaboration with local universities. The overall innovation subindex places a 3/4 weight on the hard data and 1/4 weight on the soft data.

Innovation subindex scores and rankings are listed for the full sample in Table 4 and for only the core in Table 6A. In both tables, one sees that Canada is ranked first among the core economies, just slightly ahead of the United States, while Hong Kong, Iceland, and Ireland occupy the bottom positions. The greatest driving factor on these rankings is gross tertiary enrollment, a measure on which Canada's 88 percent ratio is the highest in the world by a significant margin.[x] The United States has the second-highest ratio at 81 percent and Australia the

Table 4: Innovation subindex

innovation subindex = 3/4 hard data score + 1/4 Survey data score

Country	Innovation Subindex	Rank
Canada	6.51	1
United States	6.50	2
Taiwan	6.37	3
Finland	6.12	4
Australia	5.96	5
Korea	5.46	6
Norway	5.27	7
Belgium	5.19	8
Sweden	5.17	9
New Zealand	5.11	10
United Kingdom	5.02	11
France	5.01	12
Germany	4.98	13
Netherlands	4.88	14
Denmark	4.83	15
Austria	4.81	16
Japan	4.74	17
Israel	4.71	18
Singapore	4.48	19
Spain	4.48	20
Italy	4.47	21
Switzerland	4.44	22
Ireland	4.43	23
Iceland	4.35	24
Greece	3.95	25
Estonia	3.94	26
Slovenia	3.80	27
Russia	3.72	28
Hong Kong SAR	3.67	29
Argentina	3.61	30
Portugal	3.58	31
Costa Rica	3.51	32
Ukraine	3.48	33
Chile	3.41	34
Hungary	3.30	35
Latvia	3.29	36
Panama	3.24	37
Czech Republic	3.24	38
Bulgaria	3.19	39
South Africa	3.10	40
Uruguay	3.03	41
Venezuela	3.01	42
Poland	2.98	43
Slovak Republic	2.97	44
Philippines	2.80	45
Dominican Republic	2.78	46
Thailand	2.77	47
Lithuania	2.76	48
Brazil	2.66	49
Malaysia	2.64	50
Peru	2.62	51
Mexico	2.61	52
Romania	2.51	53
Bolivia	2.50	54
Egypt	2.47	55
Turkey	2.45	56
Colombia	2.39	57
Jamaica	2.29	58
Ecuador	2.25	59
Jordan	2.25	60
India	2.16	61
El Salvador	2.08	62
China	2.07	63
Indonesia	2.06	64
Guatemala	2.00	65
Honduras	1.96	66
Trinidad and Tobago	1.94	67
Nicaragua	1.83	68
Sri Lanka	1.81	69
Vietnam	1.77	70
Zimbabwe	1.75	71
Paraguay	1.74	72
Mauritius	1.71	73
Nigeria	1.66	74
Bangladesh	1.57	75

Country	Innovation Hard Data Score	Rank
Canada	6.84	1
Taiwan*	6.76	2
United States	6.63	3
Australia	6.24	4
Finland	6.12	5
Korea	5.69	6
Norway	5.34	7
New Zealand	5.27	8
Belgium	5.07	9
Sweden	4.89	10
United Kingdom	4.84	11
France	4.78	12
Germany	4.67	13
Denmark	4.66	14
Austria	4.62	15
Netherlands	4.61	16
Spain	4.45	17
Italy	4.44	18
Japan	4.42	19
Israel	4.35	20
Ireland	4.13	21
Singapore	4.08	22
Iceland	4.04	23
Greece	3.99	24
Switzerland	3.94	25
Estonia	3.80	26
Russia	3.73	27
Slovenia	3.65	28
Argentina	3.55	29
Portugal	3.49	30
Ukraine	3.47	31
Hong Kong SAR	3.29	32
Bulgaria	3.29	33
Costa Rica	3.25	34
Chile	3.08	35
Latvia	3.05	36
Panama	3.03	37
Hungary	2.85	38
Venezuela	2.80	39
Uruguay	2.79	40
Czech Republic	2.78	41
Poland	2.55	42
South Africa	2.55	43
Slovak Republic	2.53	44
Bolivia	2.46	45
Dominican Republic	2.46	46
Lithuania	2.46	47
Philippines	2.39	48
Peru	2.38	49
Thailand	2.36	50
Romania	2.33	51
Mexico	2.21	52
Egypt	2.15	53
Malaysia	2.11	54
Turkey	2.09	55
Brazil	2.08	56
Colombia	2.03	57
Ecuador	2.01	58
Jamaica	1.76	59
Jordan	1.73	60
El Salvador	1.73	61
Honduras	1.64	62
Guatemala	1.58	63
India	1.44	64
Indonesia	1.44	65
Nicaragua	1.40	66
China	1.35	67
Paraguay	1.32	68
Trinidad and Tobago	1.21	69
Sri Lanka	1.21	70
Vietnam	1.14	71
Zimbabwe	1.12	72
Mauritius	1.10	73
Bangladesh	1.09	74
Nigeria	1.00	75

Country	Innovation Survey Data Score	Rank
Finland	6.14	1
United States	6.11	2
Sweden	5.99	3
Switzerland	5.93	4
Germany	5.89	5
Israel	5.79	6
France	5.73	7
Japan	5.72	8
Netherlands	5.70	9
Singapore	5.70	10
United Kingdom	5.55	11
Belgium	5.54	12
Canada	5.51	13
Austria	5.38	14
Denmark	5.35	15
Ireland	5.32	16
Iceland	5.27	17
Taiwan	5.19	18
Australia	5.10	19
Norway	5.06	20
Hong Kong SAR	4.79	21
Korea	4.77	22
South Africa	4.76	23
New Zealand	4.63	24
Hungary	4.63	25
Czech Republic	4.61	26
Italy	4.58	27
Spain	4.56	28
Chile	4.40	29
Brazil	4.38	30
Estonia	4.34	31
Slovak Republic	4.30	32
India	4.29	33
Poland	4.29	34
Costa Rica	4.28	35
Slovenia	4.24	36
China	4.23	37
Malaysia	4.23	38
Trinidad and Tobago	4.14	39
Philippines	4.02	40
Latvia	4.02	41
Thailand	3.98	42
Indonesia	3.91	43
Jamaica	3.87	44
Portugal	3.86	45
Panama	3.85	46
Greece	3.82	47
Mexico	3.80	48
Jordan	3.79	49
Argentina	3.79	50
Dominican Republic	3.75	51
Uruguay	3.74	52
Russia	3.68	53
Vietnam	3.68	54
Lithuania	3.64	55
Nigeria	3.64	56
Zimbabwe	3.63	57
Sri Lanka	3.63	58
Venezuela	3.62	59
Mauritius	3.56	60
Turkey	3.53	61
Ukraine	3.50	62
Colombia	3.47	63
Egypt	3.44	64
Peru	3.34	65
Guatemala	3.26	66
El Salvador	3.14	67
Nicaragua	3.11	68
Romania	3.05	69
Bangladesh	3.01	70
Paraguay	3.00	71
Ecuador	3.00	72
Honduras	2.92	73
Bulgaria	2.89	74
Bolivia	2.61	75

*Note that Taiwan's hard data innovation score is based solely on patent levels, since gross tertiary enrollment data comparable with the other countries is not available.

Table 5: Information and communications technology subindex

ICT subindex = 2/3 hard data score + 1/3 Survey data score

Country	ICT Subindex	Rank
Finland	6.58	1
Iceland	6.47	2
Sweden	6.45	3
Singapore	6.40	4
United States	6.34	5
Norway	6.28	6
Denmark	6.25	7
Canada	6.23	8
Netherlands	6.20	9
Hong Kong SAR	6.19	10
Australia	6.15	11
Switzerland	6.10	12
Austria	6.09	13
United Kingdom	6.09	14
Germany	6.01	15
Taiwan	6.01	16
New Zealand	5.99	17
Ireland	5.97	18
Belgium	5.90	19
Estonia	5.88	20
France	5.87	21
Korea	5.87	22
Israel	5.83	23
Japan	5.82	24
Portugal	5.68	25
Spain	5.63	26
Italy	5.55	27
Slovenia	5.47	28
Czech Republic	5.45	29
Hungary	5.30	30
Slovak Republic	5.26	31
Chile	5.20	32
Malaysia	5.16	33
Uruguay	5.15	34
Greece	5.14	35
Latvia	5.02	36
Poland	4.90	37
Brazil	4.86	38
Argentina	4.84	39
South Africa	4.80	40
Mauritius	4.77	41
Costa Rica	4.69	42
Lithuania	4.67	43
Trinidad and Tobago	4.64	44
Turkey	4.61	45
Mexico	4.60	46
Jamaica	4.57	47
Venezuela	4.51	48
Panama	4.48	49
Bulgaria	4.45	50
Colombia	4.40	51
Jordan	4.26	52
Thailand	4.23	53
Russia	4.16	54
Philippines	4.12	55
China	4.04	56
Dominican Republic	4.02	57
Peru	4.01	58
Romania	4.00	59
El Salvador	3.93	60
Egypt	3.82	61
Ukraine	3.77	62
Ecuador	3.62	63
Paraguay	3.56	64
Bolivia	3.52	65
Guatemala	3.50	66
Indonesia	3.44	67
India	3.43	68
Sri Lanka	3.42	69
Honduras	3.22	70
Nicaragua	3.21	71
Zimbabwe	3.12	72
Vietnam	2.84	73
Nigeria	2.16	74
Bangladesh	1.96	75

Country	ICT Hard Data Score	Rank
Norway	6.83	1
Iceland	6.83	2
Sweden	6.77	3
United States	6.70	4
Denmark	6.69	5
Finland	6.68	6
Switzerland	6.63	7
Netherlands	6.62	8
Australia	6.60	9
Canada	6.57	10
Singapore	6.56	11
Hong Kong SAR	6.56	12
Japan	6.52	13
Taiwan	6.48	14
Austria	6.48	15
Germany	6.46	16
United Kingdom	6.46	17
New Zealand	6.45	18
Ireland	6.38	19
Belgium	6.36	20
Israel	6.30	21
France	6.26	22
Korea	6.23	23
Portugal	6.15	24
Italy	6.15	25
Estonia	6.10	26
Slovenia	6.07	27
Spain	6.01	28
Czech Republic	5.88	29
Greece	5.85	30
Slovak Republic	5.69	31
Hungary	5.66	32
Uruguay	5.62	33
Chile	5.51	34
Malaysia	5.50	35
Latvia	5.48	36
Poland	5.46	37
Argentina	5.31	38
Mauritius	5.29	39
Lithuania	5.22	40
Costa Rica	5.15	41
Trinidad and Tobago	5.11	42
South Africa	5.07	43
Turkey	5.05	44
Brazil	5.04	45
Mexico	4.99	46
Bulgaria	4.94	47
Venezuela	4.85	48
Romania	4.84	49
Jamaica	4.81	50
Panama	4.79	51
Russia	4.66	52
Colombia	4.62	53
Thailand	4.37	54
Peru	4.23	55
Philippines	4.14	56
Jordan	4.10	57
Dominican Republic	4.10	58
China	4.08	59
Ukraine	4.01	60
El Salvador	3.92	61
Paraguay	3.90	62
Ecuador	3.88	63
Bolivia	3.87	64
Guatemala	3.77	65
Egypt	3.61	66
Indonesia	3.44	67
Sri Lanka	3.41	68
Honduras	3.36	69
Nicaragua	3.29	70
Zimbabwe	3.21	71
India	2.86	72
Vietnam	2.64	73
Nigeria	1.66	74
Bangladesh	1.47	75

Country	ICT Survey Data Score	Rank
Finland	6.37	1
Singapore	6.06	2
Sweden	5.82	3
Iceland	5.75	4
United States	5.63	5
Canada	5.55	6
Hong Kong SAR	5.47	7
Estonia	5.45	8
Denmark	5.37	9
United Kingdom	5.37	10
Netherlands	5.36	11
Austria	5.33	12
Australia	5.26	13
Norway	5.18	14
Ireland	5.16	15
Korea	5.15	16
Germany	5.11	17
France	5.09	18
Taiwan	5.07	19
New Zealand	5.06	20
Switzerland	5.05	21
Belgium	4.97	22
Israel	4.88	23
Spain	4.86	24
Portugal	4.73	25
Hungary	4.60	26
Czech Republic	4.59	27
India	4.57	28
Chile	4.57	29
Jordan	4.56	30
Malaysia	4.49	31
Brazil	4.49	32
Japan	4.42	33
Slovak Republic	4.40	34
Italy	4.37	35
Slovenia	4.27	36
South Africa	4.27	37
Egypt	4.24	38
Uruguay	4.21	39
Jamaica	4.11	40
Latvia	4.09	41
Philippines	4.07	42
China	3.96	43
Colombia	3.95	44
Thailand	3.94	45
El Salvador	3.93	46
Argentina	3.92	47
Panama	3.86	48
Dominican Republic	3.86	49
Venezuela	3.84	50
Mexico	3.82	51
Costa Rica	3.78	52
Poland	3.77	53
Turkey	3.75	54
Mauritius	3.73	55
Greece	3.71	56
Trinidad and Tobago	3.71	57
Lithuania	3.58	58
Peru	3.57	59
Bulgaria	3.48	60
Indonesia	3.44	61
Sri Lanka	3.43	62
Ukraine	3.29	63
Vietnam	3.24	64
Nigeria	3.17	65
Russia	3.15	66
Ecuador	3.11	67
Nicaragua	3.05	68
Guatemala	2.97	69
Bangladesh	2.94	70
Zimbabwe	2.94	71
Honduras	2.92	72
Paraguay	2.89	73
Bolivia	2.80	74
Romania	2.34	75

third-highest at 80 percent. Finland, the top European country in this regard, is next at 74 percent. Hong Kong has the lowest ratio among core economies at 22 percent, anchoring it in a low innovation ranking. On the patent measures, the United States and Japan are clearly the world leaders, with 309 and 246 respective US patents granted per million people in 2000. Canada ranks 9th among patent recipients, with 111 per million population in the same year. On the Survey measures of innovation, Finland comes out on top, followed closely by the United States and Sweden. Italy, New Zealand, and Korea meanwhile fill out the bottom side of the same scale, indicating low levels of firm-based innovation and university-business research collaboration in those countries.

Information and communications technology subindex

The ICT subindex is comprised of 2/3 hard data and 1/3 Survey data. The hard data include simple per capita measures of telephone lines, personal computers, Internet usage, Internet hosts, and mobile phone users, as published by the International Telecommunications Union. These data were again combined into an overall 1-to-7 scale that was in turn merged with Survey questions regarding ICT usage and government policies, as outlined in Box 2.

Table 5 shows the ICT subindex scores, with the Scandinavian countries occupying three of the top six positions. Finland takes the top spot by virtue of its highest average score on the Survey questions along with a high ranking on the hard measures of ICT, reflecting the overall prioritization of communications technology in that economy. Notably, Norway has the highest combined score on the hard ICT variables, followed closely by Iceland and Sweden. Last among the core economies on the overall ICT scores are Israel, Japan, and Italy, each of which have a low ranking among the core on hard measures of connectivity. These three countries score particularly poorly, however, on the survey measures of ICT, suggesting less of an emphasis on ICT in the public policies of these economies.

To form the overall core-economy technology index, the ICT subindex is averaged with the innovation subindex. The results are presented in Table 6A, which lists technology rankings for the core separately from the non-core. The United States ranks as the global technological leader, followed by Canada, Finland, and Taiwan. Note that this ranking represents a broad measure of technology, reflecting current ICT infrastructure, recent history of scientific innovation and product innovation, human resource potential for future innovation, and the policy environment for future scientific and product discovery. Several western European economies, including Germany, France, Austria, and Belgium, are tightly clustered in the middle of the group, all lagging behind their Scandinavian neighbors. Impressively, Korea and Taiwan, two countries that were not among the core in the 1980s, both rank among the top 8 economies on this measure in 2001. Singapore, with its large push to develop local technological capacity, ranks just behind France. Further behind are Hong Kong and Ireland, two economies that, despite their fast growth, have not yet reached the top global tier of technological innovation processes.

Technology in the non-core economies

For countries that have not yet reached the stage of global technological competitiveness, one needs a measure of how quickly they are absorbing and implementing internationally competitive production technologies from the most sophisticated economies. To do this, we used the United Nations' COMTRADE database and also Statistics Canada's *World Trade Analyzer* to create a variable that measures the extent of manufacturing technology in the export structure of non-core economies. Countries with a technology-based export sector are judged to be more adept, in general, at absorbing technologies from abroad than economies with a primary commodity–based export structure. Regression analysis confirms strongly that, all other things equal, primary commodity–based economies indeed grew less rapidly in the past decade (and since 1970) than did more technology-based export economies.

To construct the technology-in-trade variable, we first calculated the average value of non-primary product exports as a proportion of GDP throughout the 1990s. To ensure the broadest possible reference base, we calculated this not just for the GCR sample, but also for the more than 100 countries for which detailed international trade data are available. Non-primary exports were defined to include most processed textiles and manufactured goods, but not mining products or processed raw materials.[xi] We then regressed the natural logarithm of the average 1990s value of non-primary exports as a percent of GDP on the natural logarithm of national population in the same period, and then converted the residual to a 1-to-7 scale, as with our other hard data.[xii] This *trade residual* term is important because small economies are inherently more open to trade, so when measuring extent of trade one needs to control for the size of an economy to understand the underlying variation in its trade performance.

The technology transfer subindex was created by averaging the technology-in-trade variable with a Survey question on the extent to which foreign direct investment "is an important source of new technology." This technology transfer subindex was then given a 3/8 weight against a 1/8 weight for the innovation subindex and a 4/8 weight for the ICT subindex to create non-core values on the overall technology index. The rationale for the various technology weightings merits a brief explanation. In our simple least squares regression analysis, we found that,

Table 6A: Technological core economies

Country	Technology Index	Core Rank	Country	Innovation Subindex	Core Rank	Country	ICT Subindex	Core Rank
United States	6.42	1	Canada	6.51	1	Finland	6.58	1
Canada	6.37	2	United States	6.50	2	Iceland	6.47	2
Finland	6.35	3	Taiwan	6.37	3	Sweden	6.45	3
Taiwan	6.19	4	Finland	6.12	4	Singapore	6.40	4
Australia	6.05	5	Australia	5.96	5	United States	6.34	5
Sweden	5.81	6	Korea	5.46	6	Norway	6.28	6
Norway	5.77	7	Norway	5.27	7	Denmark	6.25	7
Korea	5.66	8	Belgium	5.19	8	Canada	6.23	8
United Kingdom	5.56	9	Sweden	5.17	9	Netherlands	6.20	9
New Zealand	5.55	10	New Zealand	5.11	10	Hong Kong SAR	6.19	10
Denmark	5.54	11	United Kingdom	5.02	11	Australia	6.15	11
Belgium	5.54	12	France	5.01	12	Switzerland	6.10	12
Netherlands	5.54	13	Germany	4.98	13	Austria	6.09	13
Germany	5.49	14	Netherlands	4.88	14	United Kingdom	6.09	14
Austria	5.45	15	Denmark	4.83	15	Germany	6.01	15
France	5.44	16	Austria	4.81	16	Taiwan	6.01	16
Singapore	5.44	17	Japan	4.74	17	New Zealand	5.99	17
Iceland	5.41	18	Israel	4.71	18	Ireland	5.97	18
Japan	5.28	19	Singapore	4.48	19	Belgium	5.90	19
Switzerland	5.27	20	Italy	4.47	20	France	5.87	20
Israel	5.27	21	Switzerland	4.44	21	Korea	5.87	21
Ireland	5.20	22	Ireland	4.43	22	Israel	5.83	22
Italy	5.01	23	Iceland	4.35	23	Japan	5.82	23
Hong Kong SAR	4.93	24	Hong Kong SAR	3.67	24	Italy	5.55	24

Table 6B: Technological transition economies

Country	Technology Index	Rank Among Non-core Economies	Country	Innovation Subindex	Rank Among Non-core Economies	Country	ICT Subindex	Rank Among Non-core Economies	Country	Technology Transfer Subindex	Rank Among Non-core Economies
Singapore	6.26	1	Singapore	4.48	1	Singapore	6.40	1	Singapore	6.67	1
Ireland	5.96	2	Ireland	4.43	3	Hong Kong SAR	6.19	2	Ireland	6.46	3
Hong Kong SAR	5.93	3	Hong Kong SAR	3.67	8	Ireland	5.97	3	Hong Kong SAR	6.32	4

among the technology variables, ICT was linked to approximately half of the variation in average annual growth, so we gave it a corresponding weight in the technology index. Calculating the remainder of technology transfer and innovation subindexes was slightly more complicated. Using a statistical tool known as nonlinear least squares, we estimated the relative weights on innovation relative to technology transfer, and found an almost perfectly symmetrical result for the core and non-core. With the average annual 1992 to 2000 change in the per capita GDP GAP still as the dependent variable, for the core economies we found our measure of innovation to merit a weighting of 0.85 relative to technology transfer. This result and other statistical tests not reported here supported our emphasis on innovation in the core technology index.[xiii] For the non-core economies, we found that technology transfer merited a weighting of 0.81 relative to innovation. Given the small sample, the relatively short time period covered in this assessment, the other variables affecting growth that are not included in our model, and our general hesitation to place too much emphasis on any single factor in the development process, we scale back the coefficient on technology transfer to 0.75 in our GCR calculations.

In Table 6B, we present the technology index results obtained for the technological transition economies—Hong Kong SAR, Ireland, and Singapore—when they are considered non-core economies. In clear contrast to their rankings on the innovation-based core technology index, these economies score significantly ahead of the rest of the non-core economies when a technology transfer approach is used to assess their technological competitiveness. In Table 6C, we rank only the non-core economies as defined by 2000 patent levels. Notable on this list are the countries ranked 1st through 3rd: Estonia, the Czech Republic, and Hungary. Each of these economies has adopted manufacturing-based export-led growth strategies, and the success of those policies is clearly reflected in their index scores.

Portugal and Spain are also of significant interest. Both of these economies have enjoyed average real per capita growth rates of more than 3 percent over the past five years, but neither has been a tremendously successful innovator. Neither has a sufficient patenting rate to be included among the European core economies, and neither ranks among the top 15 non-core skilled manufacturing exporters. Through their close links with the rest of Western Europe, these economies do have high ICT scores, results that bolster their overall technology scores.

Table 6C: Technological non-core economies

Country	Technology Index	Non-core Rank
Estonia	5.68	1
Czech Republic	5.39	2
Hungary	5.39	3
Malaysia	5.36	4
Portugal	5.27	5
Spain	5.23	6
Slovak Republic	5.18	7
Slovenia	5.18	8
Costa Rica	4.97	9
Latvia	4.83	10
Poland	4.75	11
Mexico	4.70	12
Mauritius	4.67	13
Greece	4.62	14
Thailand	4.54	15
Philippines	4.53	16
Lithuania	4.46	17
Chile	4.45	18
Jamaica	4.43	19
Dominican Republic	4.42	20
Uruguay	4.40	21
South Africa	4.39	22
Romania	4.33	23
Argentina	4.33	24
Brazil	4.33	25
Bulgaria	4.32	26
Turkey	4.28	27
Trinidad and Tobago	4.10	28
China	4.05	29
Jordan	3.99	30
Venezuela	3.98	31
Colombia	3.92	32
Panama	3.89	33
El Salvador	3.86	34
Sri Lanka	3.82	35
Russia	3.78	36
Indonesia	3.76	37
Peru	3.71	38
Ukraine	3.68	39
Egypt	3.59	40
Vietnam	3.56	41
India	3.54	42
Bolivia	3.52	43
Guatemala	3.38	44
Ecuador	3.33	45
Honduras	3.29	46
Nicaragua	3.21	47
Zimbabwe	3.20	48
Paraguay	2.98	49
Bangladesh	2.83	50
Nigeria	2.44	51

Country	Innovation Subindex	Non-core Rank
Spain	4.48	1
Greece	3.95	2
Estonia	3.94	3
Slovenia	3.80	4
Russia	3.72	5
Argentina	3.61	6
Portugal	3.58	7
Costa Rica	3.51	8
Ukraine	3.48	9
Chile	3.41	10
Hungary	3.30	11
Latvia	3.29	12
Panama	3.24	13
Czech Republic	3.24	14
Bulgaria	3.19	15
South Africa	3.10	16
Uruguay	3.03	17
Venezuela	3.01	18
Poland	2.98	19
Slovak Republic	2.97	20
Philippines	2.80	21
Dominican Republic	2.78	22
Thailand	2.77	23
Lithuania	2.76	24
Brazil	2.66	25
Malaysia	2.64	26
Peru	2.62	27
Mexico	2.61	28
Romania	2.51	29
Bolivia	2.50	30
Egypt	2.47	31
Turkey	2.45	32
Colombia	2.39	33
Jamaica	2.29	34
Ecuador	2.25	35
Jordan	2.25	36
India	2.16	37
El Salvador	2.08	38
China	2.07	39
Indonesia	2.06	40
Guatemala	2.00	41
Honduras	1.96	42
Trinidad and Tobago	1.94	43
Nicaragua	1.83	44
Sri Lanka	1.81	45
Vietnam	1.77	46
Zimbabwe	1.75	47
Paraguay	1.74	48
Mauritius	1.71	49
Nigeria	1.66	50
Bangladesh	1.57	51

Country	ICT Subindex	Non-core Rank
Estonia	5.88	1
Portugal	5.68	2
Spain	5.63	3
Slovenia	5.47	4
Czech Republic	5.45	5
Hungary	5.30	6
Slovak Republic	5.26	7
Chile	5.20	8
Malaysia	5.16	9
Uruguay	5.15	10
Greece	5.14	11
Latvia	5.02	12
Poland	4.90	13
Brazil	4.86	14
Argentina	4.84	15
South Africa	4.80	16
Mauritius	4.77	17
Costa Rica	4.69	18
Lithuania	4.67	19
Trinidad and Tobago	4.64	20
Turkey	4.61	21
Mexico	4.60	22
Jamaica	4.57	23
Venezuela	4.51	24
Panama	4.48	25
Bulgaria	4.45	26
Colombia	4.40	27
Jordan	4.26	28
Thailand	4.23	29
Russia	4.16	30
Philippines	4.12	31
China	4.04	32
Dominican Republic	4.02	33
Peru	4.01	34
Romania	4.00	35
El Salvador	3.93	36
Egypt	3.82	37
Ukraine	3.77	38
Ecuador	3.62	39
Paraguay	3.56	40
Bolivia	3.52	41
Guatemala	3.50	42
Indonesia	3.44	43
India	3.43	44
Sri Lanka	3.42	45
Honduras	3.22	46
Nicaragua	3.21	47
Zimbabwe	3.12	48
Vietnam	2.84	49
Nigeria	2.16	50
Bangladesh	1.96	51

Country	Technology Transfer Subindex	Non-core Rank
Malaysia	6.54	1
Hungary	6.19	2
Czech Republic	6.03	3
Estonia	5.98	4
Costa Rica	5.84	5
Slovak Republic	5.81	6
Philippines	5.65	7
Thailand	5.56	8
Mexico	5.53	9
Mauritius	5.52	10
Dominican Republic	5.50	11
Romania	5.37	12
Portugal	5.28	13
Slovenia	5.24	14
Poland	5.15	15
Vietnam	5.12	16
Latvia	5.08	17
Sri Lanka	5.01	18
Jamaica	4.96	19
Spain	4.96	20
Indonesia	4.76	21
Lithuania	4.74	22
China	4.73	23
Bulgaria	4.51	24
Turkey	4.45	25
Bangladesh	4.41	26
El Salvador	4.37	27
South Africa	4.27	28
Jordan	4.21	29
Brazil	4.17	30
Greece	4.15	31
India	4.14	32
Trinidad and Tobago	4.09	33
Argentina	3.88	34
Bolivia	3.86	35
Uruguay	3.85	36
Honduras	3.84	37
Chile	3.80	38
Colombia	3.78	39
Zimbabwe	3.78	40
Nicaragua	3.69	41
Peru	3.67	42
Guatemala	3.66	43
Egypt	3.66	44
Ukraine	3.63	45
Venezuela	3.60	46
Panama	3.32	47
Ecuador	3.31	48
Russia	3.30	49
Nigeria	3.06	50
Paraguay	2.62	51

Other interesting stories are found further down the non-core technology rankings. With the exception of Mexico, Uruguay, and the Dominican Republic, most Latin American economies rank among the bottom half of the list. Argentina, one of the wealthiest countries in the non-core group, ranks 24th, just ahead of Brazil, which has a per capita GDP (PPP) nearly 50 percent smaller. Like much of Latin America, Argentina is an economy that needs to develop its technological base in order to grow.

Public institutions

Although technology provides a key pillar of economic growth, so too does the quality of the public institutions. Institutions are crucial for their role in ensuring the protection of property rights, the objective resolution of contract and other legal disputes, efficiency of government spending in public services, and transparency in all levels of government.[xiv] All of these factors underpin the division of labor, and therefore the efficiency of resource allocation. They are also fundamental in establishing the societal stability required for growth. Although the quality of institutions has been difficult to measure historically, in recent years the *Global Competitiveness Report*'s Executive Opinion Survey has played an important role in developing new techniques to quantify institutional quality across countries.[xv]

As with technology, institutions play different roles at different stages of economic development. Our regressions have shown evidence that once a threshold of institutional development has been met, it is very difficult to detect the growth effects of further modest improvements in institutional quality. (This is of course a working hypothesis that could be disproved with the development of more sophisticated measures of institutional quality.) Our regressions also show that institutional quality is closely linked to economic growth in the non-core countries. This is why we place a weight of 1/3 on the public institutions index in the non-core GCI calculations and a weight of only 1/4 in the core GCI calculations.

Box 3: Public institutions index

public institutions index = 1/2 contracts and law subindex + 1/2 corruption subindex.

contracts and law subindex Survey questions

6.01 Is the judiciary independent from the government and/or parties to dispute?
6.02 Are financial assets and wealth clearly delineated and well protected by law?
6.04 Is your government neutral among bidders when deciding upon public contracts?
6.12 Does organized crime impose significant costs on business?

corruption subindex Survey questions

7.01 How common are bribes paid in connection to import and export permits?
7.02 How common are bribes paid when getting connected to public utilities?
7.03 How common are bribes paid in connection with with annual tax payments?

The public institutions index (PII) is based entirely on Survey data and has two main components, as outlined in Box 3. The first is a measure of contract and law enforcement. It consists of economies' average score on questions concerning neutrality in government procurement, judicial independence, clear delineation and respect for property rights, and costs related to organized crime. The second element of the public institutions index is a subindex of corruption, or the abuse of public service positions for personal financial gain. This subindex measures the pervasiveness of bribery in three key public service areas: imports and exports, connection to public utilities, and tax collection.

Results for the PII and its main components are listed in Table 7. Finland, Iceland, Denmark, and New Zealand rank as the countries with the four top scores for overall institutional quality. Bangladesh, Paraguay, Nigeria, and Honduras have the lowest scores. It is further interesting to note the countries that score significantly better or worse than one might expect based on their GDP per capita. The Czech Republic and Argentina, for instance, score 53th and 55th, despite the fact that they have the 29th and 31st highest respective incomes per capita in the world. And even though it has grown to be the 24th richest economy today, Korea still rates almost as poorly at 44th. On the positive side, Egypt rates 33rd on the PII, contrasting with its 64th place ranking in per capita wealth. Jordan also ranks at 28th and Uruguay 31st on the PII, compared to 58th and 41st, respectively, on income per person.

Looking at the subindexes of the PII, Finland, Iceland, and Denmark cover the top three places on *both* the contracts and law measure and the corruption subindexes. These closely linked rankings suggest that the three countries have strong overall public and legal institutions relative to the rest of the world. Indeed, looking through the rest of the sample in Table 7, one finds that for the most part there is a strong similarity between countries' rankings on the two subindexes. This suggests that the subcomponents are capturing similar information about the rule of law in society.

Some important information may also be found when countries have significantly different rankings on the two subindexes. Among the high-income countries, for instance, Canada ranks 6th on corruption but 19th on contracts and law. Switzerland's case is nearly the exact opposite, rating 6th on contracts and law but 20th on corruption.

Lower down the list, at income levels where our research shows that differences in institutional quality play a much larger role in economic development, is where the most important information seems to be found. Consider Egypt. Its legal system of contracts and government neutrality scores in 24th place, which is high relative to its income level. Unfortunately, corruption seems to be weakening its institutions tremendously, according to the views of the business community, as indicated by its 54th place ranking on that subindex. India shares a similar problem, ranking 33rd on contracts and law but right near the bottom, at 66th, on corruption. Likewise, Thailand ranks 34th and 59th, Romania 39th and 64th, and Vietnam 49th and 71st on the respective subindexes. These are countries where effective anti-corruption measures could dramatically improve the prospects for growth.

Conversely, in many instances corruption is much less of a problem than weaknesses in contracts and law. Lithuania achieves a high score at 17th on frequency of bribery, but it ranks near the bottom at 59th on the measure of law and property rights. The pattern is similar in Peru (30th and 60th), Bulgaria (34th and 64th), and Colombia (40th and 67th). Dramatic institutional reforms

Table 7: Public institutions index

public institutions index = 1/2 contracts and law subindex + 1/2 corruption subindex

Country	Public Institutions Index	Rank
Finland	6.59	1
Iceland	6.56	2
Denmark	6.42	3
New Zealand	6.33	4
Netherlands	6.29	5
Singapore	6.27	6
Sweden	6.19	7
Australia	6.17	8
United Kingdom	6.14	9
Hong Kong SAR	6.01	10
Canada	6.01	11
United States	6.01	12
Switzerland	5.99	13
Israel	5.98	14
Austria	5.98	15
Norway	5.95	16
Germany	5.93	17
Ireland	5.87	18
Japan	5.76	19
France	5.72	20
Chile	5.69	21
Belgium	5.67	22
Spain	5.47	23
Taiwan	5.30	24
Portugal	5.25	25
Hungary	5.20	26
Italy	5.05	27
Jordan	5.04	28
Estonia	4.99	29
Slovenia	4.90	30
Uruguay	4.89	31
Mauritius	4.79	32
Egypt	4.76	33
Lithuania	4.70	34
South Africa	4.69	35
Trinidad and Tobago	4.63	36
Costa Rica	4.56	37
Slovak Republic	4.54	38
Malaysia	4.53	39
Greece	4.50	40
Poland	4.40	41
Thailand	4.36	42
Jamaica	4.30	43
Korea	4.25	44
Peru	4.24	45
Turkey	4.21	46
Brazil	4.21	47
Latvia	4.18	48
India	4.11	49
China	4.10	50
Bulgaria	4.07	51
Romania	4.06	52
Czech Republic	4.04	53
Dominican Republic	4.02	54
Argentina	4.01	55
Mexico	3.99	56
Colombia	3.85	57
Sri Lanka	3.84	58
Panama	3.83	59
El Salvador	3.79	60
Russia	3.68	61
Bolivia	3.67	62
Vietnam	3.58	63
Philippines	3.53	64
Venezuela	3.40	65
Indonesia	3.35	66
Nicaragua	3.33	67
Ecuador	3.30	68
Zimbabwe	3.30	69
Guatemala	3.22	70
Ukraine	3.15	71
Honduras	3.01	72
Nigeria	2.84	73
Paraguay	2.75	74
Bangladesh	2.48	75

Country	Contracts and Law Subindex	Rank
Finland	6.35	1
Denmark	6.21	2
Iceland	6.14	3
Netherlands	6.09	4
New Zealand	6.05	5
Switzerland	5.97	6
Singapore	5.97	7
Germany	5.89	8
Austria	5.89	9
Sweden	5.87	10
Australia	5.86	11
United Kingdom	5.86	12
Israel	5.78	13
Ireland	5.71	14
France	5.69	15
Hong Kong SAR	5.64	16
United States	5.64	17
Norway	5.62	18
Canada	5.50	19
Belgium	5.41	20
Jordan	5.27	21
Spain	5.23	22
Japan	5.23	23
Egypt	5.15	24
Portugal	5.06	25
Chile	5.03	26
Uruguay	5.01	27
Mauritius	4.91	28
Hungary	4.70	29
Taiwan	4.62	30
Estonia	4.55	31
Italy	4.55	32
India	4.54	33
Thailand	4.53	34
Costa Rica	4.52	35
Slovenia	4.50	36
Greece	4.44	37
Poland	4.32	38
Romania	4.30	39
South Africa	4.17	40
Trinidad and Tobago	4.15	41
Malaysia	4.10	42
Korea	4.09	43
Turkey	3.98	44
Brazil	3.97	45
Slovak Republic	3.95	46
Jamaica	3.89	47
Czech Republic	3.85	48
Vietnam	3.77	49
Argentina	3.75	50
China	3.74	51
Sri Lanka	3.66	52
Latvia	3.62	53
Dominican Republic	3.59	54
Mexico	3.58	55
Philippines	3.54	56
Panama	3.41	57
Indonesia	3.35	58
Lithuania	3.34	59
Peru	3.16	60
El Salvador	3.11	61
Bolivia	3.08	62
Zimbabwe	3.01	63
Bulgaria	3.01	64
Nigeria	2.98	65
Russia	2.97	66
Colombia	2.96	67
Nicaragua	2.91	68
Bangladesh	2.84	69
Ukraine	2.84	70
Venezuela	2.76	71
Paraguay	2.72	72
Ecuador	2.70	73
Honduras	2.37	74
Guatemala	2.31	75

Country	Corruption Subindex	Rank
Iceland	6.98	1
Finland	6.83	2
Denmark	6.62	3
New Zealand	6.61	4
Singapore	6.56	5
Canada	6.52	6
Sweden	6.51	7
Australia	6.49	8
Netherlands	6.48	9
United Kingdom	6.42	10
United States	6.38	11
Hong Kong SAR	6.38	12
Chile	6.35	13
Japan	6.29	14
Norway	6.28	15
Israel	6.18	16
Lithuania	6.07	17
Austria	6.07	18
Ireland	6.02	19
Switzerland	6.01	20
Germany	5.98	21
Taiwan	5.98	22
Belgium	5.92	23
France	5.75	24
Spain	5.71	25
Hungary	5.69	26
Italy	5.56	27
Portugal	5.44	28
Estonia	5.42	29
Peru	5.31	30
Slovenia	5.29	31
South Africa	5.21	32
Slovak Republic	5.13	33
Bulgaria	5.12	34
Trinidad and Tobago	5.10	35
Malaysia	4.97	36
Jordan	4.81	37
Uruguay	4.78	38
Latvia	4.73	39
Colombia	4.73	40
Jamaica	4.70	41
Mauritius	4.67	42
Costa Rica	4.60	43
Greece	4.57	44
Poland	4.48	45
El Salvador	4.47	46
Dominican Republic	4.46	47
China	4.46	48
Brazil	4.45	49
Turkey	4.44	50
Korea	4.41	51
Mexico	4.40	52
Russia	4.38	53
Egypt	4.37	54
Argentina	4.28	55
Bolivia	4.26	56
Panama	4.26	57
Czech Republic	4.23	58
Thailand	4.19	59
Guatemala	4.12	60
Venezuela	4.05	61
Sri Lanka	4.03	62
Ecuador	3.91	63
Romania	3.82	64
Nicaragua	3.76	65
India	3.67	66
Honduras	3.64	67
Zimbabwe	3.58	68
Philippines	3.51	69
Ukraine	3.47	70
Vietnam	3.39	71
Indonesia	3.35	72
Paraguay	2.77	73
Nigeria	2.70	74
Bangladesh	2.13	75

are still needed in these countries in order to advance economic development, but on the more optimistic side, the somewhat lower perceived extent of corruption may indicate an opening for increasing transparency and objectivity in key areas of governance and law.

Let us reiterate that these measures are not objective standards, but rather perceptions among business executives. We believe that governments should take these perceptions seriously, not just dispute their exactitude.[xvi] These kinds of perception indexes, in our studies and in many other studies, have helped account for differences in economic growth, with countries with high perceived corruption suffering lower growth.

Macroeconomic environment

The third and final pillar of the GCI is formed by an index of the macroeconomic environment. This index has three main elements: hard data to measure the overall stability of a country's macro economy, Survey data to assess the short-term outlook of private agents in the economy, and a measure of the share of government expenditures as a percentage of GDP.

The hard data components of the macroeconomic stability subindex, as outlined in Box 4, include the real exchange rate relative to the United States,[xvii] the interest rate spread between deposits and loans, the general government budget balance as a percent of GNP, consumer price inflation in 2000, and the national savings rate. These variables, which as always are rescaled to 1-to-7 scores for index calculations, are each evenly weighted with two Survey questions, one asking about prospects for recession in the coming year and another asking about the tightening of credit over the past year.

Table 8 reviews the results of the macroeconomic stability subindex. Singapore, with its high savings rates, sound financial system, and strong history of fiscal responsibility, rates first again on this measure. Norway, which last year enjoyed a general government surplus of nearly 15 percent, ranks 2nd. Next are Finland, the Netherlands, Sweden, and Switzerland, each of which has healthy macroeconomic environments at the moment. The United States, largely due to its low savings rate and expectations of recession, has the lowest of all its subindex rankings here, placing 42nd in the sample. Most unstable are the economies with headline-grabbing fiscal histories in recent years, including Bolivia, Nicaragua, and Zimbabwe.

To calculate the overall macroeconomic environment index, the stability subindex is given a 1/2 weighting against the broad measure of a country's current macroeconomic situation provided by the *Institutional Investor*'s country credit rating, which receives a 1/4 weight, and government expenditure as a percent of GNP, which also receives a 1/4 weight.[xviii] Many studies have shown that high levels of government expenditure relative to GNP are associated with low economic growth.[xix] This is probably because high rates of taxation are then required to pay for the government expenditures, and the high rates of taxation have a depressing effect on economic growth. The most heavily taxed region in the world, Western Europe, probably suffers a reduced rate of economic growth as a consequence.

We recognize that the optimal level of government expenditures is a much more complex issue than suggested by our approach. It certainly would not be correct to infer that economic growth would be maximized at zero government expenditures (though our equation has that perverse property). When government spending is too low, then governments do not meet even the core needs for education, health, and public services needed to underpin economic growth. This is the case, for example, in Guatemala, which has extremely low government spending—too low to meet even the basic health and education needs of the population. Higher levels of government spending, as in Western Europe, may be justified by the services provided or by the benefits for social equality even if they come at some price in terms of economic growth. These are difficult political, economic, philosophical tradeoffs. We hope in future studies to develop a more sophisticated evaluation of different types of government spending and their effects on competitiveness, stability, and other dimensions of economic performance.

Box 4: Macroeconomic environment index

macroeconomic environment index = 1/2 macroeconomic stability subindex
+ 1/4 country credit rating in March 2001
+ 1/4 general government expenditure in 2000

Macroeconomic stability subindex

macroeconomic stability subindex = 5/7 macroeconomic hard data
+ 2/7 macroeconomic survey data

Macroeconomic environment hard data

2.28 Inflation in 2000
2.30 Lending – borrowing interest rate spread in 2000
2.29 Real exchange rate relative to the United States in 2000 (1990–95 = 100)
2.24 General government surplus in 2000
2.26 National savings rate in 2000

Macroeconomic environment Survey questions

2.01 Is your country's economy likely to be in a recession next year?
2.03 Has obtaining credit for your company become easier or more difficult in the past year?

Table 8: Macroeconomic environment index

macroeconomic environment index = 1/2 stability subindex score + 1/4 country credit rating score + 1/4 government expenditure score

Country	Macroeconomic Environment Index Score	Rank	Country	Macroeconomic Stability Subindex	Rank	Country	Country Credit Rating Score	Rank	Country	Government Expenditure Score	Rank
Singapore	5.52	1	Singapore	5.37	1	Switzerland	7.00	1	Guatemala	7.00	1
Ireland	5.20	2	Norway	5.35	2	Germany	6.92	2	Dominican Republic	6.70	2
Switzerland	5.18	3	Finland	5.25	3	Netherlands	6.87	3	Thailand	6.34	3
Hong Kong SAR	5.12	4	Netherlands	5.13	4	France	6.83	4	China	6.29	4
Norway	5.08	5	Sweden	5.13	5	United States	6.82	5	El Salvador	6.17	5
China	5.04	6	Switzerland	5.13	6	United Kingdom	6.79	6	Bangladesh	6.13	6
United States	4.97	7	Korea	5.03	7	Norway	6.67	7	Hong Kong SAR	6.10	7
Korea	4.94	8	Spain	5.03	8	Austria	6.57	8	Philippines	6.07	8
Netherlands	4.88	9	France	5.01	9	Canada	6.48	9	Venezuela	5.77	9
Finland	4.82	10	Italy	4.98	10	Denmark	6.47	10	Indonesia	5.66	10
Spain	4.82	11	Austria	4.91	11	Finland	6.42	11	Costa Rica	5.65	11
United Kingdom	4.81	12	Ireland	4.91	12	Japan	6.40	12	Mexico	5.49	12
Canada	4.74	13	Belgium	4.90	13	Belgium	6.38	13	Argentina	5.39	13
New Zealand	4.70	14	Canada	4.89	14	Sweden	6.35	14	Vietnam	5.28	14
Taiwan	4.69	15	China	4.83	15	Singapore	6.29	15	Mauritius	5.22	15
Thailand	4.68	16	Germany	4.83	16	Ireland	6.29	16	Korea	5.20	16
Australia	4.68	17	Hong Kong SAR	4.77	17	Spain	6.19	17	Chile	5.06	17
Japan	4.66	18	Denmark	4.74	18	Italy	6.17	18	Ecuador	5.05	18
Germany	4.65	19	Vietnam	4.70	19	Portugal	5.97	19	Peru	5.05	18
Malaysia	4.59	20	Trinidad and Tobago	4.66	20	Australia	5.78	20	Singapore	5.03	20
Chile	4.56	21	Nigeria	4.65	21	New Zealand	5.62	21	South Africa	5.03	20
France	4.54	22	Hungary	4.64	22	Taiwan	5.56	22	Sri Lanka	5.03	20
Italy	4.53	23	New Zealand	4.61	23	Iceland	5.34	23	Trinidad and Tobago	4.92	23
Belgium	4.48	24	Malaysia	4.60	24	Greece	5.18	24	Malaysia	4.89	24
Trinidad and Tobago	4.48	25	Greece	4.60	25	Hong Kong SAR	4.86	25	Brazil	4.88	25
Austria	4.46	26	United Kingdom	4.60	26	Chile	4.76	26	Paraguay	4.82	26
South Africa	4.43	27	Taiwan	4.53	27	Slovenia	4.63	27	Ireland	4.71	27
Philippines	4.42	28	South Africa	4.53	28	Korea	4.51	28	United States	4.71	27
Sweden	4.40	29	Japan	4.52	29	Israel	4.49	29	Bolivia	4.66	29
Mauritius	4.34	30	Russia	4.52	30	Czech Republic	4.38	30	Panama	4.58	30
Denmark	4.28	31	Brazil	4.50	31	Hungary	4.35	31	Colombia	4.42	31
Greece	4.26	32	Slovenia	4.41	32	Poland	4.28	32	Egypt	4.33	32
Brazil	4.24	33	Portugal	4.41	33	Malaysia	4.25	33	India	4.29	33
Iceland	4.24	34	Thailand	4.39	34	China	4.22	34	Nigeria	4.29	33
Portugal	4.24	35	Australia	4.39	35	Mexico	4.13	35	Lithuania	4.22	35
Mexico	4.18	36	Estonia	4.39	36	Estonia	3.81	36	Australia	4.15	36
Vietnam	4.15	37	Iceland	4.33	37	Mauritius	3.74	37	Taiwan	4.12	37
Hungary	4.04	38	Philippines	4.28	38	Trinidad and Tobago	3.66	38	Honduras	4.08	38
Slovenia	4.02	39	Indonesia	4.26	39	Uruguay	3.65	39	Jordan	3.99	39
Argentina	3.99	40	Chile	4.20	40	South Africa	3.62	40	New Zealand	3.95	40
Indonesia	3.96	41	Mauritius	4.20	41	Thailand	3.59	41	Jamaica	3.86	41
Costa Rica	3.94	42	United States	4.17	42	India	3.40	42	Uruguay	3.84	42
Estonia	3.94	43	Czech Republic	4.12	43	Egypt	3.38	43	Ukraine	3.84	42
Panama	3.92	44	Israel	4.04	44	Latvia	3.25	44	Russia	3.69	44
India	3.88	45	Latvia	4.03	45	Slovak Republic	3.23	45	Turkey	3.61	45
Dominican Republic	3.87	46	Jordan	4.03	46	Panama	3.22	46	Romania	3.54	46
El Salvador	3.87	47	Slovak Republic	4.00	47	Costa Rica	3.14	47	Nicaragua	3.47	47
Bangladesh	3.81	48	Poland	3.98	48	Lithuania	3.11	48	Switzerland	3.45	48
Czech Republic	3.81	49	Panama	3.95	49	Brazil	3.09	49	United Kingdom	3.25	49
Poland	3.75	50	India	3.91	50	Turkey	3.09	49	Japan	3.22	50
Egypt	3.74	51	Argentina	3.88	51	Philippines	3.05	51	Estonia	3.18	51
Guatemala	3.73	52	Ecuador	3.75	52	Colombia	2.85	52	Spain	3.04	52
Venezuela	3.73	53	Lithuania	3.66	53	Argentina	2.79	53	Latvia	3.00	53
Jordan	3.69	54	Egypt	3.63	54	El Salvador	2.71	54	Iceland	2.98	54
Nigeria	3.68	55	Bangladesh	3.62	55	Jordan	2.70	55	Bulgaria	2.97	55
Lithuania	3.66	56	Romania	3.56	56	Peru	2.70	55	Norway	2.92	56
Russia	3.64	57	Mexico	3.55	57	Venezuela	2.49	57	Poland	2.74	57
Peru	3.62	58	Costa Rica	3.49	58	Bulgaria	2.43	58	Canada	2.71	58
Latvia	3.58	59	Bulgaria	3.48	59	Sri Lanka	2.40	59	Greece	2.65	59
Sri Lanka	3.56	60	Ukraine	3.45	60	Dominican Republic	2.38	60	Czech Republic	2.61	60
Israel	3.55	61	Sri Lanka	3.40	61	Guatemala	2.25	61	Slovenia	2.61	60
Ecuador	3.45	62	Peru	3.37	62	Paraguay	2.05	62	Hungary	2.53	62
Uruguay	3.38	63	Venezuela	3.32	63	Bolivia	1.97	63	Netherlands	2.38	63
Slovak Republic	3.35	64	El Salvador	3.30	64	Jamaica	1.94	64	Finland	2.37	64
Paraguay	3.31	65	Honduras	3.22	65	Vietnam	1.94	64	Portugal	2.18	65
Colombia	3.29	66	Dominican Republic	3.21	66	Romania	1.92	66	Slovak Republic	2.17	66
Romania	3.14	67	Jamaica	3.20	67	Bangladesh	1.85	67	Germany	2.04	67
Turkey	3.10	68	Paraguay	3.18	68	Russia	1.82	68	Italy	1.97	68
Bulgaria	3.09	69	Uruguay	3.02	69	Indonesia	1.68	69	Belgium	1.76	69
Bolivia	3.08	70	Colombia	2.94	70	Honduras	1.59	70	Zimbabwe	1.71	70
Jamaica	3.05	71	Turkey	2.85	71	Ecuador	1.26	71	Israel	1.62	71
Honduras	3.02	72	Guatemala	2.84	72	Nigeria	1.14	72	Austria	1.44	72
Ukraine	2.95	73	Bolivia	2.84	73	Ukraine	1.08	73	France	1.33	73
Nicaragua	2.48	74	Nicaragua	2.72	74	Nicaragua	1.01	74	Denmark	1.17	74
Zimbabwe	1.93	75	Zimbabwe	2.50	75	Zimbabwe	1.00	75	Sweden	1.00	75

CONCLUSION

As the world becomes increasingly interconnected but the disparities between wealthy and poor countries become ever starker, policymakers, business leaders, academics, and other globally minded citizens all require a much keener understanding of the forces contributing to economic growth in both the medium and long term, and how the importance of those forces changes at different stages of economic development. This chapter has focused on the central processes underpinning medium-term economic growth, with particular emphasis on technological advancement.

Marking a new direction in competitiveness research, we outlined key empirical distinctions between technological diffusion and innovation as pertains to economic growth. In so doing, we estimated not just the changing nature of technological advancement that typically accompanies economic development, but also the increasing importance of technology as economies create a sustainable capacity for innovation.

By dividing our sample of GCR countries into two groups, core and non-core technological innovators, we were able to estimate the respective growth-related effects of innovation and diffusion in the 1990s. Our evidence indicates that innovation matters substantially more than diffusion in the core economies, and that diffusion matters proportionately more in the non-core ones. Our evidence furthermore suggests that public institutions and the macroeconomic environment remain more important for economic growth within the non-core economies than within the core economies. This is partly due to the limited variation in institutional quality and macroeconomic factors among core economies. It is also likely due to a threshold effect, whereby economies that have attained a certain level of quality in institutions and macroeconomic policymaking yield increasingly small benefits from marginal improvements in those areas.

All of these findings are incorporated in the new Growth Competitiveness Index, which blends core and non-core measures of technological advancement with measures of institutional quality and the macroeconomic environment to create a unified competitiveness ranking across 75 countries. GCI scores represent our best estimate at the underlying growth prospects for each country, once their current level of GDP is taken into account. Of equal importance, rankings in the GCI's three component indexes of technology, public institutions, and macroeconomic environment provide important insight into each economy's specific sources of growth competitiveness.

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Notes

[i] Much of the empirical knowledge today was stimulated by Robert J Barro's seminal work, "Economic Growth in a Cross-Section of Countries," *Quarterly Journal of Economics* CVI (1991): 407–443.

[ii] The simple correlation coefficient between the rankings for the two years is 0.97.

[iii] Specifically, Singapore would jump from 4th to 2nd overall on the GCI, Ireland would shift from 11th to 8th, and Hong Kong SAR would leap from 13th to 6th—compared with their 2000 overall rankings of 2nd, 4th, and 7th, respectively.

[iv] See Jeffrey D Sachs, "Ten Trends in Global Competitiveness in 1998," *Global Competitiveness Report 1998*, (Geneva: World Economic Forum, 1998) p.18.

[v] Jeffrey D Sachs and Andrew M Warner "Year in Review," in *Global Competitiveness Report 1999,* (Geneva: World Economic Forum, 1999) p.21.

[vi] Indeed, there is strong evidence that even the catch-up effect occurs only once a minimum threshold of economic development has been met. For instance, of the 36 countries ranked as having "high" human development in the United Nations' 1990 *Human Development Report*, 35 achieved rising living standards from 1990 to 1998 and the entire group averaged 2.3 percent average annual economic growth over the same period. At the same time, the 34 middle-development countries achieved a slightly lower average growth rate of 1.9 percent per year, with 7 experiencing declines in GDP per capita. Meanwhile, low-development countries averaged 0 percent economic growth, with 15 of 34 experiencing an outright decline in living standards.

[vii] Again, the GDP GAP term is measured as a country's GDP per capita (PPP) as a percentage of the United States GDP per capita (PPP) in 1992, *ie,* all values in 1992 were between 0 and1. We then calculated the natural logarithm of those values for the regression estimates. In parallel fashion, the dependent variable in this equation was calculated as the average annual change in the GDP GAP with the United States from 1992 to 2000. As mentioned in the text, for transition economies 1995 was used as the base year rather than 1992.

[viii] The regression results for the overall GCI, with the average annual change in GDP GAP relative to the United States as the dependent variable, are as follows:

Variable	Coefficient	Standard Error
ln (Initial GDP GAP)	–.028	.005
GCI	.033	.005
Constant term	–.187	.026

Number of observations = 75; Adjusted R^2 = 0.41

[ix] The standard formula for converting each hard variable to the 1-to-7 scale was:

$$6 \times \frac{\text{(Country Value – Sample Minimum)}}{\text{(Sample Maximum – Sample Minimum)}} + 1$$

In some instances, minor adjustments were made to account for extreme outliers in the hard data.

[x] Gross tertiary enrollment data were taken from the World Bank's *World Development Indicators 2001* and the World Bank Task Force on Education's *Higher Education in Developing Countries: Peril and Promise* (Washington, DC: World Bank, 2000). Most of these figures are for 1995 and 1996. The most recent are for 1997. Many national enrollment rates have undoubtedly changed substantially since then, but data for more recent cross-country analysis are simply not available.

[xi] Specifically, we included all exports falling under the United Nations' Standard Industrial Trade Classification codes 54, 57, 58, 65, 7, 81, 82, 83, 84, 85, 87, 88, 893, 894, 898, 8996, and 95.

[xii] Note that we again used the 1995–99 values for the transition economies to match our analysis of the average growth rate over the same period.

[xiii] The specific results of the nonlinear least squares regression were as follows, with the average annual percentage change in GDP GAP relative to the United States still as the dependent variable in the following equation:

$$\begin{aligned}\text{Growth} = {} & \text{Constant} + B_1 \times \text{1980s non-core} \times \{N_1 \{0.5 \\ & \times \text{ICT subindex} + 0.5 [(1 - N_2) \text{ innovation subindex} \\ & + N_2 \times \text{technology transfer subindex}]\} \\ & + (1 - N_1) (\text{macroeconomic index} + \text{institutional index})\} \\ & + B_2 \times \text{1980s core} \times \{C_1 \{0.5 \times \text{ICT subindex} \\ & + 0.5 [C_2 \times \text{innovation subindex} \\ & + (1 - C_2) \text{ technology transfer index}]\} \\ & + (1 - C_1) (\text{macroeconomic index} + \text{institutional index})\} \\ & + G \times (\text{GDP GAP in 1992}),\end{aligned}$$

where B_1, C_1, C_2, G, N_1, and N_2 are the coefficients to be estimated.

The variables "1980s non-core" and "1980s core" take a 0 or 1 value depending on an economy's status in that period. The regression results are as follows:

Variable	Coefficient symbol	Coefficient value	Standard error
Initial GDP GAP in 1992	G	–.027	.007
Non-core Index weight	B_1	.029	.005
Core Index weight	B_2	.032	.007
Non-core technology weight	N_1	.642	.116
Non-core diffusion weight over innovation	N_2	.808	.257
Core technology weight	C_1	.896	.268
Core innovation weight over diffusion	C_2	.849	.397
Constant term	—	–.213	.033

Number of observations = 75

Adjusted R^2 = 0.50

[xiv] Stephen Knack and Philip Keefer, "Institutions and Economic Performance: Cross-Country Tests Using Alternative Institutional Measures," *Economics and Politics*, VII (1995): 207–220; Paolo Mauro, "Corruption and Growth," *Quarterly Journal of Economics*, CX: 681–713 (1995); Robert J Barro, *Determinants of Economic Growth: A Cross-Country Empirical Study* (Cambridge, MA: MIT Press, 1997.

[xv] See, for example, Shang-jin Wei, "Why Is Corruption So Much More Taxing Than Tax? Arbitrariness Kills," NBER Working Paper No. 6255, 1997; Daniel Kaufman and Shang-jin Wei, "Does 'Grease Money' Speed Up the Wheels of Commerce?" NBER Working Paper No. 7093, 1999.

[xvi] Nonetheless, in one noteworthy example of the robustness of the Survey results, we find that national scores on the public institutions index remain almost exactly the same when half the Survey responses from the sample are randomly excluded. For more details on the consistency of Executive Opinion Survey results and the possibility of national-level perception bias, consult the final chapter of this *Report*.

[xvii] For the real exchange rate measure, the average value from 1990 to 1995 is set to 100, except for the transition economies where we set 1995 values to 100. To avoid excessive complication, real exchange rates were converted to simple scores on the standard 1-to-7 scale. Values of less than 80, ie, those that are strongly overvalued, were given a score of 1. Those with values of less than 100 and greater than 80 were given a score of 2.5. Values of 100–120, 120–140, and 140 and above were given scores of 4, 5.5, and 7 respectively.

[xviii] The *Institutional Investor*'s country credit ratings are taken from http://www.iimagazine.com/premium/rr/countrycredit/ccr/2001.htm.

[xix] Most prominent among these studies is Barro 1997, *op cit.*