

Technology and the Commitment to Development Index

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April 2004

Rich countries arguably make their single greatest contribution to long-run development in poorer countries by creating new technologies. As both producers and consumers, people in developing countries benefit from technological advances. Thus, the advances in life expectancy that took Europe almost 150 years to achieve were reached in Latin America and East Asia in only forty years, due to medical breakthroughs like immunizations and antibiotics (UNDP 2001, pp. 28–29). East Asian countries would probably never have enjoyed near-miraculous growth in the past thirty years, reducing the number of poor people in the region by more than half between 1975 and 1995, if they had not been producers of consumer electronic devices first developed in rich countries. The Internet has facilitated distance learning and global civil society movements, as well as providing poor countries with new opportunities to participate in outsourcing.

Recognizing this link between technology and development, the second edition of the Center for Global Development/*Foreign Policy* Commitment to Development Index introduces a new technology component.

The CDI measures rich countries' efforts to establish a coherent set of policies favorable to the development of poor countries. It is intended to illustrate how much more rich countries could do to help the global poor, and, by ranking countries, inspire a race towards more development-friendly policies. There are two major issues in developing a new component for the Index. One issue is normative: in order to create a scorecard for countries' policies, it is necessary to state what we deem "good" and "bad" policies. The other issue is practical: we need to quantify and differentiate the policies of Index countries, and choose measures of policy for which data is available.

Of course, the role that technological progress plays in development is complex. Some new technologies—like weapons—almost certainly do more harm than good. Others may simply be a wash; a study based on U.S. FDA data suggests that only 24 percent of newly approved drugs represent significant advances over existing drugs (Baker and Chatani 2002, p. 9). Other new technologies may be inapplicable in developing countries, whose climates and needs are often different than those of rich countries. The dearth of research on malaria, tuberculosis, and other diseases endemic in poor countries highlights this concern. Finally, technological progress can also bring new challenges to the developing world: consider the motor vehicle.

While keeping these important caveats in mind, we take the stance that on balance, research and development is a global public good in the long-term, and that government investment in the development of new technologies can enhance life throughout the world.

In this background note we discuss the methodology and justification for the new technology component. We examine two kinds of rich-country policies related to technology: development of new technologies through government support for R&D, and limits on technology diffusion through intellectual property rights protection. We argue for incorporating the first kind of policy in the Index, but not the second.

Support for Research and Development

Government funding has played an important role in many major technological advances, the Internet being a prime example. There are three main kinds of government financial support for R&D: publicly performed research (done at public universities or government agencies), direct subsidies for private research, and tax incentives. To measure government support for technological development, the technology component counts all three, as a share of GDP. While it is possible that public money for R&D does not actually increase total spending on R&D but merely displaces private funding, research suggests that this is not the case (for example, see Guellec and van Pottelsberghe 2003).

The technology component differentiates defense research from other kinds of research, discounting government funding for defense R&D by 50%.¹ Clearly, fueling arms races is not analogous to supporting development through other forms of technological innovation. However, some amount of defense research is valuable for promoting international security, and defense R&D is not solely limited to weapons. For example, the development of the Internet was largely funded by the U.S. Defense Advanced Research Projects Agency (DARPA) (as well as the U.S. National Science Foundation). Tax subsidies for defense R&D are not discounted.

The Index does not specifically reward countries for supporting research that targets the immediate needs of the poorest people, such as a malaria vaccine. This is primarily due to data constraints: detailed breakdowns of R&D expenditure are simply not available for the 21 Index countries. Furthermore, on balance, research and development in many different areas can enhance life throughout the developing world in the long run. Advances in treating heart disease, for example, become increasingly valuable in China as its economy grows and waistlines widen. More broadly, the stock of knowledge is in large part a global public good, especially in the long run after patents expire, and it can often be difficult to assess a priori which innovations will be adaptable and most advantageous to the poor in the long term. Cell phones, for example, though developed for rich-country consumers, have revolutionized communications in poor countries like Nigeria.

There are other ways that governments can encourage R&D, which are not measured in the technology component. For example, the component does not look at the design of national patent laws, because Index countries generally have similar patent systems. The WTO's Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) mandates minimum standards of patent protection in all member countries. More broadly, there has been an increasing standardization of patent regulations in recent decades, with patent regulations typically providing 20-year protection terms, and requiring prior art searches and examinations for novelty, inventive steps or non-obviousness, and industrial applications. Patent law has also seen a widening of protectable subject matter, including the extension of copyright and patent protection to computer programs and DNA sequences (UNCTAD, 2001).

Price controls can also affect incentives for innovation, an issue that arises in practice with pharmaceuticals. Drug price control regimes differ significantly in Index countries. Countries with strong drug price controls, like France and Austria, weaken incentives for pharmaceutical

¹ The existing data on defense R&D is considered less accurate and not wholly analogous with other R&D data. However, given the importance of the issue, and the scale of defense spending in some countries, we chose to include it anyway.

companies to invest in drug research. Countries without price controls, like the U.S., generate a global public good by increasing incentives for R&D.² However, the conceptual and measurement issues here are complex and were beyond our reach at least in the first edition of this component.

Using OECD (2002, 2003) data, the Index uses the following algorithm to generate a technology score: To generate a figure for direct government funding, we begin with the value of government funding of R&D, using figures on the amount of R&D financed by the government as a percentage of GDP.³ Then we discount that value by 50% of total government funding for defense research to get our final figure for direct government support.

Next, we generate a figure for the value of government support for tax subsidies. To estimate these subsidies, we use figures on the value of R&D tax subsidies for manufacturing companies, per dollar of their R&D spending. The OECD's measure of subsidies is a variant of the "B-index," a commonly used index for comparing tax codes, which is defined as the present value of before-tax income necessary to cover the initial cost of R&D investment and to pay corporate income tax, so that it becomes profitable to perform research activities. The OECD subsidy figure is equivalent to one minus the B-Index, so that countries with tax subsidies receive a positive score, countries with a full write-off of current R&D expenditure and no special tax incentives receive a score of zero, and countries with less than a full write-off of current R&D expenditure receive a negative score. Using these subsidy figures, we begin by calculating the average subsidy rate for small and large companies. We then multiply this value by each country's Business Enterprise Expenditure in R&D (BERD) as a percentage of GDP. Finally, we add the government financing and tax subsidy figures, to create a final value for government support of R&D. Scores are then rescaled so that they average 5 across the 21 countries.

Intellectual Property Rights

In recent years, IPR protection has been one of the most visible issues related to technology policy. The role that patent protection plays in barring affordable access to pharmaceuticals, particularly HIV/AIDS drugs, has received significant attention and has been a polarizing issue in international trade negotiations. For example, Oxfam argues that WTO rules on IPR protection in developing countries "condemn millions of poor people to unnecessary sickness and suffering" (Oxfam 2003). In contrast, the International Federation of Pharmaceutical Manufacturers Associations (IFPMA) argues that "claims that patents are a barrier to access to medicines are unfounded and inaccurate" (IFPMA 2004). A compromise was reached last year in the WTO to allow poor countries facing public health crises to import generic versions of patented drugs. However, access barriers to pharmaceuticals remain a concern, as do the broader effects of IPR protection on poor countries.

IPR protection in poor countries is primarily governed by the WTO's Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), which took force in most developing countries in 2000.⁴ TRIPS created a set of minimum standards for IPR protection for all WTO

² Jean Lanjouw made this point to us in her comments on the technology component.

³ We chose this denominator to reward small economies that support R&D. Another alternative would be to include government-financed R&D as a percentage of total R&D in the economy. We rejected this option because it penalizes countries that encourage business R&D in ways that we fail to capture in the Index.

⁴ In some cases developing countries have until 2005 to revise their patent laws. Least Developed Countries have until 2006, and until 2016 for pharmaceutical patents.

members. One implication of TRIPS is that firms from rich countries are permitted to patent their technologies in poor countries, thereby restricting generic imitations. Thus, TRIPS is a major international policy with a direct impact on poor countries.

Yet studies on IPR's effects in poor countries show no simple relationship between strong IPR protection and development. Evidence suggests that the effects of strong protection depend on the details of a country's economy—for example, its wealth and level of development, whether it has a technological sector (and if so, in which industries), and whether multinational corporations play a large role in its economy. IPR protection may attract foreign direct investment and encourage innovation in countries with technological sectors.⁵ However, negative results include raising the prices of goods within poor countries and limiting opportunities for imitation, thereby reducing economic activity and eliminating a valuable source of learning and capacity-building (Lall and Albaladejo 2002). The world's poorest countries are least likely to benefit from strong intellectual property rights protection.

TRIPS most likely went too far in mandating uniform minimum standards for IPR protection, and failed to pay attention to the interests of the world's poorest countries. However, we chose not to include measures of IPR protection in the Index. Two obstacles loomed.

First, it is difficult, given the heterogeneity of developing countries, to assert what an ideal IPR regime would look like, and even more difficult to quantify the harm that TRIPS causes relative to that regime. We lack both data and a strong theoretical basis for measuring the overall impact of TRIPS on developing countries. Because of these limitations, it would be hard to be confident that whatever measure we devised even had the right sign, let alone magnitude.

Differentiation among rich countries poses a second challenge. One purpose of the Index is to allow for comparisons of various nations' policies. TRIPS, however, is a multilateral agreement that includes all twenty-one Index countries. We could have looked at the negotiating positions of Index countries regarding intellectual property, but this is hard to measure and often not transparent. Moreover, one country may take a particularly aggressive negotiating stance, allowing other rich countries to tacitly ride on its coat tails without publicly endorsing the position.

Another option would have been to factor in bilateral and regional agreements with intellectual property components. Bilateral and regional agreements may also include intellectual property components, requiring IPR protection that exceeds the requirements of TRIPS. Such agreements frequently pair rich and poor countries, creating unequal bargaining positions where rich countries are able to push for additional IPR protection. However, once again we faced the problem of judging what the effects of strong IPR protection would be for the countries affected. For example, it is unclear whether "TRIPS-plus" measures in the proposed Free Trade Area of the Americas (FTAA) would be a net positive or net negative for the Latin American countries involved, because many are middle income, rely on foreign direct investment, and have local technology sectors. Finally, we could have looked at the behavior of countries under the TRIPS regime, examining which countries bring grievances against poor countries to the WTO, and

⁵ For example, W Lesser (2002) finds a positive and significant relationship between levels of IPR protection and FDI. Lanjouw (1997) suggests that Indian pharmaceutical firms may become more innovative with the advent of patent protections.

which countries refuse compulsory licenses. However, this approach ignores significant, but less transparent, mechanisms of persuasion, and again raises the question of TRIPS's differential impact on poor countries. It is also biased against countries that generate innovations that are of use in developing countries. Furthermore, the world's poorest countries are not required to implement TRIPS until 2006, and 2016 for pharmaceuticals (although there are certain intermediate provisions they are required to follow), so there will be little data on grievances against these countries for several years.

We also considered assessing non-IPR policies that influence technology diffusion. Article 66.2 of TRIPS commits rich countries to "provide incentives to enterprises and institutions in their territories for the purpose of promoting...technology transfer" to LDC members. Such incentives could include technical assistance or the provision of training or scholarships, and are another area for potential inclusion in the Index. However, much of this support is already included in the Index's aid measure. Furthermore, insofar as technology diffusion occurs through "tied aid," its development benefits may be muted.⁶ Therefore, we did not include such measures in the Index.

Conclusion

Even in a world where technological diffusion is restrained in the medium term by IPR protection, technological innovation in rich countries matters for poor countries. The Technology Component represents an attempt to quantify and compare technology policies in rich countries. However, there is much that we could not capture in this component. We lack data on countries' efforts to promote research about areas of particular importance to developing countries. More research is also needed to determine how IPR affects poor countries at different stages of development. Such research would not only enrich the Index, but also inform the debates over technology policy's role in helping or hindering development.

⁶ Aid is considered "tied" when recipient nations are required to spend their aid on goods or services from donor countries. Studies suggest tying aid can increase project costs by 15–30% (Jepma 1991). The aid component of the Index discounts tied aid for this reason.

Technology Score

Total Government Support = (Average small/large company R&D tax subsidies in manufacturing (per USD of R&D) * Business Enterprise Expenditure on R&D as a percentage of R&D) + (Gross Expenditure on R&D financed by the government as percent of GDP – 50% of government expenditure on defense as a percent of GDP)

Index Country	R&D tax subsidies for manufacturing companies, per USD of R&D (average small/large company subsidy)	Business Enterprise Expenditure on R&D (BERD) as % of GDP	Tax Subsidies x BERD (% GDP)	National R&D by gov't (% GDP)	% of Gov't R&D going to Defense	Total National R&D financed by government, discounted by 50% of defense spending (% GDP)	Total government support (% GDP)	Score
Australia	0.199	0.78	0.16	0.71	7.3	0.68	0.84	6.4
Austria	0.117	1.13	0.13	0.78	0.0	0.78	0.91	6.9
Belgium	-0.008	1.60	-0.01	0.46	0.4	0.46	0.45	3.4
Canada	0.248	1.10	0.27	0.61	4.8	0.60	0.87	6.6
Denmark	-0.009	1.33	-0.01	0.67	1.2	0.67	0.65	5.0
Finland	-0.010	2.43	-0.02	0.87	2.9	0.86	0.83	6.3
France	0.061	1.41	0.09	0.82	24.3	0.72	0.81	6.1
Germany	-0.025	1.75	-0.04	0.80	6.7	0.77	0.73	5.6
Greece	-0.015	0.20	0.00	0.33	0.9	0.33	0.33	2.5
Ireland	0.000	0.80	0.00	0.26	0.0	0.26	0.26	2.0
Italy	0.209	0.56	0.12	0.51	4.0	0.50	0.62	4.7
Japan	0.065	2.26	0.15	0.57	4.1	0.56	0.71	5.4
Netherlands	0.050	1.10	0.05	0.68	1.9	0.67	0.73	5.5
N. Zealand	-0.023	0.43	-0.01	0.55	0.7	0.55	0.54	4.1
Norway	0.107	0.96	0.10	0.64	6.9	0.62	0.72	5.5
Portugal	0.335	0.27	0.09	0.51	2.0	0.50	0.60	4.5
Spain	0.441	0.50	0.22	0.38	37.3	0.31	0.53	4.0
Sweden	-0.015	3.31	-0.05	0.90	22.2	0.80	0.75	5.7
Switzerland	-0.010	1.95	-0.02	0.61	0.7	0.61	0.59	4.5
UK	0.101	1.28	0.13	0.57	30.5	0.48	0.61	4.7
USA	0.066	2.00	0.13	0.82	55.1	0.59	0.73	5.5

Source: Tax subsidy figures from OECD (2002, p. 310). All other inputs from OECD (2003).

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