CENTER FOR BUSINESS AND GOVERNMENT
79 John F. Kennedy Street, Cambridge, MA 02138
VIETNAM PROGRAM

TEL: (617) 495-1134
Fax: (617) 496-5245
David_Dapice@harvard.edu

THE INTERNET IN THREE COUNTRIES: STRATEGIES FOR GROWTH?

Professor David Dapice
Associate Professor of Economics, Tufts University and Economist, Vietnam Program at the John F. Kennedy School of Government, Center for Business and Government

MAY 2005

Introduction

Even after the popping of the Internet bubble in 2000, there has been a continuing and rapid increase in the use of the Internet by many developing nations. In spite of much writing about the "Digital Divide," recent research by the International Telecommunications Union suggests that rates of growth of telephones, computers, and the Internet itself are higher in many poor countries than rich ones and the gap is closing.[1] These gains can be caused by many factors – mobile telephones can easily increase capacity and cost less than fixed line phones, for example, and much of the recent gains in telephone coverage come from the mobile segment.[2] Likewise, computer prices have continued to fall and now new low-end machines cost only $400 or less. Global PC sales in 2002-04 exceeded 500 million, bringing the global total close to 1 billion. A $400 price puts computers in the price range of televisions, which are widely used in many poorer nations.[3] The Internet, with 5-6% penetration in developing nations, typically requires access to both a telephone line and a computer, though non-PC wireless technologies are just starting to become a factor in some developing countries. With the Internet, government policy is especially important since the costs of connection, amount of bandwidth (and thus ease of use), and degree of "filtering" of proscribed sites is usually under direct or indirect government control. Given the decline in costs, the biggest divide is often *within* a single country and due as much to government policies as other factors. In particular, the availability of telephone lines, cheap Internet connections, and Internet cafes or other public venues will often determine the overall availability of the Internet to middle and lower income families, though age and education are also important variables.

What policies are apt to promote the rapid diffusion of these critical technologies? To suggest an answer, this study analyzes the recent experience in three transition economies: China, Vietnam and Ukraine. These may seem an odd mix, since Vietnam is much the poorest of the three and Ukraine has had negative economic growth for much of the 1990's, while Vietnam and especially China have grown rapidly. But all three were centrally planned socialist economies and all three, to different degrees, have introduced a market economy. All three started with an incumbent monopoly telephone company and all three have allowed different levels of competition in various segments of the telecom market. Yet the outcomes have been different, especially in terms of the growth in recent years, as Table 1 shows on the next page.

[1] http://www.itu.int is the web address for the International Telecommunications Union. It has free annual data on-line covering fixed and mobile phones, personal computers, and Internet users.

[2] One recent news item (The Economist, 2/12/05, "Nokia's turnaround") estimated mobile handset sales at 1.9 billion in 2003 -2005. This is nearly 30% of the world's population getting handsets in three years!

[3] There were 19 televisions but only 2.8 personal computers per 100 people or 20 to 25 households in low and middle-income nations in 2002. (Table 5.11, 2004 World Development Indicators, World Bank.) Households in low-income Vietnam had 52% TV ownership in 2002 and 2 PC's per 100 people in 2004.

Basic Data

Table 1: A Snapshot of Three Nations in 1999/ 2003 or 2004

		Telephones/PC's/ Internet Users per 1000				
	GNI pc*	Fixed	Mobile	PC's	Internet	Urban %
China	$4520	86/209	34/256	12/28	7/72	37%
Ukraine	$4800	199/230	4/166	16/19	4/124	68%
Vietnam	$2300	27/ 55	4/ 67	9/14	1/74	25%

*Gross National Income per capita in purchasing power parity terms in 2002. When there is a "/", the first number is for 1999 and the second number is for 2003 or 2004. "Urban %" refers to the share of urban to total population. Data Sources: 2004 World Development Indicators, World Bank, Tables 1, 5.10 and 5.11. and ITU database.

One item of interest in Table 1 is that in China in 1999, over half of those with personal computers had access to the Internet (although some may have done so at work or through Internet cafes) while the ratio in Ukraine was only one-quarter and in Vietnam, only one-ninth. This indicates that even at that relatively early date there were already large differences in access, even adjusting for PC ownership, reflecting government policies.

By 2003-04 all of these nations had made huge strides in terms of IT metrics. Their growth in Internet and telephone use far outstripped the increases in per capita real income of 15% to 30% over the four year period. The surprising leap in mobile phones is noteworthy, even though these are not yet normally used in most places to access the Internet.[4] The 41 fold jump in five years in Ukraine is astonishing, while the leap in China by seven times from a large base is also impressive. Vietnam, with recent deregulation, also managed a 16 fold jump. Total telephones in Vietnam jumped from 2.4 to over 10 million in five years.

Geographic coverage and capacity is also improving. Access to 98% of Vietnamese communes (essentially villages) was achieved by end-2004, with 100% commune coverage expected by 2005. China, with a much larger land mass, has 85% of its villages connected to telephone lines. Ukraine has widespread service in and around all cities and along major highways. The lower cost of mobile connections and thus charges explains its rise relative to land line phones. There is also no delay in installation, and handset prices have been falling along with monthly charges. Installation of new equipment to upgrade capacity is also faster than with landlines, so faster growth rates of subscribers are possible.

The increase in PC use was also rapid, with Vietnam doubling from 1999 to 2004, while China more than doubled from 1999 to 2002. Ukraine had a much slower (20%) rise from 1999 to 2002, and may just be level with Vietnam even though Vietnam has a PPP per capita income only half of Ukraine. However, PC data tend to lag that of mobile phones or of the Internet, as the retirement rate of older computers must be estimated.

[4] Research cited by The Economist suggests that mobile telephone use has more of an impact on growth and the poor in recent years than does the Internet, which is still used by a small minority. "Calling across the divide", March 10th, 2005. The article notes subscriber growth of 150% in Africa last year!

Internet Use is Spreading Rapidly in all Nations

From low levels in 1999, the latest Internet usage data from national sources suggest very rapid growth. Internet use in Vietnam at year-end 2004 was reported to have doubled over 2003 to a *claimed* 74 per 1000.[5] China reported 94 million users at the end of 2004, or a penetration of 72 per 1000, with growth of 18% over a year earlier.[6] Ukraine's reporting is less consistent, but by year-end 2004, a commercial source (Sputnik Media) reported 5.9 million users for a penetration rate of 124 per 1000, with an annual growth rate of 50% over 2003. However, only half to two-thirds of these Ukrainians use the Internet at least once per week. Thus, comparable[7] use rates could be estimated from 6% to 8%. Given the proliferation of low-cost Internet cafes in urban areas, facilities in schools and other public places, and the declining costs of dial-up access and personal computers, this spread is not entirely surprising. In general, Internet use seems to vary positively with income per capita, education, urban residence (though this may be only a proxy for telephone ownership), and youth – and of course, lower costs and greater access to and speed of connections.[8]

The extremely rapid growth in Internet use to a high percentage of the urban elites and students has yet to be matched by a spread into rural areas and among the older population. China is the only nation with detailed and periodic surveys on user characteristics. In China, less than 1/5 of users are over 35 years old, and less than 1% of users are either farmers or military people. Geographically, the penetration in China varies from 15% in Guangdong (next to Hong Kong) and 26-28% in Beijing and Shanghai to under 5% in poorer provinces. PC ownership reached 28% of households in urban households in 2003, but was not even covered in surveys of that year for rural households. Even though Internet fees are not high – over 2/3 of users spend under $12 a month – it is still expensive relative to incomes in rural areas, especially if public facilities are not readily available. (Internet cafes in Vietnam are as little as thirty cents an hour! They are in most towns and all cities.) As the natural urban markets are saturated, continued progress will depend on improving access and lowering costs in the poorer and rural areas. Vietnam especially is investing in computers for schools and public buildings, with a budget for one million low cost computers to be distributed. However, the Internet until now is largely an urban phenomenon in all three nations.[9]

---

[5] "Internet Market Grows Despite Government Interference", Saigon Times, p. 3, January 6, 2005. The article reports two million subscribers, up from 823,000 in 2003. Users doubled to six million in a year.

[6] The China Internet Network Information Center (www.cnnic.net) conducts biannual surveys and provides the data from which most data are analyzed. See also OECD/STI Working Paper 2005/4, "Status and Overview of Official ICT Indicators for China" by Masahiro Katsuno. .

[7] The Chinese define a user as someone over 6 years old who uses the Internet at least one hour a week. The Vietnamese define a user by multiplying subscribers by about 3, a ratio that seems to assume that most above six years of age in a household will use the Internet. However, subscribers continued to grow by 3-4% a month in 2005. There is a rather broad range of estimates in Ukraine for users who are active at least once a week.

[8] A recent econometric attempt to predict and explain Internet use is found in the Yale Economic Growth Center discussion paper 881, "The Determinants of the Global Digital Divide: A Cross Country Analysis of Computer and Internet Penetration" by Menzie Chinn and Robert Fairlie, March 2004.

[9] In Ukraine, 80% of Internet users were urban in 2003, compared to 68% of the population. Nearly six in ten users lived in Kiev. However, only 15% of schools had an Internet connection in 2004.

Given the urban nature of the Internet, it *is* surprising is that Ukraine has not done better compared to either China or especially Vietnam. Let us take actual Internet penetration at close to 7% at year-end 2004 for China and at 5% to 7% Ukraine and Vietnam and compare it to the "likely user" population calculated as 60% of urban and 20% of rural population. This gives a measure of how far policy has pushed use relative to those likely to use the Internet under current conditions.[10] By this measure, China has reached 20% of its potential users – and those potential users are 35% of total population. Vietnam is probably only slightly behind China (which is astonishing given its late start and low per capita income) and a bit ahead of Ukraine, as Table 2 shows.

Table 2

	Potential Users/ Population	Actual Users/ Population	Actual Users/ Potential Users
China	35%	7%	20%
Vietnam	30%	5-7%	17%-23%
Ukraine	47%	6-8%	13%-17%

Note: Data are as of 2004. Potential users are estimated at 60% of urban and 20% of rural populations.

These "potential" measures do not assume rural Internet use will remain within a small rural minority. As more schools and public contact points become available and are seen to be useful, it is likely that the potential rural user population will increase. Cheaper used computers and wireless connections will also help.[11] Until then, much of any expansion will rely on reaching more people in the cities, though this also means that high growth rates in the number of users may not continue in the cities alone for very long. If urban penetration is now 15% to 20%, doubling cannot keep on going many times before an urban saturation point near 60% is reached. (The US has a 66% national rate of Internet use, so 60% is a generous estimate of potential users in urban areas in lower-income nations.) The slow (18%) growth in Internet users in China from January 2004 to 2005 suggests this is likely to be true. The rapid growth in Ukraine may be due to its use in recent political turmoil, while the rapid growth in Vietnam appears to be due to a government decision to make it cheap and easily available with multiple ISP's.[12] Rapid growth in telephone and computer use is also helping to increase users, which are growing at rates of 50% to 100% a year in 2004-2005.

[10] This is a rough and arbitrary adjustment. It allows for more progressive and higher-income rural people likely to be users and also for lower-income and older urban people unlikely to be adopters. A formal approach, as in Chinn and Fairlie (op.cit.) found income per capita to be the major explanatory variable, and telephone connections to contribute as well. When controlling for those variables, urbanization dropped out as a significant variable.

[11] The growth of "Wi-Max" technology will allow broadband signals to be sent and easily received over ten miles fairly cheaply. This should make rural broadband easier, faster and cheaper to introduce in the next few years. Intel recently (April 2005) introduced a new chip that should speed this development.

[12] However, the top content provider (Vietnam Net) gets .5 million hits a day according to its CEO. He has introduced controversial news (including TV over Internet) and chat rooms that attract younger users.

International Gateway Capacity is Getting Much Cheaper and More Plentiful Everywhere

The Internet in each country connects through a series of gateways or switches to international fiber optic lines. China's international bandwidth was 74,400 megabits per second in end-2004 for 94 million users[13]. Vietnam had 1,892 megabits per second for an estimated 3.2 million users at the end of 2003. Bandwidth has grown very rapidly for both Vietnam and China. China, for example increased its capacity 212 times in five years, and Vietnam 79 times in four years. At the end of 2002, Ukraine had seven times as much bandwidth as in 2000 and about the same amount of bandwidth relative to user population as China then had. Vietnam and China have similar amounts of per user bandwidth.

It is also important to note that many users do not tap international web sites, but access mainly domestic sites or e-mail, often to other domestic residents. Even so, all nations have had gateway capacity growing rapidly, and as there are many unused fiber optic lines, it is not difficult to scale up capacity quickly.[14] The costs of leasing these lines have also come down and costs in 2003 had dropped 97% relative to1998 costs! (One example from a Trans-Atlantic cable circuit carrying 155 Mbits/second showed a fall from $9.4 million a month in 1998 to $0.3 million a month in 2003.) On the other hand, given the capacity per user available in all three countries, if only 10% of all users in China were accessing the Internet at one time for international use, the bandwidth per user would be only 8 kilobits a second – very slow indeed. This suggests that further additions to gateway capacity might be needed if use is to be convenient, even at peak periods.

Another way of looking at gateway bandwidth is to compare it to other nations. In these comparisons the capacity, though very fast growing, is still relatively small. For example, China had 74,400 megabits per second of capacity for 94 million users in 2004. This compares with 7,300,000 megabits per second of international bandwidth for the city of London. The city of London had 10 times the bandwidth of all of China with perhaps 5% as many users. Still, it is not clear that international bandwidth is a limiting factor for most users since, as suggested, they often access only local web sites. In China, 86% of Internet use went to domestic websites and only 14% to foreign websites. This, and the use of popular "mirror" sites in the receiving country, can significantly reduce the amount of international bandwidth needed. The combination of demand reduction through mirroring and domestic content and rapid gateway supply increase due to ever lower costs of renting fiber optic cables and installing switches is likely to render most gateway problems minor or manageable – IF the government wants them to be. The extremely rapid growth of gateway bandwidth suggests that capacity restriction is not being practiced as a policy.

[13] By way of comparison, there were only 351 megabits/second of international gateway bandwidth for all of China in January of 2000. Thus, bandwidth increased over 212 times in five years! Vietnam jumped from 24 megabits per second in December of 2000 to 1892 in January of 2005, a 79 fold jump in four years.

[14] Projections are for Internet international bandwidth capacity to jump 4-5 times between 2003 and 2006, with peak demand going up about the same amount but averaging only 20-30% of capacity. Prices are much harder to establish, but appear to be continuing to decline. The point is there is no supply constraint.

Broadband Access is Uneven in Penetration and Cost

If computers and dialup connections and Internet cafes are making "retail" access ever easier and cheaper, while gateway connections are not a big problem, what is? An additional dimension of Internet use is that of broadband vs. dialup. A dialup connection has up to 56 kilobits a second while a broadband connection is many times faster. The higher speed connection allows faster surfing and downloads, and makes it much more likely that the Internet will be used for e-commerce and other applications needing large data downloads. This could include Internet telephony, music or video downloads, and video conferencing for business and education. (While the connection speed from the home or business to the ISP [Internet Service Provider] is usually the most important factor in perceived speed of access, other things such as international gateway bandwidth and the "wholesale" data line capacity to the gateway might also be important in determining the actual speed experienced by the user.)

The cost and availability of broadband varies considerably. China's broadband users jumped from 6.6 million at the end of 2002 to 43 million at the end of 2004, or 3.3% of population. Growth appears to be fast, perhaps 150% in 2004, and is likely to continue growing briskly if somewhat more slowly for a few more years. Costs were $15 to $25 a month for a fast connection. Vietnam was just starting to offer 1500 kilobit/second (nominal) DSL service in 2003 and had about 50,000 users at year-end 2004, with a projected 150-200 thousand expected by end-2005. In 2005, that would equal 0.2% of population. Costs were $50 to $70 a month – expensive given that its per capita income is only half of China's.[15] Ukraine was even further behind, with a dedicated line of 128 kilobits costing $300 a month. Few except companies could afford these lines. Obviously, China's level and rate of growth have been the highest and Ukraine the lowest, with Vietnam just starting out. These price differences are driven partly by cost and availability, but also by policy. If competition is allowed, it is much more likely that prices will drop and availability will increase.

Data Line Costs Can Determine Effective Connection Speeds

The speed from the consumer to the Internet service provider (ISP) is normally the main focus of attention, but the "wholesale" capacity from the ISP to the international gateway or other Internet switch is also crucial. The speed enjoyed or suffered by the end user depends on both the speed of the "last mile" connection and the "wholesale" bandwidth. As previously explained, the gateway capacity can also be a limiting factor, but that is easily upgraded since so much fiber optic capacity has been laid in the last several years and is still unused. There is a large difference in the cost of dedicated or leased lines among countries. These lines carry large volumes of data from the ISP to the global Internet and are measured in increments as little as 64 kilobits/ second at low levels and up

[15] Costs in the US are $35 to $50 a month for 1 to 1.5 megabits per second. However, the actual speeds in Vietnam are often MUCH slower than advertised. Speeds as low as 50 kilobits a second (normal dialup speed) were measured on some "broadband" connections in Vietnam during peak periods! So, the current Vietnam charges are higher than the US or China, much higher relative to income, and provide less actual capacity. But, because dial-up lines are even slower, there has been surprising growth in broadband.

to hundreds of megabits per second at higher levels. A typical data line often used is the T-1, carrying 1.55 megabits/second. The T-1 can cost as little as $500 a month in the US, about $1000 in China, and several thousand dollars in Vietnam and Ukraine. Because ISP's cannot charge high fees to relatively poor end-users, they tend to economize by buying less data line bandwidth than would be ideal to carry peak loads.

Creating Scarcity When It Does Not Exist: Why Monopolies Slow Progress

The previously mentioned cost of a Trans-Atlantic data line falling to $300,000 a month for a 155 Mb/second cable is hard to understand unless it is explained in terms of telephone call equivalents. A cable of that capacity can handle 2422 simultaneous voice calls with each one using 64,000 bits/second. If all lines were fully used, the trans-oceanic charge for a call would be about 1/4 of one cent per minute. If the cable were only used half of the time, the charge would double to 1/2 cent per minute. Of course, local charges at either end raise the cost of the total call, but these seldom amount to more than 1-2 cents per minute at either end. Thus, inter-continental telephone calls using these optical fiber cables *can easily cost less than five cents per minute*. This is considerably less than in-country long distance calls over "regular" telephone lines in many countries.

When there is such rapid technical change, it is a challenge to the "incumbent" telephone company. After all, it has invested heavily in the old technology. It often cross-subsidizes domestic use from overseas calls. It will try to convince politicians and the public that it is bad business and bad social policy to allow any company to charge anything close to the actual cost of calling overseas. In some countries, these pleas will fall on deaf ears and the cost of telephone calls and data lines will be very low. In other countries, the complaints will be persuasive and competitors will find it difficult or impossible to offer calls at their actual cost. There might be regulatory problems, or legal restrictions on using data lines and fiber optic cables to make calls, or just a policy by the incumbent telephone company not to connect and service those firms that provide overseas calls. The result is that there is a huge difference in the cost of telecommunications among nations, depending on their legal and regulatory policies. Of course, investors that use telecommunications heavily will tend to be drawn to those locations where it is cheap and easy to communicate.

If someone found a way to produce something for a small fraction of its previous cost and price, most people would see that as a tremendous benefit. People who had bought a little of the good previously could buy a lot more. Those who had been priced out altogether would be able to enjoy using it for the first time. There would be more for everyone. If the "good" in question is a telephone call, and if the buyers are businesses, the difference in price could mean finding new customers and being able to expand and hire more people. If telephone calls are seen as a luxury good and priced that way, they are likely to remain as an expensive rarity. If they are allowed to fall in price, they will be used very differently and become a common tool of business. It is likely that those nations that allow calls to be priced reasonably will attract more investment and value-added activity than others.

When this happens, the speed of connections falls and the downloading of even moderate amounts of data can be very slow. A recent survey of Internet users in Ho Chi Minh City found a majority of users complained about the "tortoise" speed of connections. The author knows of users who measure the speed of dial-up lines and they often encounter speeds of 1-10 kilobits/second!

Pro-consumer regulation has resulted in some lowering of these "wholesale" data line costs. It is possible that as VOIP (telephoning over the Internet) calls increase, more monopoly telephone companies will abandon overpricing data lines, since then it will not be possible to maintain very expensive international telephone rates. It is to protect these high rates and prevent data lines being used for voice calls that the incumbents have kept the data line prices artificially high. The tendency to inject telecom deregulation into both bilateral and multilateral trade agreements is another way that local monopolies in this area are slowly giving way in even the slower moving countries.

There has been a tendency to allow competition in certain parts of the IT system, especially for mobile telephones and Internet Service Providers. It is these areas that have seen the most rapid growth. For mobile telephones, the need for an expensive nationwide system and rights to radio frequencies tends to restrict competition to two or a few carriers. For ISP's, there can be many – up to 400 in Ukraine, for example. In contrast, there are just seven in Vietnam (two account for most traffic), and all have some link to the government. China similarly has only a few ISP's of any size, but a large number of very small local providers reliant on the incumbent telecom monopoly for their survival. Even three or four providers, if they actually compete, can provide the pressure needed for innovation, lower prices, and higher levels of service. It is especially important that governments allow several firms to provide services since new technologies and services will almost certainly appear if they are allowed to and not suppressed by a monopoly. This has been the experience in all three countries where monopoly services have shown the least growth.

As suggested, the tendency for the incumbent telecom monopoly – often still predominant, even if now technically not a monopoly – to keep connection or data line prices high is one bottleneck in the system. If competitors could access the system cheaply and use fiber optic lines to carry voice as data (Internet Protocol), then as the "Box" explains, the cost of international telephone calls falls to a very low level. Thus, the availability of VOIP might be seen as an early indicator of whether or not the pricing of data lines will become more "normal" in high-priced countries. With very high prices, there are few users and very little revenue. That is the purpose of the pricing – to prevent competition with high priced telephone charges. As this rationale dissolves, it becomes attractive for the monopoly to switch its business model to one with much lower charges and much higher usage levels. This is happening in China (5-6 cents/minute for international calls) and is also happening in Vietnam. [16] Ukraine, with low-cost international calls about triple China's should be able to switch soon as well. Thus, the pressure of VOIP *should* result in pricing closer to costs in all three countries within the next year or two. The pressure from WTO and other

[16] The international rates in Vietnam calling out are similar to China's, but calling in costs 35-40 cents/minute. Ukraine is in the 17-20 cent per minute range. Direct VOIP from a computer is much cheaper, less than five cents a minute.

trade treaties also pressures these countries to allow more competition, further pushing them in the direction of cheaper communications.

Content and Control: Worries About Websites

While there are compelling reasons to promote the Internet as a competitive tool, there are also concerns about how it may be used. These concerns often center on the control of information or use of the Internet by a political opposition, but extend to pornography, fraud, and other types of computer crimes. In Ukraine, the opposition to the previous government actively used the Internet to communicate and offset the control of TV and radio by the government. There were clear signs that the security bureau (replacement of the KGB) intended to monitor Internet e-mails and use, and legislation was introduced to allow this in 2003. The murder of one on-line journalist and the beating of another suggest that the authorities had been growing increasingly sensitive to the use of the Internet as a political tool.[17] It remains to be seen if the new Ukrainian government is more relaxed about control of the Internet, although many anticipate this will be the case.

In China the attitude towards unsanctioned Internet use has never been relaxed: "At least 23 journalists and about 50 cyber dissidents are in jail, often for long sentences, for having called for democracy or denouncing abuses…or raising sensitive issues."[18] Blocking of many websites is routine and controls on Internet cafes have been increased since a fatal fire in 2002. Registration in Cafes is now required and content is monitored. Even e-mail content is monitored in real time in China, and users can be shut down if they are sending offensive content or trying to reach forbidden sites or sensitive subject areas. The best recent study of China's policies and practices is in "Internet Filtering in China 2004-2005", an OpenNet Initiative.[19] It reports the filtering to be "the most sophisticated in the world" and calls it, "pervasive, sophisticated and effective." Even so, the recent rise of protesters expressing anti-Japanese sentiment were allowed to use the Internet but were then hard to control, especially when text messaging was used as a substitute for e-mail.

The situation in Vietnam is less strict than in China but not so open as in Ukraine. Internet café registration is legally required but often ignored. Filtering is more haphazard and less likely to stop controversial subjects except for overseas Vietnamese who are vociferously against the regime. Even government content providers like Vietnam Net are boldly experimenting with news and comment that would not be allowed in newspapers, some of which are controversial. In China, small numbers of reporters are jailed and some are threatened or harassed.

---

[17] A good discussion of Ukraine's Internet policies can be found at www.rsf.org (Reporters sans frontieres), under "Internet" and "Ukraine."

[18] www.rsf.org, China 2004 annual report. Sensitive issues include dissidence, underground religious movements, corruption, Aids in Hunan province, strikes, the plight of North Korean refugees, natural catastrophes, or Tibetan or Uighur separatism.

[19] The OpenNet Initiative is a partnership of the Munk Centre for International Studies at the University of Toronto, the Beckman Center for Internet& Society at Harvard Law School and the Advanced Network Research Group at the Centre for International Studies at the University of Cambridge, England. Primary authors of the study were Jonathan Zittrain and John Palfrey. The April 14, 2005 report of over 50 pages goes into much detail, more than this paper can easily present.

Uses of the Internet

One set of questions could relate to the *uses* of computers and the Internet. Some observers complain that the main uses by the young are for e-mail and chat rooms or games, perhaps in addition to some sites aimed at legal or illicit entertainment. By this view, many IT investments are a massive waste of money leading to little improvement in knowledge or productivity. Against this view are several others. Some argue that VOIP (Voice over Internet Protocol) allows nearly costless international telephone calls, greatly reducing marketing costs and possibly increasing outsourcing opportunities[20]. Others point to the use of the Internet in international bidding, marketing, and acquisition of information. For those with English, there is an immense amount of information useful in research on academic subjects, technology, markets, and business sites. The use of Internet based education is in its infancy, but already shows promise from the curricular publication of MIT to actual classes. On balance, the technology is still at an early stage but shows sufficient promise that it is becoming a priority for many developing nations. However, all three nations remain laggards in developing e-commerce infrastructure.[21]

Summary and Conclusions

The initial reason for this research was to see if the spread of the Internet was being held up by monopolistic telephone companies overpricing or underinvesting in various parts of the Internet/telecom infrastructure. While historically this has certainly happened, it appears that there is sufficient awareness of the importance of making these services widely available that these problems have not prevented quite rapid rates of growth. All countries have Internet user growth rates that can or have doubled use in 1-3 years. This is true even in Ukraine where there is definitely a predominant telephone company monopoly and high prices for data lines and broadband. Yet growth rates of Internet use are high and the penetration rate is broadly similar in all three nations. However, when the level of Internet users are calculated as a share of potential likely users, Ukraine comes in last by a very wide margin. It has extended use to only 1/8th of potential Internet customers compared to about 1/5th in China and Vietnam. China has clearly introduced the most investment and competition into the telecom sector, yet it has about the same coverage of potential users as Vietnam. While the Vietnamese data might be overestimated relative to China's, it is still striking that they are so close given that China has double Vietnam's per capita income.

The rise of different ways to access the Internet is crucial in extending urban use. If there are cheap Internet cafes or prepaid or dialup (no monthly subscription) services, then many potential users have access that they might not have if a home landline connection,

[20] "Outsourcing" means the transfer of certain office jobs from rich to poor nations. India is especially active in such work, but other nations such as the Philippines are also a factor. If English is widely used, there is no reason to suppose that other nations might not also be able to take advantage of such opportunities. McKinsey sees a $57 billion export industry in India by 2008 employing 4 million, or five times the current (2003) level of activity. [*Business Week*, December 8, 2003, p. 70] The potential is not small.

[21] In the "2004 E-readiness rankings" by The Economist and IBM, all three nations fell into the bottom fifth of the 64 nations reviewed. Vietnam was just below Indonesia, while Ukraine was nearly tied with Russia and China was tied with Sri Lanka but below Egypt.

computer, and monthly subscription were required. However, these innovations might not be sufficient for extending use in rural areas. For that, the rise of Wi-Max and other relatively low-cost fixed wireless technologies will probably be key, though they will only be phased in over the next two to five years. The sale of low cost (under $300) computers in Vietnam put the cost of these instruments in the same league as televisions, which over 70% of families now own. If Vietnam can extend computer use to a substantial portion of households at $500 per capita income, then many other developing nations can too. (The Vietnamese government is also providing computers to schools, libraries, and post offices.)

One question will be how rural Internet connectivity should be priced. If the price is set too low, then ISP's will skimp on investing enough and connections will be slow or unavailable without subsidies. If it is set too high, then few rural families will take advantage of the possible connections. Besides encouraging or even subsidizing the use of new and low-cost technologies, the experience of Chile might be relevant in many rural areas. Chile asked for subsidy bids for giving a company a monopoly in rural areas. That is, it asked what subsidy a company would require to provide a certain level of service at a certain price in poorly served areas. It found, to its surprise, that many companies required no subsidy, but were happy to invest if they knew that their fixed costs would not be split up with other providers. If fixed costs are high (though they are dropping with Wi-Max), there may be a natural monopoly in areas with low initial levels of use, and these kinds of negotiations might provide services sooner than open competition. However, as market penetration grows, there needs to be some point at which competition is allowed. If there is a subsidy to capital investment, then competition might be feasible at the outset. While this might initially be a bit less efficient, it is likely to result in better services over time.[22]

The other element constraining the growth of productive Internet use, which has not been studied in this paper, is the lack of content. After physical connectivity at a reasonable price is available, there still has to be a reason to use the Internet. In urban areas, this often starts as e-mail, chat, gaming, news and entertainment. Long distance and international telephoning is also becoming more common as higher speed connections increase. Only gradually do e-commerce, employment, research and other "higher" uses seem to increase. However, in rural areas it is likely to be other types of sites that induce poorer people to continuing use. Examples from India suggest sites that have agricultural prices and other practical information are popular. A number of handicraft villages or cooperatives use the Internet for marketing and sales. Some sites with medical information might also prove useful if high quality services are some distance away or expensive.

Educational use of the Internet in developing nations seems relatively limited so far, though this could be due to the lack of local content. The OpenCourseWare of the Fulbright School in HCMC got nearly 100,000 downloads (not views) a month of Vietnamese materials in the last year, suggesting that if good local content is available, it might be used even without any publicity. (The MIT OpenCourseWare material tends to be skewed

[22] The mobile phone growth in Vietnam has been so rapid that a high per centage of calls get dropped – as much as a third at busy times and places. There are only two main competitors and neither has invested enough to provide adequate service. However, more providers are being admitted and regulatory pressure is requiring more capacity investment.

towards higher income countries, though the use roughly mirrors the proportions of Internet users. For example, South Asia with over 20% of world population has only 2.5% of OCW visits, but only 2.6% of global Internet users. North America, Europe and East Asia account for nearly 90% of users.[23]) It remains to be seen if the success of the Fulbright School in Vietnam can be extended to other university-level disciplines or to primary and secondary level curricula in Vietnam. In general, many current sites tend to be a one-shot effort with little new material or maintenance, and this tends to result in a sharp reduction in users after a period of time. Budgets typically allow for setting up a site but not for maintaining it, at least not adequately. Neither long-term site content support in education nor translation has been major aspects of donor focus thus far.

In summary, the Internet is growing rapidly in the three countries studied in spite of concentrated telecom operations in some. Because the Internet is seen as important, there are often political directives to the incumbent monopoly to find ways to rapidly increase use. So far, the Internet has mainly reached younger urban users and for "entry level" uses. As prices continue to fall and speed of connections rise, this urban market should become largely developed in a few years. Reaching rural users and upgrading uses in the urban group will require more thinking, experimentation, and spending on content development – and probably in local languages. Subsidies to extending service in remote or poor rural areas can be considered, though rapidly approaching wireless technologies might lower costs so much that the subsidy amounts needed may be small or zero in a few years.

[23] This comes from MIT OpenCourseWare – Program Evaluations Findings Report, March 2004.

Appendix: ***Discussion of Internet Data***

There are different sources of Internet use from each country and they are not strictly comparable. This appendix discusses the sources and qualifications for each country.

In China, there has been a semi-annual survey of Internet users since 1997 by the *China Internet Network Information Center.* The survey released in January 2004 is used in this paper. It showed nearly 80 million users, or a rate of just over 60 per 1000 population. (A "user" is someone who uses the Internet at least one hour a week.) However, it admits that someone who uses the Internet in his office and at home, or in her home and also in an Internet café would be double counted. The increase from the January 2003 survey was 20 million or 35%, using the raw numbers. Users in the January 2000 survey came to 8.9 million, so there has been a nine-fold increase in "raw" Internet users in four years. Internet penetration rates were high in Beijing (28%), Shanghai (27%), Guangdong (12%), and Tianjin (14%). They were under less than 5% of the population in many poorer provinces (Hebei, Henan, Hainan, Jiangxi, Guangxi Sichuan, Anhui, Guizhou, Shanxi Yun'nan, Tibet, Inner Mongolia, Gansu, Qinghai) and 5-10% penetration elsewhere (Chongqing, Liaoning, Heilongjiang, Jilin, Jiangsu, Zhejiang, Fujian, Shandong, Hubei, Shaanxi, Ningxia, Xinjiang).

China also collects data on the kind of connection, and the growth of broadband is astonishing – it grew from 6.6 million to 17.4 million users in the last year! Adding leased line connections (often through an office), growing from 20 to 26.6 million users and ISDN (4.3 to 5.5 million) gives high-speed connection growth from 31 million to nearly 50 million users in just one year. Clearly, this is a far greater high-speed penetration than the other nations.

Finally, there are also special in-depth surveys of users, such as that by Dr. Guo Liang at the Chinese Academy of Social Sciences. He completed a report for the Markle Foundation in 2003, interviewing net users in 12 mid-sized cities. The survey suggests that as people use the Internet for a longer period, there usage becomes more varied and sophisticated, not just chat rooms, e-mail, entertainment and games. Certainly, spot visits to Internet cafes in China show these entry level usages now predominate.

The Vietnam data come from the Vietnam Network Information Center, which has been active since 2001. It provides much less data than its Chinese counterpart, but includes the number of Internet subscriptions (1.1 million subscriptions in April 2004 with an estimated 4.4 million users – twenty times the level in 2000! By March 2005, the subscribers had jumped to 2.2 million but the users to only 6.5 million, suggesting a different method of estimating users. In 2002, the World Bank put Vietnam's Internet penetration rate at only 1.8%, only 1/4 of the 7.4% rate for December 2004.). However, the recent introduction of dialup numbers that do not require monthly subscription and of prepaid cards might count as "users" those who also connect by other means or who are only very occasional users. The VNIC also provides data on subscriptions by Internet provider. The incumbent telephone company has a 60% share. A state linked technology company has a 25% share; two others share 10% of the market and three more share the

remaining 5%. From news stories, it appears that broadband use (about 10,000 in 2003) is just starting up, with its cost at the $70 a month level in 2003, twice the US cost and about four times the cost in China which has twice Vietnam's per capita income. It is likely these costs will drop in 2004 and numbers of broadband users should multiply. Although geographic data are not generally provided, one major ISP provided some subscribers by province. About four out of five users were in a few major cities such as Hanoi, Haiphong, Ho Chi Minh City (and nearby provinces) and Da Nang/Hue. Vietnam's penetration rate (users/population) of 5% in early 2004 was about equal to China's in early 2003. With half of China's income per capita, Vietnam is closely following its penetration rate but is far behind in the speed of connections. Also, many Vietnamese appear to get their Internet connection through an Internet café. These are inexpensive and in many cities, but far less convenient than a work or home connection.

In Ukraine, there is no official source of Internet data. One firm estimate comes from a trade publication, "The Hi-Tech Navigator" for which a 2003 issue is available. It wrote that there were 1 million regular users (once a week or more) at year-end 2002, with growth rates of 40-50% expected through to 2005. This would suggest a 4% penetration rate in 2004, or just over 2 million users. They add that from 1998 to 2002, there was a 70% annual growth in the number of Internet users. Virtually all connections are dialup, and 75% of users connect through work. Over 80% of users are found in the six largest cities. A separate estimate by a commercial group (Sputnik Media) found a 12.4% penetration rate at the end of 2004, though it is not clear how often each purported user connected. DSL rollouts should start in 2004, although costs will have to come down considerably in order to be affordable.

The International Telecommunications Union produced a "World Telecommunications Development Report" in 2003 in which it developed a "digital access index." This weighted eight factors including fixed, mobile Internet and broadband penetration rates; and adult literacy, school enrollment, international bandwidth per capita and Internet access price. All three nations studied were in the "middle access" group, or the third out of four. China and Ukraine were tied at .43 (half of top nation Sweden), while Vietnam had a score of .31. The report used 2002 data. Without decomposing the weights, it is hard to evaluate the utility of the index, but the analysis in this report would suggest that the actual situation among the three nations is closer in 2004 than that index indicates, except for Broadband penetration.