Relationship Between Technology and Social Development: a Worldwide Assessment with Conclusions for Eastern Europe

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Abstract

Internet penetration into economies around the world has been shown to be spotty at best. Yet, electronic commerce has been identified as the engine behind the growth of wealth and social development. It is forecasted to remain a driving force behind economic growth in the foreseeable future. National leaders of the Big 8 conference in Okinawa, Japan in June 2000 were vowing to eliminate, or at least reduce the "digital divide" plaguing some nations limiting their economic development. This paper examines the effects of high technology on economic activity in nations around the world. It examines commonalities among nations, which remain economically and technologically backward and attempts to highlight the prerequisites to reaping the benefits of technology, specifically of information technology and electronic commerce. The authors discuss whether technologically backward regions should investment in high technology to leapfrog into the future and to sudden wealth.

Keywords: Information infrastructure, technology, social development, Eastern Europe.

Background

Electronic commerce has been identified as the engine behind the growth of wealth and social development in the US in more recent times. It is forecasted to remain a driving force behind economic growth in the foreseeable future. National leaders of the Big 8 conference in Okinawa, Japan in June 2000 were vowing to eliminate, or at least reduce the "digital divide" plaguing some nations limiting their economic development. What effects of high technology can be observed in other nations? What are some of the commonalities among those nations, which remain economically and technologically backward? What are the prerequisites to reaping the benefits of technology, specifically of information technology and electronic commerce? Can the benefits of high technology be expected to trickle to less fortunate nations? Should technologically backward regions use investments in high technology to leapfrog into the future and to sudden wealth?

In a speech to the European American Business Council, Assistant Secretary of NTIA Gregory L. Rhode stated that,

> "Statistics show that Internet penetration is happening unevenly around the world, unevenly even throughout Europe. According to statistics from May, there are about 108 million Internet users in Europe, for a penetration rate of 34%. That figure varies from 65.2% in Sweden to 45.6% in the U.K., 31.6% in France and 11.4% in Portugal. Worldwide, we see even greater disparities. According to the Computer Industry Almanac report from last November, there were 57.5 Internet users per 1,000 people on a worldwide average. That ranged from a high of 492 Internet users per 1,000 people in North America, to 7.88 users per 1,000 people in the Middle East and Africa." (Rhode, 2000)

UNESCO (United Nations Education Science and Cultural Organization) was founded on the basic premise that information is not only a necessity to all human beings but a human right. Furthermore, the ITU (International Telecommunication Union) stresses that communication and communication infrastructures are preconditions for economic and social development (Ferguson, 2000). In other

words UNESCO implies and the ITU states direct causality between economic and social development and information infrastructures, and by implication, technology as well. Peter Meso (1999) examined the relationship between social development and geographic region as well as the importance of components of the NII (National Information Infrastructure) and social development among LDC's (Least Developed Countries) and found that geographic region is not a significant indicator of social development and only telephone density is a significant predictor of social development among NII components. However, he did find that NII variables explain only about 50% of LDC social development.

Internet related activities including education, commerce, and news dissemination are intimately dependent on communications technology, which in turn is the merging of telecommunication, mass media, and information technology (Ferguson, 2000). Do nations of the world possess at least roughly similar levels of these technologies to take advantage of the Internet? If not, then why not? Are the reasons economic, cultural, political, or other? Since some nations are much poorer than others, it is reasonable to argue that foreign developers are wont to invest in unprofitable regions and the indigenous populations cannot finance the high cost of technology development from their own budgets giving priority to other, more pressing needs. In fact the World Bank is supporting a pipeline development, a low-tech project, between Chad and Cameroon rather than Internet development, and is working to combat poverty rather than finance high technology projects in LDC's (The Wall Street Journal Europe, 2000).

Data used

To assess the level of technology in countries the following published data were used: Numbers of personal computers, High-technology exports, High technology investment, Internet hosts per million population, Number of users of Internet per million population, Low technology investment %, Medium technology investment %, Primary education participation rate, GDP per capita, (Purchasing Power Parity (PPP) in constant 1987 international dollars), Literacy rate, adult total, Newspapers per 1000 population, Radios per 1,000 population, Television sets per 1,000 population, Telephone mainlines per 1,000 population, Infant mortality rate, Health care % of population with access, Safe water % of population with access, and Life expectancy at birth. Not all data are available and conclusions drawn must take into account consequent inaccuracies.
Data items in the above set are measured on different scales. To avoid erroneous results all variables were standardized into z-scores, using their means and standard deviations resulting in essentially the same distributions without certain variables overpowering others.

Data sources were the World Bank, World Development Indicators 2000, UNESCO 1999, United Nations, Women's Indicators and Statistics Database 1999, The International Telecommunications Union (ITU) 1996/97, Telcordia Technologies Website 2000, Industrial Development: Global Report (UNIDO) 1997, CIA World Factbook 1999, and the International Labor Organization databases 1999.

Hypotheses and Methodology

It is argued that countries in similar circumstances display similar social, economic, and technical characteristics. Where these characteristics are numerically measurable, they can be used to identify and group countries which have similar development histories and predict from their collective situations their short-term economic development and technological futures.

The statistical methodology used was cluster analysis by SPSS (Statistical Package for the Social Sciences). Cluster analysis identifies relatively homogeneous groups of countries based on the selected variables. Using F statistics the procedure finds groups, which are indeed different. In order to match the World Bank's grouping of countries by income classes, four clusters were defined. Three analyses were performed.

H1: in an attempt to examine if social indicators as defined by the World Bank do indeed cluster countries into similar groups on social measures the first cluster used literacy, primary education, infant survival, access to health care and safe water, life expectancy, and per capita GDP. To test if our four socio-economic clusters differ from the World Bank model, income classes were further subdivided into the four resulting clusters.

H2: to test Peter Meso's (1999) theory that poor countries are located mostly in Africa, the clusters were further subdivided by continent.

H3: if Internet technologies are dependent on more basic communication technologies, such as telecommunication, mass media, and information technology as stated by Ferguson, (2000) then it must also be true that nations without adequate base technologies are less likely to develop high-technology Internet based economies. Communications technologies should also help cluster these countries into the familiar four groups achieved above. To examine this hypothesis the second cluster was for information infra-

structure measured by telephone mainlines, television sets, radios, and newspapers.

H4: after a country establishes a basic communications industry, it then has the base on which to build an Internet and e-commerce economy. Because the industrial application of technology is considered to be an important ingredient in raising productivity, it is expected that per capita GDP also plays an important role in determining cluster membership. The third cluster was for available technology measures such as high-technology exports, high-technology investments, low technology investments, medium technology investments, personal computers, Internet users, Internet hosts, and GDP per capita. It is expected that the resulting clusters will again display similar continent and income class memberships as for the previous clusters and further highlight the need for the presence of low and medium technology industries before high technology can take root.

Results

Clusters of the social indicator variables described above resulted in variable descriptors for the undeveloped nations (Table 1, Cluster 1) as follows. Some countries located in cluster 1, Under Developed Nations, are Afghanistan, Chad, Ethiopia, Sudan, etc.

Nations located in the group labeled Developing Nations (Cluster 2) display descriptive characteristics as in Table 2. Some of the countries located among cluster 2 nations are Bangladesh, Gabon, Malawi, Nepal, Swaziland, Zimbabwe, etc.

Nations located in the group labeled Rapidly Developing Nations (Cluster 3) display the following descriptive characteristics in Table 3. Among these nations are the ex-Soviet nations and newly independent republics of the USSR. These are Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Kazakhstan, Kyrgyz Republic, Latvia, Lithuania, Macedonia FYR, Moldova, Poland, Romania, Russian Federation, Slovak Republic, Slovenia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan, and Yugoslavian FR, as well as Ecuador, Jamaica, Jordan, Mexico, Portugal, Venezuela, etc.

Developed Nations clustered into group 4. Their descriptive statistics can be found in Table 4. Nations clustering into this group include most western and northern European nations, USA, Singapore, Australia, Bahrain, Brunei, etc.

In order to examine if our clustering is different from the World Bank (WB) income groups our clusters were plotted against the four income classifications of the WB in Figure 1. Figure 1 indicates that there is a strong correspondence between the World Bank income categorization and the clustering here on social development. The low-income category by the World Bank consists of about equal numbers of under developed and developing nations clusters from the clustering achieved here. We can be confident that our clustering effort achieves reliable consistency.

On this basis 85.3% of low income countries are underdeveloped and developing according to our social development index; 94% of lower middle-income countries are developing or rapidly developing countries; 75% of upper middle-income countries are rapidly developing; and 94.9% of high-income nations are developed.

Figure 2 indicates that while Asian nations are represented at all levels of development, African nations are heavily weighted toward under developed and developing countries. Of the Underdeveloped Nations 10% of them are located in Asia and the remaining 90% are in Africa. None of the Developing Nations are in Europe or North America. Of the Rapidly Developing nations 23.3% are in Europe; an overwhelming majority of them are ex-USSR states or recently liberated satellite states. The rest of Europe belongs to the group of developed nations, South America is primarily rapidly developing, and North America consists of developed nations only. Level of social development then appears to be linked to continent

Clusters of the information infrastructure (II) variables resulted in variable descriptors for the Poor Information Infrastructure Nations (cluster 1) as shown in Table 5. Some countries located in cluster 1 are Afghanistan, Chad, Ethiopia, Sudan, Zimbabwe, etc. as before. In addition many of the ex-USSR states such as Azerbaijan, Armenia, Tajikistan, Turkmenistan, Uzbekistan, can be found here as well as Bosnia and Herzegovina, Macedonia FYR, and Yugoslavia FR.

Cluster 4, Developing Information Infrastructure Nations, can be described by the statistics in Table 6. The remainder of the ex-USSR states are located in this group as well e.g. Belarus, Bulgaria, Czech Republic, Georgia, Hungary, Kazakhstan, Latvia, Lithuania, Moldova, Poland, Romania, Russian Federation, Slovak Republic, Slovenia, and Ukraine. Some of the other countries here are Argentina, Belize, Italy, Malawi, Qatar, etc.

Cluster 3, Rapidly Developing Information Infrastructure Nations descriptive characteristics can be found in the Ta-

ble 7. Among the third cluster group are some European nations e.g. Austria, Belgium, Germany, Liechtenstein, Netherlands, Norway, Switzerland, and Sweden. Also, Singapore and the single ex-communist state of Croatia are located among the Rapidly developing Information Infrastructure Nations.

Among the Well Developed Information Infrastructure Nations represented by Cluster 2, in Table 8, we find Australia, Canada, Finland, France, Spain, UK, USA, etc.

Clustering within the Social Development Indicators and the Information Infrastructure variables appear to be parallel: underdeveloped nations will display poor information infrastructures while developed nations enjoy well-developed information infrastructures. Similarly, developing and rapidly developing countries cluster into developing and rapidly developing information infrastructure nations.

Graphical review of the data reveals that low to lower middle income countries have poor information infrastructures while upper middle to high income countries enjoy rapidly developing to well developed information infrastructures (see Figure 3).

Furthermore, most of the African and Asian continents suffer with poor information infrastructures while the best-developed information infrastructures are found in Europe and North America (see Figure 4). It should be noted that 48.8% of Developing II nations and 9.8% of Poor II nations in Europe are made up of the ex-USSR and her satellite states.

Clusters of technology variables resulted in variable descriptors for the technology poor nations (cluster 2) as shown in Table 9. Some countries located in cluster 1 are Afghanistan, Argentina, Chad, Ethiopia, Sudan, Swaziland, Zimbabwe, etc. as before. In addition many of the ex-USSR states of Azerbaijan, Armenia, Georgia, Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan, Ukraine, Uzbekistan, can be found here as well as many of the ex-Soviet sphere states of Bosnia and Herzegovina, Hungary, Latvia, Lithuania, Macedonia FYR, Moldova, Poland, Romania, Russian Federation, and Yugoslavia FR.

Technology variable descriptors for nations with beginning technology development are displayed in Table 10. Some representative nations from this group are Bhutan, Gabon, Mexico, Qatar, Saudi Arabia, Singapore, and South Africa, as well as the ex-Soviet sphere country of Bulgaria, and the west European country of Ireland.

Variable descriptors for rapidly evolving technology nations are displayed in Table 11. Among these nations are clustered the European nations of Austria, Belgium, France, Germany, Italy, Liechtenstein, Luxembourg, Spain, and the UK, as well as the ex-Soviet sphere states of the Czech and Slovak Republics, and Slovenia.

Descriptor variables for the technology leader countries are in Table 12. Among these are Australia, Canada, Iceland, the Netherlands, New Zealand, the Nordic nations, Switzerland, and the USA.

From Figures 5 and 6 it should be clear from earlier analysis, that technology poor nations are those classified as low income and lower middle income. They are concentrated in Asia and Africa. In fact 61.3% of technology poor nations are on those continents as are 50.3% of beginning technology nations. Put in another way 45% of technologically deprived nations are on the Asian and African continents. In contrast, 47.6% of European nations are also technologically deprived and most of these are ex-Soviet sphere nations. This illustrates the lack of available technology infrastructure maintained by Soviet policy makers, which is now making its impact felt on those nations.

In order to test similarity of cluster membership using clusters of social indicators, information infrastructure, and technology a non-parametric test was performed. Using Kendall's W test for measure of agreement yielded a value of 0.605 for overall agreement, which is an acceptable value indicating similarity of membership among the three clusters. That is, largely the same countries belong to the group classified as underdeveloped social indicators, with poor information infrastructure, and technologically poor; and similarly, largely the same countries belong to the group classified as well developed social indicators, with well developed information infrastructure, and technology leader, etc.

Interpretation

Figure 2 depicts the relationship between social development and continent. It should be clear that underdevelopment is primarily limited to Asia and Africa whereas advanced social development is found primarily in Europe and North America. These observations support Peter Meso's (1999) conclusions regarding poverty, information infrastructures, and continents and our Hypothesis 1 and 2 (H1 and H2).

Communist governments left their peoples with dismal communications infrastructures as this was demonstrated in Figures 3 and 4 above. This stands to reason since commu-

nication within and outside these countries was not to the regime's benefit. Equally alarming is the fact that 17.5% of the nations in this study with their well developed to rapidly developing information infrastructures are leaving the remainder of the world behind on their way to harnessing productivity and income gains to benefit their societies. The rest are busy developing basic industries such as communications technologies to base high technology industries on in the future. Countries without the necessary information infrastructures are likely those with few social amenities as well who need to develop basic necessities first. Kendall's W test further confirms this observation. This conclusion supports hypothesis three (H3).

Comparing the list of countries classified among underdeveloped and developing nations on social development to those classified as technologically poor and beginning technology nations it becomes apparent that these are mostly the same countries. Furthermore countries with poor to developing information infrastructures are also the ones who suffer with backward technologies. Hypothesis 4 is further confirmed by Kendall's W test above. Leapfrogging from backwardness to high technology and e-commerce is not likely to occur without first investing in basic human needs, and then in low- and medium- technology sectors. These observations support our fourth hypothesis (H4).

At the conclusion of the eight nation monetary conference in Okinawa, Japan, in July 2000, leaders of those nations vowed to bring the rest of the world up to the level of the technology leaders in order to reap the benefits of high-technology. That day is long in coming and is not likely to be speeded up without significant aid from advanced and wealthier nations. Investments in high technology projects are expensive and even wasteful without also investing in basic human needs and basic technologies first. When poor nations invest 90% of their GDP in low- and medium-technology projects just to catch up on basic social needs, it is difficult to imagine them spending 20 to 40% of their GDP on high-technology.

In conclusion

Does the use of high technology contribute equally to the development of nations? No, it does not. It contributes to the development of only 7.7% of the countries' economies, and including rapidly developing technology nations, that figure increases to only 22.2%. Low and medium technologies have a perceptibly higher impact on the welfare of under developed nations and their investment patterns bare this out as reported by UNIDO (1997). In comparing data from 1997 to 1994 the UNIDO report suggests that most South American, African, and Asian countries are reducing high technology investments and increasing investments in low and medium technologies.

Is communications technology more important in some cases than high technology? Yes, for less than developed nations building basic infrastructures is more important than investing in high technology. This conclusion was reached by many ex-Soviet sphere nations as can be seen in Table 13 (UNIDO, 1997). With the exception of Slovenia they all reduced high technology investments during the period. Slovenia increased investments in medium and high technology because of its dismally low investment rates in the 70's. For developed nations where information infrastructures are in place high technology will remain the driver behind productivity gains for the foreseeable future (“Why the Productivity Revolution will Spread,” 2000). Other nations, mostly with outside financial help, will have to play catch-up.

Which components of telecommunications contribute to social development? Though this study does not directly address this question logic suggests that basic information technologies have more of a direct affect on social development than high technology based programs. UNIDO (1997) reports that 80.1% of East and South-East Asian growth between 1970 and 1995 was generated by the basic industries of agriculture, manufacturing, and services; not by high technology.

What aspect(s) of high technology contribute(s) more to social development? To the extent that high technology requires the development of low- and medium-technologies first traditional industry development is first needed before high technology can make its effects felt. With this relationship in mind, many African nations are inviting basic industry investments now and abandoning the high technology bandwagon (“Investment in Africa: More than Expected,” 2000).

Table 1. Descriptive Statistics for Cluster 1: Underdeveloped Nations

	N	Minimum	Maximum	Mean	Std. Deviation
Literacy rate, adult total (% of people 15+)	29	19.20	67.80	43.3793	12.4220
Primary education particip. rate. (%)	24	29.00	89.00	62.2917	14.8309
Infant survival (%) (100-mortality)	30	81.71	93.67	88.8400	2.7946
Health care (% of population with access)	26	12.50	79.33	43.0538	18.1229
Safe water (% of population with access)	29	13.33	95.00	39.7293	18.1147
Life expectancy at birth, total (years)	30	35.83	54.35	48.1339	4.5034
GDP per capita, PPP (constant 1987 international $)	30	350.57	1575.40	864.3707	331.0837
Valid N (listwise)	22				

Table 2. Descriptive Statistics for Cluster 2: Developing Nations

	N	Minimum	Maximum	Mean	Std. Deviation
Literacy rate, adult total (% of people 15+)	40	27.50	93.70	66.9625	15.2231
Primary education particip. rate. (%)	30	79.00	162.00	105.0333	18.1383
Infant survival (%) (100-mortality)	43	86.65	97.40	93.1938	2.4305
Health care (% of population with access)	34	10.00	99.40	64.1544	20.3234
Safe water (% of population with access)	43	12.90	77.00	49.3027	14.7696
Life expectancy at birth total (years)	44	43.70	68.86	59.3145	5.9477
GDP per capita, PPP (constant 1987 international $)	44	478.76	5834.77	1784.498	1201.4067
Valid N (listwise)	23				

Table 3. Descriptive Statistics for Cluster 3: Rapidly Developing Nations

	N	Minimum	Maximum	Mean	Std. Deviation
Literacy rate, adult total (% of people 15+)	74	61.60	99.00	90.8554	8.9143
Primary education particip. rate. (%)	59	69.00	133.00	102.0847	13.6373
Infant survival (%) (100-mortality)	85	93.48	99.35	97.6470	1.2643
Health care (% of population with access)	45	44.50	100.00	93.2044	10.7186
Safe water (% of population with access)	61	35.65	100.00	82.2839	14.0192
Life expectancy at birth total (years)	86	59.19	76.61	70.4878	3.2318
GDP per capita, PPP (constant 1987 international $)	85	800.00	9924.03	4257.295	2372.7528
Valid N (listwise)	28				

Table 4. Descriptive Statistics for Cluster 4: Developed Nations

	N	Minimum	Maximum	Mean	Std. Deviation
Literacy rate, adult total (% of people 15+)	31	78.60	100.00	94.8968	6.3986
Primary education particip. rate. (%)	27	77.00	116.00	100.1481	7.0586
Infant survival (%) (100-mortality)	47	94.40	99.57	99.0370	.8180
Health care (% of population with access)	29	94.00	100.00	99.2862	1.6225
Safe water (% of population with access)	33	90.00	100.00	98.5393	2.4706
Life expectancy at birth, total (years)	47	62.95	83.46	76.0917	3.0943
GDP per capita, PPP (constant 1987 international $)	48	9147.22	25000.00	15831.97	3780.7309

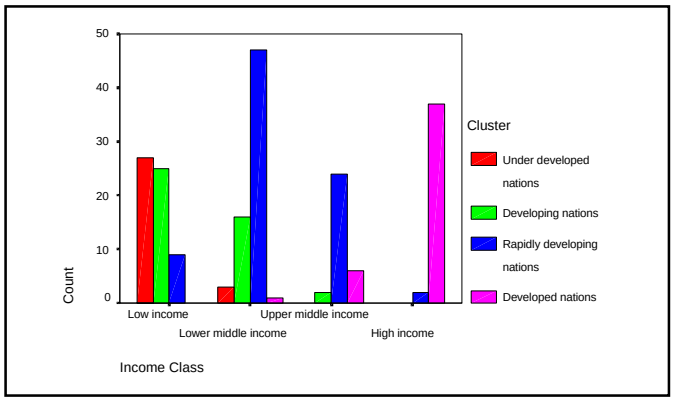

Figure 1. World Bank Income Class and Cluster Relationships

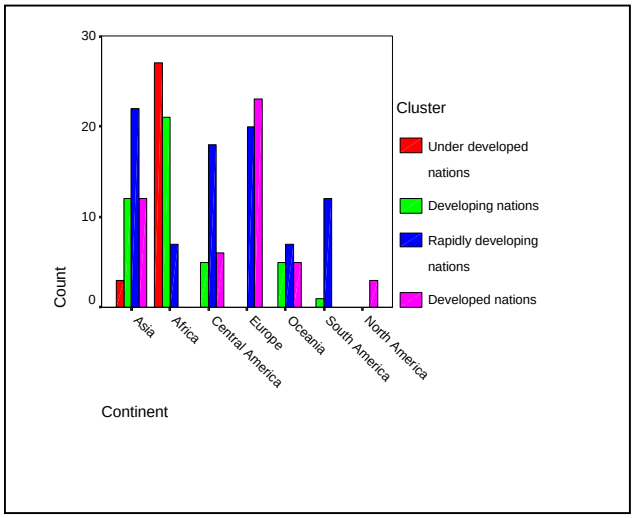

Figure 2. Social Development by Continent

Table 5. Descriptive Statistics for Cluster 1: Poor Information Infrastructure Nations

	N	Minimum	Maximum	Mean	Std. Deviation
Telephone mainlines (per 1,000 people)	110	.78	223.62	40.6000	45.6340
Television sets (per 1,000 people)	106	1.32	279.27	89.4720	80.7723
Radios (per 1,000 people)	108	31.92	875.00	200.0254	142.1524
Newspapers per 1000	92	.00	213.00	31.4761	37.5161

Table 6. Descriptive Statistics for Cluster 4: Developing Information Infrastructure Nations

	N	Minimum	Maximum	Mean	Std. Deviation
Telephone mainlines (per 1,000 people)	60	3.53	517.57	248.2673	122.4440
Television sets (per 1,000 people)	59	73.06	644.18	326.7984	117.4974
Radios (per 1,000 people)	60	62.02	1461.19	530.5934	251.7884
Newspapers per 1000	49	2.00	297.00	133.1633	76.9676

Table 7. Descriptive Statistics for Cluster 3: Rapidly Developing Information Infrastructure Nations

	N	Minimum	Maximum	Mean	Std. Deviation
Telephone mainlines (per 1,000 people)	23	232.27	683.22	479.7179	121.1322
Television sets (per 1,000 people)	23	215.09	699.74	417.6840	117.0194
Radios (per 1,000 people)	22	184.52	1207.60	738.4567	271.6913
Newspapers per 1000	19	250.00	757.00	472.7368	149.3917

Table 8. Descriptive Statistics for Cluster 2: Well Developed Information Infrastructure Nations

	N	Minimum	Maximum	Mean	Std. Deviation
Telephone mainlines (per 1,000 people)	13	392.48	768.46	561.5967	91.4611
Television sets (per 1,000 people)	13	509.29	1057.69	662.5298	145.5541
Radios (per 1,000 people)	13	886.32	2119.44	1227.090	316.1875
Newspapers per 1000	13	104.00	473.00	273.4615	99.3140

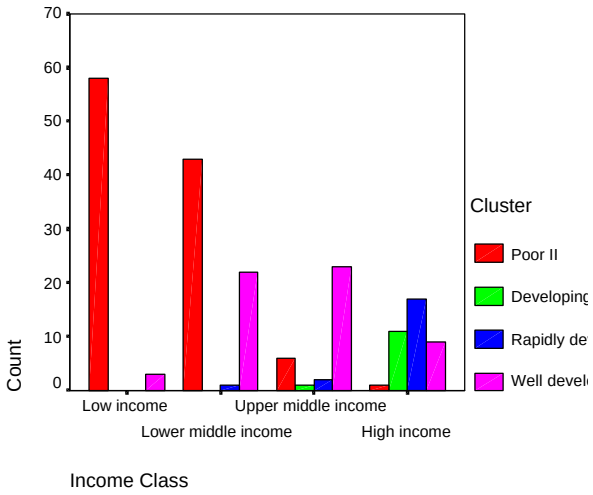

Figure 3. Level of Information Infrastructure by World Bank Income Group

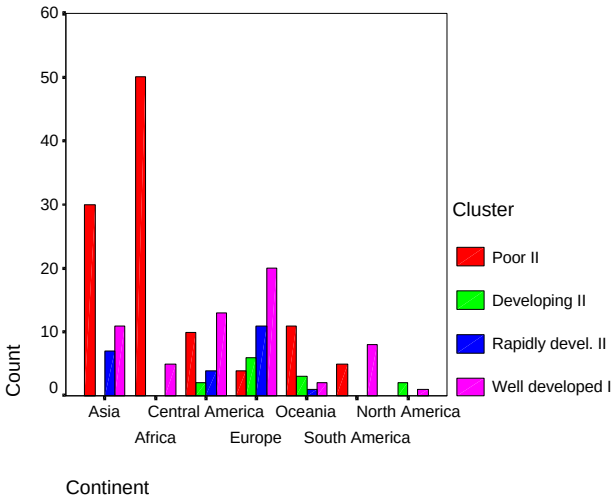

Figure 4. Level of Information Infrastructure by Continent

Table 9. Descriptive Statistics for Cluster 2: Technology Poor Nations

	N	Minimum	Maximum	Mean	Std. Deviation
High-technology exports (% of manufactured exports)	77	.02	35.78	10.6602	8.3121
Internet hosts per 1M population (WDI, 1998) updated 4/24/00	115	0	17465	703.73	2106.55
Expenditure on R&D, as % of GNP	59	.00	1.70	.4767	.3505
Low tech investment %	26	54.7	91.2	74.685	10.251
Med tech investment %	26	5.7	30.8	16.385	6.785
Num. users of Internet per 1M popula-tion	66	.17	26954.18	1696.151	4066.4451
Updated personal comp /1000 pop. (4/24/00)	78	.0	111.6	18.668	23.673
High tech investment %	26	1.2	21.6	6.854	5.227
GDP per capita, PPP (constant 1987 international $)	137	350.57	9924.03	2531.053	2047.0425

Table 10. Descriptive Statistics for Cluster 4: Nations with Beginning Technology Development

	N	Minimum	Maximum	Mean	Std. Deviation
High-technology exports (% of manufactured exports)	17	33.81	94.01	49.3334	15.6475
Internet hosts per 1M population (WDI, 1998) updated 4/24/00	19	2	32230	3340.95	7851.57
Expenditure on R&D, as % of GNP	15	.00	1.51	.4503	.4991
Low tech investment %	2	32.8	42.6	37.700	6.930
Med tech investment %	2	17.6	23.2	20.400	3.960
Num. users of Internet per 1M popula-tion	18	7.19	30135.61	4914.263	8603.4146
Updated personal comp /1000 pop. (4/24/00)	15	1.7	458.4	100.422	132.373
High tech investment %	2	33.8	48.8	41.300	10.607
GDP per capita, PPP (constant 1987 international $)	24	1000.00	17950.51	6947.519	4356.1198

Table 11. Descriptive Statistics for Cluster 1: Nations with Rapidly Evolving Technology

	N	Minimum	Maximum	Mean	Std. Deviation
High-technology exports (% of manufactured exports)	22	.59	37.69	18.2544	10.6734
Internet hosts per 1M population (WDI, 1998) updated 4/24/00	23	147	27060	9223.97	8887.26
Expenditure on R&D, as % of GNP	17	.06	2.90	1.4968	.9275
Low tech investment %	4	46.5	55.9	48.875	4.684
Med tech investment %	4	15.5	39.3	30.900	10.523
Num. users of Internet per 1M popula-tion	22	1052.81	53485.47	13395.81	14661.41
Updated personal comp /1000 pop. (4/24/00)	22	28.7	304.7	164.817	84.048
High tech investment %	4	13.7	24.8	18.125	4.714
GDP per capita, PPP (constant 1987 international $)	30	5137.22	25000.00	16019.50	4902.1968

Table 12. Descriptive Statistics for Cluster 3: Technology Leaders

	N	Minimum	Maximum	Mean	Std. Deviation
High-technology exports (% of manufactured exports)	12	8.88	45.08	25.7894	9.6432
Internet hosts per 1M population (WDI, 1998) updated 4/24/00	11	31007	150877	63303.68	36675.94
Expenditure on R&D, as % of GNP	11	1.07	3.63	2.0618	.7317
Low tech investment %	1	43.2	43.2	43.200	.
Med tech investment %	1	30.9	30.9	30.900	.
Num. users of Internet per 1M popula-tion	11	35511.36	138997.7	60296.80	33931.12
Updated personal comp /1000 pop. (4/24/00)	11	205.2	458.6	353.484	70.043
High tech investment %	1	25.3	25.3	25.300	.
GDP per capita, PPP (constant 1987 international $)	16	9000.00	20589.72	14510.86	3024.7619

Table 13. Investment composition in some ex-Soviet sphere nations as % of industry

Country	Level of technology	1970	1994
Hungary	Low	59.90	61.80
	Medium	23.50	23.60
	High	15.00	14.00
Poland	Low	58.40	66.90
	Medium	24.00	19.90
	High	17.30	12.20
Romania	Low	56.70	68.10
	Medium	20.70	14.40
	High	19.60	5.60
Slovenia	Low	99.30	46.60
	Medium	0.20	39.30
	High	0.40	13.70

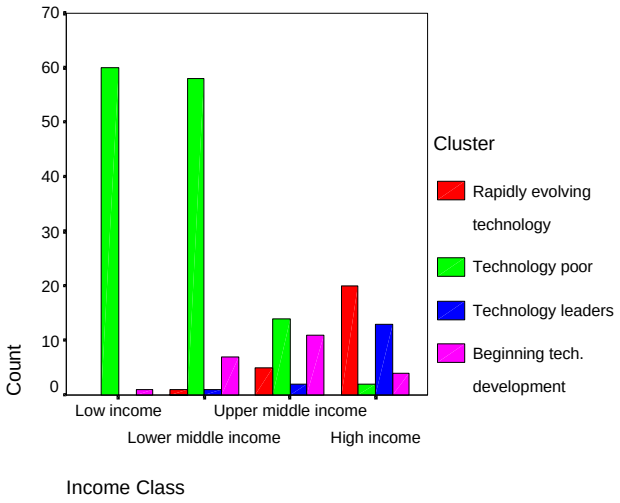

Figure 5. Level of Technology Development by World Bank Income Group

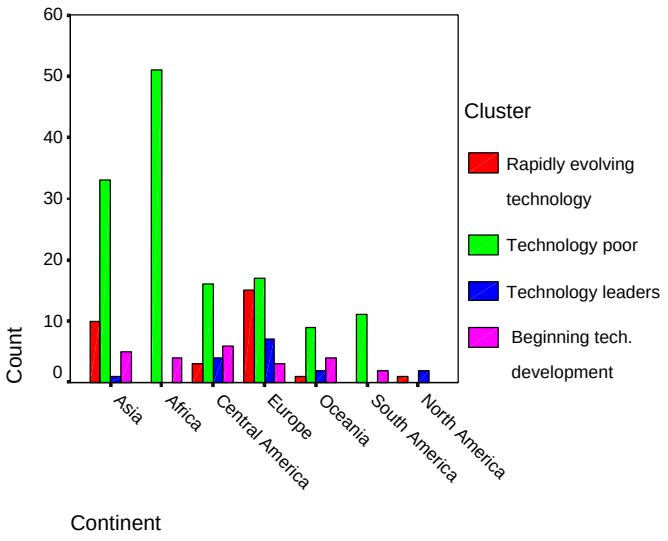

Figure 6. Level of Technology Development by Continent

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