Andrew Sunil Rajkumar
David Wheeler

Internet Diffusion and Electronic Commerce: Prospects for Developing Countries

Introduction

Rapid growth of Internet use in the OECD economies has raised concern about an emerging "digital divide" between rich and poor nations. Dertouzos (1997) anticipates a widening income gap if the global Internet develops under laissez-faire conditions:

> *Left to its own devices, the Information Marketplace will increase the gap between rich and poor countries and between rich and poor people.*
>
> *(Michael Dertouzos, Director, MIT Laboratory for Computer Science, 1997)*

In a recent Human Development Report, the United Nations takes an equally sober view of the prospects:

> *The network society is creating parallel communications systems: one for those with income, education and—literally—connections, giving plentiful information at low cost and high speed; the other for those without connections, blocked by high barriers of time, cost and uncertainty and dependent on outdated information. With people in these two systems living and competing side by side, the advantages of connection are overpowering. The voices and concerns of people already living in human poverty—lacking incomes, education and access to public institutions—are being increasingly marginalized. Determined efforts are needed to bring developing countries—and poor people everywhere—into the global conversation.*
>
> *(Chapter 2, "New technologies and the global race for knowledge," United Nations Human Development Report, 1999 (p.7))*

These concerns reflect the view that poor nations will lack *connectivity* -- the physical means to access the Internet and utilize it for development. This chapter draws on new evidence to argue that connectivity will become widespread during the coming decade. Internet users in the developing world are likely to outnumber those in the OECD by 2010, and their numbers will continue to expand rapidly. Although Sub-Saharan Africa will lag behind Asia and Latin America, millions of households and businesses in Africa may also have Internet access within a decade.

Unfortunately, rapid progress in connectivity may not produce any tendency toward convergence in productivity or income. Existing evidence points to strong complementarity between productive Internet use and the education, technical skills and transport infrastructure available to households and businesses. In this chapter, we focus particularly on the business side by considering the prospects for e-commerce during the coming decade. We address four principal questions:

- Can developing-country businesses use this new resource effectively?
- Will the Net level the competitive playing field, or the converse?
- How will the Net affect absolute and relative income growth in rich and poor countries?
- How can policies promote more effective use of the Net by developing-country businesses?

Section 1 uses a new study of Internet diffusion to chart the probable course of Internet use by region during the next ten years. Avoiding deterministic forecasts, we highlight the impact of policy reform on the growth of Internet use. In Section 2 we discuss its probable impact on developing-country households and businesses, and conditions for firms' effective use of the Net. We consider the partial equilibrium impact of falling information and communications costs, along with the longer-run general equilibrium impact of this new technology. Section 3 considers firm-level effects, focusing particularly on the implications of firm size, sector and location. Section 4 broadens the discussion to consider the likely impacts of Net expansion on more general patterns of development. In Section 5, we conclude the paper by providing tentative answers to the four questions posed in the Introduction.

1. Internet Growth in Developing Countries

1.1 The Current Industry View

The current consensus among industry consultants is that Internet connections will grow very rapidly in developing countries during the next decade. Figure 1.1 provides a representative forecast from Pyramid, a consulting firm affiliated with the Economist Intelligence Unit. It predicts approximate parity in OECD and developing-country users by 2010.

Figure 1.1

The forecast assumes that Internet use will grow at a much faster rate in developing countries than in the industrial nations. As Figure 1.2 shows, this implies a rapid narrowing of the digital divide in both absolute and relative terms. It also implies convergence in per capita use, since projected Internet growth rates are in the double-digit range -- greater than projected population growth by an order of magnitude. Skeptics might argue that apparent convergence in access will mask a growing disparity in available bandwidth. However, current trends suggest that new digital

communications technologies in developing countries will closely resemble their counterparts in the industrial economies. A good example is provided by digital cellular telephone systems, which we identify in Section 2 as the most rapidly-growing medium for Internet access. The key to Internet access through cellular systems is the Wireless Application Protocol (WAP). This will be embedded in every new digital cellular phone by June, 2001, according to the International Data Corporation (IDC), a leading provider of information on new digital technologies (IDC, 2000). The new digital phones will be sold in Africa, Asia and Latin America as well as in the OECD economies.

Another example is provided by low-earth-orbit (LEO) satellite systems that will start providing broadband Internet access to all points on the globe during the next two years. Consortia such as *Teledesic* (Teledesic/Boeing/Motorola) and *Skybridge* (Alcatel/Loral/Mitsubishi) will launch LEO systems capable of supporting high-speed Internet access for millions of users simultaneously. Bandwidth for *Teledesic* and *Skybridge* has been approved in a series of World Radiocommunication Conferences convened by the International Telecommunications Union. Developing countries have enthusiastically supported these initiatives because they offer the potential to leapfrog conventional technologies.[1]

Teledesic and *Skybridge* have announced no change in plans despite the financial difficulties of Motorola's *Iridium* system, whose constellation of 66 LEO satellites is now offering first-generation telephone service to all points on the globe.[2] *Iridium*'s difficulties stem, not from limited demand for such services, but from the unexpectedly-rapid onset of competitive cellular telephone service in many developing countries.

These examples suggest that businesses and households in developing countries will have rapidly-growing access to high-bandwidth Internet services, as well as the ability to purchase communications devices that will give them access to these services. In major urban centers, at least, lags of only two or three years in technology availability are now common.

Figure 1.2

1.2 Explaining Internet Diffusion in the 1990's

The Pyramid forecast is a "black box" prediction that provides no insight into the possible effects of policy reform and other development-related changes on Internet growth. To study these effects, we have developed an econometric analysis of the

[1] Teledesic and Skybridge are the two most ambitious projects, but many competitors have announced their intention to provide similar services. These include Orblink, Pentriad, Virtual Geo/VIRGO, @contact, GIPSE, Rostelesat, Spaceway, Astrolink, Cyberstar, Euroskyway, GESN, KaStar, Worldspace, Aster, V-Stream, WEST, Voicespan / Undersea Fibre, Concert, Sky Station, HALO, Platform International, and Skysat. For a complete description of commercial developments in satellite communications, see Wood (1999).

[2] For details, see Iridium (1999) and Wood (1999).

determinants of Internet diffusion in the 1990's. Our results are summarized here and discussed more fully in Appendix 1.

To date, almost all Internet users have depended on telephone lines for connection. The dependent variable in our analysis is therefore growth in the ratio of Internet subscribers to available telephone lines (I/T) for the period 1990-1997. Employing this measure of "Internet intensity," we find a remarkable similarity in Internet use patterns across developed and developing countries. In the econometric results, the estimated parameter for the lagged value of log (I/T) is almost precisely -1 (see Appendix 1). This result implies a rate of diffusion so rapid that by 1997, developing countries had completely closed the initial gap in the "autonomous" component of (I/T). However, I/T growth has also been strongly affected by the size of the urban population and a World Bank measure of national policy orientation (the more pro-competitive the policy, the higher the level of I/T). Income per capita has no effect and – equally remarkable – Sub-Saharan Africa, Asia and Latin America have *higher* I/T than the OECD countries once we control for policy and urban population. Although more developed countries tend to have more pro-competitive policies than their poorer counterparts, Figure 1.3 shows that developing countries display the full range of policy regimes.

Our results are quite robust, and they have a surprising implication: There does not seem to be any "digital divide" in the propensity to use available telephone lines to access the Internet. However, telephone lines themselves remain scarce in many developing countries. The problem lies in differential access to telecommunications, not in the use of the Internet when telecommunications are available.

Figure 1.3

1.3 Internet Access via Digital Cellular Systems, 1990 – 2010

During the 1990's, most users have accessed the Internet by connecting a PC to a telephone line via modem or, in the case of large businesses and universities, to a high-speed internal network. This practice has created the popular impression that Internet use requires a personal computer for data processing, graphics display and data storage; a phone line, a modem, a power source and a library of software. Pessimism about the potential for Net access in developing countries stems largely from the scarcity and cost of such components in developing countries. In reality, however, the Internet is a packet-switching network that can coordinate the operation of supporting components in widely-dispersed locations at zero incremental cost to the user. The rapid diffusion of digital cellular phone systems with embedded WAP circuitry means that much of the Internet's capacity can be leveraged at very low cost by households and businesses in developing countries.

In Cote d'Ivoire, for example, a plantation owner with a WAP-enabled digital phone can retrieve a free weather forecast for his area from a linked system of computers, data storage facilities, high-speed processors and satellite systems that are based in the OECD economies. He can access the latest futures prices for cocoa, coffee and bananas from

London at zero cost, and he can negotiate orders with customers anywhere in the world via free e-mail. If he needs to store and retrieve significant volumes of information, he can do so at one of numerous advertising-supported sites that offer hundreds of megabytes of free online storage. With the purchase of one small digital device and a subscription to a local cellular network, the plantation owner has an extremely valuable new business asset.

During the next few years, communications speeds via WAP-enabled cell phones will expand into ranges currently available only to users of high-speed corporate and university networks. Figure 1.4 summarizes the likely future of bandwidth available through WAP devices, along with forecasts for several competing technologies. Cable television systems may be important carriers for households and businesses in Asian cities; satellite systems will make bandwidth available in areas unserved by cable or cell phones; and, in a more speculative mode, it may prove possible to access the Internet at extremely high speeds through existing power lines.

Recent anecdotal evidence also suggests that poor, uneducated people in developing countries will be able to access this capacity, at least in rudimentary ways. In a number of pilot experiments, village handicraft workers have successfully developed international markets for their products. During the past two years, for example, village women in Lethem, Guyana have used a local Net connection to sell hand-crafted hammocks for as much as $1,000 each (Romero, 2000). A recent experiment with village e-mail in Bangladesh has shown that basic electronic communication via the Net can be profitable even in poor rural areas.[3] The Bangladesh Village Pay Phone Program has also shown that a cell phone system can be operated efficiently and profitably by very poor rural people with low levels of education (Quadir, 1998).

Figure 1.4

Figure 1.5 illustrates the rapid international diffusion of cell phone systems, which are now available in 85% of 194 member countries of the International Telecommunication Union (ITU). In many developing countries, telecommunications growth is predominantly through cell systems rather than expanded use of telephone lines.

Figure 1.5

The advent of WAP-enabled cell phones offers the potential for rapid diffusion of Internet use, since our econometric results suggest a very short lag in developing-country use of telecom connections for Net access. WAP systems are already spreading very rapidly in Japan and Western Europe. According to the Japanese Ministry of Posts and

[3] Dr. Abdul Bayes recently provided this account of the first Internet experience in Modhupur, Bangladesh to the press in Dhaka: "I met Pervin Akther (30) who came to send e-mail to her husband working in Kuwait in the UN peace force. She informed me that (since) the availability of e-mail facility in Modhupur, she has been sending 3-4 e-mail each month. Earlier she used to talk on telephone once a month. GB charges Tk.15 for a one page out going e-mail and Tk.8 for an incoming one. It costs Parvin Akther Tk.15 plus Tk.10 for rickshaw fare. The same message by phone would have cost her at least 15-20 minutes duration Tk.1200-1600 (Tk.80 per minute)."

Telecommunications, approximately 10 million Japanese users accessed the Net through mobile communications devices in May, 2000 -- an expansion to 40% of total users since the advent of wireless access (Reuters, 2000). After analyzing recent growth trends, IDC has projected over 700 million mobile Internet subscribers by 2002, significantly exceeding its projection of 500 million users who will access the Net through phone lines and wired networks (IDC, 2000).

1.4 Modeling and Forecasting Cell Phone Diffusion

To understand the future of Internet access in developing countries, we therefore need to understand the determinants of cell phone use. In a second econometric exercise, we have investigated this question for a large sample of developed and developing countries in the 1990's. The econometric results are presented in Appendix 1. To summarize briefly, we find that cell phone diffusion within countries is strongly influenced by income per capita (elasticity .78); % change in income per capita (elasticity 2.12); the size of the urban population (elasticity .78); and, again, the strength of pro-competitive policy (elasticity 1.06). In addition, our result for the initial level of cell phone use (elasticity -.84) implies extremely rapid convergence in cell phone use across countries (other things equal).

Our results suggest that cell phone use will expand very rapidly in developing countries with large urban populations, pro-competitive policy regimes, and policies that promote rapid growth in income. To investigate the potential magnitude of these effects, we have projected cell phone growth rates for the period 2000-2010 from our econometric results for the period 1990-1999. For the forecasting equation, we have adopted estimates for urban population and income in 2000 as the baseline data. To gauge the impact of very rapid development, we have set the forecast income growth rate at 5% (the upper quartile point for countries in the 1990's) and the World Bank pro-competitive policy index at a high level (5, a value currently assigned countries such as Uganda, Malawi, Botswana, Guatemala, Brazil, Peru, Philippines, Malaysia and Bangladesh (see Figure 1.3)). While we recognize that 5% annual growth in income per capita is optimistic for many developing countries, we use this figure to illustrate the potential scope for cell phone expansion.

We include projections for selected African and Latin American countries in Figures 1.6 and 1.7, along with more detailed projections by region in Table 2.1. In the two figures, we have included three projections. The first (colored blue) is a recent forecast for the World Bank by Pyramid, Ltd. The red forecast is our own baseline projection, which incorporates the country's current World Bank policy score and its actual income growth during the past decade. Finally, as we have noted above, we include an optimistic projection based on a 5% annual growth rate and a policy score of 5.

Figure 1.6

Figures 1.6 and 1.7 show that our baseline forecasts are generally close to those provided by Pyramid. The baseline forecasts represent "business as usual." Even if countries in Sub-Saharan Africa and Latin America replicate their less-than-ideal policy and growth performance of the past decade, the experience of the '90's suggests that cell phone growth will be extremely rapid: from a minimum of 10-15% annually (doubling every 4-5 years) to a maximum of 35-40% (doubling every two years). In the more optimistic policy scenario, growth rates are significantly faster in most cases: 20% or greater in most Sub-Saharan African countries, and over 50% in a few countries such as Cameroon.

Figure 1.7

Table 2.1 provides a more detailed accounting of the projection exercise for Asia, Latin America, while Table 2.2 reports results for Africa. Table 2.1 reports cell subscriber data in millions, while Table 2.2 reports the same data in thousands to facilitate comparisons among African states. Our country sample has been limited by data availability, particularly for Asia. We focus on the baseline projections, since they reflect actual growth and policy experience in the 1990's. The more optimistic projections provide an indication of the potential for rapid telecom development under more favorable conditions.

Tables 2.1, 2.2

Even the baseline projections suggest very rapid changes in all three regions during the coming decade. China dominates the Asian estimates, with projected growth from 24 million subscribers in 1998 to 102 million in 2010.[4] India has more moderate, but still impressive projected growth: from 1 million users in 1998 to 21 million in 2010. Impressive gains are also projected for the other eight Asian countries in the sample.

Our results for 18 Latin American countries[5] suggest baseline growth from 18 million cell subscribers in 1998 to 80 million in 2010. Argentina and Brazil account for considerably more than half of the total increase. More moderate gains are projected for our sample of six countries in the Middle East and North Africa: Egyptian subscribers increase from 100 thousand users in 1998 to 3 million in 2010, while Lebanese cell subscribers grow from 500 thousand to over 2 million.

In Sub-Saharan Africa, South Africa dominates the cellular subscription statistics. South African cell subscribers numbered 2.5 million in 1998, while subscribers totaled only 440 thousand in 21other Sub-Saharan countries. Our model projects much more rapid growth in the latter, however, so the baseline 2010 forecast is 3.7 million South African subscribers and 4.3 million in the other states. Cameroon, Ghana and Nigeria figure most prominently in these projections.

[4] In Table 2, China's baseline projection is higher than the "optimistic" projection because its growth rate in the 1990's was significantly higher than 5% per year.

[5] For brevity in labeling, we have included Trinidad and Tobago in this regional category.

For Sub-Saharan Africa outside of South Africa, our baseline ("conservative") projection anticipates a tenfold increase in cell phone subscribers during the coming decade. Such growth is extremely impressive by historical standards, and particularly for telecommunications infrastructure in Africa. In Nigeria, our model projects over 700,000 cell phone subscribers by 2010: a 37-fold increase in ten years. However, Nigeria's projected population for 2010 is 166 million.[6] Even after a huge increase in cell phone use, subscribers will be less than one percent of the population. Of course, this does not imply that only one percent of Nigerians will have access to cell phones. In the Bangladesh Village Pay Phone program, provision of one cell phone per village has given hundreds of people access to each unit.

Nevertheless, the baseline forecasts for Nigeria and the other Sub-Saharan states are obviously not large by OECD standards. At least another decade of extremely rapid diffusion would be required for true convergence to become a reality, even under optimistic assumptions. To illustrate this, the last column in Table 2.2 provides an estimate of cell phones per capita in 2010 under the optimistic assumption that the Sub-Saharan economies manage 5% annual growth in per capita income and pro-competitive policy ratings of 5. Even in this case, only a few countries are near current OECD-level use rates by 2010. Botswana (38%), Cameroon (23%), Ghana (11%) and Namibia (10%).

In Latin America, by contrast, the optimistic projections for 2010 yield penetration rates that are generally comparable with current rates in the OECD. Particularly striking examples are provided by Argentina (69%), Uruguay (73%) and Chile (50%). Brazil's forecast is 32%, but this reflects a huge user base (62 million, up from 8 million in 1998).

1.5 Summary of Results

We began this section with an econometric analysis of cross-country Internet use. Our results suggest that convergence in (I/T) has already occurred: Given the availability of telephone lines, households and businesses in all countries are revealed to have about the same Internet use propensity, once we control for the scale of urban population and the local policy regime. Internet use is still lagging badly in developing countries, however, because they are far from convergence in T (telephone lines). Given the glacial pace of mainline expansion in many developing countries, the prospects for overcoming the "digital divide" would be poor indeed if Internet use remained dependent on this medium alone.

Fortunately, the evidence suggests that this dependency will erode very rapidly during the next ten years: Cable, satellite and cellular phone systems promise to provide viable alternatives for Internet access. In many countries, the rapid diffusion of WAP-enabled cell phones seems to offer the best prospect for increased Internet access. For this reason, and because cell phone data are plentiful, we have focused our econometric

[6] To project population in 2010, we have used population growth rates for 1990-97 reported by the World Development Report.

analysis on the determinants of cell phone diffusion. At the same time, we recognize that many millions of households and businesses are likely to access the Internet through cable television systems in heavily-urbanized societies such as India and China. Satellite systems (and, possibly, power-grid transmission systems) appear promising but speculative at this stage. In any case, our cell phone diffusion estimates provide a very conservative basis for projecting the potential for Internet access in many developing countries.

While we project very rapid expansion of WAP-enabled cell phones,[7] the implied penetration rates will remain modest for most developing regions. Even in our optimistic scenario, the rates are 7% in China, 3% in India and the rest of South Asia, 4% in Sub-Saharan Africa outside South Africa, and 11% in the Middle East and North Africa. Only in the NIC's of East Asia and South America do projected penetration rates reach OECD levels, with the most impressive rates projected for Korea (70%), Argentina (69%) and Uruguay (73%). In South Africa, penetration reaches 31% under optimistic assumptions.

While penetration rates will remain modest, they offer the potential for a very rapid increase in the absolute number of businesses and households that can access the Internet. By 2010, the numbers suggest potential access for many hundreds of thousands of small and medium enterprises in Latin America and Asia. In Sub-Saharan Africa, even the baseline projections offer the prospect of access for tens of thousands of firms that currently have no connection to the Net. At the very least, the rapid diffusion of telecommunications technology should offer provide a potential platform for rapid enterprise growth in some sectors. However, access to the Net will not, by itself, assure rapid growth of e-commerce for developing-country businesses. In the following sections of this report, we discuss the key growth issues for developing-country firms that gain access to the Internet during the next ten years.

2. The Impact of Internet Use by Households and Businesses

In Section 1, we have summarized an econometric study that projects very rapid expansion of cell phone use and Internet access in developing countries during the coming decade. Furthermore, rapid growth in bandwidth for Internet access devices means that many thousands of developing-country households and businesses will be closer to their OECD counterparts in their ability to access the full power of the Net.

For developing-country households with relatively high education levels, access to the Net will offer entertainment, information and education services that are similar to those currently enjoyed by connected households in the OECD economies. However, local benefits will be strongly affected by the availability of local information services in local languages. Rapid development of such services is evident in India, China and Latin America, where the relevant skills are widely available at low cost and new services can

[7] As we noted previously, the IDC has projected that all cell phones shipped after 2002 will be WAP-enabled.

profit from the existence of large, literate urban populations. These conditions are not met in many developing regions, where the main value of Net access may be limited to e-mail and free telephone services during the coming decade. However, evidence from South Asia (Quadir (1999) on e-mail in Bangladesh; Pitroda (1993) on telephone service in India) suggests that even such "basic" services will be highly valued. In the long run, it is quite possible that the Net's greatest social, economic and political impact on poor households will come from the broadening of access to the "universal library" of digital information. This will include books, journals and newspapers, as well as recorded music and broadcasts from a large number of radio and television stations.

For businesses, the financial impact of Internet use seems likely to depend on the complementary resources available. The evidence to date suggests that the Net, as a relatively advanced information factor, is complementary with capital, technical skill and high-level human resources. Conversely, it is a substitute for unskilled labor, raw materials and energy. From these relationships, it is possible to deduce the partial equilibrium impact of a rapid fall in the cost of accessing the Net: It should lead to increased relative demand for capital and skilled labor and a decreased relative demand for basic labor, raw materials and energy. While general cost savings may well expand demand for all inputs, demand for the former group seems likely to expand more quickly.

If these relations hold, then the partial equilibrium impact of the Net should be to maintain or widen the gap in productivity between developed and developing country firms, and maintain or widen the existing income advantage for owners of capital and high-level skills. We will return to this issue in Section 4.

For businesses, cost savings associated with Net use may depend critically on sectoral characteristics. Since the Net purveys high volumes of information in digital form, its most powerful effects should be on information-related activities. It should have major impacts on search costs for buyers and sellers, transport costs for pure information goods (music, books, software, etc.) and transactions costs associated with order delays, etc. Savings in these categories should translate to significant cost reductions for buyers and sellers in highly differentiated product markets; producers and consumers of pure information goods; and transactors with very high time opportunity costs (e.g. stock brokers).

While the partial equilibrium impact of Net use seems likely to improve the relative status of producers and consumers in developed economies, the general equilibrium impact offers more hope for their counterparts in developing countries. As search costs fall, equilibrium levels of product differentiation should rise because it will be easier for buyers to search more categories, and for sellers to advertise broader sets of offerings. For craft products, specialty furniture, and other goods with high labor content, the result should be a boom in demand for new products from low-wage countries. The same reasoning applies to labor-intensive pure information goods such as music, standard software products, animated video productions, etc. Within developing countries, the advent of much broader Net access should reduce the role of middlemen who have

profited from poor communications to extract a substantial share of value added in a variety of marketing activities

--------- Revised Section 3 to go here ----------

4. Impacts on Development

In the previous sections, we have considered the probable rate of Internet diffusion in developing countries and the associated prospects for B2B e-commerce. In this section, we broaden the discussion to consider more general impacts on development. Our approach is unavoidably speculative, since empirical research on the Internet and economic development is only beginning.

The preceding discussion has suggested that rapid growth of Internet use will stimulate a repartition of the value chain between producers and emerging electronic networks. Traditional middlemen seem almost certain to lose share in both developed and developing countries; network operators will gain share (predominantly in economies with high-quality information infrastructure). Changes in benefits for buyers and sellers may depend on the network relationship. Current evidence suggests that the use of the Internet in traditional supply networks may have differential benefits for the large firms that buy inputs in these networks. Confronting far lower search and intermediation costs, these firms are in a better position to foster price competition among their suppliers. Traditional suppliers in developing countries may find their share of value added falling in this new relationship, although the overall impact of the Internet should raise product demand sufficiently to ward off any absolute losses. Of course, such losses may well be incurred by firms that are no longer included in supplier networks because they are relatively inefficient.

In emerging B2B sites such as Alibaba, by contrast, the situation may be quite different. Such sites offer small and medium firms the opportunity for new participation in transactions beyond their home regions. In effect, the new sites replicate some of the advantages of scale that have previously been enjoyed by large multinational firms. Because they have the potential to includes much larger numbers of buyers and sellers, the new sites may emerge as a major threat to incumbent supplier networks in the coming years. Ultimately, large firms may find that their best option is to drop the limited options available in their established networks in favor of a larger, less-costly set of opportunities in the new middleman sites.

4.1 Impact on Investment Flows

In Section 2, we provided an overview of the basic microeconomics of Internet use. Given the apparent complementary of the Net with capital and skill, its primary impact should be to increase the demand for (and relative price of) these factors. At the same time, relative profitability should decline for homogeneous goods that are intensive in unskilled labor and raw materials. One unfortunate implication may be an increase in the relative rate of return to investment in developed economies. Investment statistics for the

1990's are consistent with this conclusion, although many other factors could be cited to explain recent trends. Figure 4.1 displays the world foreign investment share of the OECD economies during the 1990's. The latter part of the decade has witnessed a striking reversal of the previous trend toward falling share.

Figure 4.1

Many factors are at work in this picture, of course. But the advent of the Internet has been a sufficiently powerful market force in the latter 1990's that its impact on expected profitability must have played some role. Rapid diffusion of the Internet to developing countries may ameliorate this picture, but the basic complementarity between the Net, capital and skills makes it unlikely that diffusion will do more than stabilize developing-country investment at a lower share. Of course, the current boom in equity values suggests that the Internet has had a strong general impact on expected profitability. Thus, while differential profitability may generate a larger investment share for the developed economies, an overall increase in investment may well lead to larger absolute investment flows into developing economies.

4.2 Impact on Incomes

We can extend the previous argument by asserting that the rapid diffusion of Internet use, with attendant cost savings and creation of new business opportunities, seems likely to generate significant income gains at almost all points in the international economy. For developing countries, the strongest gains may come from export expansion in labor-intensive, differentiated products with high signals content (e.g. handicrafts, art, music, virtual tourism, pornography, and remote processing of routine information). Strong benefits will certainly be realized through lower-cost educational and information services, as it becomes possible for households everywhere to access the "world library" and distance learning services from many educational institutions. In addition, they will benefit from cost reductions in manufactured imports associated with widespread Internet use.

The extremely rapid diffusion of the Internet suggests that it will have a large, positive impact on household incomes in both developed and developing countries. However, its impact on relative incomes seems likely to be far less progressive. The ratio of incremental gains from net use in developed and developing economies will be a function of the price and/or quality of complementary factors such as technical skills, transport infrastructure and well-functioning market and regulatory institutions. Although the Net may have a positive long-run impact on all these factors in developing countries, it seems likely to provide considerably more leverage to developed-country households and businesses in the near term.

5. Conclusions

We began this report with four questions about the impact of the Internet on the prospects for developing countries. In the conclusion, we will use the report's major findings to suggest some tentative answers.

1). Can developing-country businesses use this new resource effectively?

Our results in Section 1 suggest a strongly affirmative answer: All evidence points to extremely rapid expansion of Internet use in developing countries and a rapid narrowing of the access component of the "digital divide."

2). Will the Net level the competitive field for developing-country firms?

Our results suggest that the Net is likely to reduce suppliers' opportunities for "inside" transactions with incumbents through traditional supply networks. However, new networks are rapidly increasing the scope for "outside" transactions. The overall result should be expanded business opportunities for developing-country producers but reduced opportunities for developing-country middlemen.

3). How will the Net affect absolute and relative income growth in rich and poor countries?

Our findings suggest that Net use will significantly increase incomes in both rich and poor countries, but relative incomes in developing countries will probably remain stable or fall (other things equal) unless there are rapid improvements in the quality of complementary factors (education, technical skills, transport infrastructure, administrative/regulatory institutions). The traditional development agenda remains very important in the digital age.

4). How can feasible policies affect this result?

Obviously, connectivity is critical: Direct promotion of rapid net expansion will yield a high social rate of return. In addition, our econometric results suggest that pro-competitive policies will strongly accelerate adoption of supporting cell phone systems and the intensity with which these systems are exploited for Internet use. Our results also show that more general policies that promote rapid growth will accelerate adoption of supporting communication technologies.

Development of complementary factors will be highly important for effective Internet use. The new opportunities therefore put an additional premium on rapid expansion of secondary education and basic technology training. Complementary improvements in transport infrastructure will be critical for profiting from increased opportunities in physical goods production. In addition, subsidized promotion of locally-produced pure information goods (e.g. indigenous crafts and music) may be socially profitable because potential markets will be much larger in worldwide electronic distribution networks.

Finally, our results are cautionary about the urban/rural divide in developing countries. Both telecommunications diffusion and the accompanying Net use are considerably faster in countries with large urban populations. Although satellite and cell networks will enhance the prospects for low-cost access to the Internet in rural areas, differential costs seem likely to generate a strong advantage for urban residents unless cross-subsidy arrangements are directed toward parity in access.

References

Dertouzos, M., 1997, **What Will Be: How the New World of Information Will Change Our Lives** (New York: HarperEdge).

Goldman Sachs, 1999, "B2B: 2B or Not 2B? Version 1.1," Goldman Sachs Investment Research (E-Commerce/Internet), Goldman Sachs, New York.

IDC, 2000, "Mobile Access to Internet Gains Momentum," IDC Forecaster Newsletter, March 21.

Iridium, 1999, consortium Webpage at www.iridium.com.

Organization for Economic Cooperation and Development (OECD), 1999, "The Economic and Social Impacts of Electronic Commerce: Preliminary Findings and Research Agenda. Main Report," OECD, Paris.

Quadir, I. Z., 1998, "Connecting Bangladeshi Villages," paper presented to the conference, "Partnerships and Participation in Telecommunication for Rural Development: Exploring What Works and Why," School of Rural Extension Studies, University of Guelph, Guelph, Ontario, Canada, October 26-27.

Reuters, 2000, "It's a Wireless World in Japan," June 20.

Romero, S., "Weavers go Dot-Com, and Elders Move In," New York Times, March 28.

The Economist, 1999, "A Survey of Business and the Internet." June 26th-July 2nd issue, "The Economist" Company, London.

The Economist, 2000, "Business-to-Business Exchanges: A Market for Monopoly?" June 17th-23rd issues, "The Economist" Company, London.

Washington Post, 2000, "The Wired Economy: A Special Section," April 5.

Wood, L., 1999, "Lloyd's Satellite Constellations," Internet Website (www.ee.surrey.ac.uk/Personal/L.Wood/constellations/overview.html).