HIGH TECH INDICATORS:

TECHNOLOGY-BASED COMPETITIVENESS OF 33 NATIONS

2005 FINAL REPORT

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Report to the Science Indicators Unit, Science Resources Studies Division, National Science Foundation under Contract D050144

September 4, 2006

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HTI-05 Summary

High Tech Indicators 2005 compares the technological competitiveness of 33 nations, including a large number of industrializing economies. This continues a series prepared every three years since the late 1980's. For those of you unfamiliar with "HTI," the "Background" section describes its heritage. For those familiar with the indicators, we note several changes over the past few years:

- We now label the indicators set according to the year in which they are produced instead of the year of most data sources used; key point – the "2003" HTI really lags the "1999" HTI by only three years.
- We are shifting to a 2-year cycle to align with *Science & Engineering Indicators* (e.g., 2003, 2005, 2007).
- We no longer present two output indicators – Rate of Technological Change (RTC) and Technological Emphasis (TE) because these have proven less useful.
- We add a composite predictive, or "input," indicator – the sum of our four input (leading) indicators.
- This (HTI-05) is a transition year. We provide HTI-05 (T) in the traditional format, as composite indicators based on a mix of statistical time series data and expert panel judgments. We explore a new approach based solely on statistical measures – HTI-05 (S). In conjunction with this changeover, we expand the statistical coverage to address "information economy" (i.e., service) elements to extend HTI focus beyond technology-intensive manufactured products.
- We regroup the 33 nations by geographical region.

Results appear primarily in a main data table and a large set of charts. These offer manifold comparisons. Note particularly the compelling evidence that rapidly advancing nations, led by China, demonstrate tremendous gains in technological competitiveness. Our leading indicators suggest that technological competitiveness will broaden even more dramatically over the coming decades.

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Background

"**High Technology Indicators**" (**HTI**) development work at Georgia Tech has proceeded in phases. This year (2005) initiates a significant transition to a fourth phase.

The *first phase* generated indicators of national capabilities to produce high technology products suitable for export. We developed a conceptual model of the processes by which industrializing nations gain access to external technology and technical information, absorb that technology/information effectively, and institutionalize a science-based development and manufacturing capability. The model included four "input" or leading indicators of a nation's future capacity (roughly 15-year time horizon) to compete in international markets in high technology products. It derived three "output" indicators of a nation's current international competitiveness. The research team compiled data for 20 countries representing a range of regions and extent of industrialization to prepare the initial HTI round for 1987.

The *second phase* used data on an expanded set of 28 countries to examine in detail the indicators' reliability and validity. Conceptual development is described in this article:

- Roessner, J.D., Porter, A.L., and Xu. H., "National Capacities to Absorb and Institutionalize External Science and Technology," *Technology Analysis & Strategic Management,* Vol. 4, No. 2, p. 99-113, 1992

The *third phase* of HTI work was effected for HTI-1993, albeit work extended into 1995. We refined formulas for the seven indicators developed in the previous phases, applied them empirically, tested the value of the indicators for policy and scholarly purposes, and assessed the processes of data collection and verification. HTI were prepared for 1996, 1999, and 2003 following closely the format developed for 1993. The results from this phase are incorporated in Figures 7-11 of the 2003 report and were compared in several articles:

- Roessner, J.D., Porter, A.L., Newman, N.C., and Cauffiel, D., "Anticipating the Future High-Tech Competitiveness of Nations: Indicators for Twenty-Eight Countries," *Technological Forecasting and Social Change*, Vol. 51, No. 1, p. 133-149, 1996
- Porter, A.L., Roessner, J.D., Newman, N.C., and Cauffiel, D., "Indicators of High-Tech Competitiveness of 28 Countries," *International Journal of Technology Management*, Vol. 12, No.1, p.1-32, 1996
- Porter, A.L., Roessner, J.D., Jin, X-Y., and Newman, N.C., "Changes in National Technological Competitiveness: 1990-93-96-99, *Technology Analysis & Strategic Management*, Vol. 13, No. 4, p. 477-496, 2001.
- Roessner, J.D., Porter, A.L., Newman, N., and Jin, X-Y., "A Comparison of Recent Assessments of the High-Tech Competitiveness of Nations," *International Journal of Technology Management*, Vol. 23, No. 6, p. 536-557, 2002.

NSF reported the third phase HTI findings in a number of publications:

- *Science & Engineering Indicators -- 1993* (National Science Board, Washington, DC, U.S. Government Printing Office, NSF 93-1, p. 186-189
- *Asia's New High-Tech Competitors* (NSF 95-309, 1995), a special report of NSF's Science Resources Studies Division
- *Science & Engineering Indicators --1998* (National Science Board, Washington, DC, U.S. Government Printing Office), p. 6-33 -- 6-37, Appendix table 6-23
- *Science & Engineering Indicators -- 2002* (National Science Board, Washington, DC, U.S. Government Printing Office, and NSF website), section on "New High-Technology Exporters" and Appendix Table 6-8.

Selected results from the 2003 HTI are reported in:

- *Science & Engineering Indicators -- 2004* (National Science Board, Washington, DC, U.S. Government Printing Office, and NSF website), section on "New High-Technology Exporters" and Appendix Tables 6-5 and 6-6.

Additional papers have explored aspects and implications of the indicators. Many of these, along with the HTI Summaries themselves, are posted at the website: //tpac.gatech.edu [both under "High Tech Indicators" and under "Papers"]. We note some recent papers:

- Porter, A.L., Roessner, J.D., Newman, N.C., Jin, X-Y., and Kongthon, A., High Tech Indicators: Who's Gaining?, *Technology Exports*, Vol. VI, No. 3, Jan-Mar, 2004, p. 1-6.
- Newman, N.C., Porter, A.L., Roessner, J.D., Kongthon, A., and Jin, X-Y. Differences Over a Decade: High Tech Capabilities and Competitive Performance of 28 Nations, *Science & Technology Indicators Conference,* Leiden, The Netherlands, 2004.

In sum, HTI have been prepared at 3-year intervals from 1987 through 2003 (see Note just below). Beginning with 1993, the indicators stabilized to permit sound time series indicator comparisons. This report summarizes findings from the 1993, 1996, 1999, 2003, and 2005 HTI using this stable formulation.

Note -- we changed the dating system as of 2003 to reflect the year when the indicator is constructed (2003), instead of the year in which most of the data are reported (2002). HTI for a given year previously appeared in the following year because various statistical measures used in HTI usually do not become available until then. So the actual span between HTI for 1999-2003 is 3 years, just as in the previous versions being compared.

HTI are now on a 2-year cycle. HTI-05 are posted as of July, 2005. We call these indicators HTI-05, but recognize the statistics were compiled early in 2005. Thus, many of the component measures lag to some degree. The Appendix details current sources and years. Note that these can vary considerably from country to country, indicator to indicator. Specific cell sources (e.g., for Taiwan on a particular component) are noted in the underlying MS Excel data tables. Also note that sources increasingly report data dynamically. That is, a given source table's contents are apt to be modified over time.

Initiation of the *fourth phase* began as the U.S. National Science Foundation (NSF) requested that Georgia Tech enhance the indicators in several ways:

- broaden the scope beyond its previous technology-based manufactured products focus to capture "Information Economy" advanced services as well;
- expand the statistical measures that are incorporated in the indicators;
- explore whether statistical measures could supplant expert-opinion-based measures.

The "HTI 2001 Final Report" posted on the TPAC website describes initial research on ways to improve HTI that supports such revisions. This was followed by research to explore potential new formulations of HTI:

- Porter, A., Roessner, D., Newman, N. Kongthon, A., and Jin, X-Y., Review and Revision of High Tech Indicators 2003, Report to the Science Indicators Unit, National Science Foundation (Contract D020024), 2004.

An article explores bibliometric-based indicator explorations:

- Porter, A.L., Roessner, J.D., Jin, X-Y., and Newman, N.C., "Measuring National 'Emerging Technology' Capabilities," *Science and Public Policy*, 2002, Vol. 29, No. 3, p. 189-200, 2002.

This report presents both the new Statistics-only HTI for 2005 and the corresponding Traditional HTI-05 indicators. It also reports on time series from 1993-2005, using the Traditional HTI. [The 1987 and 1990 HTI versions differ considerably in content and coverage, so are not included.]

Country Coverage

Country coverage is especially oriented toward the industrializing nations (e.g., several countries in Southeast Asia and Latin America). We do not cover all of the highly developed nations, nor any of the less developed ones. Coverage has evolved modestly since 1993. The 1996 HTI added Poland, Venezuela, and South Africa, but dropped Hong Kong, so the total number of countries came to 30. [Regularization of statistics for China and Hong Kong remains problematic even through 2005, particularly in sorting out exports.] For 1999, HTI added Ireland, Israel, and the Czech Republic, yielding a total of 33 countries. In previous reports, the countries were usually clustered in charts as follows:

- The "Big Three"--United States, Japan, and Germany
- Western Europe
- English heritage nations (Canada, Australia, South Africa, New Zealand)
- Eastern Europe
- Asian Tigers
- Asian Cubs
- Latin America, and
- Israel.

For 2005 we refine the categorization slightly. The revision reflects the dramatic shifts underway. At least two of the "Asian Cubs" – China and India – belie that nomenclature. In particular, the rise of China is so marked that we considered reporting a "Big 4." We also did not like having a single-country "group" for Israel. In the end, we opted for five groupings based mainly on geography. The most difficult nation to locate in this scheme is Russia. Should it be located with Europe, with Asia, or – as we decided – with "The Others." Of course, the reader can readily get at results for any one country or subset of countries of interest as desired. Here is the grouping generally used in reporting HTI-05:

- North America – United States, Canada, Mexico
- Latin America – Argentina, Brazil, Venezuela
- Europe – Czech Republic, France, Germany, Hungary, Ireland, Italy, Netherlands, Poland, Spain, Sweden, Switzerland, UK
- Asia – China, India, Indonesia, Japan, Malaysia, Philippines, Singapore, South Korea, Taiwan, Thailand
- Others – Australia, Israel, New Zealand, Russia, South Africa

The 33 countries are listed alphabetically within regional grouping, with the exception of the U.S., placed first to expedite U.S. comparisons.

The Traditional HTI Indicators

The *conceptual definitions* of the traditional indicators follow. [Complete component information and computational formulas appear in the Appendix.] These definitions have been used throughout the 1993-1996-1999-2003-2005 studies. Each indicator is comprised of both statistical data (**S**) and data from a survey of experts (**E**). Full operational definitions of the indicators, including the questions to the experts and sources of data for the indicators, appear in the Appendix. Of the original Output indicators, we now only compute Technological Standing. We no longer address Technological Emphasis or Rate of Technological Change.

Raw data are transformed to "**S-scores**." Each indicator component is scaled from 0 to 100 and then averaged to generate comparable indicators with a 0 to 100 range. For survey items, 100 represents the highest response category for a question; for statistical data, 100 typically represents the value attained by the country with the largest value among the 33-country set. Thus, this is a relative scaling so that an apparent decline over time or low score should be viewed relative to the other countries in the set of 33.

National Orientation (**NO**): Evidence that a nation is undertaking directed action to achieve technological competitiveness. Such action can be manifested at the business, government, or cultural levels, or any combination of the three.

> **S**: investment risk index (constructed from the Political Risk Services data series)
>
> **E**: questions addressing national strategy, implementation, entrepreneurship, and attitudes toward technology.

Socio-economic Infrastructure (**SE**): The social and economic institutions that support and maintain the physical, human, organizational, and economic resources essential to the functioning of a modern, technology-based industrial nation.

> **S**: Harbison-Myers Human Skills Index (from World Bank data on % in higher education and % in secondary school)
>
> **E**: questions addressing national policies toward multinational investment, mobility of capital.

Technological Infrastructure (**TI**). Institutions and resources that contribute directly to a nation's capacity to develop, produce, and market new technology. Central to the concept are the ideas of economic investment and social support for technology absorption and utilization. These could take the forms of monetary payments, laws and regulations, and social institutions. Also included is the physical and human capital in place to develop, produce, and market new technology.

> **S**: number of scientists in R&D; electronic data processing purchases
>
> **E**: questions addressing technical training and education, contributions to knowledge, R&D with industrial relevance, technological mastery.

Productive Capacity (**PC**): The physical and human resources devoted to manufacturing products, and the efficiency with which those resources are used.

> **S**: electronics production

E: questions addressing supply of skilled labor, indigenous component supply, indigenous management capability.

Technological Standing (**TS**): An indicator of a country's recent overall success in exporting high technology products.

S: value of high tech exports; value of electronics exports

E: question addressing current high technology production capability.

Expert Panel

Expert opinion data were obtained from a survey of the International Technology Indicators Panel during winter 2004 and spring 2005. Surveys were largely completed through a website interface [at http://tpac.gatech.edu/], augmented by e-mail. The resulting 386 expert responses were screened to yield 361 high quality responses. Of these, 94% responded for a single country. We discarded respondents who rated their expertise as low, and checked for extreme outliers and untoward patterns (e.g., the same response for every item). The average number of responses per country was 11; all countries received at least 9 responses with one exception: 6 for Australia (after removal of 2 lower quality responses).

Beginning in the late 1980's, we have worked together with our National Science Foundation colleagues to invite selected professionals to serve on the International Technology Indicators Panel. Our criteria include direct knowledge of the country and of the bases for technological competitiveness. Prototypical experts include embassy science attaches, faculty members, and industrial professionals. Attendees at international conferences and participants in journal advisement and publishing relating to technology analysis, forecasting, management, and so forth are good candidates for the Panel. We seek balance among multiple perspectives, and between indigenous and external "watchers." Over time, turnover in membership has been heavy – e.g., only 31% of the 2003 respondents also participated in 1999. We invite various persons who appear to meet these criteria to participate, but ultimately self-selection comes into play. The respondents indicate their familiarity on a self-report scale item.

Table 1 shows the number of respondents by country for the 1996-2005 panels.

As part of our International Technology Indicators Panel effort, we pose a set of questions [www.tpac.gatech.edu/hti2005/question.php] asking for the respondents' assessment of current and 15-year future prospects for a nation's overall technology-intensive products (see Figure 15). We also ask about ten specific sectors (e.g., aerospace, software). Due to the general nature of our panel selection criteria, we are cautious in interpreting the sector-specific item responses. Those data are available should others wish to analyze them.

Table 1: Responses for the 33 target countries in four periods of HTI surveys

	Serial #	HTI-96	HTI-99	HTI-03	HTI-05
North America					
USA	32	10	22	42	17
Canada	4	10	7	11	10
Mexico	17	6	9	12	10
South America					
Argentina	1	9	7	12	10
Brazil	3	15	11	16	16
Venezuela	33	7	11	11	12
Europe					
Czech Rep	6	-	7	10	10
France	7	7	7	11	11
Germany	8	17	17	13	11
Hungary	9	7	10	14	9
Ireland	12	-	6	11	12
Italy	14	9	8	10	10
Netherlands	18	8	8	11	11
Poland	21	5	9	10	14
Spain	26	7	10	11	10
Sweden	27	7	8	10	14
Switzerland	28	9	7	10	13
UK	31	12	8	10	11
Asia					
China	5	12	22	23	16
India	10	7	7	14	12
Indonesia	11	5	13	10	10
Japan	15	19	9	11	11
Malaysia	16	8	14	11	11
Philippines	20	4	10	10	12
Singapore	25	7	8	11	11
South Korea	24	10	8	11	11
Taiwan	29	8	8	10	13
Thailand	30	6	16	11	10
All Others					
Australia	2	12	11	14	8
Israel	13	-	8	10	13
New Zealand	19	5	8	10	15
Russia	22	5	8	10	12
South Africa	23	11	14	11	10

Note: Israel, Ireland, and the Czech Republic were added beginning with HTI 1999.

Transitioning: Toward Statistics-Only HTI Indicators

In the 1980's one had to use expert opinion to address the newly industrializing countries effectively. Now we see expansion of those economies and also of the available statistical measures. We are now looking more toward parity levels, not just new competitors.

In the 1980's, HTI delivered the message that the newly industrializing countries are showing capacity. However, during that period the depth and breadth of what they were doing paled in comparison to countries like the U.S. and Western Europe. HTI were construed to pick up signals of change in the emerging economies. Keep in mind that the indicators do not include all the OECD countries; rather they include several to provide benchmarks against which to track and anticipate progress of the industrializing countries. For those purposes, reliance on purely statistical measures was problematic. Besides dire coverage problems, the scaling was so extreme that moderated indicators were in order. For instance, only a handful of U.S. patents were issued to inventors or assignees from nations such as Malaysia. Another example was high tech exports, where differences were measured in orders of magnitude. For reasons explored in the early HTI papers, we chose not to normalize by using per capita measures. HTI aimed to judge changing competitiveness in technology-based trade, not relative development status. Traditional HTI indicators reflect the dampening effect of responses on 1-5 scale survey items.

It now seems desirable to move to new scales to track developments that are changing in competitive magnitude and implications. Rather than scanning for signals of potential future technological competitiveness, we are tracking significant economic capabilities. And, many statistical series are covering nations beyond the highly developed OECD core. Further, the nature of the Information Economy warrants expanding coverage from a focus on manufactured products for export to knowledge-based services and processes (e.g., software development) as well. And still one more argument for change: securing expert opinion on technological capabilities in each of 33 or so countries takes great effort. Sampling is opportunistic to obtain the desired 10 or more respondents for each country. The nature of judging multi-faceted aspects of a technological economy is inherently error-prone, encouraging us to seek established statistical measures (see "Expert Opinion" section).

On the other hand, we note that our research on substitutability of statistical series for the model-based question items of HTI does not suggest direct replacement. The behavior of statistics-only indicators can be tracked against the traditional HTI blend of statistics and expert opinion [see *Review and Revision of HTI 2003*]. We offer initial comparisons for 2005 here, but will continue to research validity and comparability. We do expect the measures to change considerably from Traditional to Statistics-only HTI over the coming years.

- As noted, we are transitioning toward formulation of HTI based solely on statistical measures. We did attempt to go back and compose Statistics-only HTI for 2003. However, when we scan component-by-component, these do not offer stable bases for comparison with the Statistics-only HTI-05. Some of the components have not been updated in this time span. Others require more research to determine the right form for inclusion. Hence, we do not report on such temporal comparisons. Instead, we limit these preliminary explorations to comparing Traditional HTI-05 to Statistics-only HTI-05. And in so doing, we note that the Statistics-only formulation is likely to be refined.

Each of the HTI indicators retains its conceptual description in moving toward a purely statistical formulation. The composition of each changes. Note that each component is treated as an S-score – as described above, this scales on a 0-100 basis against the leading country, for this indicator, for this reporting period.

HTI 2005 – Two Perspectives: Traditional HTI-05 (T) and Statistics-Only HTI-05 (S)

We offer two ways to consider HTI-05 indicators. The following discussion considers them indicator by indicator: TS, INPUT (SUM), NO, SE, TI, and PC. These brief observations can be amplified by flipping to the respective figures indicated. [It may be helpful to print the data table as well.]

Alternatively, one can browse through the charts. These are organized somewhat orthogonally to this section's discussion. The first set of charts (Figures 1-7) provides the HTI-05 (T) results, followed by a set giving HTI-05 (S) (Figures 8-14). Next is a radar chart contrasting expert perceptions of future vs. current technological competitiveness (Figure 15) – pointing toward increasingly broad technological competition. That is followed by a set contrasting the respective (T) vs. (S) -- Traditional vs. Statistics-only--indicators (Figures 16-23).

The next batch of charts addresses the time series results, all using traditional (T) indicators. Figures 24-29 give each of the indicators over time. Figures 30-33 accentuate differences – which nations have changed and which have not changed much from 1993 to 2005. Figures 34-35 show scattergrams of the degree of national change in TS and INPUT. Brief comments are offered with the figures.

Technological Standing (TS):

TS-05 (T) (Figure 1) spotlights four nations as notable leaders: U.S., China, Japan, and Germany. That result is startling in that China has come so far, so fast. Rounding out a Top 10 are Singapore, the UK, South Korea, France, The Netherlands, and Taiwan. Lagging in this set of 33 leading technology competitors (not including all of the OECD nations) are a mix of Latin American, Asian, Eastern European, and Other countries.

TS-05 (S) (Figure 8) accentuates the differences among nations compared to TS-05 (T). For instance, the highest scoring country on both is the U.S. On traditional TS-05, the range is from the U.S. at 83 down to Argentina at 13. TS-05 (S) ranges from the U.S. at 91 down to Venezuela at 0.1 (Argentina scores 0.3).

Note the contrast as well in Figures 16 and 18. The more extreme picture that results from HTI (S) seems fair. HTI (T) is overly muted by the scaling of the questionnaire items (1-5). The differences in technology-based export capabilities between countries like the U.S. and Venezuela or Argentina really are extremely large.

However, this said, ranks show close correspondence between TS-05 (T) and (S). Only two countries shift rank by more than 5 places. Traditional TS ranks correlate 0.96 with Statistics-only TS ranks. Given the substantial change in adding two new statistical series (royalties and exported services) to two ongoing statistical series, in lieu of one questionnaire item, this stability is reassuring.

The largest difference in ranks occurs for Australia (from the Traditional TS placement at 19 to Stats at 26). But the change is not great. For TS-05 (S), on this 0-100 scale, 14 countries score around 2 (ranging from 0 to 5). Comparison of Figures 1 and 8 conveys that the reconstituted TS measure is notably more extreme than is TS-05 (T).

It is interesting to note the position of some of the rising technological powers. TS (S) downplays the rise of China, Singapore, and South Korea – but only slightly. On TS (S), China ranks 3d (vs. 2d on Traditional TS); Singapore ranks 7th (vs. 5th); South Korea 9th (vs. 6th).

The strength of the U.S. position is amplified by TS (S). The U.S. scores double its nearest technological competitor, Japan, on this indicator. In contrast, on TS (T) the U.S. appears at 83 vs. Japan's 73. We believe that TS (S) better reflects actual technology-based trade competitiveness than does TS (T).

INPUT (Sum):

The composite "INPUT (Sum)" simply adds up the four Input Indicators: NO, SE, TI, and PC. In prior year HTI's we reported INPUT (Average). Conceptually these are essentially equivalent – an overall leading indicator of potential future high tech competitiveness. Computationally, INPUT (Sum) is just 4x INPUT (Average). INPUT (Sum) makes visualization of the four indicators together attractive (e.g., as a stacked bar chart – Figure 3). For HTI-05, we always report INPUT (Sum); the reader wishing to consider INPUT (Average) can just divide reported values by 4.

INPUT-05 (T) (Figure 2) shows the U.S. faring well, leading Japan, Germany, Sweden, U.K., and China on this complex of precursors of technological competitiveness.

HTI (S) INPUT (Sum) heightens the differences among leaders and laggards (Figures 9 and 10). The leader on both is the U.S. (344 on Traditional INPUT vs. 354 on Stats INPUT). In contrast, Venezuela brings up the rear on INPUT-05 (S) at 43. Traditional and Stats INPUT values correlate 0.85, while their ranks correlate the same (0.85).

Two countries shift by 14 places in the ranks: Spain moves up using the INPUT-05 (S) relative to INPUT-05 (T) from 24 to 10, while Israel drops from 6 to 20. However, only 5 of the 33 countries shift ranks by more than 5 places. So, INPUT is reasonably stable to the shift from (T) to (S).

Figures 17 and 19 offer different contrasting perspectives on the difference depicted by INPUT (T) vs. (S). Figure 17 visually compares each country's score on the two measures. We see a fairly consistent lowering of the INPUT-05 (T) value in shifting to INPUT-05 (S). Figure 19 reaffirms this consistent shift, with the lone country increasing its INPUT score being the U.S. Israel is most diminished in switching from INPUT-05 (T) to (S).

National Orientation (NO):

NO-05 (T) (Figure 4) shows widespread intent to compete in technology-intensive goods and services. The leader, Sweden at 80 is followed by 16 countries scoring 70 (rounded) or more. The laggards are Venezuela, followed by Russia, Indonesia, and Argentina.

The composition of this indicator shifts from one external expert judgment item plus 4 questionnaire items in NO (T) to that same external expert judgment item plus one additional external expert judgment item (World Values Survey), without the 4 HTI survey items, to make up NO (S). This Statistics-only NO indicator formulation is quite possibly the weakest among the HTI indicators in terms of empirical base. Figure 11 shows NO-05 (S).

Figure 20 charts the difference between (T) and (S) for NO-05. Traditional vs. Statistics-only NO values correspond reasonably well – correlation of 0.76 between these and of 0.74 between their ranks. However, 11 of the countries shift Rank by more than 5 places. Most extreme are Israel (showing lower at 27th vs. 4th) and The Netherlands (showing higher at 3d vs. 17th). The U.S. rises in NO value from 79 to 82, but drops in NO Rank from 2d using NO (T) to 5th on NO (S).

Socio-economic Infrastructure (SE):

Figure 5 presents SE-05 (T). Several nations cluster in the lead – Israel, U.S., U.K., and Sweden. The range for SE-05 (T) is relatively muted, ranging from the U.S. at 85.8 to Indonesia at 40.8. The progression appears generally quite linear.

This indicator shifts the most from (T) to (S) – compare Figures 12 and 5. Looking at the indicator formulation, this is not surprising. Two questionnaire items are dropped; one empirical measure is retained; and two new empirical measures are added. Figure 12 presents SE-05 (S). This accentuates the range, from the U.S. at 78 to Venezuela at 15. Figure 21 shows (T) minus (S) difference scores. National shifts range considerably.

The correlation between Traditional and Statistics-only SE is just 0.63, while that between the respective ranks is similar, 0.60. Looking at ranks, 13 countries shift by more than 5 places. Double-digit declines from SE-05 (T) to SE-05 (S) occur for Israel, Malaysia, Taiwan, and Singapore. Double-digit increases show for Switzerland, China, Spain, and France.

Technological Infrastructure (TI):

TI-05 (T) (Figure 6) shows a standout U.S. stature, dropping sharply to Japan, Germany and China, trailed by everyone else.

Figure 13 presents TI-05 (S), further accentuating the U.S. lead. With the U.S. scoring 93, 11 nations score single digits (with 2 others rounding up to 10).

The TI indicator formulation is changed extensively to TI-05 (S). Four questions are dropped and four new statistical measures are added to the continuing use of two statistical measures. Given that, the consistency between Traditional and Statistics-only TI is reassuring – correlation is 0.90 and correlation between the respective ranks is 0.94. Figure 22 presents the difference scores for TI-05 between (T) and (S).

Only 4 countries see shifts in their TI ranks by more than 5 places. Taiwan and Spain increase, using TI-05 (S) relative to TI-05 (T), while India and Canada decline.

Productive Capacity (PC):

Figure 7 shows PC-05 (T). Japan nudges out the U.S. for the lead, followed by Germany and then China.

This indicator also changes considerably from PC (T) to PC (S). Three questions are dropped; two statistical measures are added; one statistical measure is in common.

Figure 14 portrays PC-05 (S). The U.S. moves into the lead, almost doubling Japan's score, which almost doubles China's, with Germany in fourth place.

Again, Statistics-only scoring accentuates the range among the 33 countries (Figure 23 shows difference scores). PC-05 (S) shows the most dramatic Statistics-only indicator difference from the Traditional indicator – note that all countries except the U.S. shift in one direction. On PC-05 (T) the range is from Japan at 84.4 to Venezuela at 29.1. On PC-05 (S), it is from the U.S. at 100 to Venezuela at 0.7.

The new PC (S) corresponds reasonably well with Traditional PC; correlation is 0.77, while that between the respective ranks is lower, 0.66. However, fully 18 of the 33 countries show shifts of greater than 5 places in their ranks; nine are double-digit changes.

In compiling the new statistical components (MVA and SVA), we noted that they are quite unstable from year to year. In-depth exploration is needed to determine how best to treat PC.

HTI 1993-2005 – Time Series and Observations

Figures 24-35 speak to changes in national technology-based competitiveness between 1993 and 2005. All of these results employ the Traditional HTI indicators. [The Statistics-only indicators were calculated in 2003, but are not sufficiently stabilized to offer bonafide temporal comparisons yet.]

Technological Standing is our output measure, seeking to reflect the resulting degree of high tech export competitiveness. Figure 24 stacks each country's TS (T) scores from 1993 (lowest bar) up to 2005 (top bar). Prior year values are shown in blue; 2005, in black. In general, countries' TS scores show stability. Certain changes warrant attention. The two leaders, U.S. and Japan, have slipped somewhat. This message, particularly to the U.S., should not be lost in considering the new HTI, on which the U.S. stands out remarkably. This is conveying that, on this consistently measured time series, the other countries have gained relative to the U.S. in technological competitiveness.

The stunning gain in Technological Standing over this 12-year period is by China.

Figure 25 shows INPUT (T) from 1993-2005. Recall that INPUT is the sum of National Orientation to compete in technology-intensive exports (NO), socio-economic infrastructure to do so (SE), technological infrastructure (TI) and productive capacity (PC). Again, national stability is demonstrated. This, again, makes shifts especially interesting. One gainer stands out – China. Two nations slip enough to be notable: Japan and South Africa.

Figures 30-33 show the change in INPUT (T) over time in another way. These line graphs track national change through the sequence of 5 measurements. Figure 30 spotlights China and India against the background of the others. Figure 31 highlights those countries whose composite INPUT scores have increased 10% or more over this period. According to our conceptualization, these nations are positioning themselves to advance in future Technological Standing.

Figure 32 pulls out the nations showing 10% or greater declines in INPUT (T). While only measured since 1999, the drop for Ireland is surprising. Figure 33 shows remaining nations that have been quite stable on INPUT.

Figure 34 (and its Black & White twin, Figure 35) combines Technological Standing and INPUT in one scattergram. We have drawn a vector pointing from a country's 1993 values to its 2005 values (not including intermediate points). [Note that HTI country coverage has expanded during the past decade; we only have 27 countries measured from 1993 through the present.] This shows movement on both INPUT, the HTI leading indicator, and on TS, the output indicator. While our original model anticipated that INPUT would be a good predictor of output (TS) roughly 15 years later, results since initiation of HTI in 1987 suggest refining that model. Among the input indicators, TI and PC appear to exert greater short-term influence than do NO and SE. For the overall INPUT indicator, change (as well as level) seems influential. That is, a country that enhances its input capabilities that enable technological competitiveness is more likely to achieve future gains in Technological Standing than one which remains stable on INPUT.

Figure 34 can be explored to discern interesting movement patterns, worthy of further analyses. For instance, what is happening to cause Malaysia to slip from a modest INPUT position and gain sharply on TS? [Indonesia, Thailand, and Brazil also show vectors pointing in this upper-left direction.] Those investigating a particular country can find interesting benchmarks with which to compare. Obviously, interpretation requires remembering that these are just indicators of vastly complex socio-technical systems. And as this report emphasizes, these Traditional HTI, based on composite statistical and expert opinion components, have limitations in comparing industrializing and highly developed nations.

That said, stepping back from Figure 34, its dominant message is – China.

Figures 26-29 break out the four Traditional input indicators – NO, SE, TI, and PC. NO shows notable declines for Indonesia, South Africa, and Ireland. SE finds shows increases for China, U.K., Sweden, Russia, India, and Israel; with notable drops at various points for South Africa, Canada, Argentina, Indonesia, and the Philippines. TI appears relatively stable. Declines show for Ireland, Spain, Japan, and Russia; increases, for China and Singapore. PC finds two clear leaders – the U.S. and Japan, both of which show relative declines toward the others. A number of countries evidence increases, led by China and India.

Figure 15 provides a different temporal comparison. It compares present with future competitiveness, reflecting expert opinion only. It clearly predicts that technology-based competitiveness is likely to continue to globalize. Observers expect that nearly all these nations intend to compete in technologically driven products and services and will achieve considerable success over the coming decades. Complacency in the U.S. and Western Europe should be undercut by these perceptions. Of course, the dramatically demonstrated rise of the Asian Tigers, and more recently of China, send a similar message.

Acknowledgements

We expressly thank the following organizations, which graciously provided critical data for the HTI:

Reed Electronics Research contributes their data on several key electronics measures, including electronics exports and equipment purchases, based upon their *Yearbook of World Electronics Data 2004/2005.*

IMD World Competitiveness Yearbook 2005, provided by IMD, Lausanne, Switzerland [www.imd.ch/wcc].

The PRS Group, Inc. kindly provided the January, 2005, issue of the Political Risk Letter, from which we draw their "5-year investment risk assessment index."

The United Nations is very helpful in guiding us and providing high tech inter-country export data. UNESCO provides various statistics, as indicated.

The World Values Survey group (Inglehart et al.) have helped us access their data and to identify suitable items.

Indicators 1993,1996,1999, 2003 Summary

Suggestions are most welcome!

HTI 2005 Appendix: Indicator Formulations and Data Sources

Technology Policy and Assessment Center *

Georgia Institute of Technology

June 2006

Beginning with HTI-03, we are investigating a new indicators approach based solely on statistical measures. In conjunction with this changeover, we have expanded HTI statistical coverage to address "information economy" (i.e., technology-intensive service) elements to expand HTI coverage beyond technology-intensive manufactured products. So, we have the following two data sets in our HTI 2005 study:

- **Traditional (T)** -- [Survey questions + old statistics components]
- **Statistics-only (S)** -- [new and more inclusive statistics components without survey data]

The formulas for HTI (T) and (S) are as follows:

Traditional (**T**):

NO (T) = [Q1 + (Q2 + Q3)/2 + Q4 + F1V]/4.
SE (T) = (Q5 + Q10 + HMHS)/3.
TI (T) = [(Q7 + Q8)/2 + Q9 + Q11 + EDP + S&E]/5
PC (T) = [(Q6 + Q12 + Q13)/3 + A26/2]/1.5.
TS (T) = (X + A2 + Q14a)/3
IN (T) = [NO (T) + SE (T) + TI (T) + PC (T)]

Statistics-only (**S**):

NO (S) = [F1V+WVS {V27}]/2
SE (S) = [HMHS + FDI + PatApNon]/3
TI (S) = [EDP+S&E+ RATIOROYL + ICTCON + PatApRes + BIBLIO + R&DEXP]/7
PC (S) = [A26 + MVA + SVA]/3
TS (S) = [X + A2 + ROYLR + SOCSE]/4
IN (S) = [NO (S) + SE (S) + TI (S) + PC (S)]

All the "Q" items (questions) are based on responses to our survey. We invite persons to answer closed-form questions as part of our International Technology Indicators Panel. This is conducted as an electronic survey with e-mail invitations, with most responding to our web-based survey instrument [www.tpac.gatech.edu/hti.php]. In the survey, respondents first assess their "familiarity with technology-intensive development in this country" on a 1-4 scale (1 = less familiar, to 4 = expert). They then answer a series of questions (Questions 1-14 or Questions C-P on the web). This expert opinion information is combined with several statistical sources to compose the Traditional High Tech Indicators (T) as detailed below.

* **TPAC** -- the Technology Policy and Assessment Center -- is affiliated with the School of Public Policy of the Georgia Institute of Technology in Atlanta, Georgia.

For each statistical source we herein describe the data source and provide a formal citation reference. In a number of cases data were provided directly to us, rather than from a formal publication. In addition, many sources are now dynamic; that is, the contents of a data table are updated on an ongoing basis. Hence, the cited source table is apt to give some changed values if one refers to it some time later.

Below are all the indicator formulations, both Traditional (T) and Statistics-only (S), with definitions and the data source for each of above 12 indicators.

Raw data are transformed to "**S-scores**." Each indicator component is scaled from 0 to 100 and then averaged to generate comparable indicators with a 0 to 100 range. For survey items, 100 represents the highest response category for a question (nearly all items are scaled 1-5, so 1 transforms to S = 0; 5 transforms to S = 100).[†] For statistical data, 100 typically represents the value attained by the country with the largest value among the 33-country set. Thus, this is a relative scaling so that an apparent "decline" over time or low score is only relative to the other countries in the set of 33. Depending on the component, two classes of scaling are used:

- Absolute 0; Relative 100: for some items there is a true zero minimum (e.g., high tech exports cannot be negative) and a relative maximum (i.e., divide by the highest national value).
- Relative 0; Relative 100: for the remaining items, add the most negative country value to the raw scores, then divide by the highest national value to obtain 0-100 scaling.

We noted some apparent inconsistencies in reviewing HTI from 1993 through 2005. The actual calculations appear consistent, but the reported formulas differ slightly. In some places we call for averaging of S-score component question items, whereas elsewhere we call for taking the S-score of the averaged raw question items. These are equivalent for question items that use a "fixed maximum and minimum."[‡] That is we note that question responses range from 1-5, which we score 10-50. To get S scores, we subtract 10 (making the scale be 0-40); then multiply by 2.5 (making the scale be 0-100). Transitivity applies – subtracting a constant from each component, then multiplying by a second constant equates to subtracting the constant from the sum, then multiplying by the second constant.

We also observed that sometimes the formulas don't specify averaging question items being combined. For instance, in NO, just below, Q2 and Q3 are combined this way. It seems most straightforward to so average (in principle taking the S-scores using a suitably adjusted multiplier is equivalent).

Technological Standing (TS)

The current world market share in high technology products reflects not only current export market share statistics but also current manufacturing capability.

Formula: **TS (T) = [SQ14a+SX-2003+SA2-2005]/3**
TS (S) = [SX-2003 + SA2-2005 + SROYLR + SSOCSE]/4

Q14a = Please characterize present and future technology-intensive production in this country. Judge the production in

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[†] Scaling varies by question – see: http://www.tpac.gatech.edu/hti2005/question.php. For example, Q14's parts all correspond to:

1. Essentially no production in this sector
2. Nearly all production in this sector is relatively low value-added assembly
3. Some indigenous production capability in this sector, largely of standard products
4. Considerable indigenous manufacturing activity in this sector with products well-respected for quality and value in international markets
5. Extensive indigenous manufacturing activity in this sector with products considered technically advanced, "state-of-the-art" in international markets.

[‡] We have discovered that the expert component of the PC (T) value we reported and that appears in S&EI 2006, was based on a "sample maximum." In prior years we used a "Fixed Maximum," as we do for other Question-based indicators. So, for PC (T) series continuity (from 1993 forward), we should go back to using a fixed maximum. [The "sample maximum" was introduced as an attempt to help address the ceiling effect. Given that we are introducing the Statistics-only scores, we think it best to leave "Traditional" HTI as it has been calculated.]

each of ten sectors for which you feel reasonably familiar: first, today, and second, 15 years in the future. Part "a" pertains to "Overall technology-intensive production in this country."

X-2003 = The value of high tech exports as drawn from the United Nations Statistical Office (UNSO) COMTRADE trade statistics for 2003. High tech exports were defined in accord with the U.S. Department of Commerce's DOC3 definition, excluding missiles and ordinance. It includes STIC Revision 2 codes 51, 52, 54, 58, 712, 713, 714, 716, 718, 75, 76, 772, 776, 792, 87, and 88. All UN trade data is obtained directly from the United Nations Statistical Office.

Date: Data are from 2003.
Unit: 1,000's of US Dollars
Data Source Location: Data were online from United Nations Statistical Office, Commodity Trade Statistics Database.
Reference: United Nations Statistical Office, Commodity Trade Statistics Database, *COMTRADE,* New York, United Nations, 2005.

A2-2005 = The value of electronics exports in 2005 (forecasted) as obtained from the Reed Electronics Research.

Date: Data are based on a 2005 forecast.
Unit: 1,000's of US Dollars
Data Source Location: Data is available from the *Yearbook of World Electronics Data 2004/2005,* however for the purposes of this project, the statistical data series was obtained directly from Reed Electronics Research in electronic from as drawn from their *Full Statistical Database 1985-2005*. [http://www.rer.co.uk]
Reference: Reed Electronics Research. 2005. *Yearbook of World Electronics Data 2004/2005.* Surrey, United Kingdom. Reed Electronics Research Ltd.

ROYLR: Royalty/license fees, receipts (Balance of Payments)

Date: Data are primarily from 2002.
Unit: Current US Dollars
Data Source: World Bank World Development Indicators 2004 (CD).
Reference: World Bank, April 2004, World Development Indicators 2004, New York, World Bank.

SOCSE: Export of Computer, communications and other services. Data are reported as a percentage of commercial service exports. Dollar value is calculated from the total Commercial Services Exports.

Date: Data are primarily from 2002.
Unit: Current US Dollars
Data Source: World Bank World Development Indicators 2004 (CD).
Reference: World Bank, World Development Indicators 2004, New York, April 2004.

National Orientation (NO)

Evidence that a nation is taking directed action to achieve technological competitiveness. Evidence of such action could be manifested at the business, government, or cultural levels, or any combination of the three.

Formula: **NO (T) = [SQ1+S ((Q2+Q3)/2)+SQ4+SF1V-2005]/4**
NO (S) = [SF1V-2005+SWVS {V27}]/2

Q1 = To what extent does this country's government evidence a deliberate strategy to promote technology-intensive production for export?

Q2 = To what extent do this country's basic cultural values associate technology and technological change with desirable social development?

Q3 = How closely do influential groups (e.g., unions, trade associations, religious organizations) in this country associate technology with desirable social development? For instance, one could imagine some groups not being favorably disposed toward introduction of more technologies. Or, some societies may emphasize redistributive measures, such as land reform, over technology-intensive industrial development?

Q4 = Please rate the presence of an "entrepreneurial spirit" in this country. That is, to what extent are its citizens, especially the business community, predisposed toward innovative action and economic risk-taking?

F1V2005 = The Political Risk Letter 5-year investment risk assessment index for January 1, 2005,[§] from the PRS Group; rescaled from D- = 1 to A+ = 12.

Date: Data are drawn from the 1 January 2005 letter.
Unit: N/A
Data Source Location: Political & Economic Forecast Table, Political Risk Letter, PRS Group, January 1, 2005. [http://www.prsgroup.com]
Reference: PRS Group, Political Risk Letter, New York, January 1, 2005.

WVS {V27} = World Values Survey Trust Question (V27)

Date: Data represent responses from a range of years (1994-1999).
Unit: N/A
Data Source Location: http://www.worldvaluessurvey.org/
Reference: Ronald Inglehart, Miguel Basanez, Jaime Diez-Medrano, Loek Halman and Ruud Luijk, Editors, 2004 Human Beliefs and Values, Mexico City, Mexico, Siglo XXI Editores.

Socioeconomic Infrastructure (SE)

The social and economic institutions that support and maintain the physical, human, organizational and economic resources essential to the functioning of a modern, technology-based industrial nation.

Formula: **SE (T) = [SQ5+SQ10+SHMHS]/3**
SE (S) = [SHMHS + SFDI + SPatApNon]/3

Q5 = Aside from the amount of financial resources, it is also important to assess the extent to which such resources can be mobilized to support technology-intensive development. Please judge the mobility of capital in this country.

Q10 = To what extent are foreign-owned firms encouraged to do business in this country?

HMHS = Harbison-Myers Human Skills Index. The formula for the index is W4+4*W6.

W4 = The net percentage of students enrolled in secondary education in 2002. The percentage is based on the number of individuals in school vs. the total number of individuals who could be enrolled as defined by UNESCO and adjusted for local practice.

Date: Data are primarily from 2002.
Unit: N/A
Data Source Location: UNESCO Web Site, Gross and Net Enrolment Ratios, and Gender Parity Index, secondary (ISCED 2&3), for school years 1998/1999 to 2004/2005, UNESCO, May 2005.
Reference: UNESCO, Institute for Statistics, Gross and Net Enrolment Ratios, and Gender Parity Index, secondary (ISCED 2&3), for school years 1998/1999 to 2004/2005, New York, United Nations, May 2005.

[§] Four digit numbers at the end of statistical variables (e.g., F1V2005) represent the year from which the data are drawn.

W6 = The gross percentage of students enrolled in tertiary education in 2002. The percentage is based on the number of individuals in school vs. the total number of individuals who could be enrolled as defined by UNESCO. The values are not adjusted for local practice.

Date: Data are primarily from 2002.
Unit: N/A
Data Source Location: UNESCO Web Site, Gross Enrolment Ratios, and Gender Parity Index, tertiary (ISCED 5&6), for school years 1998/1999 to 2004/2005, UNESCO, May 2005.
Reference: UNESCO, Institute for Statistics, Gross Enrolment Ratios, and Gender Parity Index, tertiary (ISCED 5&6), for school years 1998/1999 to 2004/2005, New York, United Nations, May 2005.

FDI = Foreign Direct Investment (Net Inflow, Balance of Payments)

Date: Data are primarily from 2003.
Unit: Current US Dollars
Data Source: World Bank World Development Indicators 2004 (CD).
Reference: World Development Indicators 2004, New York, World Bank, April 2004.

PatApNon = Patent applications by non-residents

Date: Data are primarily from 2001.
Unit: Applications
Data Source Location: WIPO Website (http://www.wipo.int/ipstats/en/statistics/patents/index.html)
Reference: Industrial Property Statistics, Patent Applications Filed and Patents Granted, Geneva, WIPO, 2001.

Technological Infrastructure (TI)

The institutions and resources that contribute to a nation's capacity to develop, produce, and market new technology.

Formula: **TI (T) = [S((Q7+Q8)/2)+SQ9+SQ11+SEDP-2005+SS&E]/5**
TI (S) = [SEDP-2005+SS&E+ SRATIOROYL + SICTCON + SPatApRes + SBIBLIO + SR&DEXP]/7

Q7 = To what extent is this country capable of replenishing and increasing its supply of qualified, graduate-level (post-baccalaureate) scientists and engineers via local (indigenous) training and educational institutions?

Q8 = How would you characterize this country's contribution to the international pool of significant scientific and technical knowledge?

Q9 = To what extent do R&D activities in this country relate to industrial enterprise?

Q11 = The acquisition of "technological mastery" (the ability to make effective use of technological knowledge) is critical to development of technology-intensive products. To what degree has this country achieved technological mastery?

EDP2005 = Electronic data processing equipment purchases for 2005 as obtained from the Reed Electronics Research

Date: Data are based on estimates of 2005 purchases.
Unit: 1,000 of US Dollars
Data Source Location: Volume 3, Table 2.4.4, *Yearbook of World Electronics Data 2004/2005*, Reed Business Information Ltd, England, 2005. [http://www.rer.co.uk]
Reference: Reed Electronics Research. 2005. *Yearbook of World Electronics Data 2004/2005.* Surrey, United Kingdom. Reed Electronics Research Ltd.

S&E = The number of scientists and engineers engaged in research and experimental development as defined by UNESCO.

Date: Data are drawn from different years with many from 2001.
Unit: Number of Individuals
Data Source Location: UNESCO Web Site, *Science and Technology, Research and development (R&D) personnel by occupation (1996-2002)*, Institute for Statistics, UNESCO, May 2005.
Reference: UNESCO, Institute for Statistics, *Science and Technology, Research and development (R&D) personnel by occupation (1996-2002)*, New York, United Nations, May 2005.

RATIOROYL: Ratio of royalty and license receipts /royalty and receipts payments (Balance of Payments)

Date: Data are from 2002.
Unit: Current US Dollar/Current US Dollar
Data Source: World Bank World Development Indicators 2004 (CD).
Reference: World Development Indicators 2004, New York, World Bank, April 2004.

ICTCON: "Connectivity" measure defined as the minimum set of measures necessary for ICT access, comprising Internet hosts per capita, PCs per capita, telephone mainlines per capita, and mobile subscribers per capita.

Date: Data are from 2001.
Unit: N/A
Data Source: http://www.unctad.org/en/docs/iteipc20031_en.pdf
Reference: United Nations Conference on Trade and Development, *Information and Communication Technology Development Indices*, New York & Geneva, United Nations, 2003.

PatApRes: Patent applications by residents.

Date: Data are from 2001.
Units: Applications
Data Source Location: WIPO Website (http://www.wipo.int/ipstats/en/statistics/patents/index.html).
Reference: Industrial Property Statistics. 2001. *Patent Applications Filed and Patents Granted during 2001*, Geneva, WIPO.

Biblio: A measure of scientific and technical publishing as indicated by bibliometric measures on data from the EI Compendex database, accessed via the Engineering Village 2 website.

Date: Data are publications for 2004.
Unit: N/A
Data Source: GT/TPAC bibliometric analyses
Reference: Georgia Institute of Technology, Technology Policy and Assessment Center.

Methodology: Six emerging technologies (ETs) were selected based on the RAND Science & Technology Policy Institute industrial Critical Technologies survey. Coverage in EI Compendex was notably superior to that in INSPEC for each. We retrieved samples of 4000 records for each ET for 2004.

Emerging Tech	**EI Compendex Class. Code**	**Limits**	**EI Pub. Count**
Nano (Crystal) Structures & Mtls	933.1	Year=2004	27848
Advanced materials for comp/comm tech	(549.3 OR 712.1)	Year=2004	23550
Semiconductor Devices & IC's	714.2	Year=2004	46464
Optics	(741.1 OR 741.3)	Year=2004	83158
Biotech	461.*	Year=2004	67797
Fuel/Solar Cells	(702.2 OR 702.3 OR 801.4.1)	Year=2004	11479

We calculate an S-Score as a measure of publication activity of a country (CountryTotal) compared to the publication total of the leading country (USATotal), expressed as a percentage. That is: (CountryTotal/USATotal * 100)

Six S-Scores are calculated for each country (one per ET) and the average of those six S-Scores is the indicator value.

R&DEXP: Research and Development Expenditures.

Date: Data are from a range of years.
Unit: US Dollars
Data Source: World Competitiveness Report 2005 (http://www.imd.ch/wcc).
Reference: *IMD World Competitiveness Yearbook 2005, International Institute for Management Development (IMD), Lausanne, Switzerland.*

Productive Capacity (PC)

The physical and human resources devoted to manufacturing products, and the efficiency with which those resources are used.

Formula: **PC (T) = [S((Q6+Q12+Q13)/3)+SA26-2005/2]/1.5** [**]
PC (S) = [SA26-2005 + SMVA + SSVA]/3

Q6 = Please rate the quantity and quality of skilled manufacturing labor available in this country.

Q12 = To what extent does a system of indigenous producers of components for technology-intensive products exist?

Q13 = Please rate indigenous industrial management capabilities to develop, produce, and market technology-intensive products.

A26-2005 = The value of total electronics production for 2005 as obtained from the Reed Electronics Research.

Date: Data are an estimate of 2005 production.
Unit: 1,000's of US Dollars
Data Source Location: Volume 3, Table 2.3.4, *Yearbook of World Electronics Data 2004/2005*, Reed Business Information Ltd, England, 2005. [http://www.rer.co.uk]
Reference: Reed Electronics Research, 2005, *Yearbook of World Electronics Data 2004/2005* Surrey, United Kingdom, Reed Electronics Research Ltd.

MVA: Manufacturing Value Added.

Date: Data are from primarily 2001.
Unit: Current US Dollars
Data Source: World Bank World Development Indicators 2004 (CD).
Reference: World Development Indicators 2004, New York, World Bank, April 2004.

SVA: Services Value Added.

Date: Data are from primarily 2001.
Unit: Current US Dollars
Data Source: World Development Indicators 2004 (CD), World Bank.
Reference: World Development Indicators 2004, New York, World Bank, April 2004.

INPUT (T, S)

[**] The PC (T) values reported in *Science & Engineering Indicators 2006* differ slightly. This is because we used a relative scaling -- the "maximum" country value on the question items, combined, as 100. That was done in the context of an effort to reduce ceiling effects on survey responses. However, since HTI are moving to the Statistics-only formulation, and we want to retain time series comparability, we herein revert to the absolute 100 scaling for these question items used historically.

This composite simply sums up (as INPUT (Sum)) the four Input Indicators: NO, SE, TI, and PC. In the past, we sometimes calculated INPUT (Average) – which is just INPUT Sum divided by 4. Conceptually these two are equivalent – an overall leading indicator of potential future high tech competitiveness. INPUT (Average) retains the 0-100 scale, whereas INPUT (Sum) makes visualization of the four indicators together attractive (e.g., as a stacked bar chart). Our default form is "INPUT" (IN) which is really INPUT (Sum).

Formula: **IN (T) = [NO (T) + SE (T) + TI (T) + PC (T)]**
IN (S) = [NO (S) + SE (S) + TI (S) + PC (S)]

Tables: High Tech Indicator Values: 1993-2005

Table 2: Input, National Orientation, Socio-economic Infrastructure

	INPUT=Sum of NO + SE + TI + PC						National Orientation						Socio-Economic Infrastructure					
COUNTRY	INPUT-93	INPUT-96	INPUT-99	INPUT-03(T)	INPUT-05(T)	INPUT-05(S)	NO-93	NO-96	NO-99	NO-03(T)	NO-05(T)	NO-05(S)	SE-93	SE-96	SE-99	SE-03(T)	SE-05(T)	SE-05(S)
North America																		
USA	331.2	344.8	349.6	341.7	337.9	353.5	70.0	75.5	78.4	79.8	79.3	82.4	84.0	85.1	87.0	86.4	84.2	78.4
Canada	236.0	239.2	276.4	268.8	249.7	157.2	60.1	69.0	78.5	81.8	76.3	94.1	78.3	82.5	91.7	82.4	73.1	42.4
Mexico	148.0	162.4	128.8	168.2	171.2	103.4	47.9	54.8	41.8	55.2	55.1	62.3	47.7	45.5	40.4	49.0	48.7	28.6
South America																		
Argentina	166.0	149.2	153.2	160.7	165.1	76.9	45.0	41.5	41.3	44.9	47.7	45.9	63.2	49.4	53.3	52.4	53.3	25.5
Brazil	208.4	188.8	190.4	174.2	189.4	75.8	63.6	58.0	61.5	52.5	59.6	36.3	55.1	53.1	49.1	50.5	51.3	29.1
Venezuela	-	145.6	135.6	123.0	140.6	43.2	-	45.0	40.2	37.2	36.5	25.5	-	47.7	51.7	46.0	47.8	14.7
Europe																		
Czech Rep	-	-	213.2	208.3	225.9	117.9	-	-	68.2	64.6	74.4	76.9	-	-	58.9	64.4	59.2	30.4
France	254.0	266.0	272.4	259.3	249.1	165.7	74.2	75.9	78.5	67.9	66.8	56.2	63.8	64.9	71.5	76.2	67.3	70.0
Germany	276.8	263.6	275.2	283.6	282.2	175.2	75.2	76.6	73.8	75.6	71.7	66.6	69.8	62.9	71.8	77.5	75.5	58.3
Hungary	198.8	190.8	222.4	216.7	212.6	108.3	66.7	67.0	74.5	66.7	61.7	62.0	54.0	47.7	61.4	67.9	66.2	33.7
Ireland	-	-	294.4	262.0	239.4	149.9	-	-	99.2	84.1	74.1	78.9	-	-	82.6	80.7	74.3	57.7
Italy	215.2	225.6	218.4	239.6	228.0	137.8	59.2	66.3	63.1	69.4	67.0	59.1	53.6	59.3	59.7	69.4	63.5	54.1
Netherlands	241.2	268.0	252.0	273.7	251.2	162.4	68.5	81.3	68.9	82.4	69.6	85.0	67.7	74.7	74.2	80.6	77.2	54.5
Poland	-	197.6	202.4	211.1	209.6	103.6	-	69.4	63.9	63.7	61.8	57.2	-	54.2	57.0	68.3	65.6	39.4
Spain	208.8	206.0	221.2	192.7	197.0	156.4	55.9	63.8	65.8	55.1	56.9	69.2	64.4	59.3	68.2	68.8	69.0	71.8
Sweden	258.0	238.4	230.8	260.7	272.0	189.8	83.0	66.8	61.1	75.5	80.1	95.5	66.6	65.3	67.9	78.9	82.0	65.6
Switzerland	242.4	221.2	236.8	248.1	231.2	151.8	71.5	57.8	66.0	69.2	64.6	67.7	62.0	59.6	60.6	71.2	62.8	62.1
UK	235.2	248.0	263.6	276.9	272.4	191.8	63.2	70.9	72.4	76.5	77.7	79.6	65.6	65.6	78.0	84.0	82.9	71.1
Asia																		
China	180.4	182.0	205.6	222.8	264.8	192.3	62.3	65.3	65.5	63.0	74.3	75.3	46.4	44.8	52.7	55.0	60.4	59.8
India	170.4	192.0	219.2	196.6	212.0	84.0	52.4	57.4	68.5	62.5	61.6	56.8	46.4	46.0	50.0	49.3	52.8	21.0
Indonesia	162.0	127.2	138.8	132.6	141.1	78.8	62.5	54.8	55.1	45.1	44.2	56.2	49.5	35.2	42.2	39.1	40.8	19.6
Japan	334.4	312.4	304.4	297.6	291.4	225.2	85.3	73.8	79.5	76.4	70.3	75.1	72.7	62.3	63.2	67.0	65.5	42.0
Malaysia	226.4	218.8	202.8	205.9	220.7	91.9	81.1	81.0	69.7	73.0	75.4	65.2	63.7	62.7	58.2	64.9	70.4	16.1
Philippines	160.8	220.4	178.0	183.3	182.4	56.6	43.1	75.1	63.8	59.4	53.2	36.7	57.6	63.4	55.6	55.0	52.9	16.4
Singapore	261.2	259.6	249.2	272.4	261.1	131.5	92.7	88.4	87.2	83.8	78.5	74.3	73.5	75.7	71.2	84.2	79.6	38.6
South Korea	240.4	238.4	241.6	259.0	252.5	149.4	81.9	78.9	74.9	80.4	74.7	65.8	69.7	64.6	73.5	81.1	72.7	52.0
Taiwan	236.0	259.2	262.0	272.2	248.9	125.4	81.1	90.2	90.7	83.0	73.6	72.1	74.5	76.3	74.2	84.4	77.2	29.1
Thailand	178.8	173.6	148.4	156.7	170.4	89.0	67.5	63.5	50.8	47.7	58.7	65.2	51.0	48.7	46.5	54.2	53.2	18.1
All Others																		
Australia	217.6	225.6	266.0	236.9	259.6	143.6	66.8	66.2	78.4	70.5	76.2	83.0	63.9	60.6	83.2	74.3	78.4	43.0
Israel	-	-	272.4	266.2	268.8	113.0	-	-	91.4	79.5	78.4	56.2	-	-	72.5	85.0	85.8	36.5
New Zealand	203.6	234.8	223.6	245.6	232.5	134.5	57.1	66.7	67.3	75.1	70.0	79.1	70.0	74.3	70.9	75.9	75.7	43.5
Russia	162.4	197.6	187.2	206.6	182.0	112.1	32.5	48.9	48.9	48.6	42.0	53.7	39.5	50.7	52.4	60.4	59.2	43.4
South Africa	210.0	170.4	172.8	169.2	172.3	74.8	74.4	49.2	50.2	53.7	50.6	47.1	69.6	51.0	53.6	49.1	52.8	21.2

Table 3: Technological Infrastructure, Productive Capacity, Technological Standing, Current & Future High Tech Production Capability

	Technological Infrastructure						Productive Capacity						Technological Standing						Expert Opinion: Perception of	
COUNTRY	TI-93	TI-96	TI-99	TI-03(T)	TI-05(T)	TI-05(S)	PC-93	PC-96	PC-99	PC-03(T)	PC-05(T)	PC-05(S)	TS-93	TS-96	TS-99	TS-03(T)	TS-05(T)	TS-05(S)	Current Hi Tech Production Capability-05	Future Hi Tech Production Capability-05
North America																				
USA	87.5	94.8	96.1	92.7	91.9	92.7	89.8	89.4	88.1	82.8	82.5	100.0	90.0	91.4	95.4	93.9	82.9	91.2	43.6	42.1
Canada	49.5	47.5	53.5	51.5	54.5	15.4	48.1	40.2	52.8	53.1	45.8	5.4	24.0	28.2	35.4	32.6	27.6	9.3	35.0	40.0
Mexico	25.2	30.2	21.8	28.7	30.4	4.2	27.2	31.7	24.8	35.4	37.1	8.3	11.6	20.1	19.8	27.3	26.3	10.7	22.9	30.0
South America																				
Argentina	25.5	27.4	27.5	31.0	30.1	3.6	32.2	31.0	31.0	32.5	34.0	1.9	12.7	9.6	11.4	12.7	12.7	0.3	25.0	32.5
Brazil	41.6	37.4	40.4	35.4	36.9	5.7	48.1	40.3	39.6	35.8	41.6	4.8	15.5	19.1	18.2	15.4	18.8	2.2	30.6	41.3
Venezuela	-	28.0	18.6	19.5	27.2	2.3	-	25.1	25.1	20.3	29.1	0.7	-	10.5	7.7	7.5	14.3	0.1	28.6	30.0
Europe																				
Czech Rep	-	-	41.5	34.7	43.6	9.8	-	-	44.6	44.6	48.7	0.8	-	-	16.4	18.5	21.1	1.9	32.2	40.0
France	60.0	61.3	57.7	55.9	55.2	25.9	56.1	64.1	64.7	59.2	59.8	13.6	45.6	45.7	48.0	44.0	45.0	22.6	41.3	41.3
Germany	66.6	62.4	64.1	65.5	64.5	27.8	65.0	61.6	65.3	65.0	70.6	22.6	60.5	59.2	58.7	61.4	65.4	37.8	45.5	42.7
Hungary	41.4	36.4	43.5	40.0	40.5	11.3	36.8	39.8	43.1	42.2	44.2	1.4	15.4	17.1	20.9	20.3	22.4	3.8	32.2	41.3
Ireland	-	-	53.0	44.2	41.9	9.9	-	-	59.6	53.0	49.2	3.4	-	-	32.7	34.3	35.9	12.4	40.0	42.0
Italy	50.5	48.6	48.4	48.4	46.4	14.3	51.8	51.4	47.1	52.3	51.1	10.4	31.5	29.5	26.2	31.4	29.3	10.7	35.6	35.6
Netherlands	54.4	55.7	53.1	55.2	52.5	19.1	50.5	56.3	56.0	55.5	51.9	3.8	35.1	40.3	38.7	45.3	40.4	20.2	37.0	37.8
Poland	-	35.0	39.7	36.6	34.1	5.3	-	39.1	41.9	42.5	48.1	1.6	-	18.8	18.4	14.9	14.9	1.4	26.7	38.3
Spain	36.4	39.1	42.2	33.7	33.5	10.5	52.3	43.6	45.2	35.1	37.6	4.9	18.3	16.0	18.4	20.3	20.0	6.7	28.6	37.1
Sweden	55.5	53.7	54.7	53.2	54.5	24.8	52.8	52.6	47.2	53.0	55.5	3.9	28.0	32.2	30.2	34.7	31.9	7.2	42.9	38.6
Switzerland	55.4	51.1	54.9	54.6	51.5	17.9	53.4	52.9	55.6	53.1	52.3	4.2	32.5	30.5	32.8	31.9	31.8	8.0	39.2	36.7
UK	57.5	59.4	59.8	62.0	58.0	26.2	49.0	52.3	53.6	54.5	53.8	14.9	49.3	48.6	53.8	54.1	47.7	32.6	40.0	37.8
Asia																				
China	38.6	39.3	46.5	55.2	64.7	23.8	33.2	32.8	41.0	49.6	65.4	33.5	20.7	22.5	44.2	49.3	73.9	42.3	35.8	45.8
India	33.0	39.3	48.3	37.0	43.2	2.7	38.6	49.1	52.4	47.8	54.5	3.5	13.5	18.3	20.8	17.9	20.0	4.6	32.7	44.6
Indonesia	25.3	17.8	18.2	20.7	24.1	0.8	24.8	19.6	23.2	27.7	32.0	2.3	11.0	11.2	14.0	14.0	14.2	1.7	24.4	34.4
Japan	83.7	81.7	78.3	73.9	71.1	51.1	92.7	94.4	83.4	80.3	84.4	57.1	90.8	94.0	82.7	81.6	73.1	44.6	47.5	47.5
Malaysia	34.3	31.9	31.0	28.8	31.4	4.0	47.5	43.1	44.2	39.2	43.5	6.5	24.3	28.2	30.8	32.8	35.8	14.0	32.0	43.0
Philippines	25.2	35.7	21.9	24.0	31.2	1.3	34.9	46.2	36.7	45.0	45.1	2.2	12.6	14.9	15.0	19.7	23.2	4.4	31.4	34.3
Singapore	40.5	41.6	37.4	46.7	50.3	12.4	54.6	54.0	53.4	57.7	52.7	6.2	35.8	46.7	51.5	52.4	47.7	21.6	37.0	44.0
South Korea	42.6	44.4	44.6	45.3	48.0	16.0	46.4	50.6	48.8	52.3	57.1	15.7	28.7	32.6	32.7	40.1	45.2	18.5	38.0	46.0
Taiwan	37.4	43.0	43.6	45.3	43.7	16.5	43.0	49.9	53.7	59.6	54.3	7.6	27.0	31.5	35.2	39.3	37.9	14.3	36.9	40.8
Thailand	26.8	28.2	20.5	23.9	25.0	2.0	33.4	33.1	30.6	30.9	33.4	3.7	17.2	18.1	16.6	20.0	21.1	6.3	26.7	35.6
All Others																				
Australia	45.8	51.3	53.0	46.9	53.5	14.9	41.3	47.7	51.6	45.2	51.5	2.7	15.7	20.6	19.5	19.6	23.3	1.8	35.0	36.0
Israel	-	-	57.8	52.3	54.0	18.4	-	-	50.6	49.4	50.5	1.9	-	-	29.5	26.7	25.1	3.5	34.4	43.3
New Zealand	41.9	48.3	45.9	49.8	47.0	11.4	34.6	45.6	39.6	44.7	39.8	0.5	16.8	13.5	16.8	21.0	19.3	0.4	32.5	40.0
Russia	58.4	55.6	50.5	51.2	43.9	11.0	31.8	42.6	35.6	46.5	36.9	4.0	14.7	19.0	15.2	17.5	16.5	1.7	28.3	32.5
South Africa	23.0	40.3	40.5	35.9	36.5	5.4	43.0	30.0	28.7	30.4	32.4	1.0	22.1	15.4	14.3	12.5	15.4	0.4	28.0	35.6

HTI-05data-Component-Master

We have the following two data sets in our HTI-05 series:

- **Traditional (T)** -- [Survey questions + old statistics components]
- **Statistics-only (S)** -- [old and new statistics components without survey data]

The formulas for HTI (T) and (S) are as follows (See the Appendix for component definitions and data sources for each indicator):

Traditional (**T**):

NO (T) = [Q1 + (Q2 + Q3)/2 + Q4 + F1V]/4.
SE (T) = (Q5 + Q10 + HMHS)/3.
TI (T) = [(Q7 + Q8)/2 + Q9 + Q11 + EDP + S&E]/5
PC (T) = [(Q6 + Q12 + Q13)/3 + A26/2]/1.5.
TS (T) = (X + A2 + Q14a)/3
IN (T) = [NO (T) + SE (T) + TI (T) + PC (T)]

Statistics-only (**S**):

NO (S) = [F1V+WVS {V27}]/2
SE (S) = [HMHS + FDI + PatApNon]/3
TI (S) = [EDP+S&E+ RATIOROYL + ICTCON + PatApRes + BIBLIO + R&DEXP]/7
PC (S) = [A26 + MVA + SVA]/3
TS (S) = [X + A2 + ROYLR + SOCSE]/4
IN (S) = [NO (S) + SE (S) + TI (S) + PC (S)]

The component tables below indicate “S” with component values to remind that these are “S-scores” (i.e., relative scoring with the leading country in the sample set to 100 on empirical items and the absolute possible maximum set to 100 on questionnaire items). See the Appendix for calculation details.

Table 4: HTI-05 TS(T) and TS(S) Values and their Components

COUNTRY	TS(T)	TS(S)	SX2003	SA22003	SRoyR	SSOCSE	SQ14a
North America							
USA	82.9	91.2	100.0	64.8	100.0	100.0	83.9
Canada	27.6	9.3	13.1	7.3	3.8	12.8	62.5
Mexico	26.3	10.7	18.2	23.3	0.1	1.0	37.5
South America							
Argentina	12.7	0.3	0.6	0.0	0.0	0.5	37.5
Brazil	18.8	2.2	3.3	1.4	0.2	3.8	51.6
Venezuela	14.3	0.1	0.2	0.0	0.0	0.1	42.5
Europe							
Czech Rep	21.1	1.9	3.6	2.1	0.1	1.7	57.5
France	45.0	22.6	36.6	20.3	7.3	26.3	78.1
Germany	65.4	37.8	66.2	41.3	8.5	35.1	88.6
Hungary	22.4	3.8	6.7	4.8	0.8	3.0	55.6
Ireland	35.9	12.4	21.1	14.0	0.6	14.0	72.7
Italy	29.3	10.7	16.5	7.4	1.2	17.5	63.9
Netherlands	40.4	20.2	27.3	26.2	4.5	22.9	67.5
Poland	14.9	1.4	2.8	1.0	0.1	1.7	41.1
Spain	20.0	6.7	8.2	4.4	0.8	13.4	47.2
Sweden	31.9	7.2	9.1	5.8	3.4	10.5	80.8
Switzerland	31.8	8.0	16.6	5.8	3.5	5.8	72.9
UK	47.7	32.6	41.1	26.9	17.5	44.9	75.0
Asia							
China	73.9	42.3	58.3	100.0	0.3	10.6	63.5
India	20.0	4.6	2.4	0.7	0.0	15.2	56.8
Indonesia	14.2	1.7	3.1	3.3	0.0	0.1	36.1
Japan	73.1	44.6	59.9	66.7	23.6	28.3	92.5
Malaysia	35.8	14.0	20.5	31.7	0.0	3.7	55.0
Philippines	23.2	4.4	8.9	8.4	0.0	0.5	52.3
Singapore	47.7	21.6	31.7	43.9	0.3	10.6	67.5
South Korea	45.2	18.5	27.4	38.3	1.9	6.4	70.0
Taiwan	37.9	14.3	19.5	26.9	0.8	9.8	67.3
Thailand	21.1	6.3	9.4	12.4	0.0	3.3	41.7
All Others							
Australia	23.3	1.8	2.1	1.2	0.7	3.1	66.7
Israel	25.1	3.5	3.5	3.0	1.1	6.5	68.8
New Zealand	19.3	0.4	0.4	0.1	0.2	0.7	57.5
Russia	16.5	1.7	3.0	0.7	0.3	2.9	45.8
South Africa	15.4	0.4	0.9	0.3	0.1	0.3	45.0

Table 5: HTI-05 NO(T) and NO(S) Values and their Components

COUNTRY	NO(T)	NO(S)	SF1V02	SWWVS-V27	SQ1	SQ2	SQ3	SQ4
North America								
USA	79.3	82.4	90.9	74.0	73.2	75.0	70.0	80.4
Canada	76.3	94.1	100.0	88.0	65.0	70.0	80.0	65.0
Mexico	55.1	62.3	81.8	43.0	40.0	45.0	52.0	50.0
South America								
Argentina	47.7	45.9	54.6	37.0	30.6	55.6	44.4	55.6
Brazil	59.6	36.3	63.6	9.0	54.7	53.1	58.8	64.1
Venezuela	36.5	25.5	27.3	24.0	30.0	47.5	50.0	40.0
Europe								
Czech Rep	74.4	76.9	100.0	54.0	57.5	70.0	70.0	70.0
France	66.8	56.2	72.7	40.0	80.0	75.0	54.0	50.0
Germany	71.7	66.6	81.8	51.0	77.3	65.9	61.8	63.6
Hungary	61.7	62.0	72.7	51.0	58.3	58.3	40.0	66.7
Ireland	74.1	78.9	81.8	76.0	83.3	64.6	76.7	60.4
Italy	67.0	59.1	63.6	54.0	62.5	67.5	66.0	75.0
Netherlands	69.6	85.0	90.9	79.0	60.0	75.0	70.0	55.0
Poland	61.8	57.2	72.7	42.0	46.2	53.9	67.1	67.9
Spain	56.9	69.2	81.8	57.0	42.5	47.5	64.0	47.5
Sweden	80.1	95.5	90.9	100.0	82.7	80.8	78.5	67.3
Switzerland	64.6	67.7	81.8	54.0	62.5	58.3	61.7	54.2
UK	77.7	79.6	90.9	68.0	80.6	66.7	62.2	75.0
Asia								
China	74.3	75.3	54.6	96.0	87.5	83.9	72.9	76.8
India	61.6	56.8	54.6	59.0	68.2	54.6	65.5	63.6
Indonesia	44.2	56.2	54.6	58.0	33.3	44.4	55.6	38.9
Japan	70.3	75.1	81.8	68.0	75.0	80.0	64.0	52.5
Malaysia	75.4	65.2	72.7	58.0	85.0	67.5	80.0	70.0
Philippines	53.2	36.7	63.6	10.0	39.6	54.2	65.0	50.0
Singapore	78.5	74.3	90.9	58.0	92.5	82.5	74.0	52.5
South Korea	74.7	65.8	72.7	59.0	84.1	75.0	72.7	68.2
Taiwan	73.6	72.1	72.7	72.0	71.2	67.3	64.6	84.6
Thailand	58.7	65.2	72.7	58.0	58.3	50.0	57.8	50.0
All Others								
Australia	76.2	83.0	90.9	75.0	70.8	79.2	73.3	66.7
Israel	78.4	56.2	54.6	58.0	90.4	82.7	73.9	90.4
New Zealand	70.0	79.1	72.7	85.0	69.2	61.5	72.3	71.2
Russia	42.0	53.7	54.6	53.0	29.2	60.4	33.3	37.5
South Africa	50.6	47.1	54.6	40.0	60.0	42.5	48.0	42.5

Table 6: HTI-05 SE(T) and SE(S) Values and their Components

COUNTRY	SE(T)	SE(S)	SHMS2000	SFDI	SPatApNon	SQ5	SQ10
North America							
USA	84.2	78.4	95.3	60.0	80.0	76.8	80.4
Canada	73.1	42.4	76.9	10.0	40.0	57.5	85.0
Mexico	48.7	28.6	33.6	17.0	35.0	35.0	77.5
South America							
Argentina	53.3	25.5	71.1	2.0	3.0	25.0	63.9
Brazil	51.3	29.1	33.6	16.0	38.0	40.6	79.7
Venezuela	47.8	14.7	38.5	5.0	1.0	35.0	70.0
Europe							
Czech Rep	59.2	30.4	52.5	5.0	34.0	42.5	82.5
France	67.3	70.0	72.0	71.0	66.0	45.0	85.0
Germany	75.5	58.3	65.3	18.0	92.0	70.5	90.9
Hungary	66.2	33.7	62.5	5.0	34.0	47.2	88.9
Ireland	74.3	57.7	65.7	40.0	67.0	59.1	97.9
Italy	63.5	54.1	70.6	25.0	66.0	50.0	70.0
Netherlands	77.2	54.5	74.1	24.0	65.0	67.5	90.0
Poland	65.6	39.4	77.2	7.0	34.0	39.3	80.4
Spain	69.0	71.8	76.9	39.0	100.0	47.5	82.5
Sweden	82.0	65.6	93.9	6.0	97.0	71.2	80.8
Switzerland	62.8	62.1	61.3	27.0	98.0	35.4	91.7
UK	82.9	71.1	82.1	31.0	100.0	66.7	100.0
Asia							
China	60.4	59.8	27.7	100.0	52.0	62.5	91.1
India	52.8	21.0	21.9	7.0	34.0	54.6	81.8
Indonesia	40.8	19.6	25.2	0.0	34.0	25.0	72.2
Japan	65.5	42.0	69.0	10.0	47.0	52.5	75.0
Malaysia	70.4	16.1	41.3	5.0	3.0	75.0	95.0
Philippines	52.9	16.4	42.0	1.0	6.0	33.3	83.3
Singapore	79.6	38.6	63.6	18.0	34.0	75.0	100.0
South Korea	72.7	52.0	100.0	6.0	50.0	52.3	65.9
Taiwan	77.2	29.1	68.2	8.0	11.0	75.0	88.5
Thailand	53.2	18.1	48.5	4.0	2.0	33.3	77.8
All Others							
Australia	78.4	43.0	81.1	11.0	37.0	75.0	79.2
Israel	85.8	36.5	74.8	6.0	28.0	84.6	98.1
New Zealand	75.7	43.5	90.4	4.0	36.0	59.6	76.9
Russia	59.2	43.4	81.8	13.0	36.0	37.5	58.3
South Africa	52.8	21.2	28.4	2.0	33.0	52.5	77.5

Table 7: HTI-05 TI(T) and TI(S) Values and their Components

COUNTRY	TI(T)	TI(S)	SEDP 2005	S(S&E)	SRatio Royl	SICT Con	Spat ApRes	SBIB 202	SR&D	SQ7	SQ8	SQ9	SQ11
North America													
USA	91.9	92.7	100.0	100.0	100.0	100.0	49.0	100.0	100.0	88.5	91.7	83.9	85.7
Canada	54.5	15.4	9.3	5.5	20.0	55.0	1.0	10.0	6.0	90.0	85.0	80.0	90.0
Mexico	30.4	4.2	6.9	1.4	3.0	15.0	0.0	2.0	1.0	62.5	40.0	50.0	42.5
South America													
Argentina	30.1	3.6	1.9	1.4	3.0	17.0	0.0	1.0	0.0	72.2	44.4	41.7	47.2
Brazil	36.9	5.7	8.0	3.1	4.0	17.0	2.0	4.0	2.0	87.5	50.0	48.4	56.3
Venezuela	27.2	2.3	0.5	0.3	0.0	15.0	0.0	0.0	0.0	62.5	52.5	40.0	37.5
Europe													
Czech Rep	43.6	9.8	1.2	0.8	17.0	48.0	0.0	1.0	0.0	100.0	57.5	60.0	77.5
France	55.2	25.9	12.4	9.6	72.0	57.0	6.0	12.0	11.0	90.0	82.5	75.0	92.5
Germany	64.5	27.8	24.7	13.7	32.0	62.0	21.0	19.0	21.0	100.0	95.5	88.6	97.7
Hungary	40.5	11.3	2.9	0.8	38.0	36.0	0.0	1.0	0.0	97.2	72.2	55.6	58.3
Ireland	41.9	9.9	2.6	0.5	1.0	63.0	0.0	1.0	0.0	85.4	64.6	62.5	68.8
Italy	46.4	14.3	10.7	3.7	18.0	55.0	1.0	8.0	4.0	85.0	70.0	60.0	80.0
Netherlands	52.5	19.1	7.7	2.3	33.0	82.0	2.0	4.0	3.0	100.0	85.0	75.0	85.0
Poland	34.1	5.3	2.2	3.0	3.0	24.0	1.0	4.0	0.0	80.4	46.4	46.4	55.4
Spain	33.5	10.5	5.1	4.8	9.0	46.0	1.0	5.0	2.0	72.5	52.5	47.5	47.5
Sweden	54.5	24.8	2.7	2.4	74.0	86.0	2.0	3.0	3.0	98.1	82.7	86.5	90.4
Switzerland	51.5	17.9	4.1	1.3	39.0	73.0	2.0	4.0	2.0	89.6	81.3	79.2	87.5
UK	58.0	26.2	17.9	8.1	56.0	67.0	9.0	14.0	10.0	97.2	97.2	72.2	94.4
Asia													
China	64.7	23.8	59.5	41.7	2.0	9.0	8.0	39.0	7.0	91.1	67.9	69.6	73.2
India	43.2	2.7	3.0	6.1	2.0	2.0	0.0	5.0	1.0	88.6	65.9	61.4	68.2
Indonesia	24.1	0.8	0.8	1.7	1.0	3.0	0.0	0.0	0.0	47.2	27.8	38.9	41.7
Japan	71.1	51.1	38.7	33.3	41.0	61.0	100.0	39.0	44.0	100.0	87.5	90.0	100.0
Malaysia	31.4	4.0	1.8	0.4	1.0	24.0	0.0	0.0	0.0	77.5	37.5	50.0	47.5
Philippines	31.2	1.3	1.3	0.3	0.0	7.0	0.0	0.0	0.0	60.4	39.6	45.8	58.3
Singapore	50.3	12.4	6.9	0.9	5.0	69.0	0.0	5.0	1.0	75.0	62.5	85.0	90.0
South Korea	48.0	16.0	5.1	7.8	12.0	50.0	19.0	12.0	6.0	79.6	70.5	72.7	79.6
Taiwan	43.7	16.5	3.5	4.6	9.0	76.0	9.0	11.0	2.0	76.9	67.3	69.2	69.2
Thailand	25.0	2.0	3.4	0.9	0.0	9.0	0.0	1.0	0.0	44.4	36.1	44.4	36.1
All Others													
Australia	53.5	14.9	5.8	3.4	13.0	73.0	3.0	4.0	2.0	100.0	83.3	79.2	87.5
Israel	54.0	18.4	2.2	0.5	63.0	60.0	1.0	1.0	2.0	90.4	90.4	86.5	90.4
New Zealand	47.0	11.4	0.8	0.5	11.0	66.0	0.0	1.0	0.0	90.4	73.1	73.1	78.9
Russia	43.9	11.0	2.7	25.1	19.0	13.0	6.0	9.0	2.0	100.0	75.0	52.1	52.1
South Africa	36.5	5.4	2.1	0.5	20.0	15.0	0.0	0.0	0.0	87.5	47.5	55.0	57.5

Table 8: HTI-05 PC(T) and PC(S) Values and their Components

COUNTRY	PC(T)	PC(S)	SA262005	SMVA	SSVA	S(Q6)	S(Q12)	S(Q13)
North America								
USA	82.5	100.0	100.0	100.0	100.0	67.9	67.9	85.7
Canada	45.8	5.4	4.1	7.0	5.0	77.5	57.5	65.0
Mexico	37.1	8.3	11.1	8.0	6.0	45.0	55.0	50.0
South America								
Argentina	34.0	1.9	0.1	3.0	3.0	63.9	47.2	41.7
Brazil	41.6	4.8	5.9	4.0	4.0	60.9	56.3	60.9
Venezuela	29.1	0.7	0.2	1.0	1.0	42.5	32.5	55.6
Europe								
Czech Rep	48.7	0.8	1.2	1.0	0.0	90.0	70.0	57.5
France	59.8	13.6	12.7	15.0	13.0	90.0	75.0	85.0
Germany	70.6	22.6	23.8	27.0	17.0	97.7	88.6	95.5
Hungary	44.2	1.4	3.1	1.0	0.0	86.1	52.8	55.6
Ireland	49.2	3.4	7.3	2.0	1.0	89.6	56.3	64.6
Italy	51.1	10.4	6.6	14.0	10.0	75.0	70.0	75.0
Netherlands	51.9	3.8	3.9	4.0	4.0	82.5	62.5	82.5
Poland	48.1	1.6	1.4	2.0	1.0	82.1	69.6	62.5
Spain	37.6	4.9	2.9	7.0	5.0	70.0	45.0	50.0
Sweden	55.5	3.9	3.6	6.0	2.0	96.2	67.3	80.8
Switzerland	52.3	4.2	4.0	6.0	2.0	87.5	62.5	79.2
UK	53.8	14.9	15.2	15.0	14.0	69.4	69.4	80.6
Asia								
China	65.4	33.5	65.7	29.0	6.0	67.9	66.1	61.5
India	54.5	3.5	2.8	5.0	3.0	81.8	75.0	84.1
Indonesia	32.0	2.3	3.5	2.0	1.0	33.3	50.0	55.6
Japan	84.4	57.1	73.3	60.0	38.0	90.0	95.0	85.0
Malaysia	43.5	6.5	17.2	2.0	1.0	70.0	50.0	50.0
Philippines	45.1	2.2	4.9	1.0	1.0	85.4	52.1	58.3
Singapore	52.7	6.2	16.5	1.0	1.0	77.5	60.0	75.0
South Korea	57.1	15.7	34.8	9.0	3.0	72.7	65.9	65.9
Taiwan	54.3	7.6	12.8	8.0	2.0	88.5	67.3	69.2
Thailand	33.4	3.7	7.6	3.0	1.0	55.6	55.6	27.8
All Others								
Australia	51.5	2.7	1.8	3.0	4.0	75.0	70.8	83.3
Israel	50.5	1.9	2.9	2.0	1.0	86.5	61.5	75.0
New Zealand	39.8	0.5	0.2	1.0	0.0	67.3	51.9	59.6
Russia	36.9	4.0	0.9	9.0	2.0	72.9	50.0	41.7

Figure Notes and Sources

NOTES: Through 1999, High Tech Indicators (HTI) was labeled based on the most recent full year of statistical data. In 2002 we shifted to name HTI by year of data generation and year in which panel of experts rated countries, so that year was relabeled as HTI-03. HTI-05 follows two years later.

Scaling: For score and indicator calculations, raw data were transformed into scales of 0–100 for each indicator component and then averaged to generate comparable indicators with a 0–100 range. For survey items, 100 represents the highest response category for each question. For statistical data, 100 typically represents the value attained by the country with the largest value among the 33 countries included in the study.

Figures 1-23 draw upon HTI-05. We present:

- Technological Standing (TS)
- National Orientation (NO)
- Socio-economic Infrastructure (SE)
- Technological Infrastructure (TI)
- Productive Capacity (PC)
- INPUT (Sum) – the sum of NO + SE + TI + PC

INPUT adds together our four Input (leading) indicators – NO, SE, TI, and PC -- each of which is an average of components scaled 0-100, so the potential INPUT range is 0-400.

The preceding section on **HTI 2005 Appendix: Indicator Formulations and Data Sources** specifies the computational formulas for both the Traditional (T) and Statistics-only (S) indicators. It provides detailed *Sources* as well. We can provide underlying component data in MS Excel files upon request.

Figures 24-35 report on High Tech Indicators for 1993, 1996, 1999, 2003, and 2005. In general, sources correspond to those detailed in the HTI 2005 Appendix. For specific data source citations, refer to the HTI 1993, 1996, 1999, and 2003 Appendices posted at //tpac.gatech.edu under “High Tech Indicators.”

SOURCE: Georgia Institute of Technology, Technology Policy and Assessment Center, *High Tech Indicators: Technology-based Competitiveness of 33 Nations 2005 Final Report*, report to National Science Foundation, Division of Science Resources Statistics (2005).

Figures

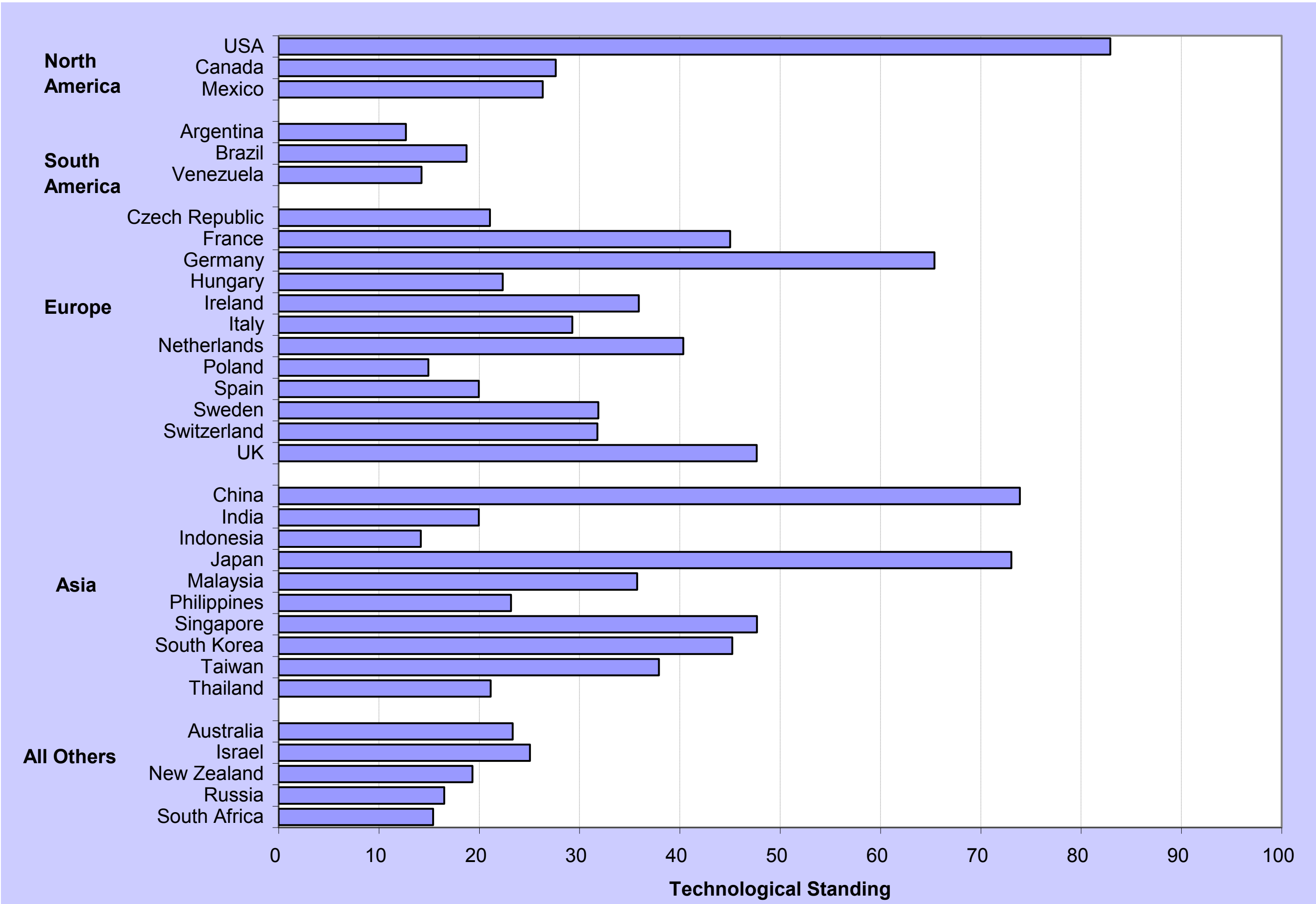
Figures 1-23 derive from the 2005 High Tech Indicators. We offer observations with the figures. Figures 1-7 present the HTI-05 (T) – i.e., the Traditional indicator formulations. Figures 8-14 present the counterpart HTI-05 (S) versions – i.e., the Statistics-only indicator formulations. We explore the latter in somewhat more detail.

Figure 15 provides a different perspective – it contrasts the Expert Panel responses regarding national technology-based production capabilities at present with those anticipated some 15 years in the future.

Figures 16-23 offer different comparisons between the Traditional (T) and Statistics-only (S) indicators.

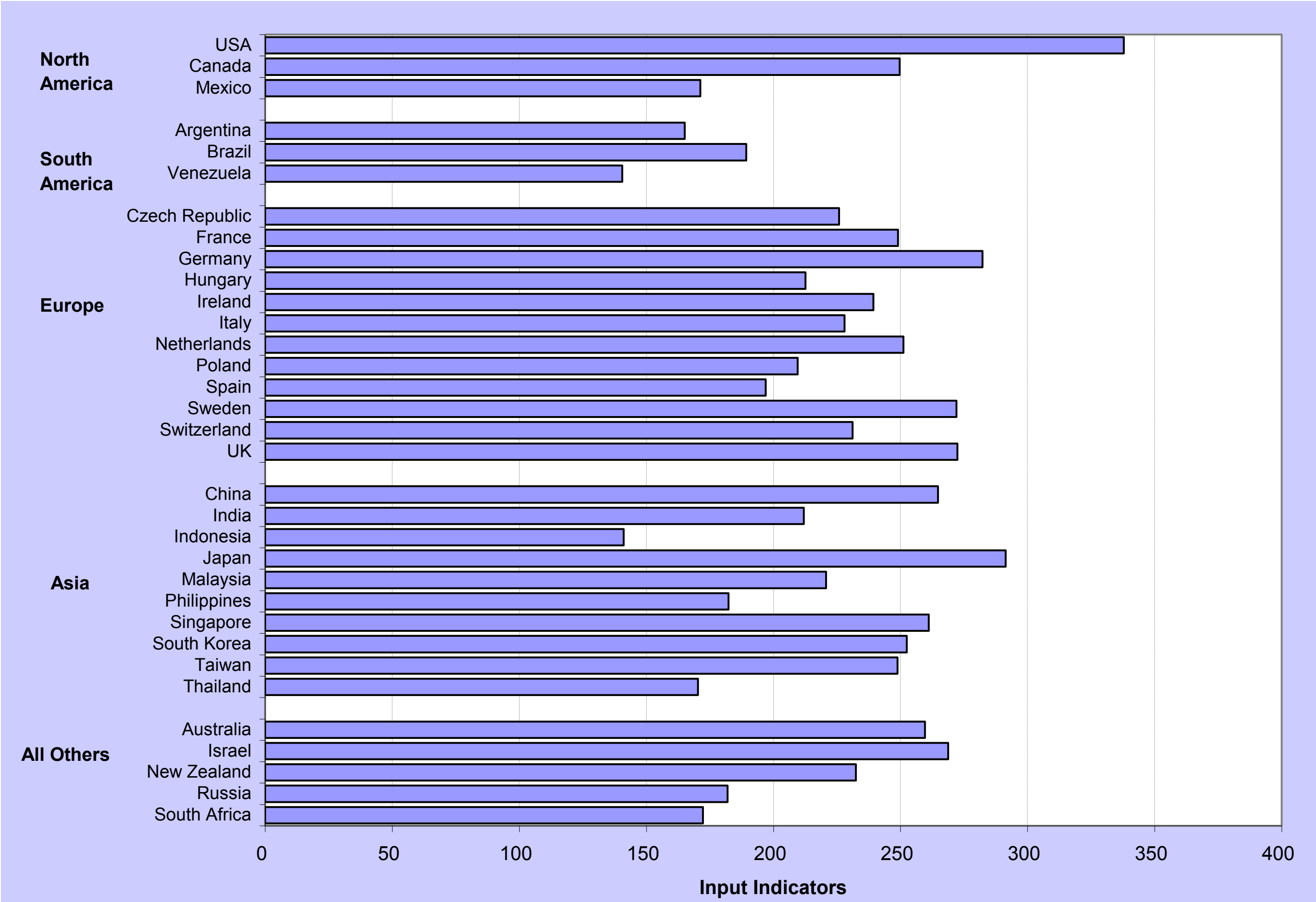
HTI 2005 Figures

Figure 1: Technological Standing 2005 Traditional -TS-05 (T)



The Technological Standing indicator shows a diverse array of values with the highest scoring countries -- USA, Germany, China, and Japan -- eclipsing the remaining countries' scores. The average score for the aforementioned countries is 73.8 (median, 73.5), while the overall average score is 32.7 (median, 26.3) with a standard deviation of 18.7. In comparing Asia and Europe, the median score for our Asian countries (36.8) is greater than that of our European ones (31.8). However, the Asian scores also exhibit greater variation. See also discussion of Figure 8.

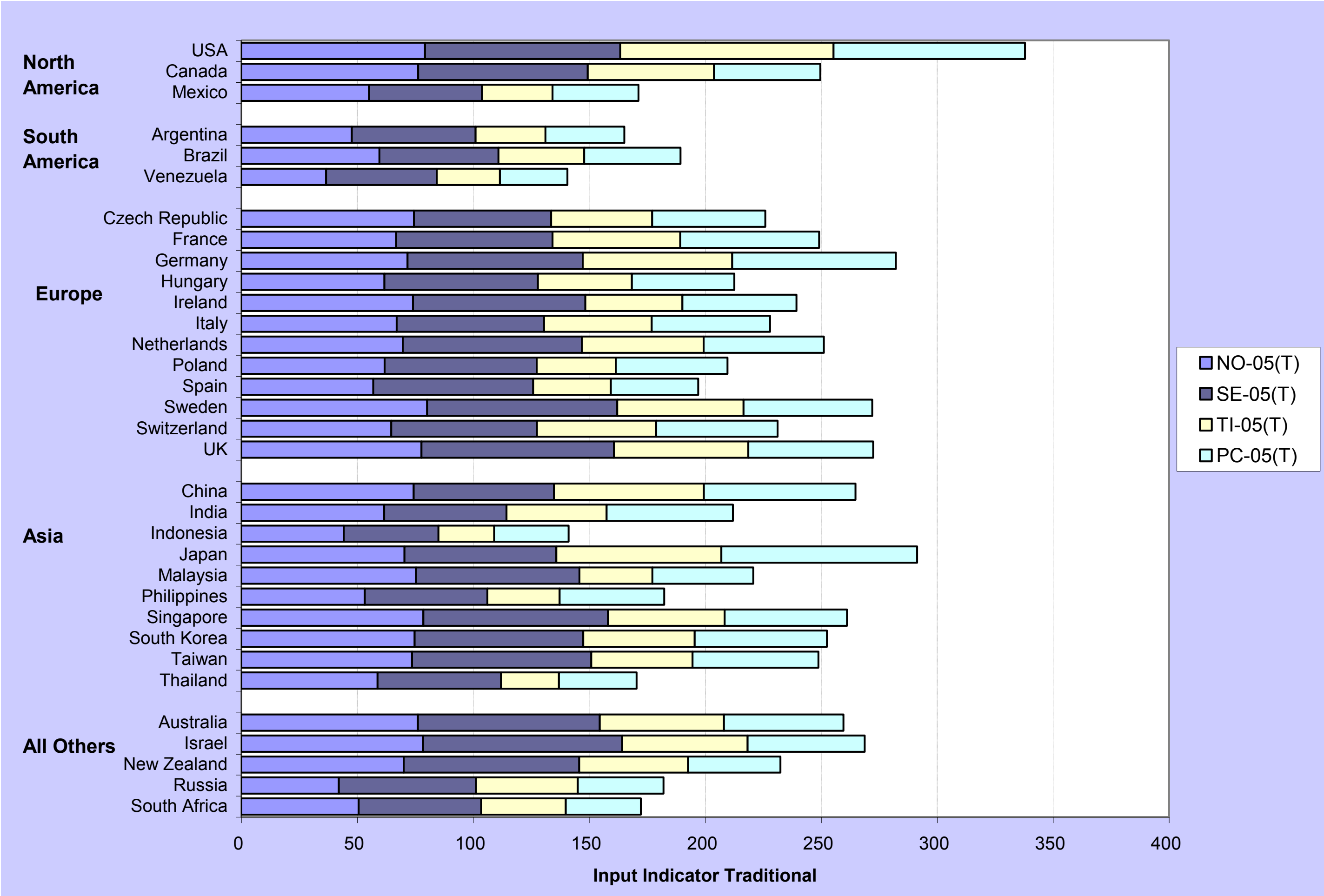
Figure 2: INPUT 2005 Traditional - IN-05 (T)



Note: INPUT adds together our four Input (leading) indicators – NO, SE, TI, and PC -- each of which is an average of components scaled 0-100, so the potential INPUT range is 0-400.

The Traditional formulation of the INPUT indicator ranges from 140.6 for Venezuela to 337.9 for the U.S. The average score for the set of 33 countries is 226.8 (median, 231.1), while the standard deviation is 45.8. Of the entire population, a few of the countries show considerably more deviation from the population mean, namely: U.S. (2.43), Indonesia (-1.87), and Venezuela (-1.88). The average score for each regional group ranked from highest to lowest is: North America (252.9), Europe (241.2), Asia (224.5), All Others (223.0), and South America (165).

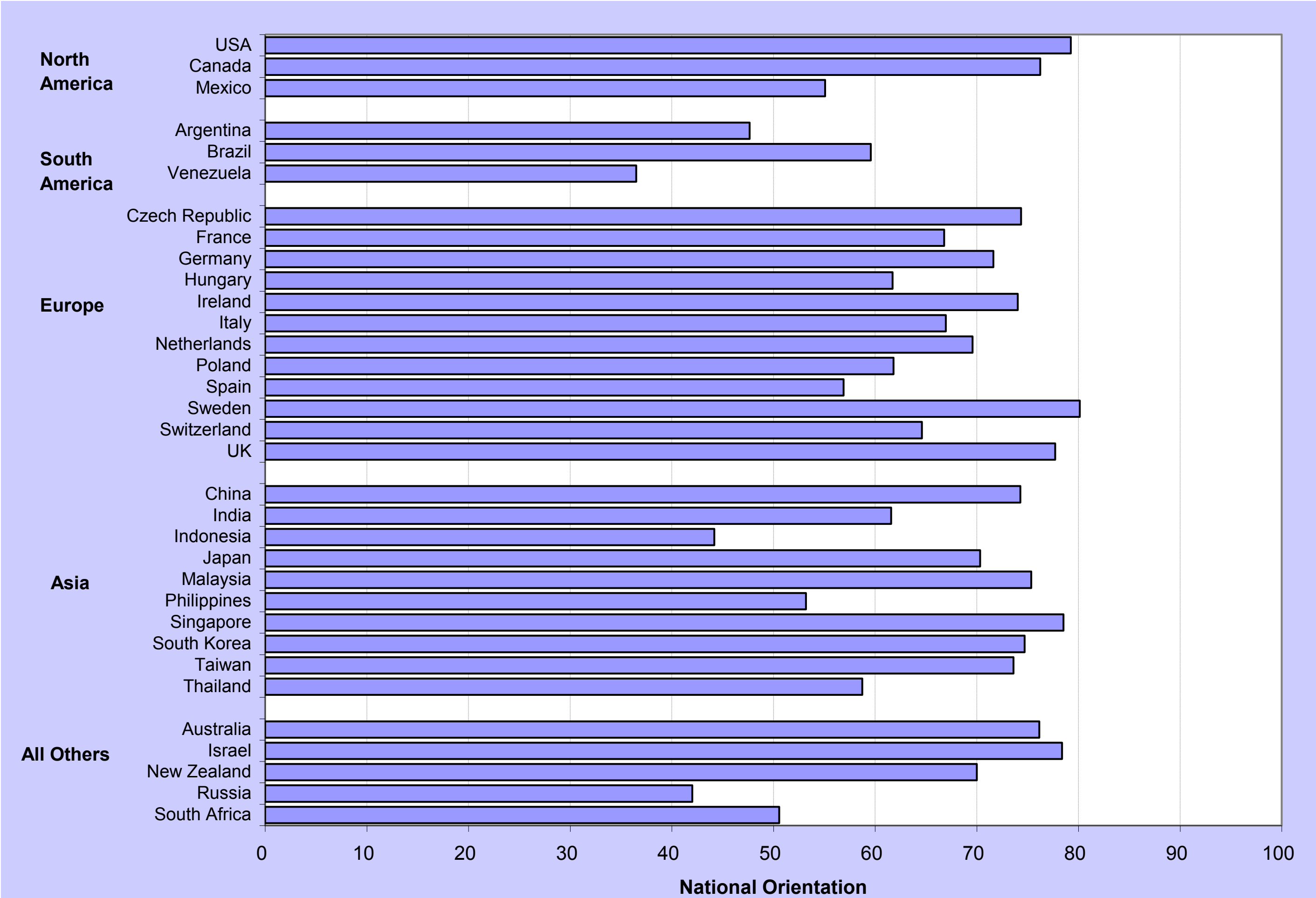
Figure 3: INPUT 2005 Traditional – INPUT-05 (T) -- Breakout



Note: INPUT adds together our four Input (leading) indicators – NO, SE, TI, and PC -- each of which is an average of components scaled 0-100, so the potential INPUT range is 0-400.

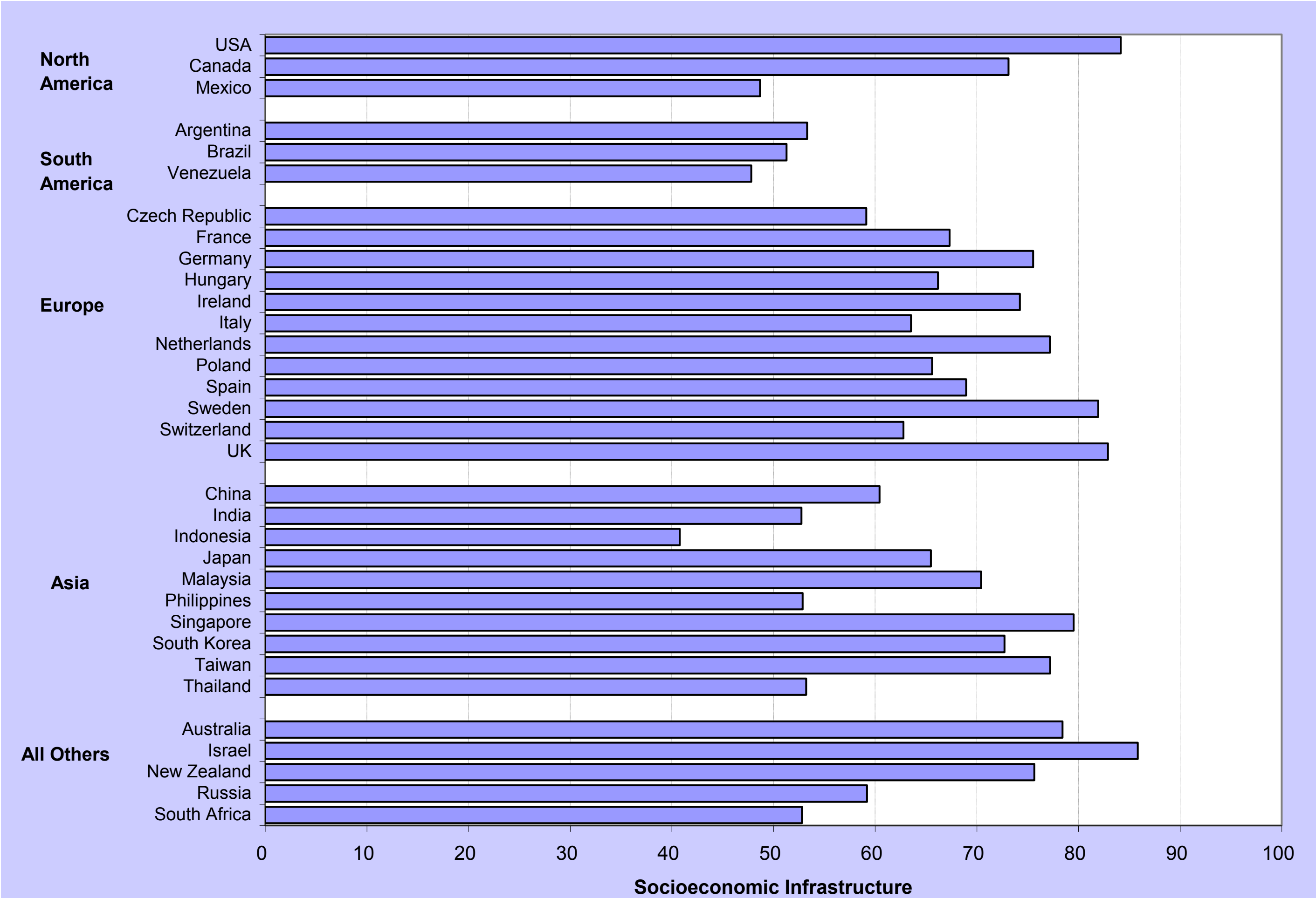
The graph "INPUT-05 (T) Breakout" dissects the INPUT indicator into its component parts. A cursory look at this graph shows a more even contribution from the individual indicators than seen in the INPUT-05 (S) breakout (Figure 10). From this formulation, the indicators National Orientation and Socio-economic Infrastructure exhibit statistical similarities; each has means and standard deviations equal to approximately 65 and 12, respectively. Technological Infrastructure and Productive Capacity are similar to each other with means and standard deviations of about 47 and 14, respectively.

Figure 4: National Orientation 2005 Traditional -- NO-05 (T)



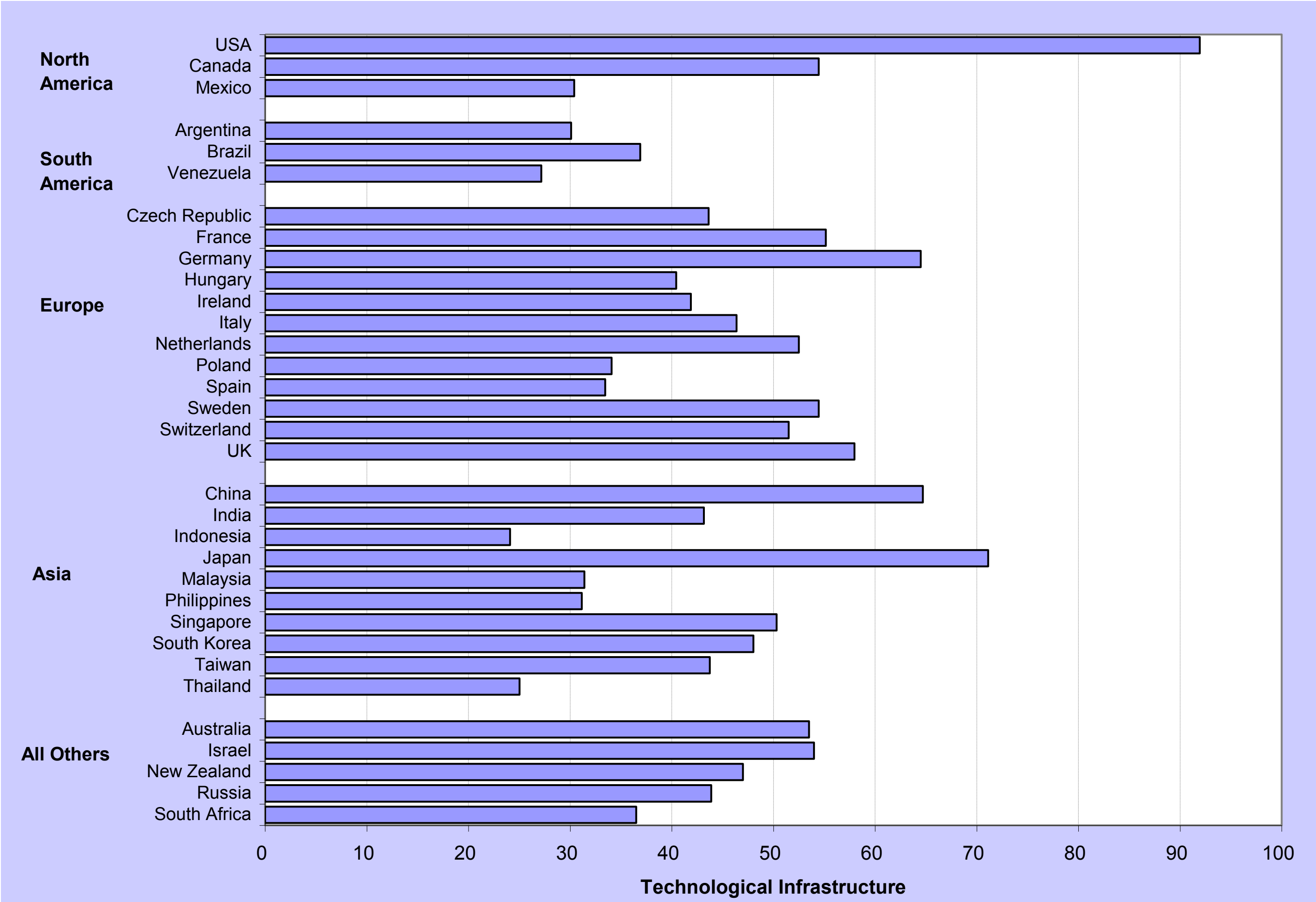
Of the Traditional (T) indicator formulations, National Orientation exhibits the smallest standard deviation (11.9). The mean score for National Orientation is 65.5 (median, 69.6). National Orientation scores do not suggest significant outliers that are greater than the mean. Sweden shows the highest National Orientation score. However, NO-05 (T) does show a few outliers that score at least two standard deviations below the mean -- Russia, Indonesia, and Venezuela.

Figure 5: Socio-economic Infrastructure 2005 Traditional -- SE-05 (T)



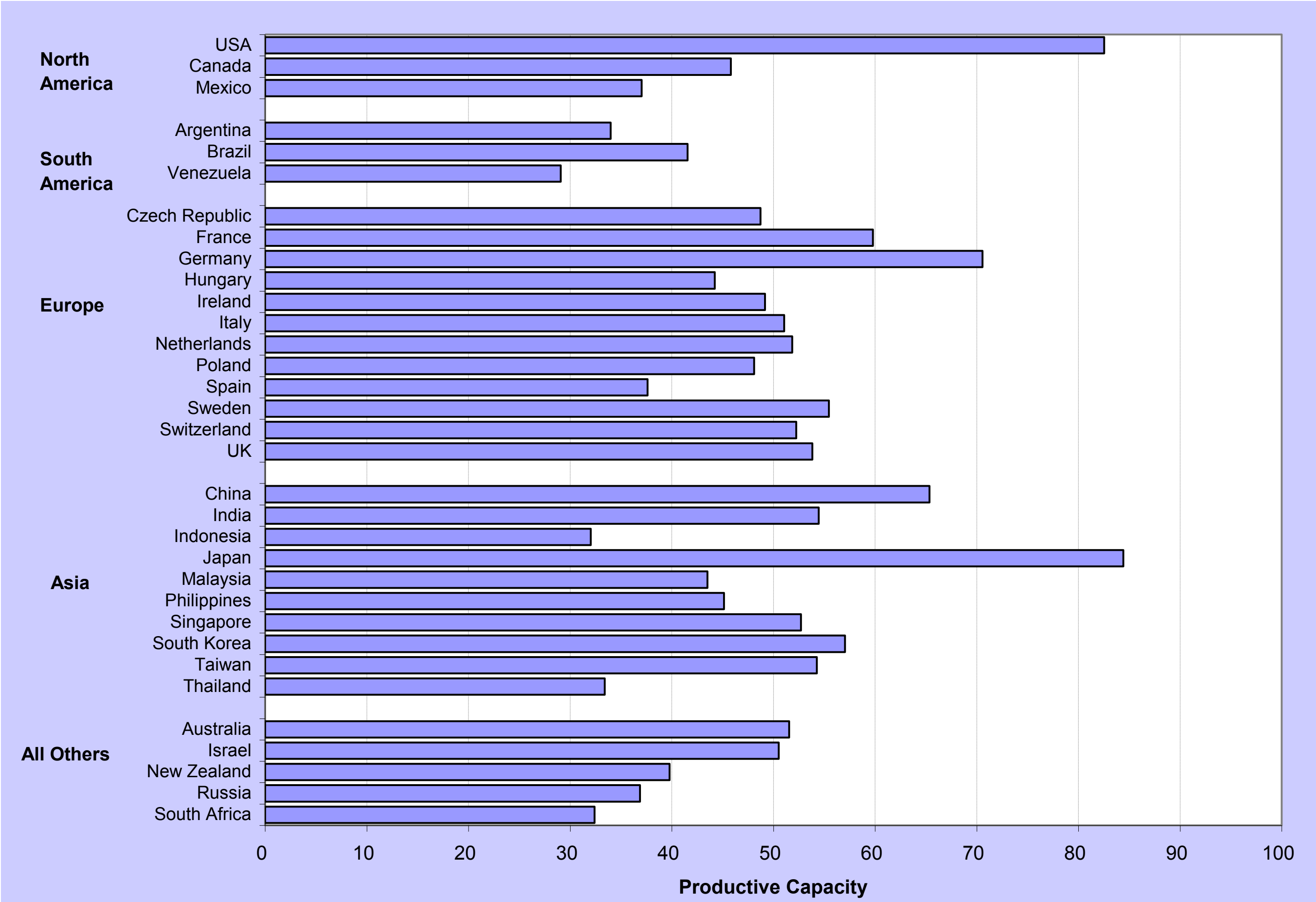
The Socio-economic Infrastructure indicator exhibits some variation, yet relative to the other indicators, it has the second lowest standard deviation (12.1). Israel (85.8) scores highest, while Indonesia scores the lowest (40.8). Interestingly, China's score (60.4) does not exceed the mean (66.1), which is not the case for any of the other indicators.

Figure 6: Technological Infrastructure 2005 Traditional – TI-05 (T)



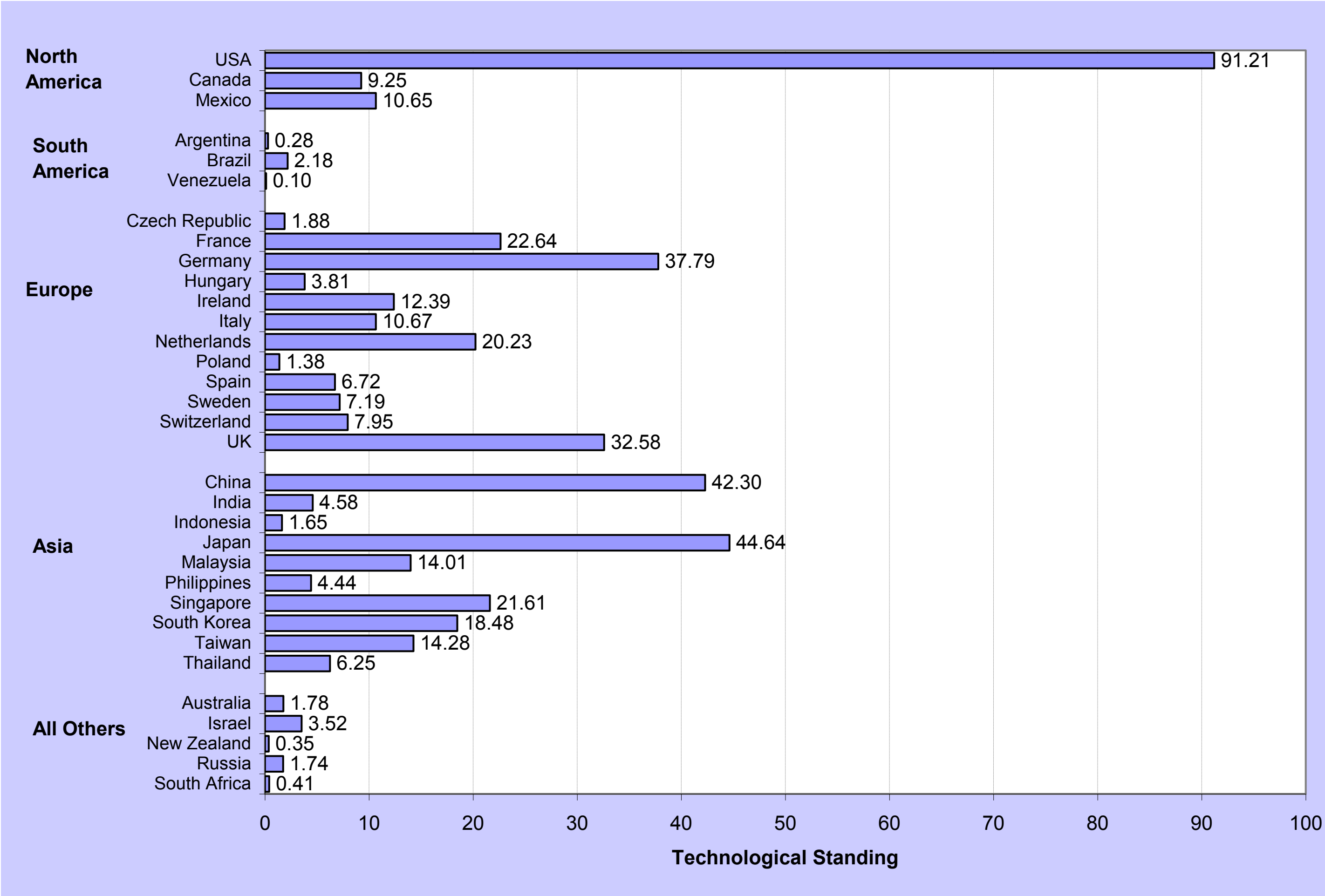
The Traditional formulation of Technological Infrastructure ranges from 24.1 (Indonesia) to 91.9 (USA). The U.S. score significantly exceeds the mean score (45.9; median – 43.9) by 3.2 standard deviations. China , Japan, and Germany are other high scoring countries.

Figure 7: Productive Capacity 2005 Traditional – PC-05 (T)



The Traditional formulation of Productive Capacity shows some variation, with a few notable outlier countries: U.S. (82.5), Japan (84.4), Germany (70.6), and China (65.4). Without these the overall standard deviation decreases from 13.1 to 8.6. Similarly, the mean decreases from 49.3 to 45.6. [The median is similar to the mean, 49.2.]

Figure 8: Technological Standing 2005 Statistics-only – TS-05 (S)



The Statistics-only formulation of Technological Standing (TS-05) shows tremendous variation. The average score excluding the USA equals 11.5, while the U.S. scores 91.2, more than six standard deviations away from the mean. For the 33 countries, the mean is a low 13.9 (median, 7.2).

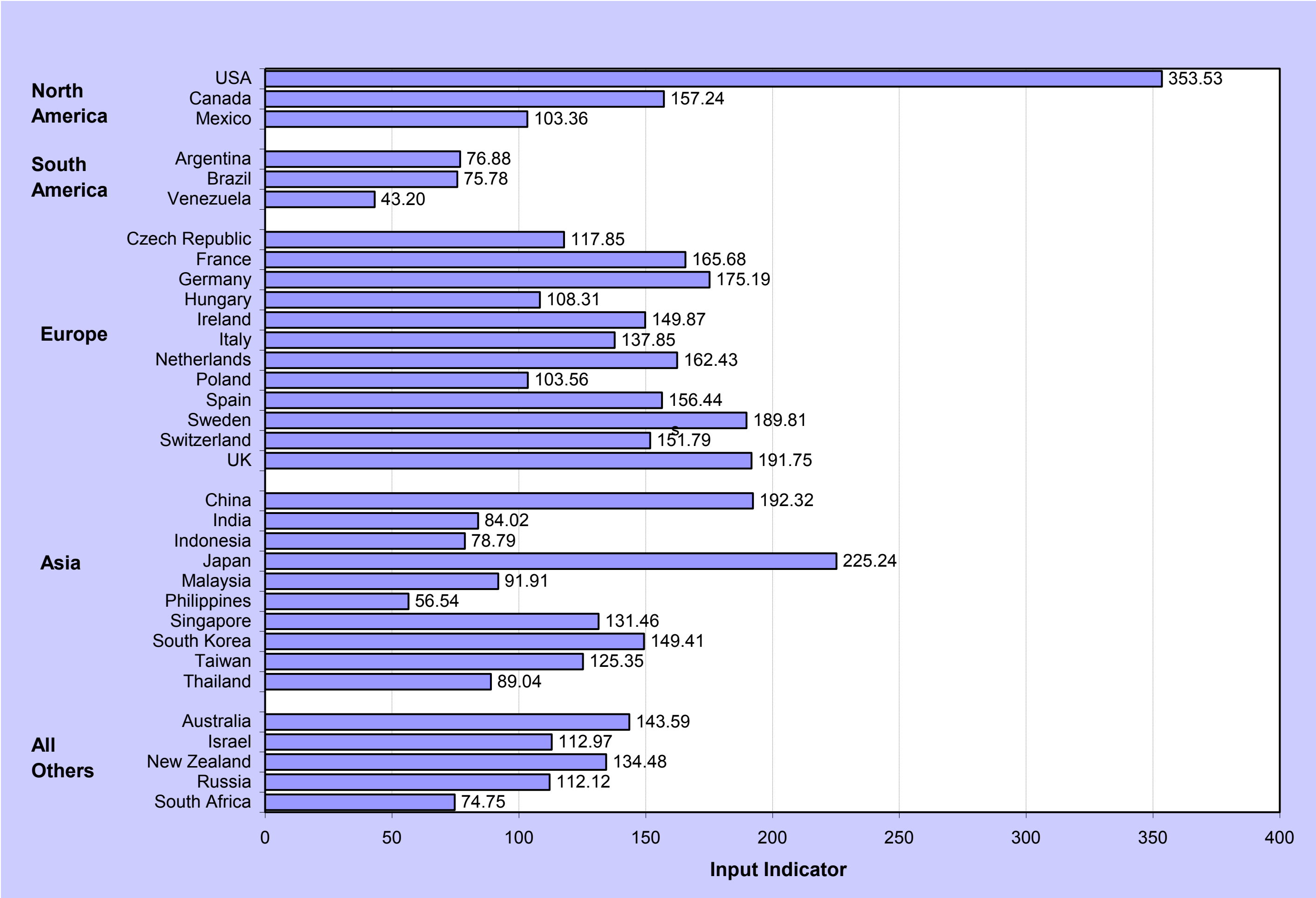
China's strength is notable. A concern with the Traditional indicators, especially TS (T), is that the statistical components show huge range across these countries, whereas the expert opinion item is more muted (1-5 scale). Indeed, as per Figure 18, this benefits countries such as China considerably on the TS (T) indicator. What Figure 8 conveys is that even without the expert opinion, China's strength stands out. Since 1987 HTI has distinguished the "Big Three" of the U.S., Japan, and Germany. China now supplants Germany in third position. Probing into the components of TS (S), China's profile is interesting:

- X-2003 (Hi Tech Exports) – strong 4th (China's \$167 billion?? is trailed in 5th position by the UK's \$118)
- A2-2005 (Electronics Exports, forecasted) – strong #1 (China's \$167 billion?? Trailed in 2d position by Japan at \$108 and in 3rd by the U.S. at \$105)
- ROYLR -- Royalties and License Fees for 2002 – China's \$133 million is orders of magnitude behind the leaders (9 nations over \$1 billion, led by the U.S. at \$44 billion)
- SOCSE – Exports of computer, communications and other Services – 2002 – China's \$13 billion is in the "teens" along with India, Ireland, Spain, Canada, Singapore, Sweden, andTaiwan. Seven nations export over \$20 billion, led by the U.S. at \$122 billion.

We don't attempt detailed analyses in this report, but the interested reader is invited to focus on countries of special interest. [Component-level data are available on request as MS Excel files.]

It is worth remembering that HTI are total metrics; they are not normalized by a factor such as “per capita.” This is because they were formulated in the 1980’s as indicators of national competitiveness. However, Traditional HTI blended statistical and expert opinion components, and the latter tend to downplay national size factors. That said, the position of certain small nations on TS (S) is remarkable. For instance, the city-nation of Singapore compares favorably with France and The Netherlands.

Figure 9: INPUT 2005 Statistics-only – INPUT-05(S)



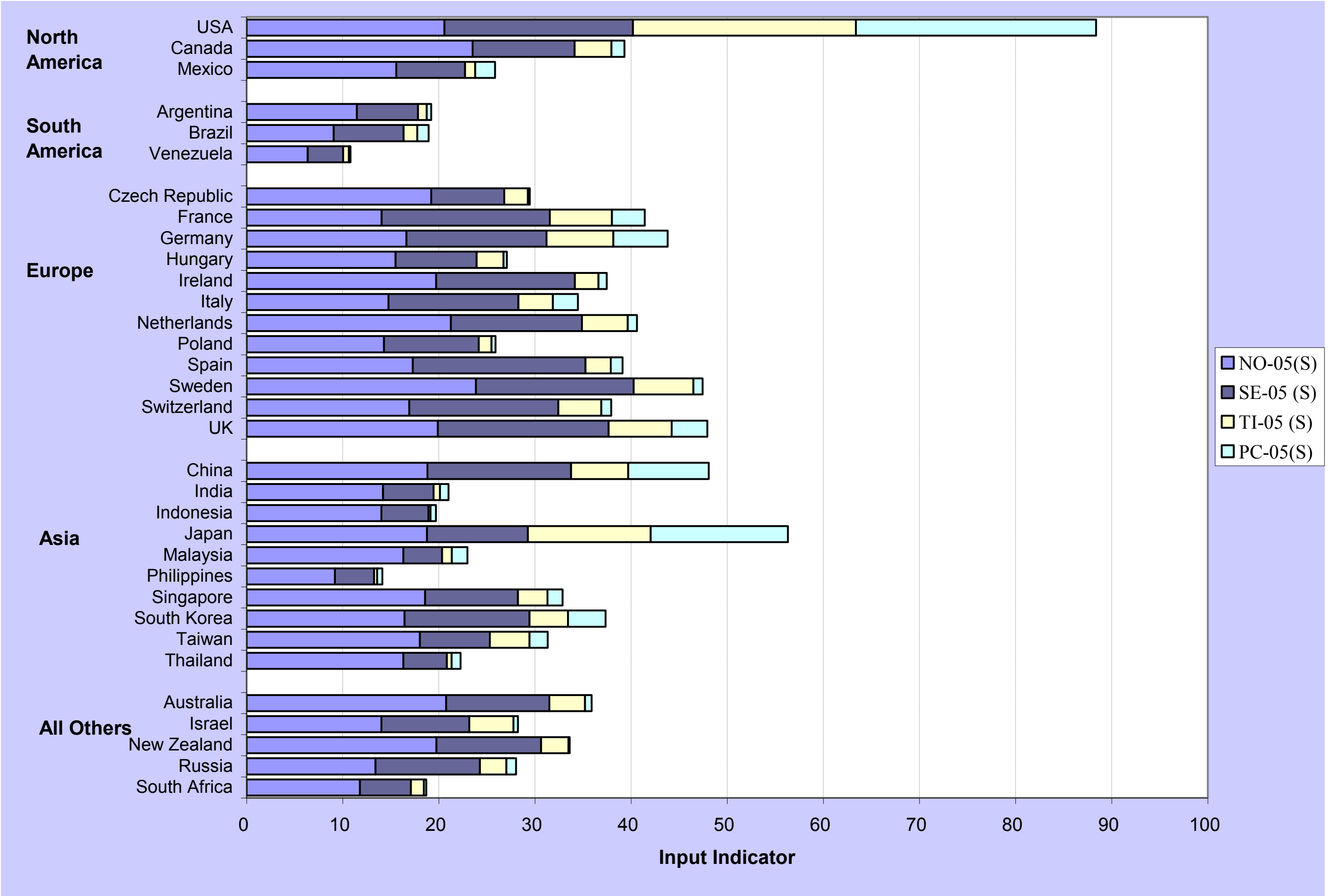
Note: INPUT adds together our four Input (leading) indicators – NO, SE, TI, and PC -- each of which is an average of components scaled 0-100, so the potential INPUT range is 0-400.

INPUT consolidates the four leading indicators. It aims to provide a gauge on which industrializing countries appear to be positioning themselves effectively to enhance their technology-based export competitiveness in the future. Figure 10 presents the same INPUT plot, but showing the make-up in terms of NO, SE, TI, and PC. Figures 2 and 3 are the INPUT (T) counterparts. Comparing these to the INPUT (S) charts, the national differences are heightened by the Statistics-only version (as is generally the case). Figure 2 presents a relatively "across the board" image – that all these nations are pointing toward future high tech competitiveness. Figure 9 suggests that some of our 33 countries are pretty weak in this regard – e.g., scoring below 100 are South Africa, all three South American countries, and half of the Asian countries, including India. Those interested in probing what underlies these scores might next investigate the following individual Input indicators – NO, SE, TI, and PC.

Figures 17 and 19 compare INPUT (T) vs. (S) explicitly. The only country that gains in shifting from (T) to (S) is the U.S. There are a number of large losers (e.g., Israel and half of the 10 Asian countries included in HTI).

The Statistics-only INPUT-05 indicator ranges from 43.2 for Venezuela to 353.5 for the U.S. Excluding the U.S., the average score is 127.2 with a standard deviation of 43.9. For the 33 countries, the mean is 134.0 (median, 131.5. The U.S. exceeds the second largest Indicator score (Japan) by 128. China and Japan significantly eclipse the rest of Asia.

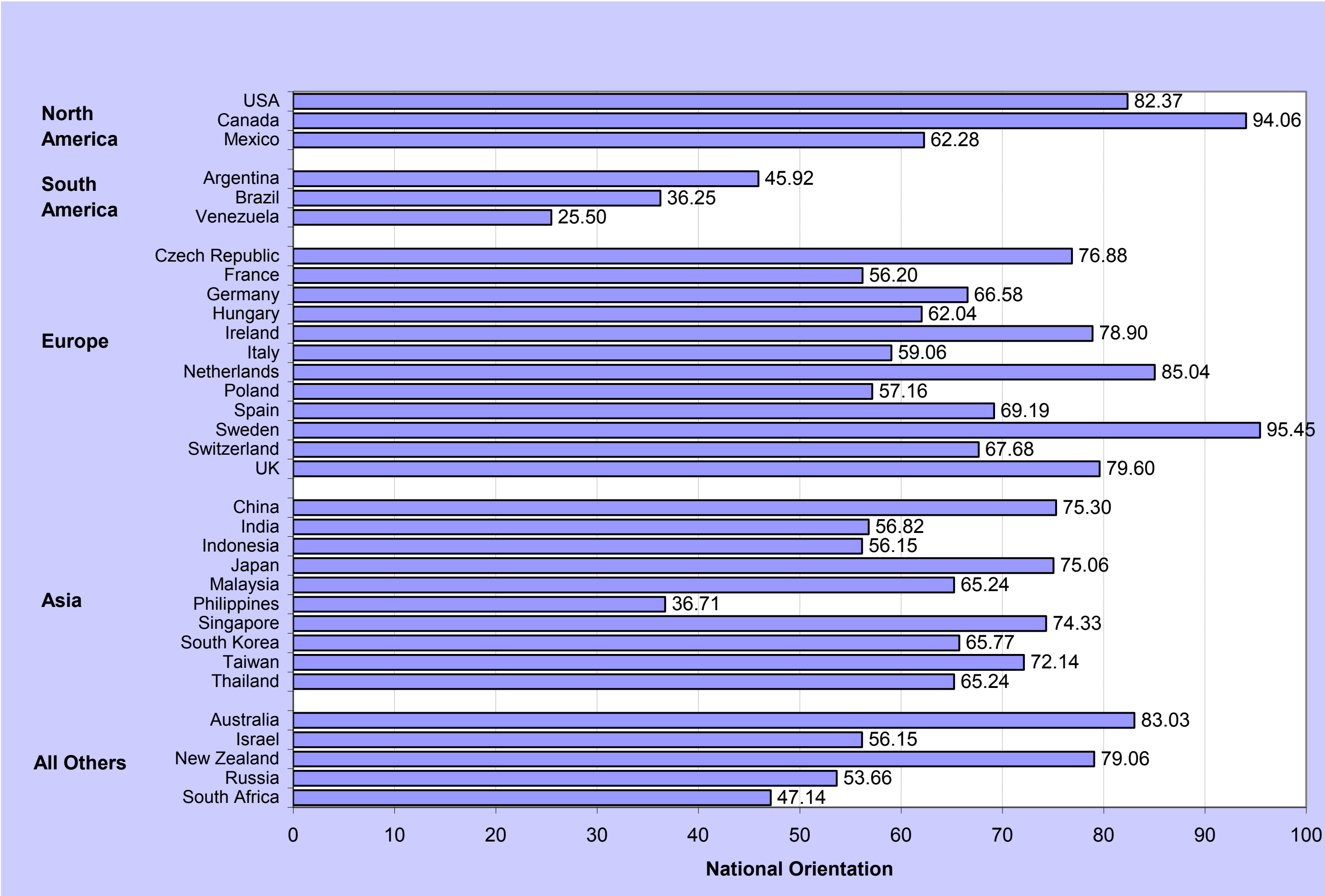
Figure 10: INPUT 2005 Statistics-only – INPUT-05 (S)- Breakout



Note: INPUT adds together our four Input (leading) indicators – NO, SE, TI, and PC -- each of which is an average of components scaled 0-100, so the potential INPUT range is 0-400.

The Statistics-only formulation for the INPUT indicator suggests that two components, National Orientation and Socio-economic Infrastructure, contribute more substantially than Technological Infrastructure and Productive Capacity to most countries' scores. While on average National Orientation and Socio-economic Infrastructure add approximately 107 points, Technological Infrastructure provides, on average, 15.7, and Productive Capacity, 10.8. The U.S. achieves its dominant position largely from its strong TI and PC values.

Figure 11: National Orientation 2005 Statistics-only -- (NO-05) (S)



Of the Statistics-only indicators, National Orientation has the highest overall mean (65.5; median is 65.8). Note that the United Kingdom scores highest, and the second highest scorer is Canada. Unlike other Statistics-only indicator formulations, the U.S. and Japan are not noticeable outliers here.

Figure 20 shows the differences in subtracting NO (S) from NO (T). Unlike the other indicators, here there are very big gainers and losers. Referring to the NO formulas (Appendix), NO (S) is not as robust an indicator as we might like.

National Orientation appears the HTI indicator whose Statistics-only characterization has most to gain by augmenting with question responses. For instance:

Q1 = *To what extent does this country's government evidence a deliberate strategy to promote technology-intensive production for export?*
* Notably low scores for Germany, France, Canada, The Netherlands, USA, and (very surprising) India and Ireland; also low for The Philippines
* Interestingly high scores for Malaysia, Czech Republic, New Zealand, Mexico, Spain, and Australia (among others not so surprising)

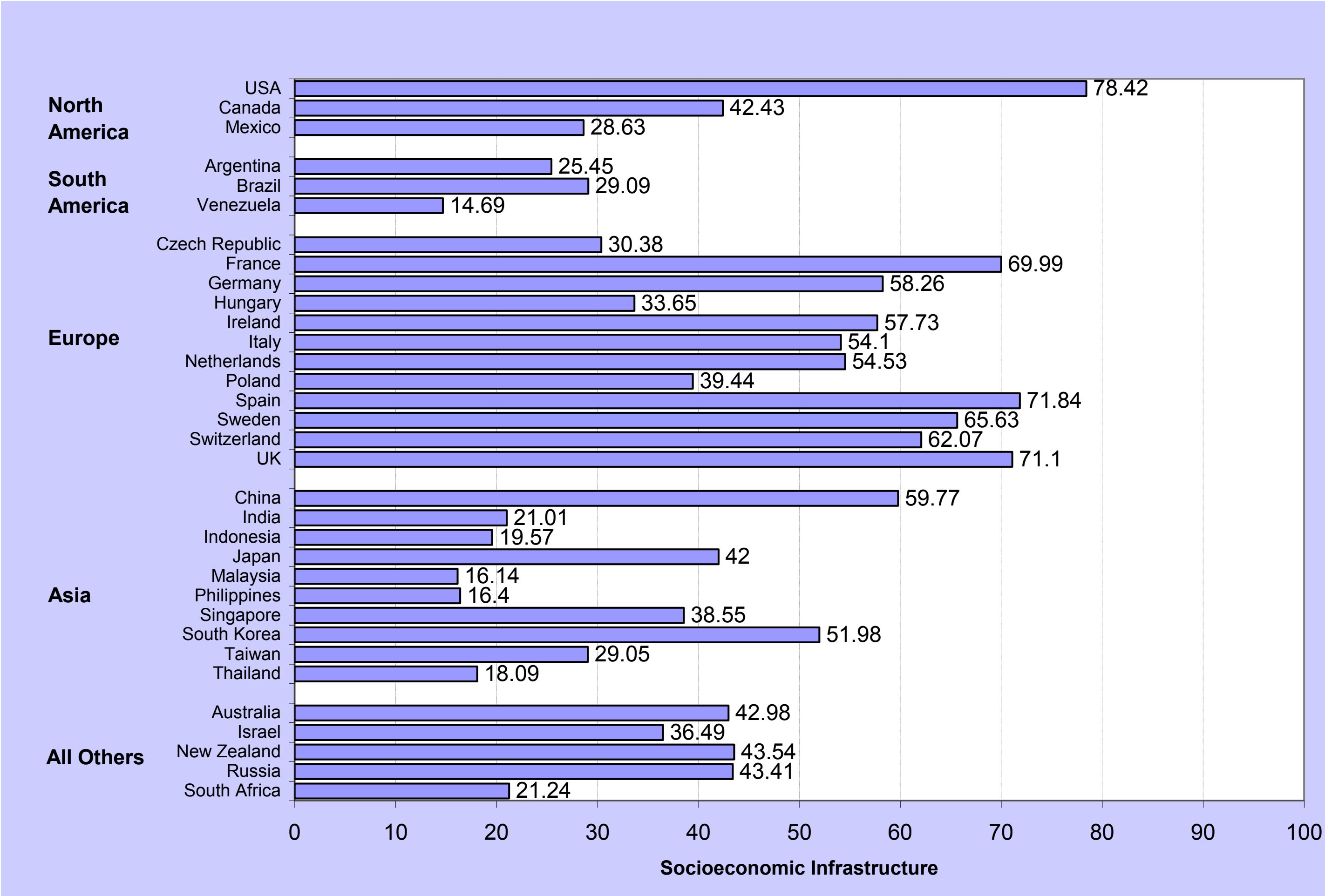
Q2 = *To what extent do this country's basic cultural values associate technology and technological change with desirable social development?*
* Intriguing variation among the Western nations – e.g., with Sweden and Australia high, but Italy,

Canada, The Netherlands, France, and the USA low.
* Some surprises – Malaysia, Mexico, and Thailand among the highest

Q3 = *How closely do influential groups (e.g., unions, trade associations, religious organizations) in this country associate technology with desirable social development?* [shortened version]
* Possible clues to effective resistance in these responses – notably low are Germany, the UK, and The Philippines; at the other extreme, 13 of the countries score 4.5 or higher on this 5.0 scale item (evidencing notable consensus among about 10 independent respondents)

Q4 = *Please rate the presence of an "entrepreneurial spirit" in this country* [shortened version]
* This item is definitely expert "opinion" – the five lowest are capitalist societies – Germany, Canada, France, Italy, and the U.S.
* The six leaders are: Czech Republic, Argentina, Taiwan, Sweden, Israel, and Spain.

Figure 12: Socio-economic Infrastructure 2005 Statistics-only – SE-05 (S)



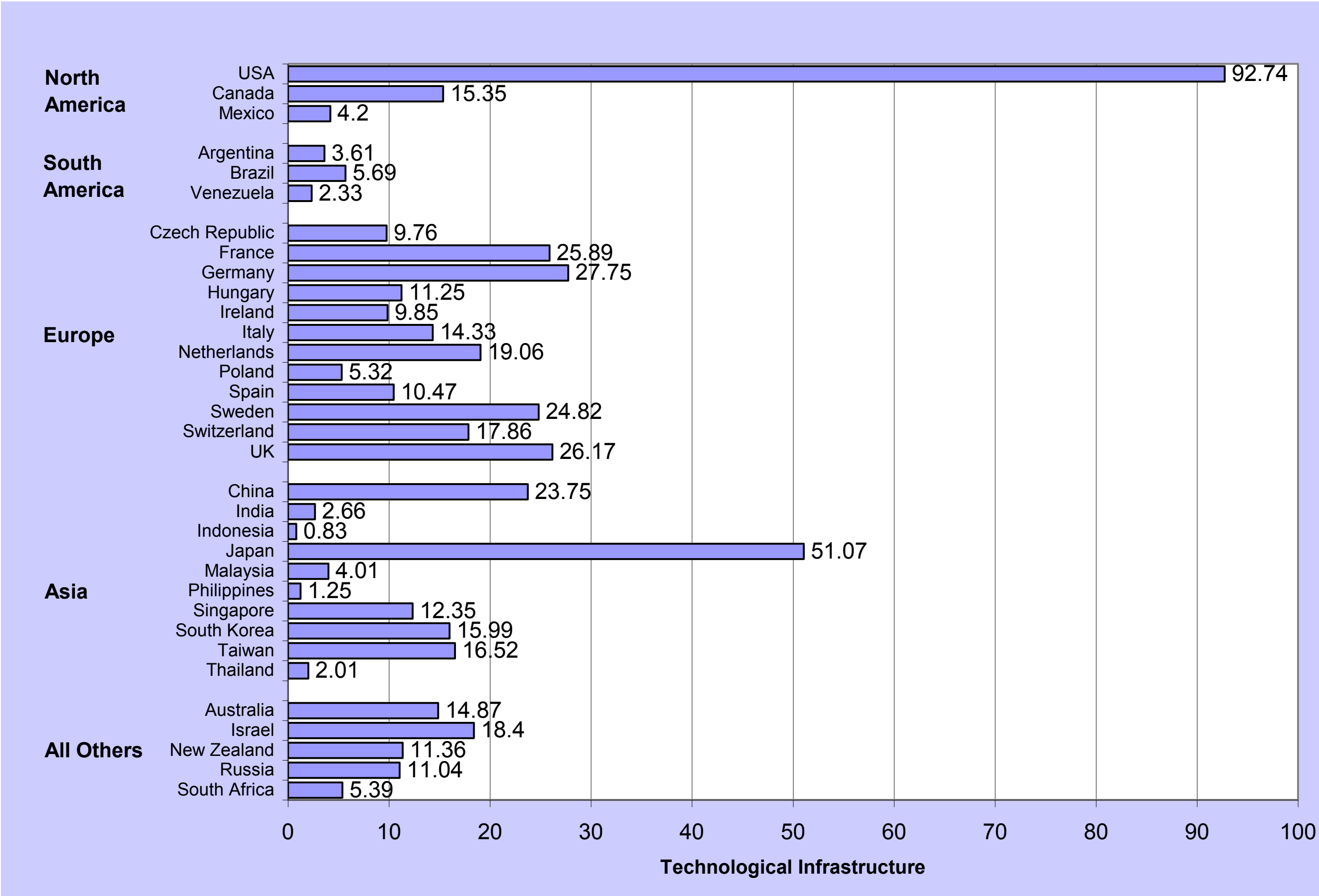
Socio-economic Infrastructure, recalling Figure 10, is a substantial contributor to most countries' INPUT status. The SE (S) formulation is considerably changed from the SE (T) version, which paints a more uniform picture. See also Figures 5 and 21. [France and Spain are the two countries that gain in the switch from (T) to (S).]

The SE-05 chart shows significant variation, except that it does not show singular outliers. The mean (42.1; median is 42.0) exceeds that of Technological Infrastructure and Productive Capacity. This indicator ranges from 14.7 to 78.4, with a standard deviation of 18.6. South America and some Asian countries (including India) score poorly on this indicator, while Europe overall fares well relative to the mean of all 33 countries.

SE (S) combines three components (see the Appendix), addressing:

- Educational attainment (HMHS – tertiary and secondary school participation)
  [Laggards include India, Indonesia, South Africa.]
- Foreign direct investment (FDI)
  [Dramatically led by China, followed by France and the U.S. – this is a particularly volatile measure; laggards include 16 countries (half of the sample) scoring less than 10 on the S-scale to 100.]
- Market attractiveness – (PatApNon – patent applications by non-residents)
  [Western Europe and the U.S. score notably highly; strikingly low are Venezuela, Thailand, Malaysia, Argentina, and The Philippines.]

Figure 13: Technological Infrastructure 2005 Statistics-only – TI-05 (S)

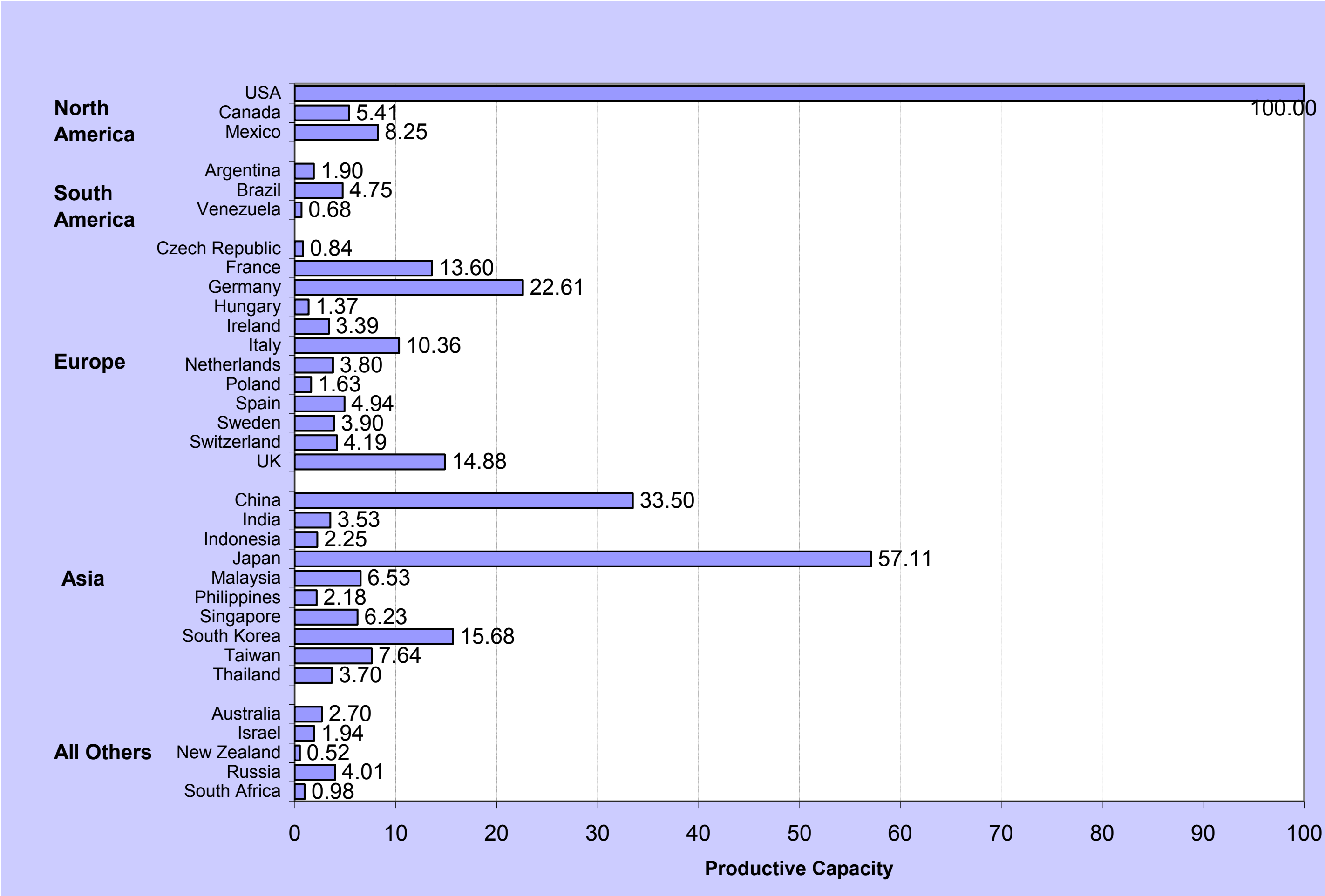


The graph for "TI-05 (S)" indicates extreme variation with the U.S. and Japan as prominent outliers. For the 33 countries, the mean is a low 13.9 (median, 7.2).

TI (S) is far more extreme than TI (T) (Figure 6). The chart showing difference scores (Figure 22) shows all nations but one (the U.S.) scoring much lower on TI (S). As discussed, TI is especially "statistically enriched" in incorporating 7 empirical components, compared to 2 plus 4 question items that make up TI (T).

Western Europe stands tall on TI (S), following the U.S. and Japan. China scores comparably to European leaders. Israel is quite strong. Interesting to note, India only scored 2.7 on this indicator, while China scored 23.8. The extreme range seen here is similar to that for PC-05 (S).well, with a number of nations within range (especially the Asian Tigers – Taiwan, South Korea, Singapore).

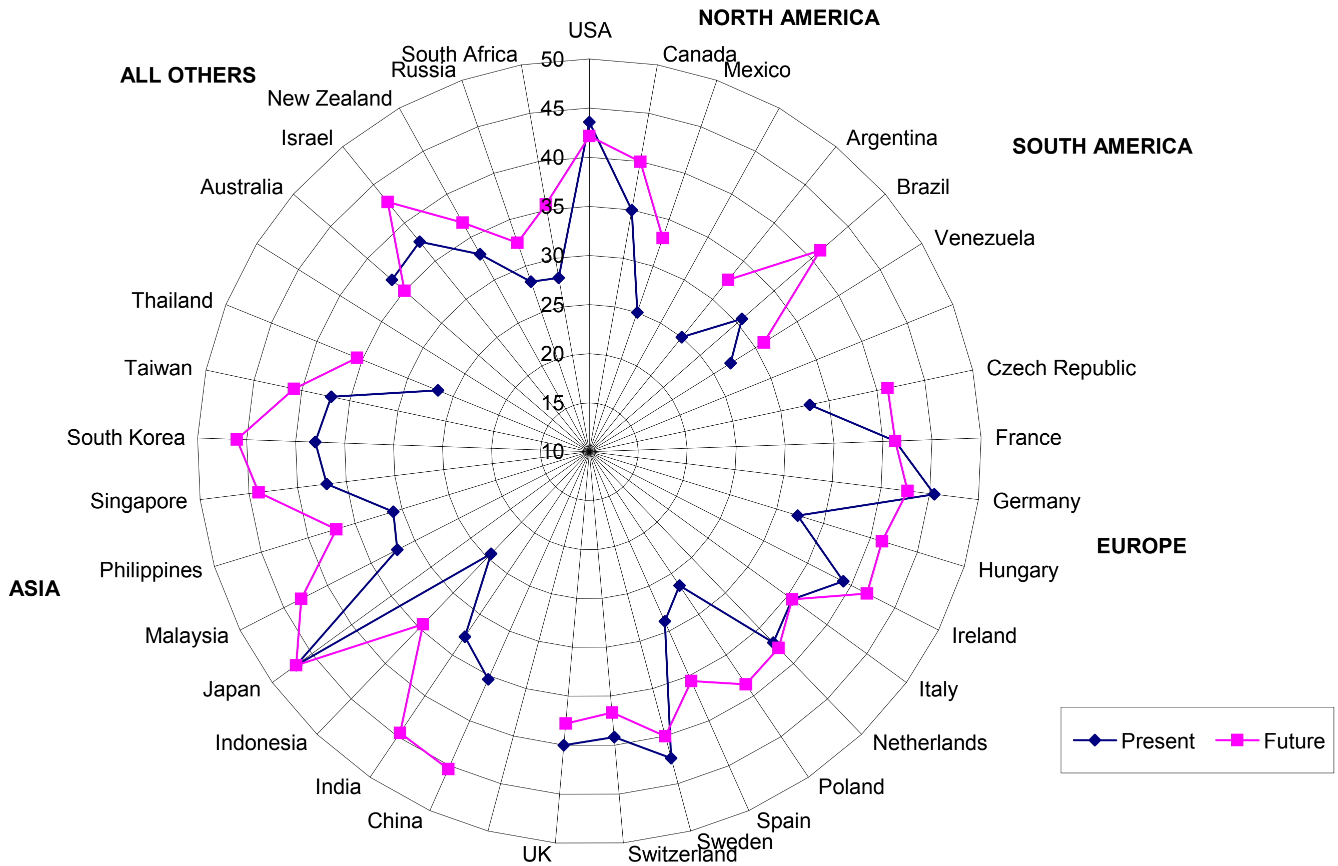
Figure 14: Productive Capacity 2005 Statistics-only – PC-05 (S)



In looking at the Statistics-only formulation of Productive Capacity, indicator scores show significant variation with prominent outliers such as the U.S., Japan, and China. Overall, the low mean (10.8; median of 4.0) and high standard deviation (19.6) suggest that outliers heavily affect these summary statistics. Without the aforementioned outliers, the mean (5.5) and standard deviation (5.2) lower drastically.

As with TI, PC (S) shows much greater variance across countries than does PC (T). Reflecting on their composition, this is not surprising. Three questionnaire items are replaced; one empirical component continues (electronics production), and two are added. Those two – Manufacturing Value Added (MVA) and Services Value Added (SVA) are highly volatile from year to year. [We intend to research this further, exploring smoothing and alternative formulations.] The three empirical components do correlate very highly with each other, serving to reinforce the differences among countries.

Figure 15: Perceived High Tech Production Capability: Present vs. Future 2005 [based on expert opinion]



Note: Response of experts to:

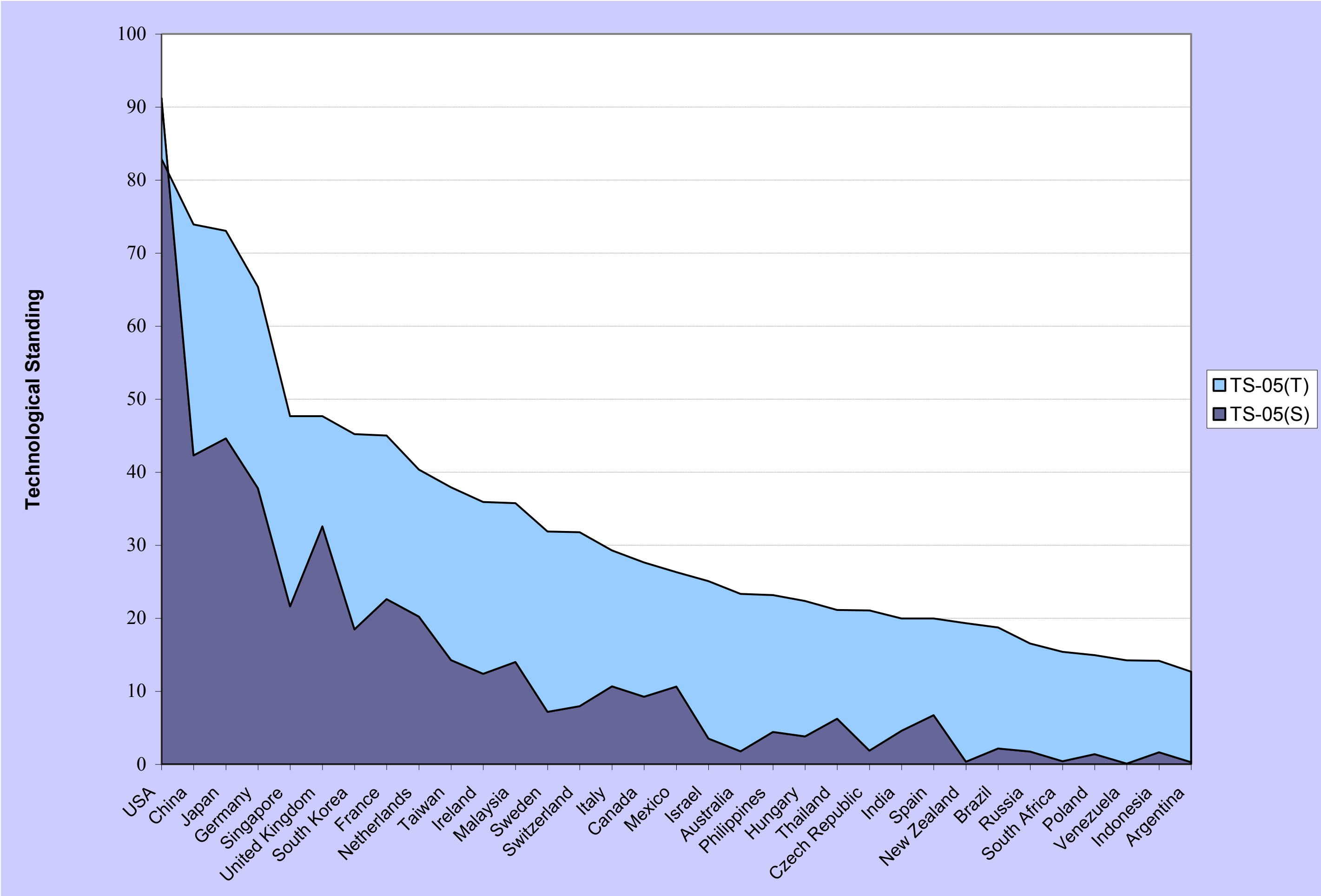
> "Please characterize present and future technology-intensive production in this country. Judge the nature of production overall (reflected here) and for each of ten sectors for which you feel reasonably familiar: first today, and second, 15 years in the future."

Responses on a 5-point scale, rescaled here to 10-50, where
10 = "essentially no production," to
50 = "extensive indigenous manufacturing activity with products considered technically advanced, 'state of the art' in international markets."

The "Present vs. Future: Overall High Tech Production Capability" graph (Figure 15) shows the currently perceived production capability and that expected in 15 years, based on expert judgment. UK, Switzerland, Sweden, USA, Germany, and Australia interestingly show present productive capability exceeding anticipated future productive capability. This seems best attributed to a ceiling effect on this measure rather than expected real declines. Asia and South America show the greatest expected growth in productive capability. This measure paints a picture of broadening global technological competitiveness.

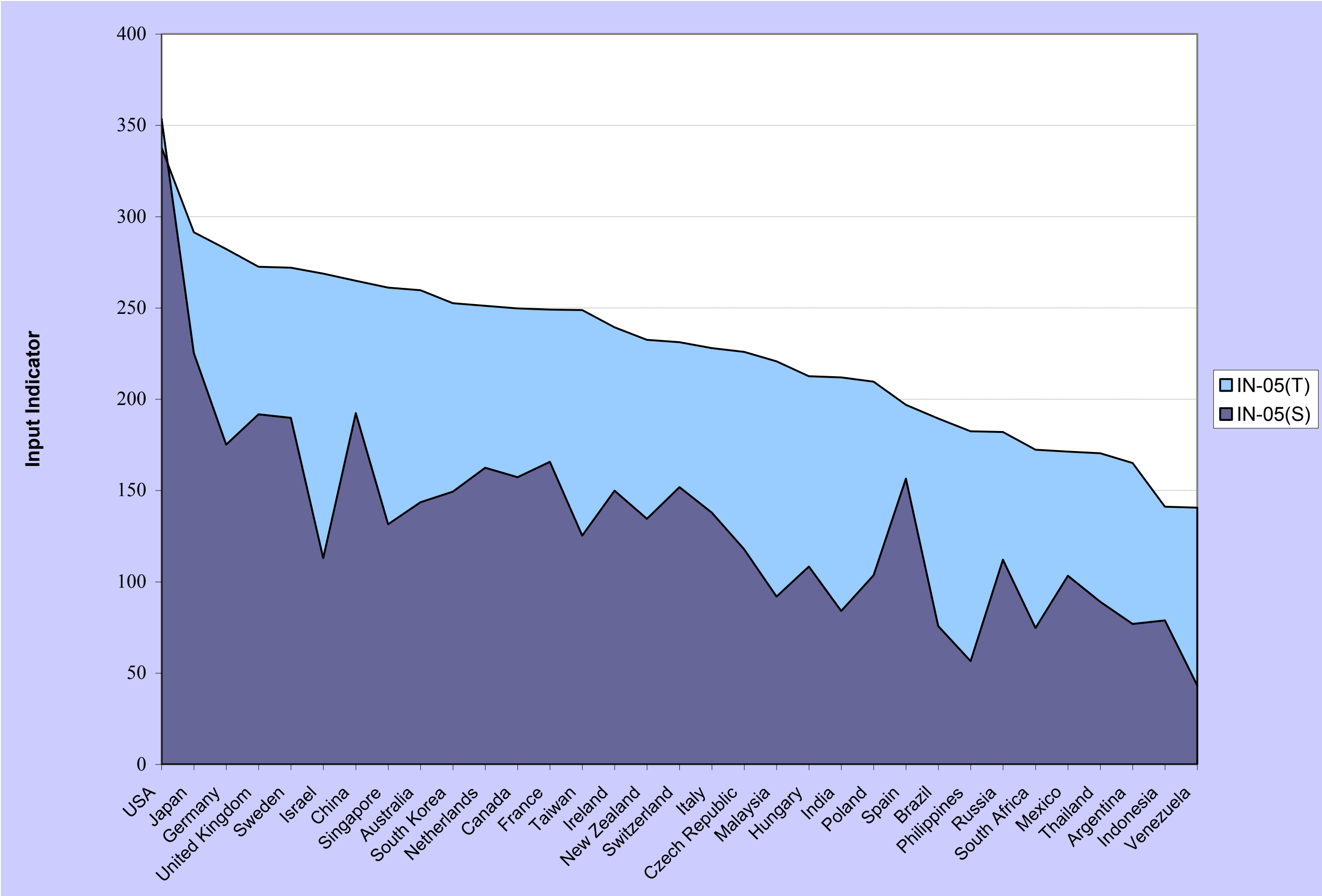
The following set of graphs, Figures 16-23, compare the Traditional (T) and Statistics-only (S) indicators.

Figure 16: Technological Standing 2005 --TS-05 – Traditional vs. Statistics-only



This chart shows the difference between the Statistics-only and Traditional formulations as graphical area. Technological Standing shows a high correlation (0.93) between the Traditional and Statistics-only formulations. The average difference per country is approximately 18.8.

Figure 17: INPUT 2005 -- INPUT-05: Traditional (T) vs. Statistics-only (S)

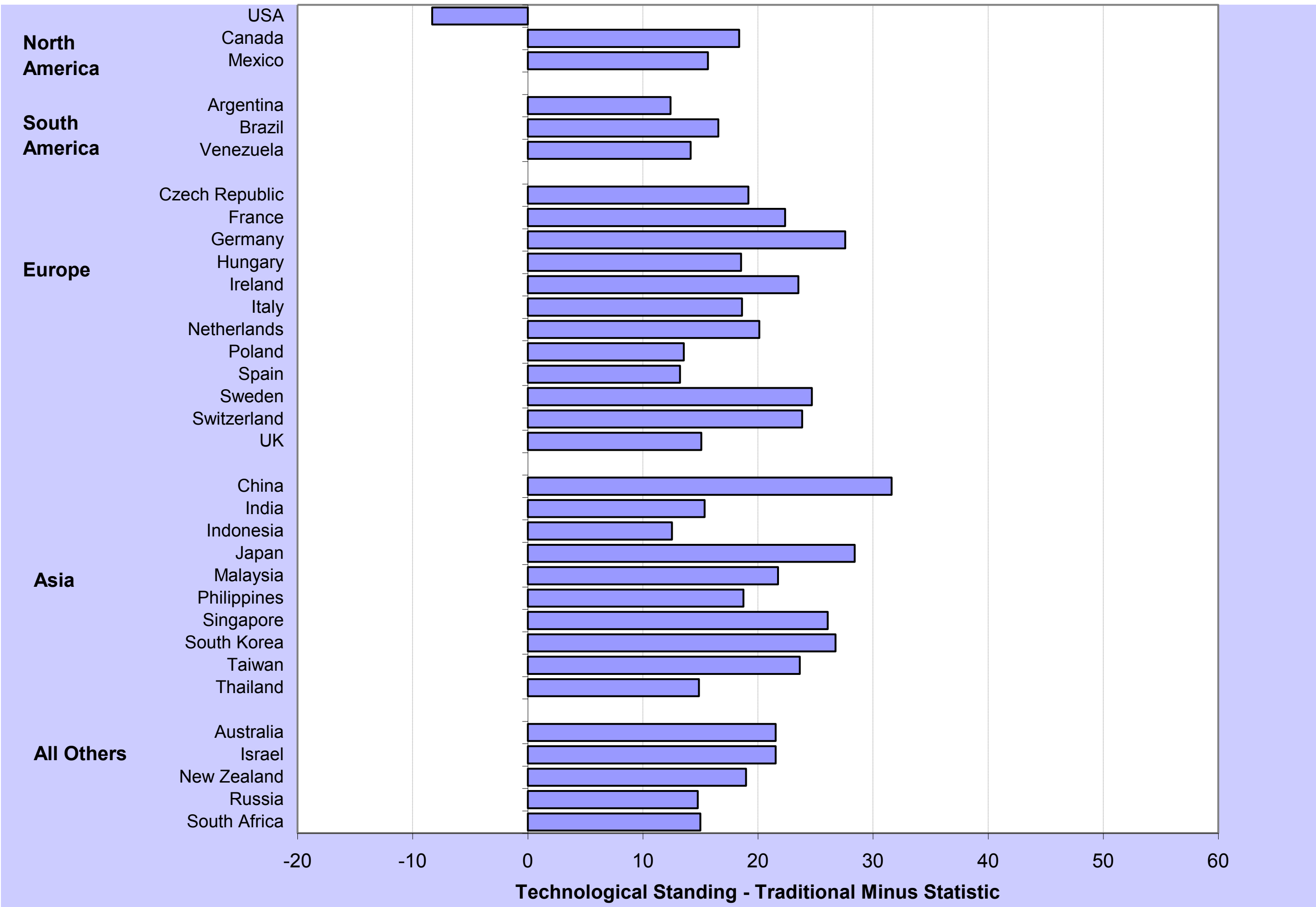


Note: INPUT adds together our four Input (leading) indicators – NO, SE, TI, and PC -- each of which is an average of components scaled 0-100, so the potential INPUT range is 0-400.

When examining the differences between the Statistics-only and Traditional formulations, Figures 16-17, we find that the Statistics-only formulation provides greater variation, while on average showing correlation with the traditional formulation. The correlation between these formulations for INPUT is 0.85. [Figure 19 -- "INPUT-05, Traditional vs. Statistics-only" -- shows the difference between these formulations spatially.]

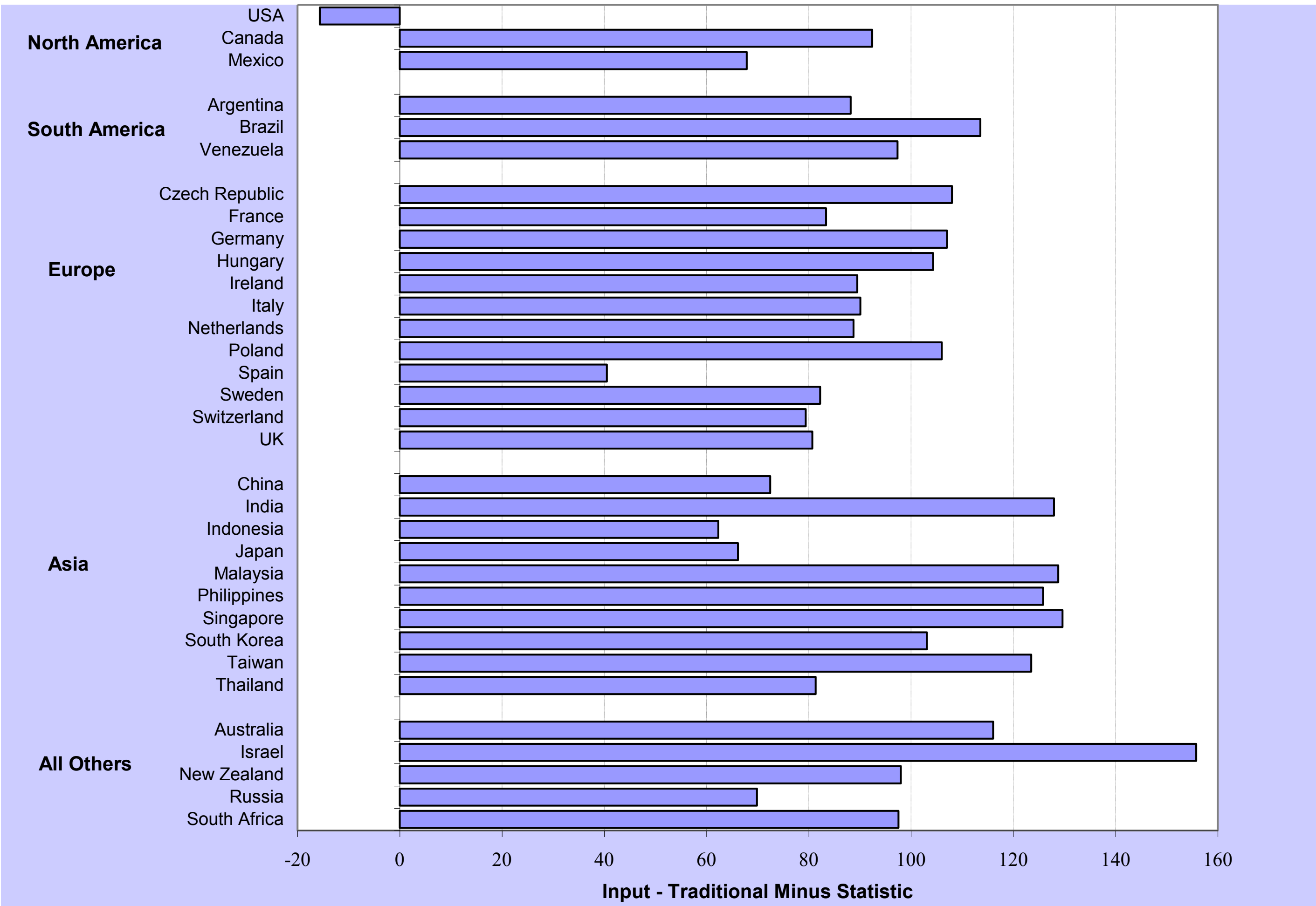
Charts 18-23 present difference scores for 2005 between the Traditional (T) and new Statistics-only (S) indicators. These convey the degree to which shifting from (T) to (S) alters the relationships among the 33 nations. To a striking degree, the overall indicators -- technology-based output (TS) and the factors that enable such output (INPUT) – find 32 nations scoring lower on the (S) metrics with only one nation (U.S.) scoring higher.

Figure 18: Difference Scores, Traditional Minus Statistics-only for Technological Standing 2005 (TS-05)



The Technological Standing indicator exhibits another case where the Traditional indicator exceeds the Statistics-only indicator consistently, with exception of the USA score. The difference has a mean of 18.8 with a standard deviation of 5.1. The U.S. score is more than five standard deviations away from the mean.

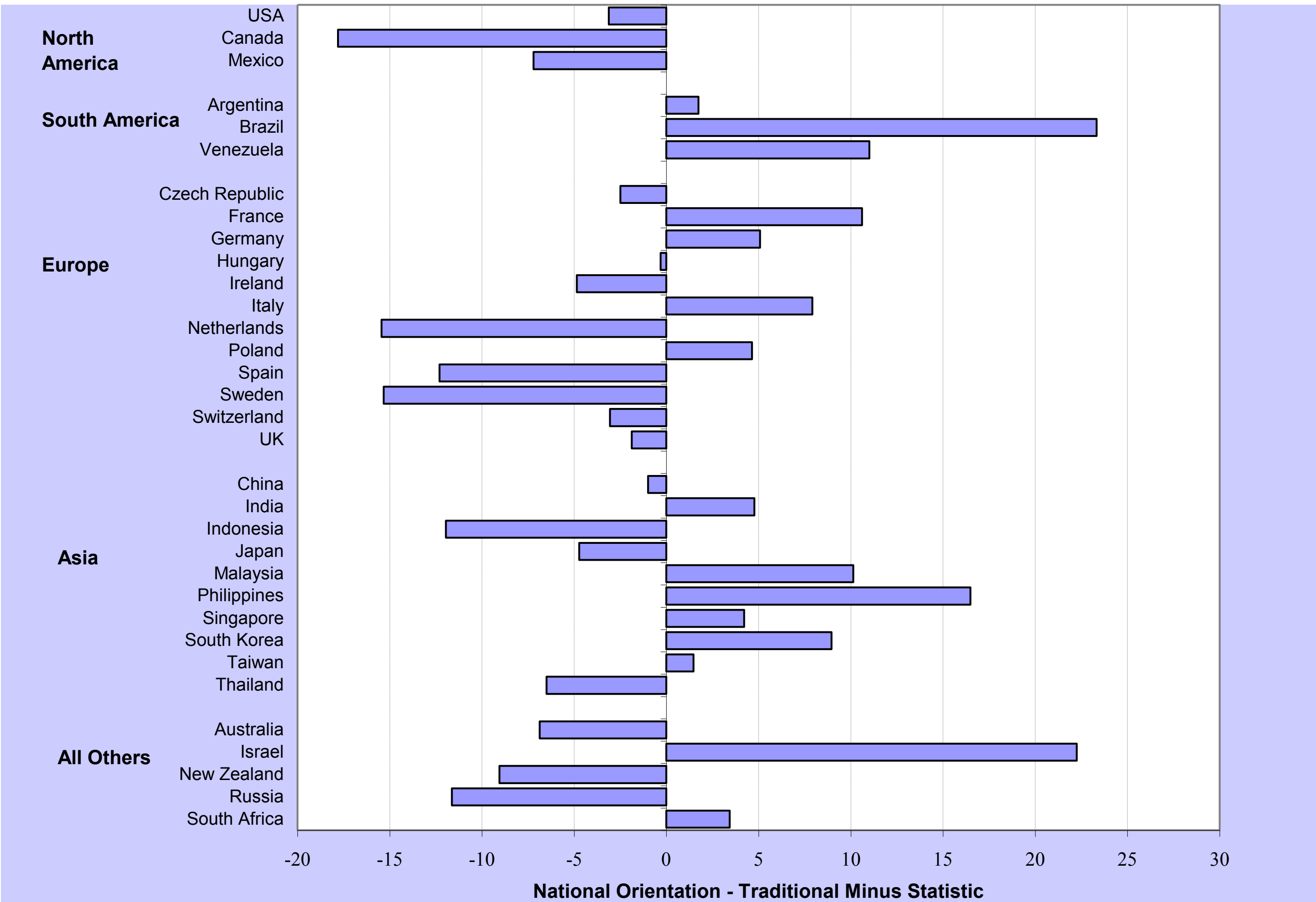
Figure 19: Difference Scores, Traditional Minus Statistics-only for INPUT 2005 (INPUT-05)



Note: INPUT adds together our four Input (leading) indicators – NO, SE, TI, and PC -- each of which is an average of components scaled 0-100, so the potential INPUT range is 0-400.

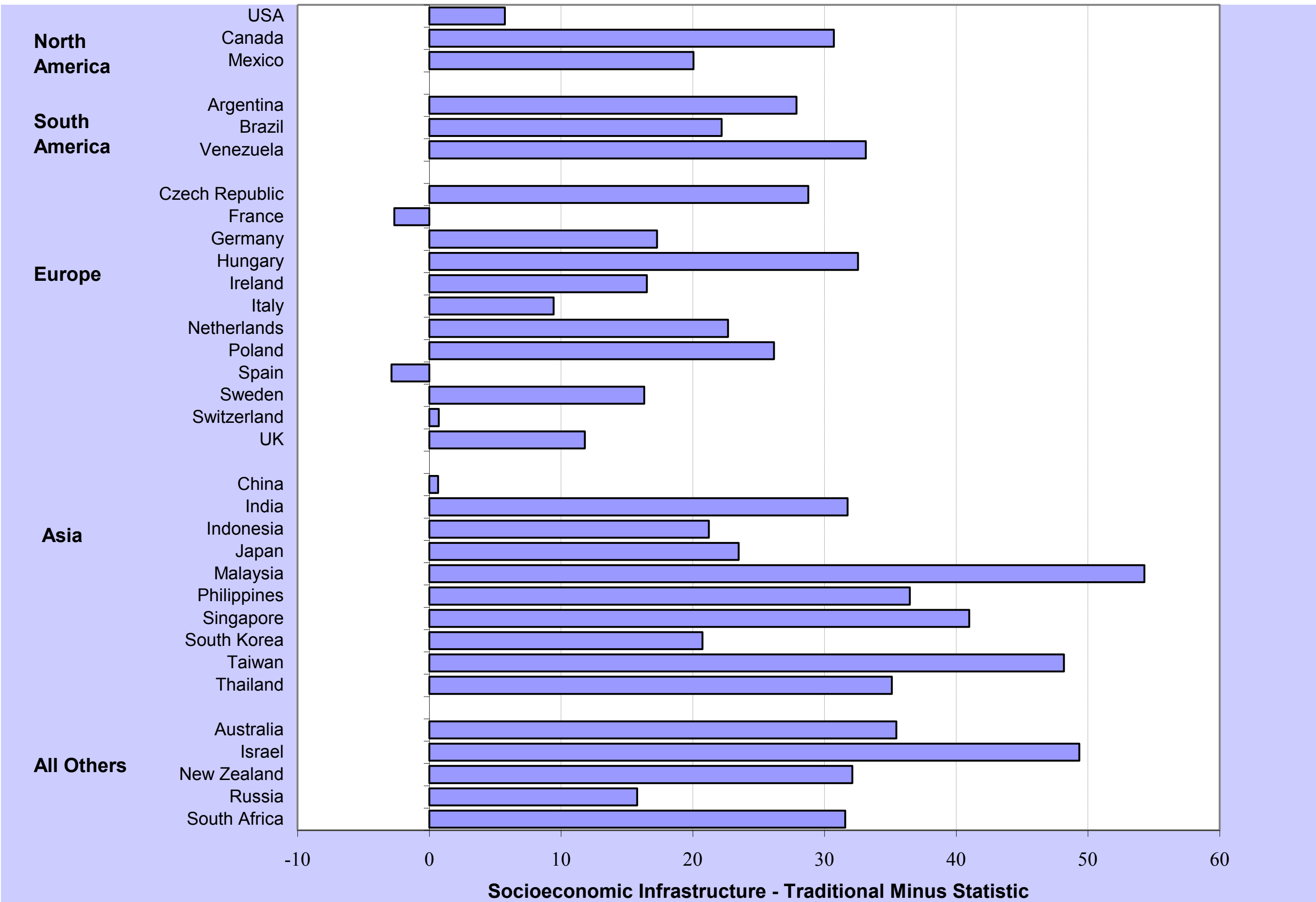
Between the Traditional and Statistics-only formulations of the INPUT-05 (Sum) indicator, all of the countries except for the USA show significant increases ranging from approximately 40 to 155. The mean and sample standard deviation for the difference in formulations is 92.8 and 30.7, respectively. The USA (S) formulation uniquely exceeds the (T) formulation.

Figure 20: Difference Scores, Traditional Minus Statistics-only for National Orientation 2005 (NO-05)



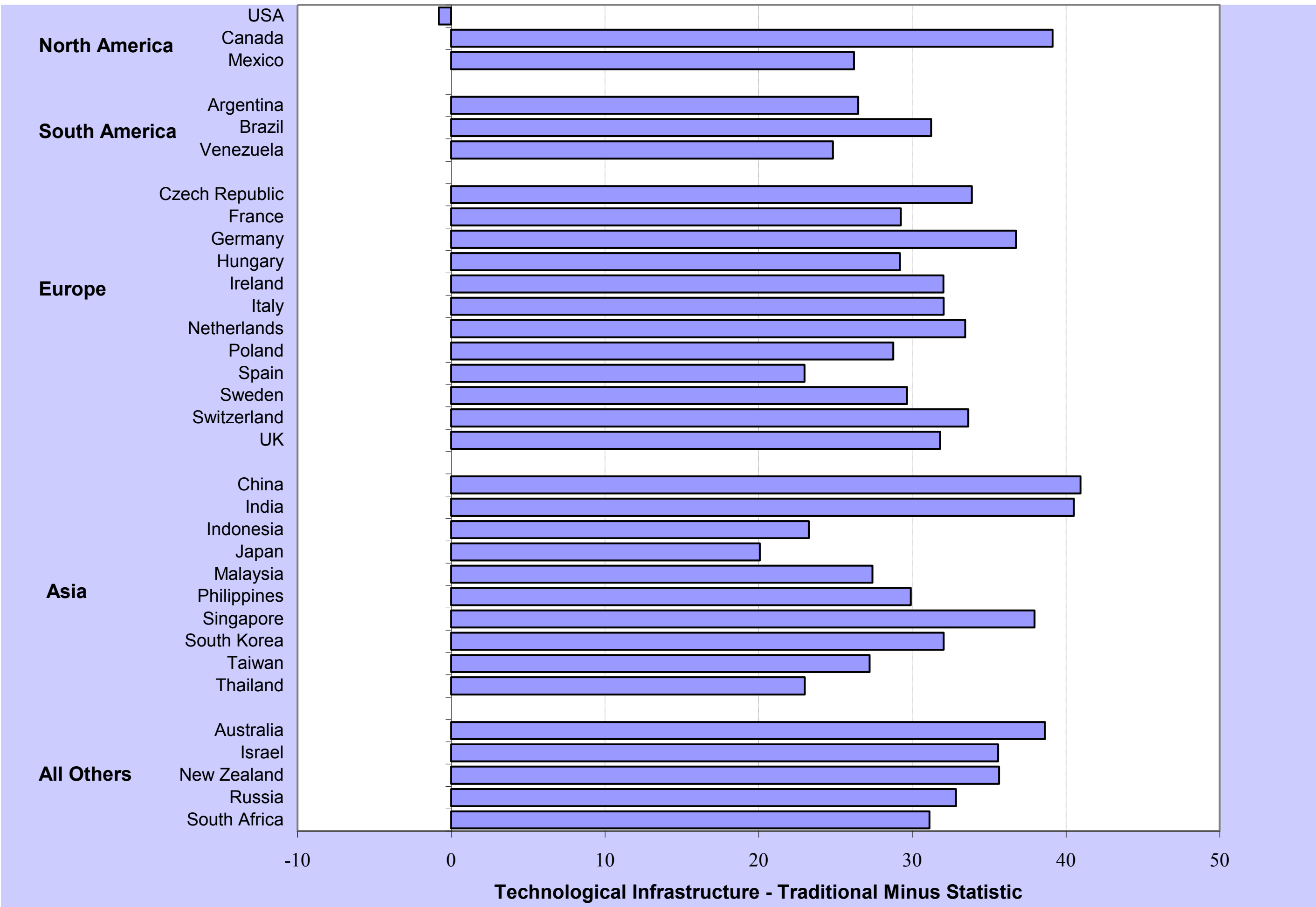
The National Orientation 2005 indicator difference scores between (T) and (S) show an interesting display of variability ranging from approximately -18 to +24, with a mean of 0.02 and a standard deviation of 10.5. In the North American country data, the Statistics-only exceeds the traditional formulation, while the South American country data suggests the opposite. For the other countries, there is no distinct pattern as to which is greater, the traditional or statistics-only formulation.

Figure 21: Difference Scores, Traditional Minus Statistics-only for Socio-economic Infrastructure 2005 (SE-05)



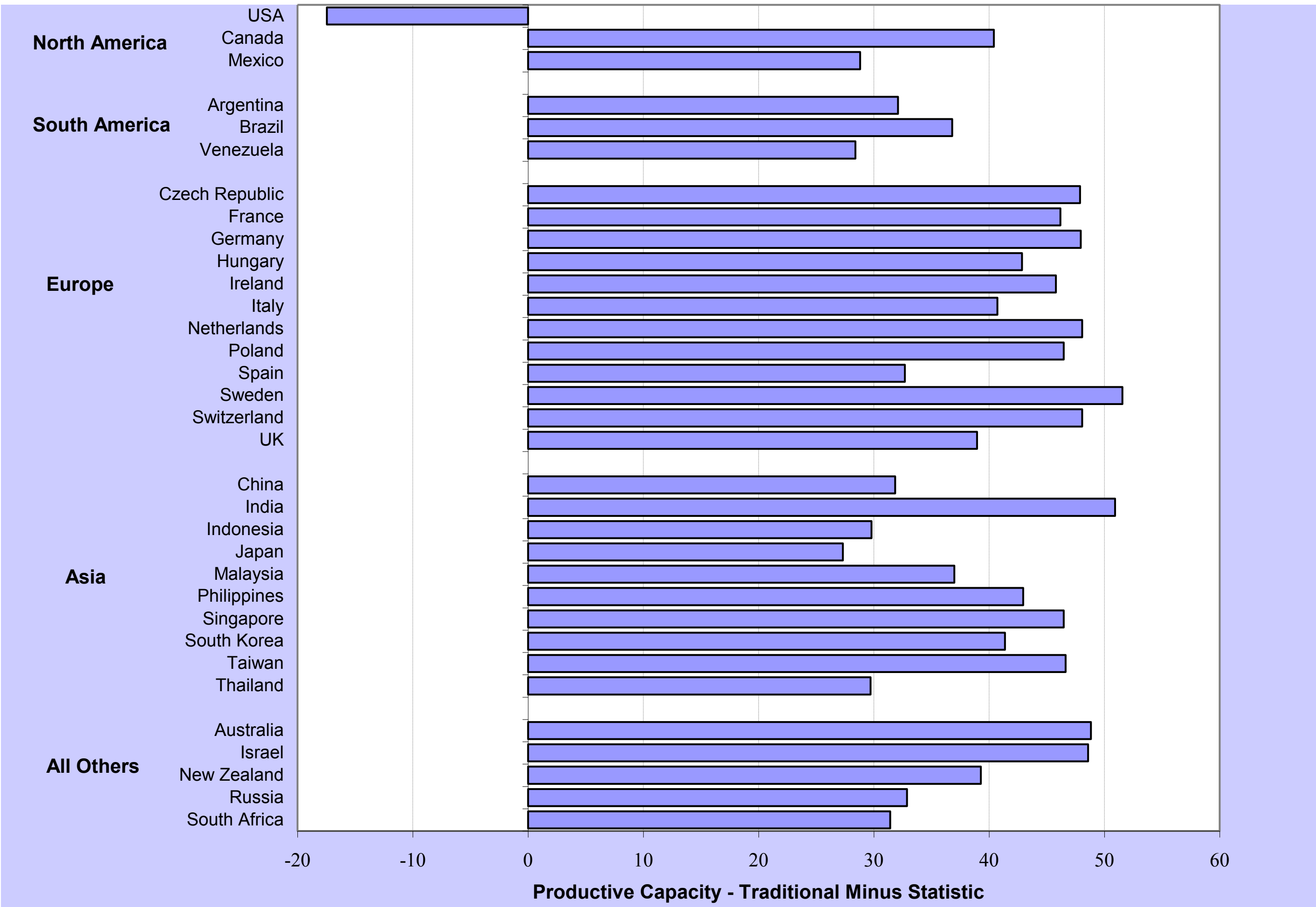
The Socio-economic Infrastructure 2005 indicator shows indeterminate results as to whether there is a general trend in the difference between the Statistics-only and Traditional formulation. While overall Traditional significantly exceeds the Statistics-only formulation, some notable exceptions include France, Switzerland, Spain, and China.

Figure 22: Difference Scores, Traditional Minus Statistics-only for Technological Infrastructure 2005 (TI-05)



The Technological Infrastructure 2005 indicator shows that the Traditional formulation exceeds the Statistics-only, except for the case of the U.S. This outlier lies approximately four standard deviations away from the mean difference of 30.2.

Figure 23: Difference Scores, Traditional Minus Statistics-only for Productive Capacity 2005 (PC-05)



The Productive Capacity 2005 indicator demonstrates overall a significant difference between the Traditional and Statistics-only formulations. Excluding the USA datum, the difference suggests that the Statistics-only formulation is consistently greater than the Traditional formulation. The overall mean increases from 38.5 to 40.3 if the USA datum is ignored, and the standard deviation decreases from 12.6 to 7.7. The U.S. outlier is more than seven standard deviations away from the mean. So, PC-05 (S) comparisons among the nations will largely parallel PC-05 (T) unless the U.S. is involved.

HTI 1993-2005 Time Series Figures

The following six figures show each of the High Tech Indicators over time. Because those figures require a full page, we offer observations on them collectively here. Figures 30-35 offer different temporal perspectives, with observations interposed.

Figure 24 -- "Technological Standing, Traditional 93-05" -- shows noticeable trends in indicator scores for Asian countries. The greatest increase in score occurs in China, with a 127% increase from 1993 to 2005. Similar to the results for "Productive Capacity, Traditional 93-05," Japan and the U.S. consistently remain at least 2.5 standard deviations greater than the overall mean (yearly mean 31.1). The 2005 Technological Standing indicator score for China is 73.9, 2.2 standard deviations above the mean.

We are planning to prepare a separate HTI 2005 report focusing on Asia. In that we will explore TS together with the Input indicators, collectively and individually. While HTI are just what their name suggests –

"indicators" – we anticipate interesting exploration of potential influential factors at work. Do note the considerable information provided herein for those who wish to probe. Taking China's TS scores (T) and (S) for 2005 as an example, Table 4 shows component contributions. Electronics exports (variable A2) is a powerful contributor as China is overwhelmingly #1 in the world. On overall high tech exports (variable X), China is a strong #4 in the world, close to #'s 2 & 3 (Germany and Japan), and way ahead of #5, UK. So, China's strong position is not heavily reliant on electronics production. The third component of TS (T) is a questionnaire item on which China's position is relatively muted. For TS (S), the picture is strikingly different. On Royalties received (variable RoyR), with the U.S. at 100, China is at 0.3. On variable SOCSE -- Export of Computer, communications and other services – China is again not very prominent (scoring 10.6 compared to the U.S. at 100).

As HTI moves forward using the Statistics-only (S) indicators, we plan to retain the questionnaire items. We believe that responses to these could help illuminate the statistically based indicators, without necessarily incorporating expert opinion in the indicators per se.

The chronology of the INPUT indicator does not suggest any overall positive or negative trend per country (Figure 25). This reflects the fact that S-scores set the range for each year to a maximum of 100 for each component (NO, SE, TI, and PC) for the leading country (e.g., the USA). Average percent change from 1993 to 2005 is 3% and standard deviation of percentage change is 12%. Each country can be distinguished by two factors, average indicator value and the amount of variation. China exhibits the highest standard deviation with a value of 34.8, while the USA maintains the highest mean value at 341.1. China shows a dramatic increase from 180.4 in 1993 to 264.8 in 2005. Similarly, India's score has increased noticeably since 1993 – see Figure 30 too. Japan and Ireland show a significant decline over time.

Over time, the National Orientation indicator shows no discernible general trend (Figure 26), yet individual countries yield interesting results. The average percent change is -2% with a standard deviation of 12%. South Africa (-39%) shows the greatest decline in indicator value from 1993 to 2005, and Indonesia (-35%) the second greatest decline. Also, apparent is that countries show significant spikes in National Orientation values, for example; Ireland lists a value of approximately 98 in 1999, and later a value of 74 in 2005.

The Socio-economic Infrastructure indicator shows significant spikes without any significant trends within each country, with a few exceptions (Figure 27). Notable movement appears for Spain, Sweden, UK, China, India, Russia and Israel.

Over time, the Technological Infrastructure indicator does not show any general significant trend (Figure 28). This indicator shows an average standard deviation between 1993 and 2005 equal to 3.6 and the average change, per country, over time is 4%; this percent change ranges from -29% to 52%. Of the 33 countries, 18 show negative change over the period 1993 to 2005. Overall, the data reveal few prominent spikes within each country's yearly scores. TI (T) is relatively stable.

Figure 29 -- "Productive Capacity, Traditional 93-05" -- shows two countries that have remained prominent outliers, Japan and the U.S. They have consistently remained at least 2.5 standard deviations above the mean score for each year. Between the years 1993 and 2005, the average percent change is 7% with a high standard deviation of 20%. Moreover, the average standard deviation of each country's yearly scores is 4.1. China, India, South Korea, Mexico, UK, and Hungary show perceptible increasing trends over time, while Ireland and the US suggest negative trends in Productive Capacity.

Figure 24: Technological Standing, Traditional-- TS (T): 1993-2005

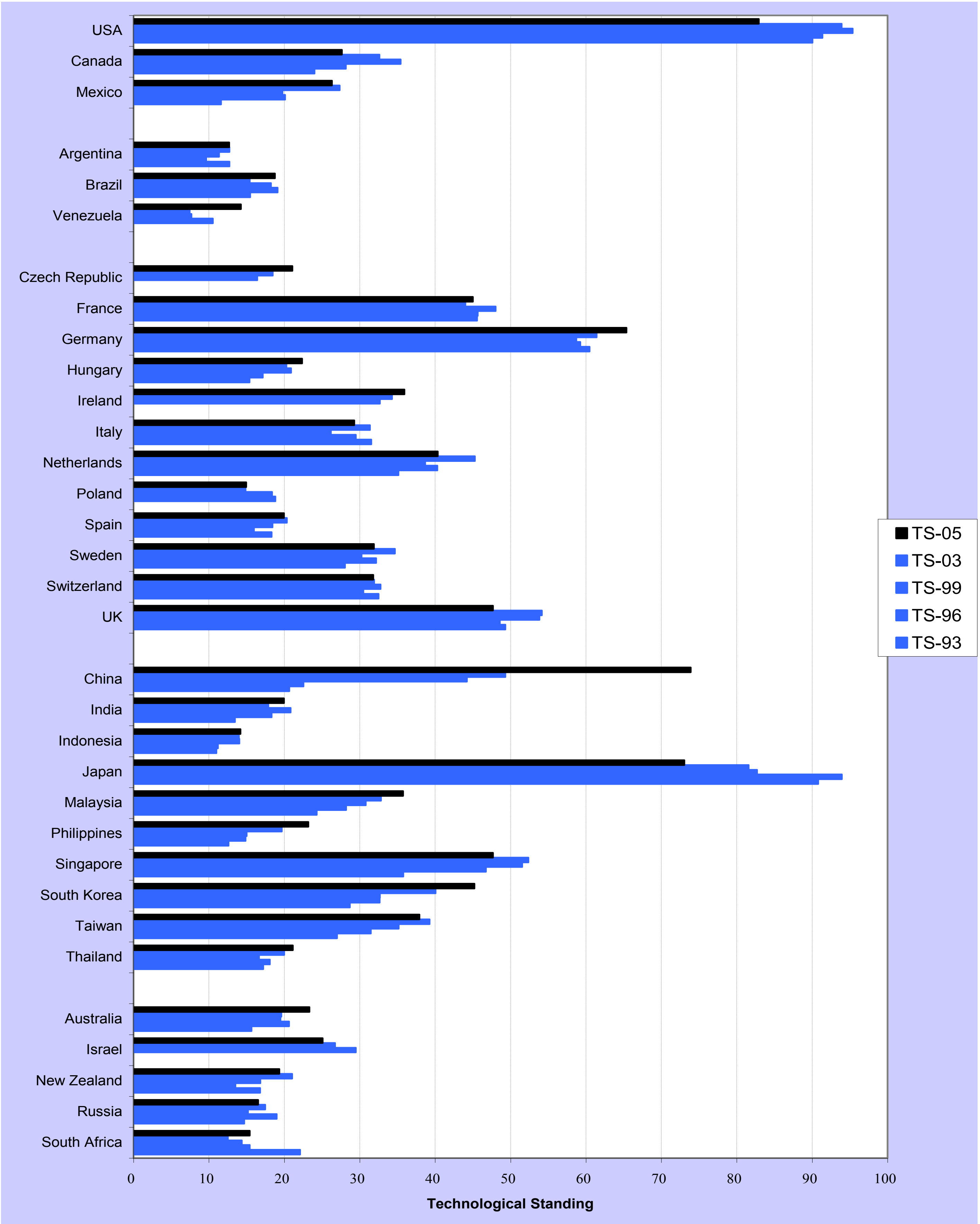
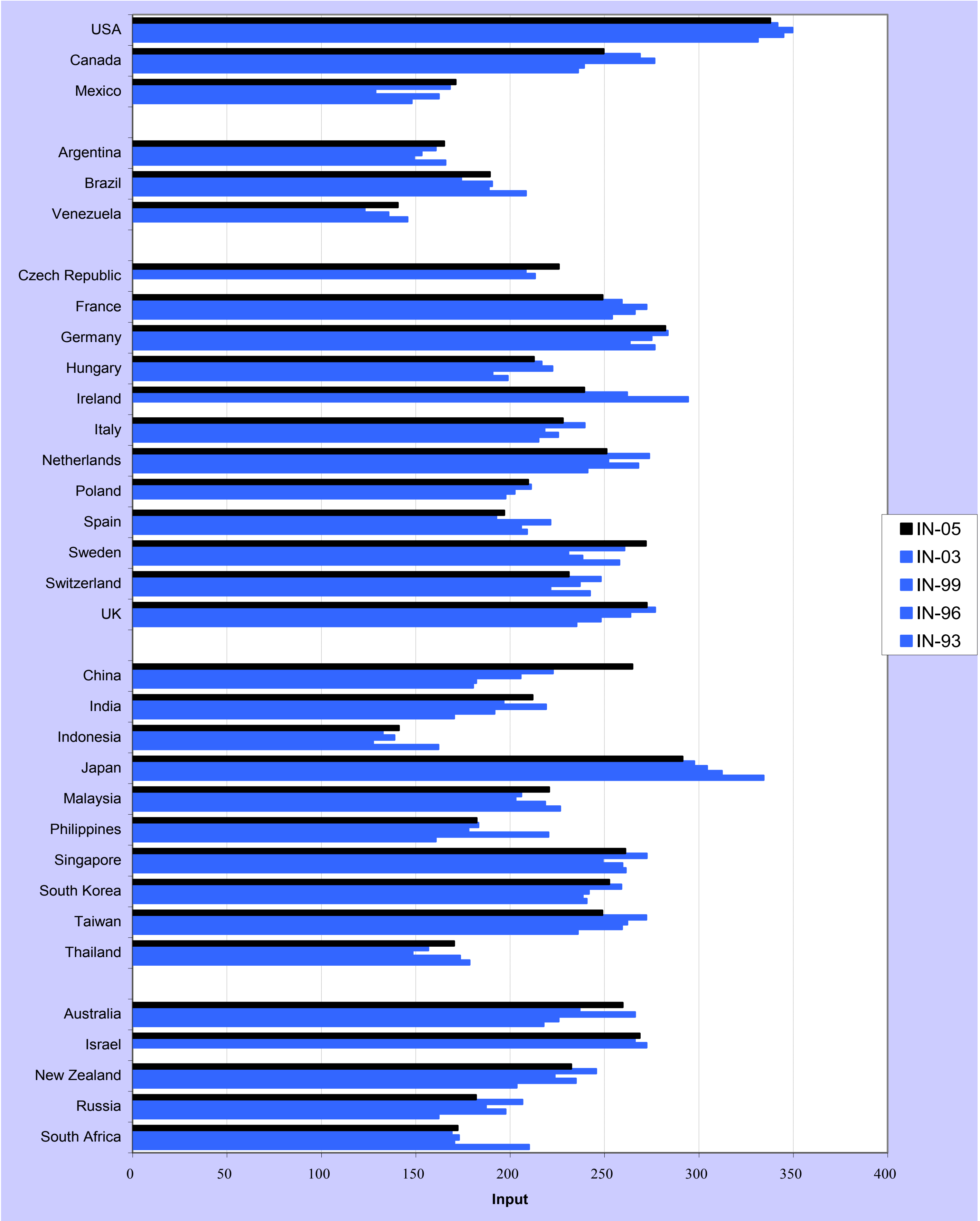


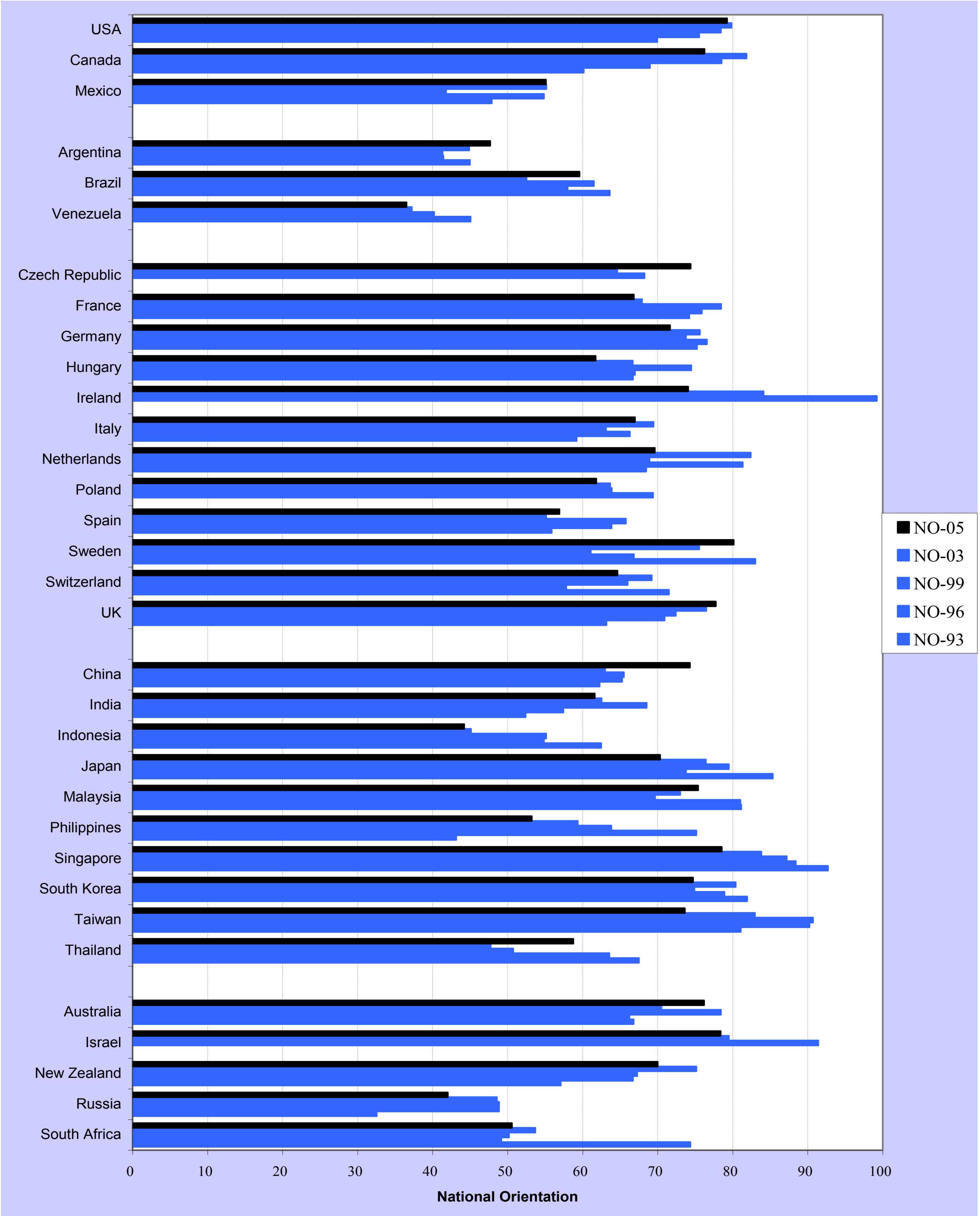
Figure 25: INPUT, Traditional – INPUT (T): 1993-2005



Note: INPUT adds together our four Input (leading) indicators – NO, SE, TI, and PC -- each of which is an average of components scaled 0-100, so the potential INPUT range is 0-400.

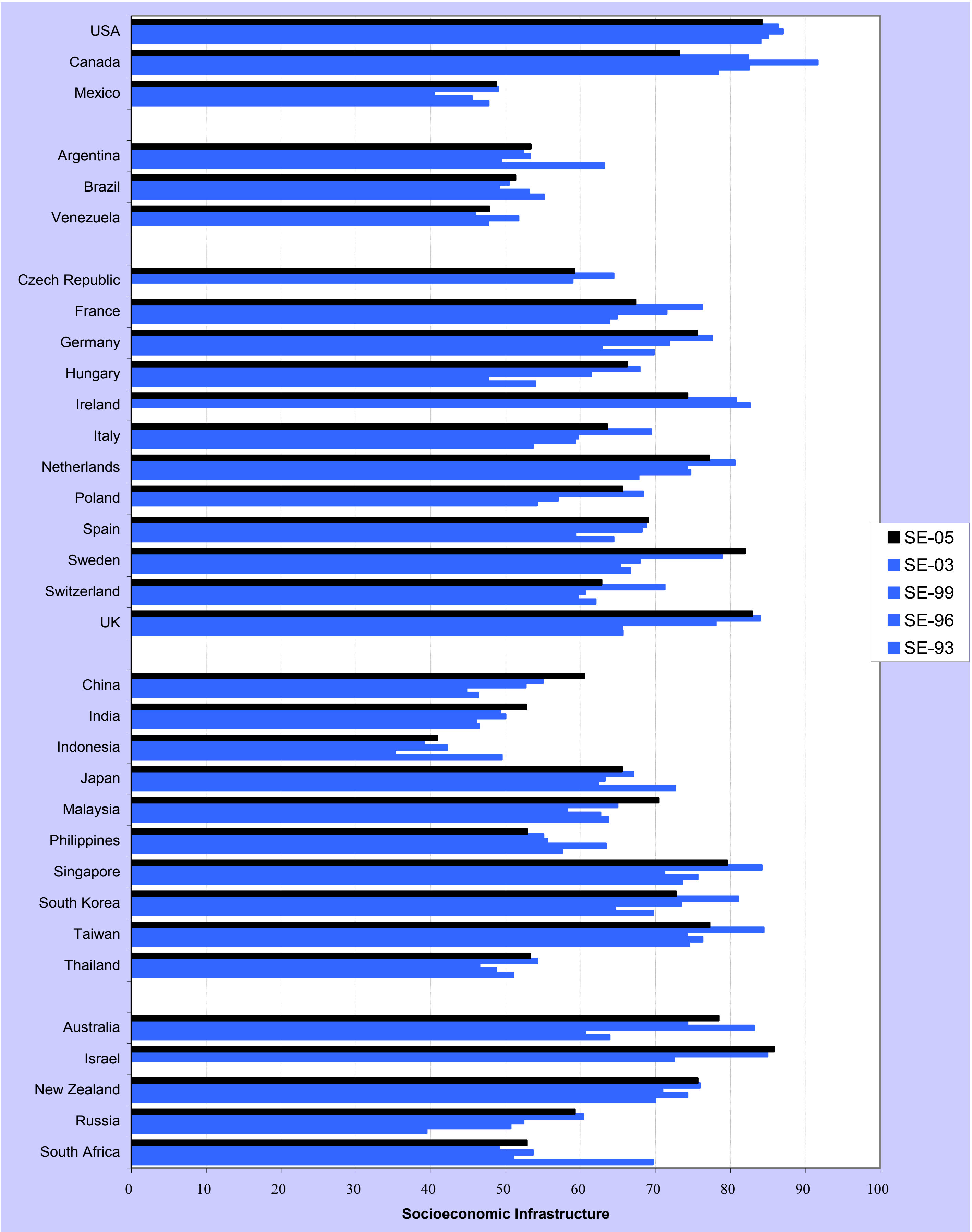
The chronology of the INPUT indicator does not suggest any overall positive or negative trend per country. This reflects the fact that S-scores set the range for each year to a maximum of 100 for each component (NO, SE, TI, and PC) for the leading country (e.g., the USA). Average percent change from 1993 to 2005 is 3% and standard deviation of percentage change is 12%. Each country can be distinguished by two factors, average indicator value and the amount of variation. China exhibits the highest standard deviation with a value of 34.8, while the USA maintains the highest mean value at 341.1. China shows a dramatic increase from 180.4 in 1993 to 264.8 in 2005. Similarly, India's score has increased noticeably since 1993 – see Figure 30 too. Japan and Ireland show a significant decline over time.

Figure 26: National Orientation, Traditional – NO (T): 1993-2005



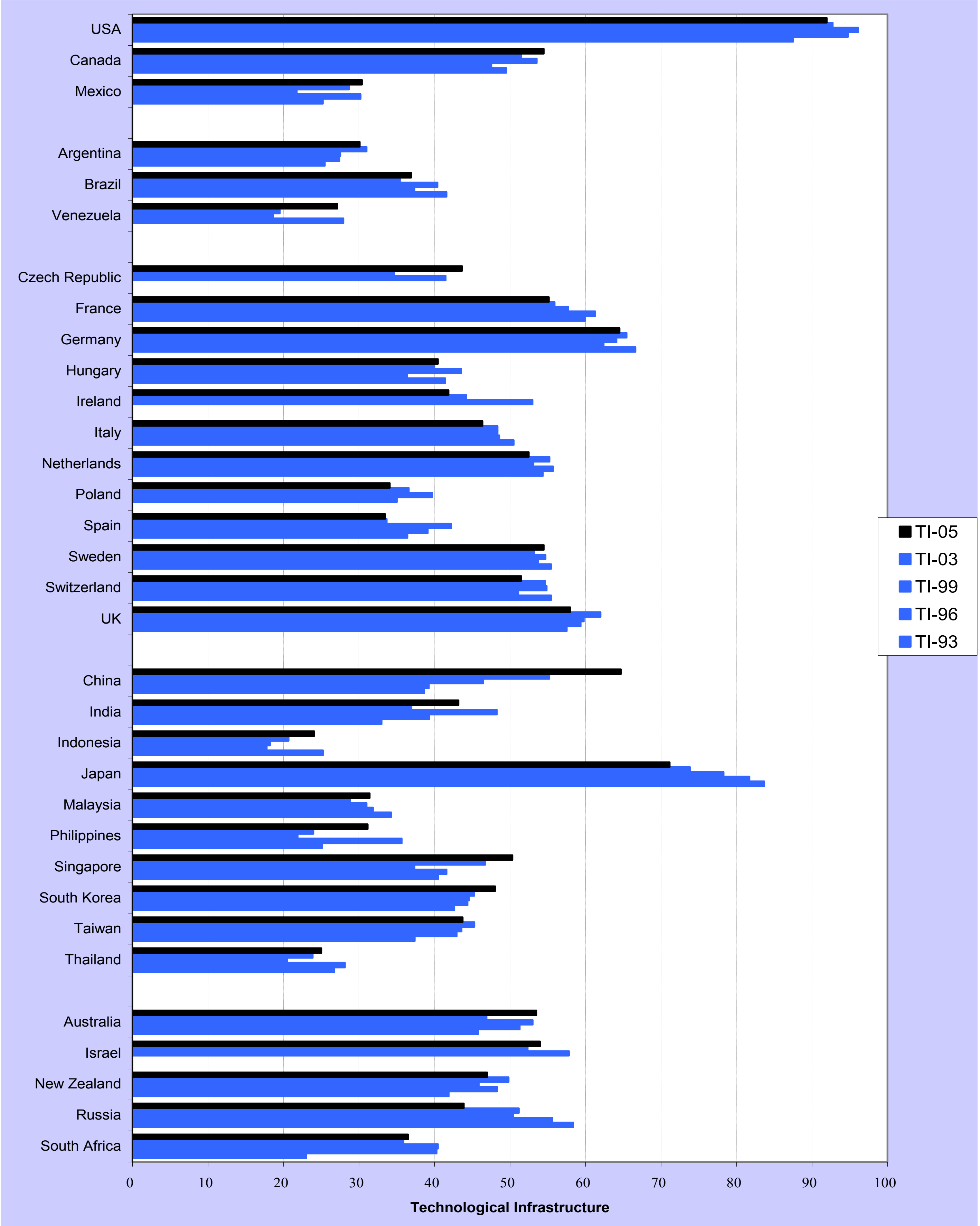
Over time, the National Orientation indicator shows no discernible general trend, yet individual countries yield interesting results. The average percent change is -2% with a standard deviation of 12%. South Africa (-39%) shows the greatest decline in indicator value from 1993 to 2005, and Indonesia (-35%) the second greatest decline. Also, apparent is that countries show significant spikes in National Orientation values, for example; Ireland shows a value of approximately 98 in 1999, and later a value of 74 in 2005.

Figure 27: Socio-economic Infrastructure, Traditional – SE (T) : 1993-2005



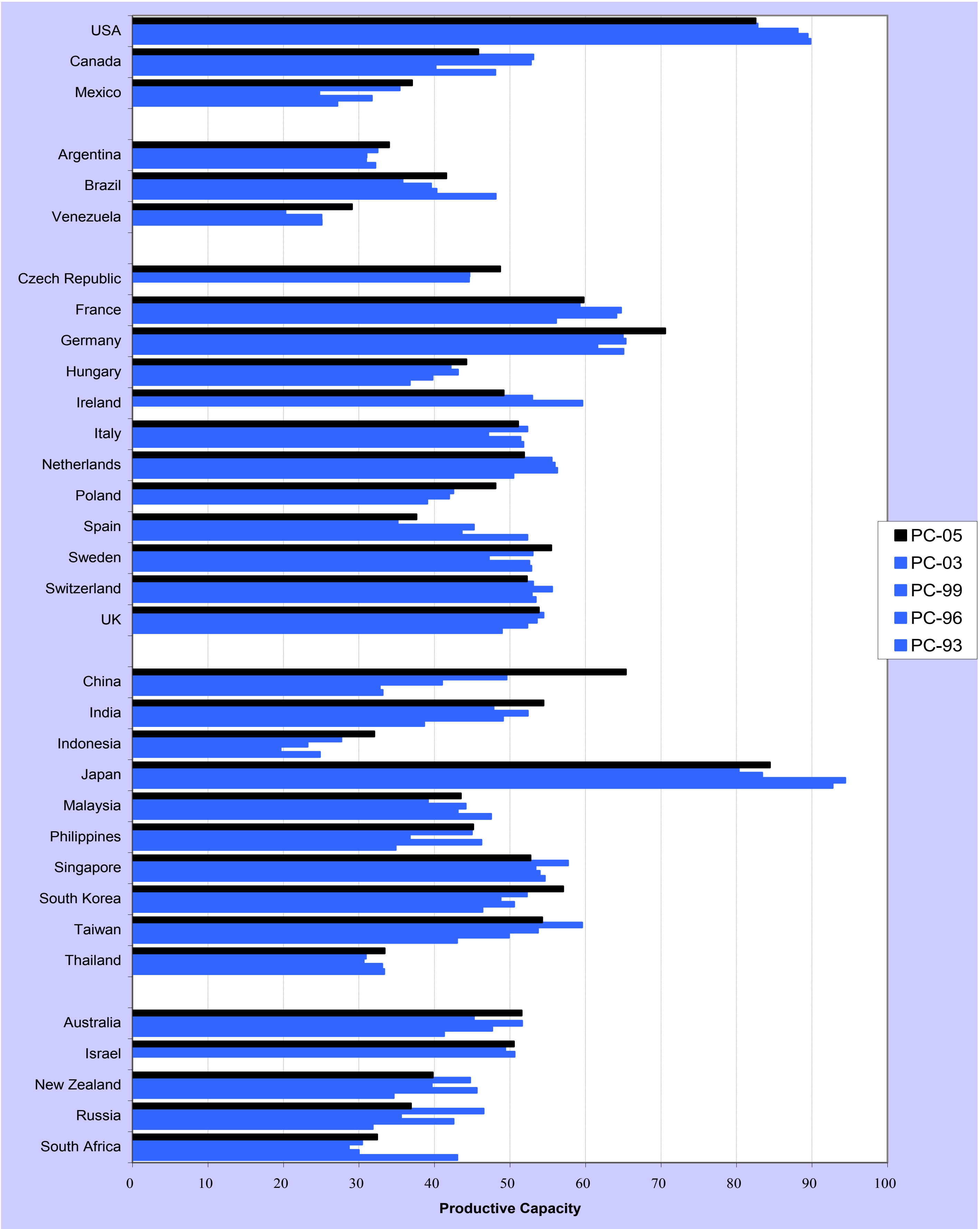
The Socio-economic Infrastructure indicator shows significant spikes without any significant trends within each country, with a few exceptions. Notable movement appears for Spain, Sweden, UK, China, India, Russia and Israel.

Figure 28: Technological Infrastructure, Traditional -- TI (T): 1993-2005



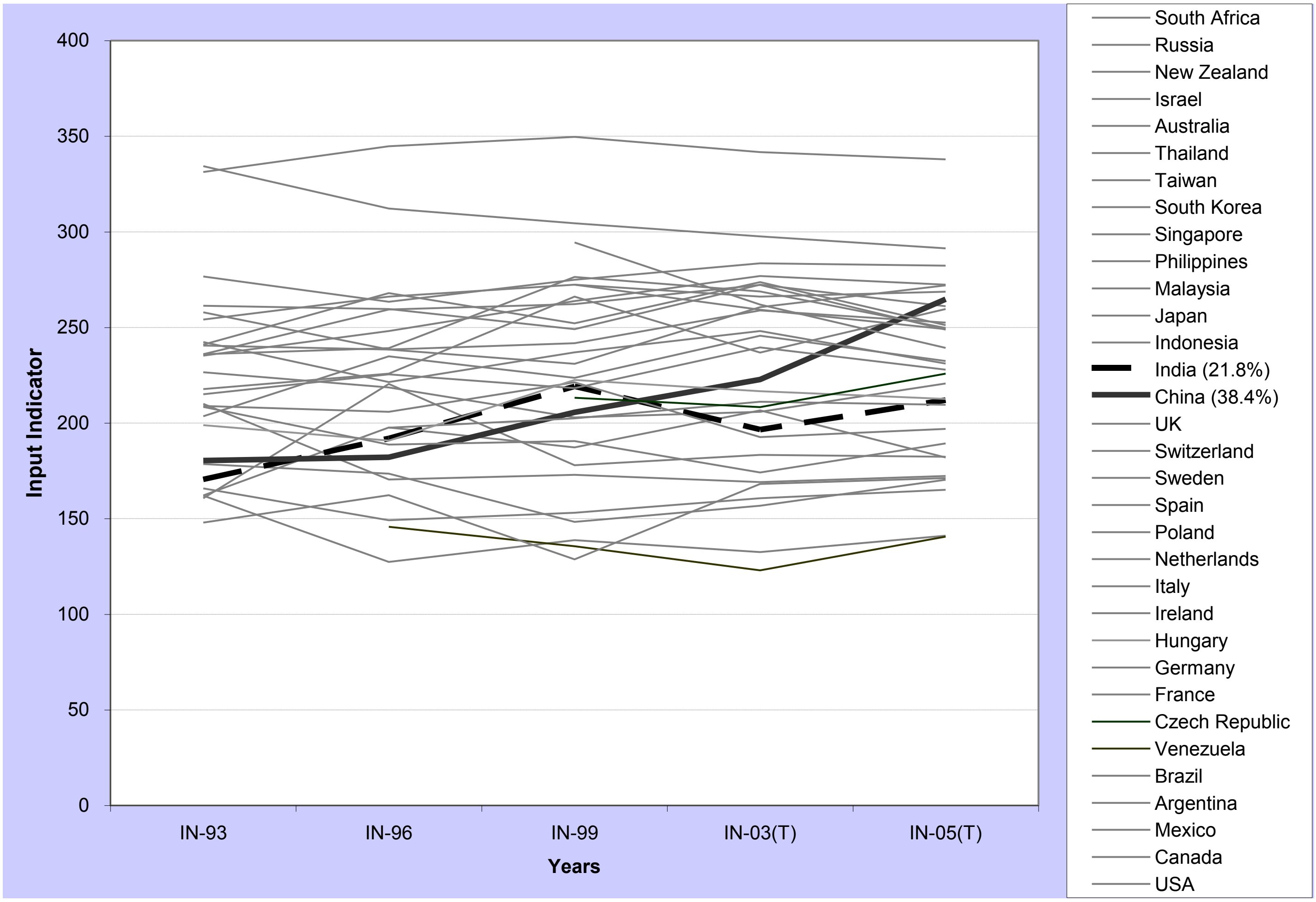
Over time, the Technological Infrastructure indicator does not show any general significant trend. This indicator shows an average standard deviation between 1993 and 2005 equal to 3.6 and the average change, per country, over time is 4%; this percent change ranges from -29% to 52%. Of the 33 countries, 18 show negative change over the period 1993 to 2005. Overall, the data reveal few prominent spikes within each country's yearly scores. TI (T) is relatively stable.

Figure 29: Productive Capacity, Traditional – PC (T): 1993-2005



The graph "Productive Capacity, Traditional 93-05" shows two countries that have remained prominent outliers, Japan and the U.S. They have consistently remained at least 2.5 standard deviations above the mean score for each year. Between the years 1993 and 2005, the average percent change is 7% with a high standard deviation of 20%. Moreover, the average standard deviation of each country's yearly scores is 4.1. China, India, South Korea, Mexico, UK, and Hungary show perceptible increasing trends over time, while Ireland and the US suggest negative trends in Productive Capacity.

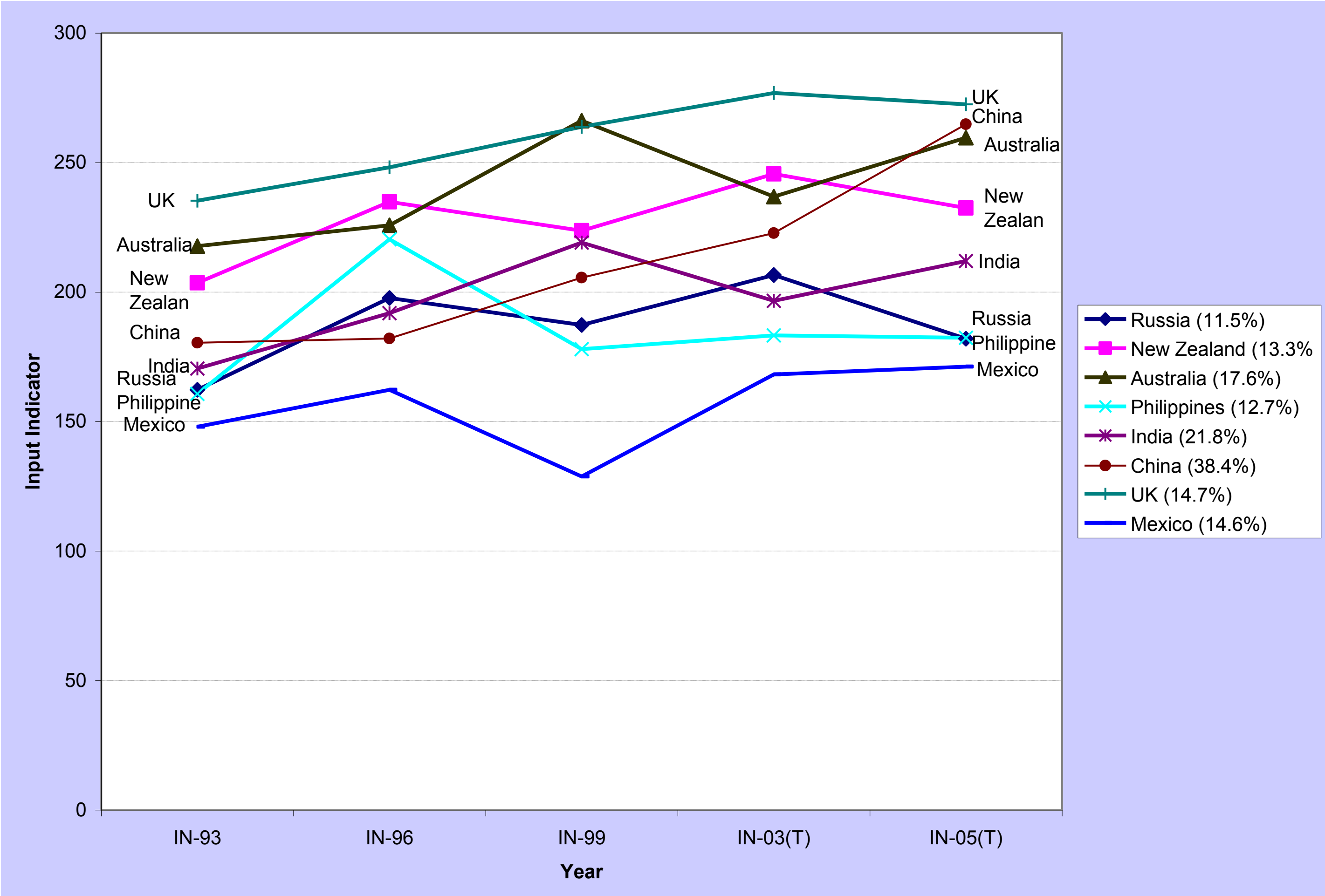
Figure 30: INPUT, Traditional -- INPUT(T) 1993-2005: Spotlighting China and India



Note: INPUT adds together our four Input (leading) indicators – NO, SE, TI, and PC -- each of which is an average of components scaled 0-100, so the potential INPUT range is 0-400.

India and China have exhibited a significant increase over time in comparison to other countries. The development of their INPUT capabilities shows huge gains from 1993 to 2005. India shows an average percent growth each year of 1.8%, while China returns an average 3.2%. In comparison to the average yearly growth of the remaining countries (0.05%), the growth of the China and India Input indicator is significant. [As with all the indicators, each employs S-scoring that pegs components to a maximum of 100 each time, so general stability is mandated.]

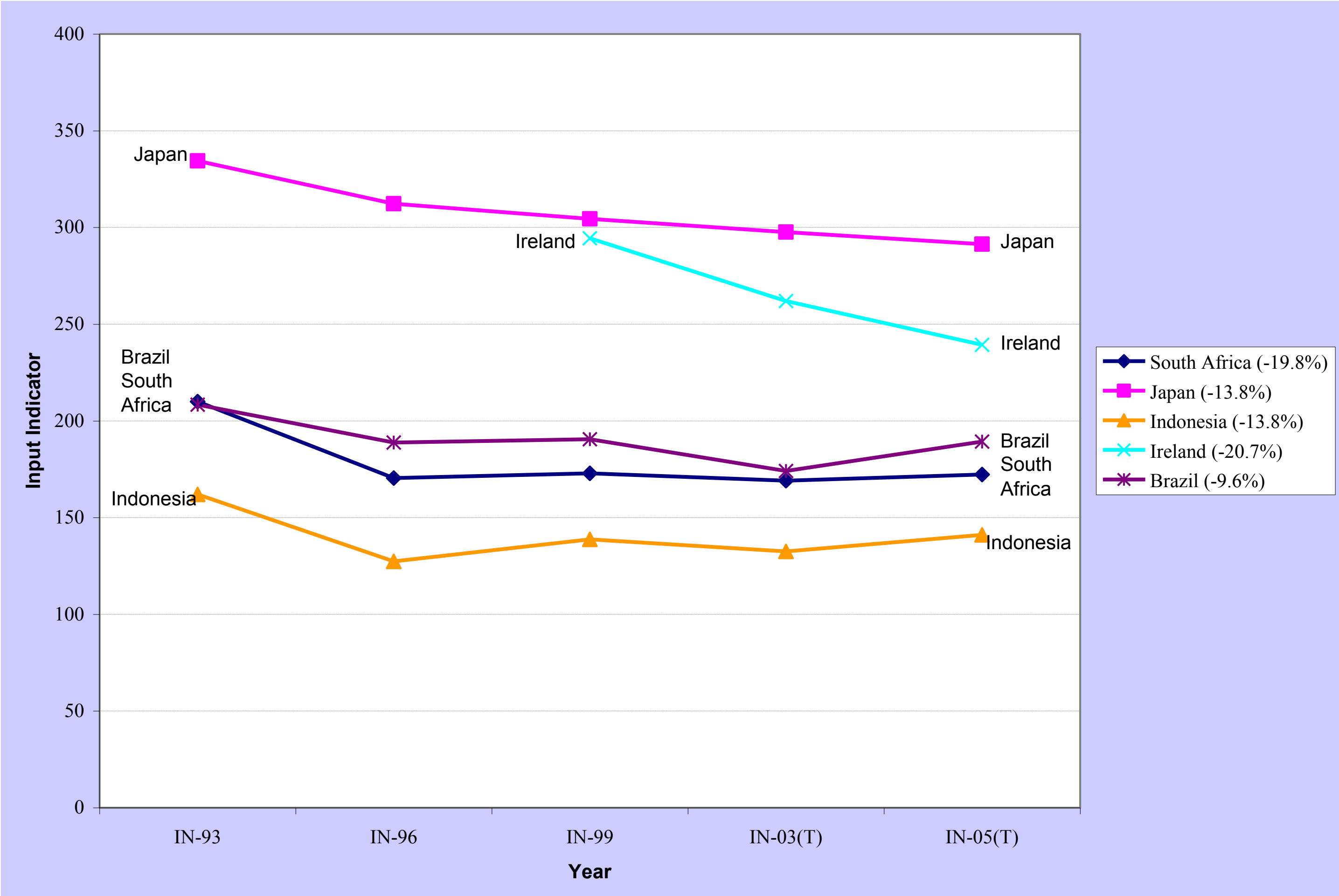
Figure 31: INPUT, Traditional – INPUT (T) 1993-2005: Greatest Percent Gains (+ 10% or more)



Note: INPUT adds together our four Input (leading) indicators – NO, SE, TI, and PC -- each of which is an average of components scaled 0-100, so the potential INPUT range is 0-400.

This graph highlights the INPUT indicator gainers based on percent change between 1993 and 2005. All of the above countries show at least a 10% gain in their Input indicator (traditional formulation). The most significant increases in Input indicator are found in China (38.4%) and India (21.8%).

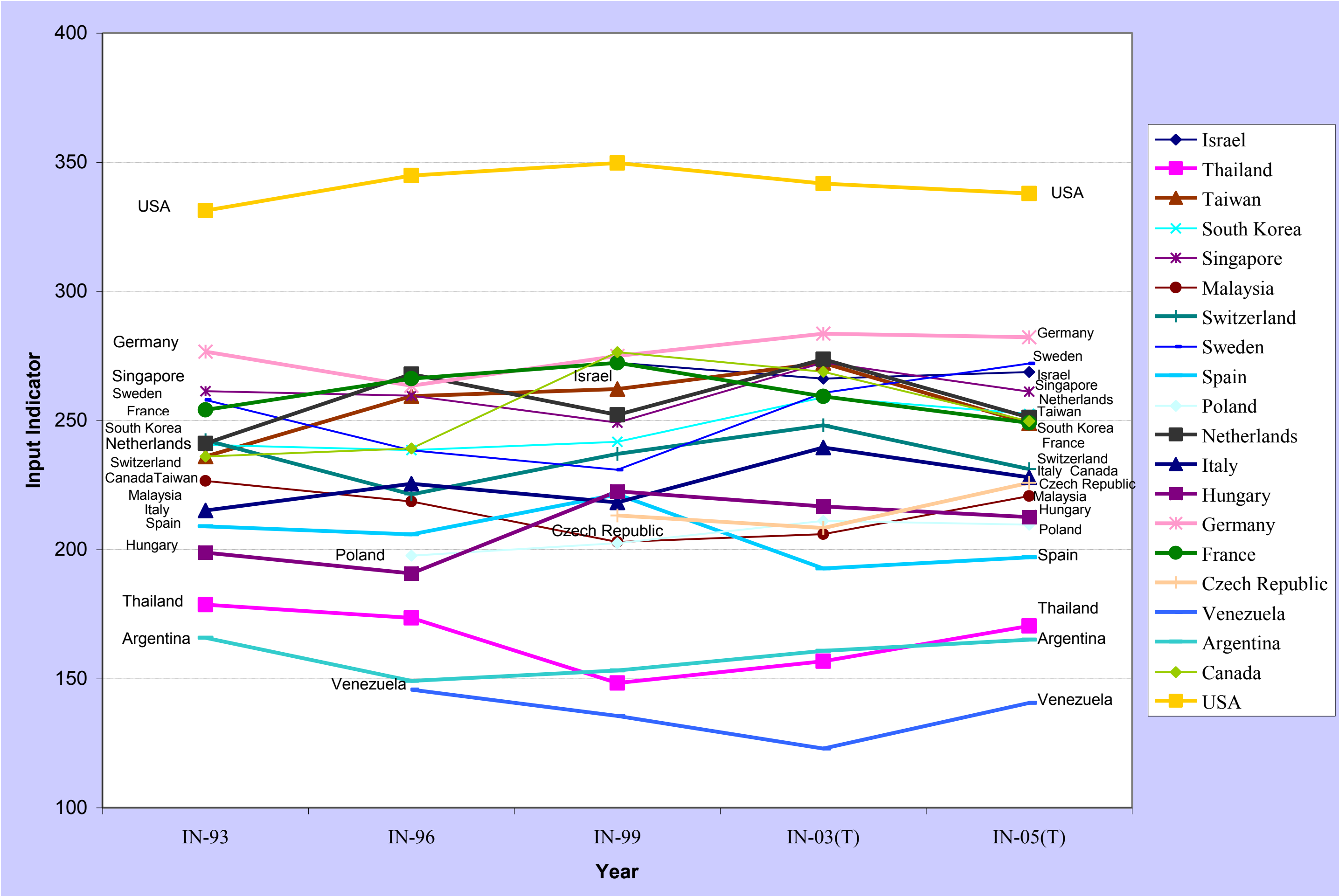
Figure 32: INPUT, Traditional -- INPUT (T) 1993-2005: Greatest Percent Declines (- 10% or more)



Note: INPUT adds together our four Input (leading) indicators – NO, SE, TI, and PC -- each of which is an average of components scaled 0-100, so the potential INPUT range is 0-400.

This graph is a selected picture of the countries that show at least a 10% decline in INPUT indicator value (Traditional formulation) over time from their first score (usually 1993) to 2005. South Africa (-19.8%) shows the most significant decline from 1993 to 2005, however in the time period of 1999 to 2005, Ireland (-20.7%) surpasses South Africa in percent decline.

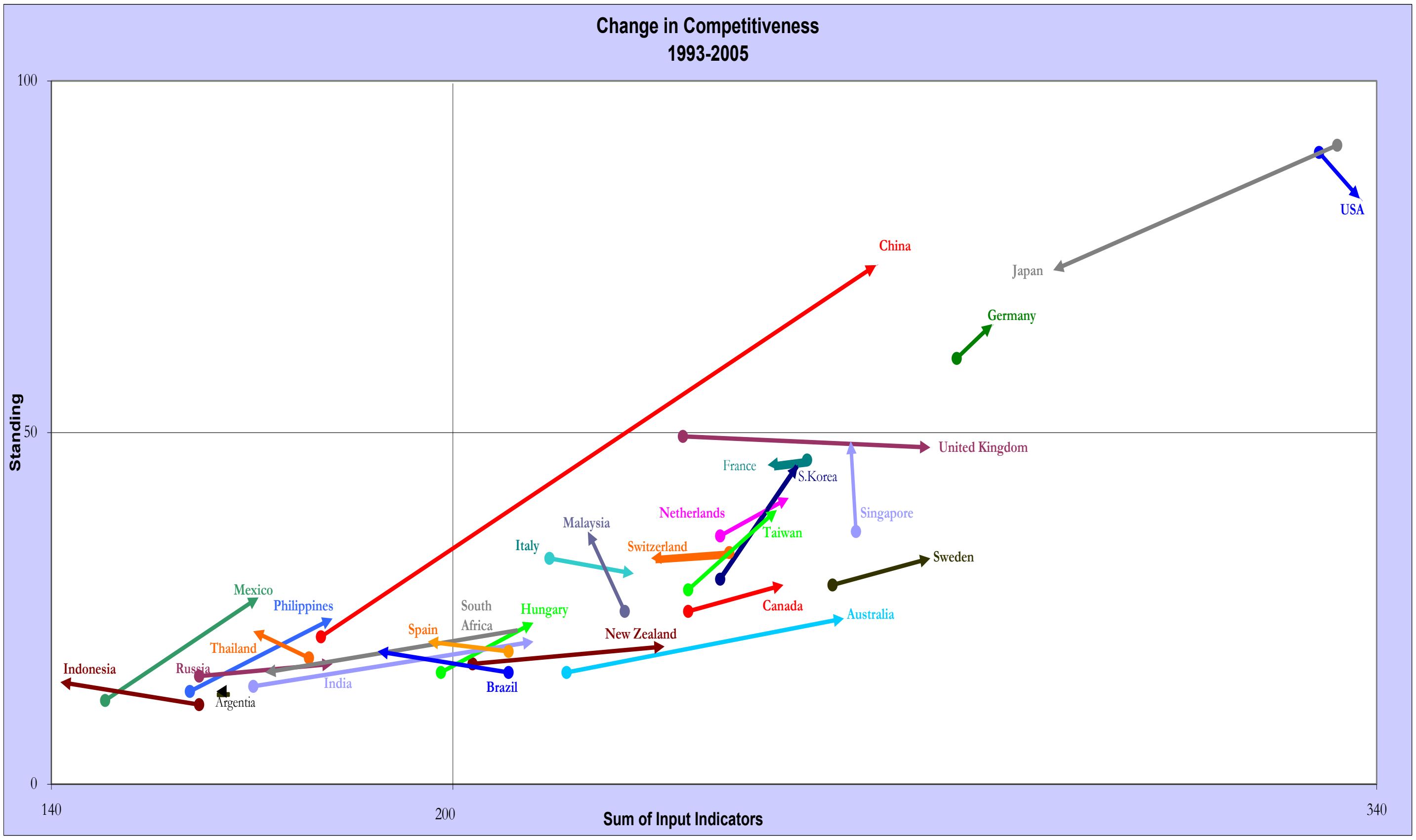
Figure 33: INPUT, Traditional -- INPUT(T) 1993-2005: Relatively Stable Nations (between +10%and -10% change)



Note: INPUT adds together our four Input (leading) indicators – NO, SE, TI, and PC -- each of which is an average of components scaled 0-100, so the potential INPUT range is 0-400.

This group of countries remained relatively consistent over time in their INPUT indicator (Traditional formulation). The 2005 INPUT indicator value for these countries has not deviated more than 10% away from their original 1993 indicator value. These countries comprise 60% of the 33 country sample.

Figure 34: Change in Competitiveness, 1993-2005: INPUT vs. Technological Standing, Traditional – INPUT vs. TS (T)



The "Change in Competitiveness 1993-2005" graph shows the change in INPUT and Technological Standing over time to indicate the technological progress of a country. The most noticeable growth is apparent in China, which dramatically increases 84.4 points in Input indicator score and also 53.3 points in Technological Standing score.

China provides an interesting case to illustrate the "leading indicators" of HTI. Our model predicts that the Input indicators – NO, SE, TI, and PC – should foretell likely future technology-oriented development on the order of 15 years in advance. Experience with HTI since the late 1980's suggests relationships are more complicated. In particular, we now believe that change in Input indicator levels may be as important as level per se. China's meteoric rise supports this view. Table 2 provides the stream of INPUT and its particular indicators through the period 1993-2005. China's INPUT-93 was not very strong (as Figure 34 shows too). However, as of 2005, its INPUT has risen very strongly, in conjunction with the rise in its output, TS (T). Of its Input indicators, TI and PC have risen much more sharply than have NO and SE. TI and PC appear to be more proximate indicators of advancing technological export capabilities.

Figure 35: Change in Competitiveness 1993-2005: Input vs. Technological Standing (B&W)