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The Internet and Economic Growth in Least Developed Countries

A Case of Managing Expectations?

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Abstract

A discussion of the theory of technology and economic growth suggests potentially negative implications for the impact of the Internet on developing countries. Technology in general is undoubtedly central to the growth process, but economists define technology in very broad terms. The impact of any particular, invented, technology is likely to be small. This theoretical perspective is supported by the empirical evidence regarding the limited impact of past 'information revolutions' on least developed countries (LDCs) and the present impact of the Internet on advanced economies. Furthermore, LDCs appear ill-prepared to benefit from those opportunities that the Internet does present—they lack the physical and human capital, along with the institutions required to exploit the e-economy. Finally, even more optimistic forecasts of the Internet's global economic impact are small in scale compared to the challenge of development. This has some significant implications for development policy.

Keywords: Internet, economic growth, developing countries

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1 Introduction

The hope is widespread that the Internet will provide a powerful new tool in the battle against global poverty. These sentiments were echoed in the G-8's recent Charter on the Global Information Society that declared:

> Information and Communications Technology (IT) is one of the most potent forces in shaping the twenty-first century ... IT is fast becoming a vital engine of growth for the world economy ... Enormous opportunities are there to be seized and shared by us all (G-8 2000).

To back these claims, there is mounting anecdotal, econometric and theoretical support for the role of information technology in growth and development. This paper does not dispute such evidence. Because of the scale of the improvement over previous communications tools, the invention of the Internet might lead to a significant impact on growth through better functioning of markets and firms. Added to such effects are those working within the sector itself—in particular the impact of network externalities, whereby the value of a connection to a network such as the telephone or Internet rises as others join the network. Beyond the theoretical, the increasing power for a given cost of computers has shown up significantly in US productivity figures. Businesses and jobs have been created, economies have gained, schools have acquired new pedagogical tools, NGOs and pressure groups have exploited the technology to further agendas. And it is likely that this impact will grow worldwide.

This paper does take a slightly more sceptical look at the likely impact of the Internet on long-term economic growth rates in developing countries, however. It is, of course, too early for there to be any firm answers about the relationship between the Internet and economic development in LDCs,[1] but this paper attempts to suggest likely orders of magnitude for such an impact. The results of such an exercise are perhaps worrying for those pinning LDC growth prospects on ICT rollout.

The paper is divided into four sections: a discussion of the theoretical role of technology in growth and the theoretical case for the Internet as a growth-inducing technology; evidence of the Internet's impact on growth rates in the US and OECD; the appropriateness of the Internet as a growth-promoting technology for LDCs; and estimates of future impacts in LDCs and a look at the past impact of individual communications technologies on worldwide growth rates.

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[1] For example, cross-country econometric evidence on the impact of the Internet itself on economic growth or firm productivity is sparse to non-existent given the fact that the technology is so young. Altig and Rupert (1999) try a novel approach, estimating the impact of 1999 Internet users as a percentage of population on GDP growth between 1974-92 controlling for 1950 income per capita (from this, they estimate that 100 per cent Internet usage would be associated with about 4 per cent per annum additional economic growth). Concerns over the direction of causality in this study must throw some doubt on their conclusions, however.

2 Theories of economic growth: Does technology cause growth? Is the Internet a likely candidate?

The Internet is a highly efficient tool for transferring information—email, for example, is cheaper than a telephone call, leaves an electronic record and can be 'broadcast' simultaneously to many recipients. Further, the Internet is a technology which benefits from network externalities—my use of the system increases its value to others, by providing another partner in the web information transfer.

The Internet appears a good candidate as a technology that causes growth, then. And given that most recent theories of economic growth suggest a significant role for technological change (differing rates of broad technological adaptation are, for example, the driving force behind divergence in Romer's (1990) popular model), the impact of the Internet on growth might be substantial.

The definition of 'technology' used by Romer or by growth accountants in general spreads far beyond 'physical things that are invented,' however. This is because, especially in most empirical discussions of economic growth, the impact of 'technology' is measured through estimates of total factor productivity (TFP). Growth accounting procedures measure increases in stocks of physical capital (the quantity of assets such as factories and roads measured by their dollar value), of human capital (the education stock, usually measured by average years of schooling) and of labour (measured in numbers of people of working age). The procedures then estimate how much output growth can be 'expected' from such increases in capital and labour stocks. Total factor productivity (TFP) is defined as the actual measured growth of output minus the growth rate expected from increases in capital and labour stocks. As a measure of the efficiency with which capital and labour are combined to produce output, TFP is calculated as the residual from a growth accounting exercise.[2]

As such, as well as new inventions, 'technology' as defined by growth accountants includes 'business technology' (management techniques and systems) 'political technology' (forms of government and institutions) and 'social technology' (modes of human interaction)—indeed, it includes everything that might affect output which isn't

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[2] 'Technology' as defined by TFP is open to a wide range of assumptions about the importance of various factors to output that can dramatically alter its aggregate size, then. Calculating the scale of TFP growth is a process laden with more or less arbitrary decisions that can dramatically alter results. Depending what is defined as 'physical capital,' (and what we define as the labor stock), how we measure the growth of the stock of capital, what we measure as 'human capital,' whether we include measures of 'natural capital' or 'social capital,' what (if any) allowances we make for technological change 'embodied' in capital investment, or market failures such as scale effects, whether we believe that capital can be substituted for labour one-for-one, what share we give to human over physical capital in output estimates and a range of other more-or-less arbitrary assumptions, we can come up with markedly different estimates for the residual from a growth accounting equation which is defined as 'total factor productivity'. For example, one recent study looked at the impact of changing just two of these assumptions within reasonable bounds on long-term TFP growth in Korea, and produced estimates of annual growth 1960-97 that ranged between 3.0 per cent of GDP and -1.4 per cent (The two were assumptions about returns to scale and shares of physical and human capital) (Ghosh and Kraay 2000). This sensitivity of technology's estimated impact on growth to a range of more or less arbitrary assumptions is why, for example, the extent to which it has been important in practice in regions like East Asia remains hotly debated. Felipe (1999) concludes his survey of TFP growth and capital accumulation in East Asia by noting 'this work has become a war of figures ... It seems that re-working the data one can show almost anything'.

physical (and sometimes educational) capital or labour, including factors such as market power, increasing returns, technical complementarities, excess capacity, unmeasured fluctuations in work effort and hours, and other errors in measurement.

Because 'technology' as defined by TFP equations is very broad, including far more than technology 'embodied' in physical capital, it might be that the effect of each individual technological advance is small and/or that other types of technology are more important for sustained growth than 'formally' invented, embodied (physical), technologies such as the Internet. Indeed, Paul Romer argues that 'technologies' such as Wal-Mart's management of inventory data—not invented under an R&D programme—are probably more significant than inventions such as the transistor (Perkins and Perkins 1999). The Internet might also have less impact than the invention of 'just in time' management, for example.[3]

Thus, technology 'broadly defined' as it is in TFP calculations covers a multitude of factors beyond 'inventions,' such as the Internet policies, institutions, social relationships, and these other factors might be more important in determining growth than all inventions, let alone the impact of just one such as the Internet. This paper now turns to evidence from the United States and the OECD regarding the impact of computers in general and the Internet in particular on economic growth.

3 Evidence on computers, the Internet and economic growth in the US and OECD

This section will briefly review the evidence linking an uptick in TFP in the United States in the last few years to the expansion in computer use and utility, and will evaluate the likely future productivity impact of the Internet. It concludes that there is evidence for a link, but not for significant spillovers (TFP increases outside the computer manufacturing sector) necessary for computers to have a major impact on long-term growth rates.

At the micro level, Lehr and Lichtenberg (1999) claim there have been excess returns to investments in computers across a range of industries compared to other types of capital (in the US), especially in the presence of skilled labour. Further, some argue that the impact of the IT revolution is at last beginning to be felt at the macro level. A recent 'survey of surveys' (Pohjola 1998) concluded that in the 1980s and the early 1990s, the consistent finding was that there was a broadly negative correlation between IT investment and economy-wide productivity in the United States. A few studies in the late 1990s began to reverse this conclusion, however. Some of the more optimistic studies looking at the 1996-99 period suggest that computer hardware is responsible for between 0.49 to 0.82 per cent of US output growth in that period, and a significant percentage of productivity improvements (see Yusuf 2000).

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3 One reason to believe that technologies like the Internet that are traditionally 'researched and developed' cannot be a central cause of the process of economic growth is that the number of scientists and engineers employed in R&D in the US has increased fivefold 1950-90, while US growth rates have fallen over that period (Keely and Quah 1998).

This evidence has been disputed, however. 'Excess' micro-level returns apparently disappear when other factors, including company reorganization, are taken into account (David 2000).[4] Robert Gordon (2000) presents macro evidence that computers and the Internet do not represent a dramatic leap forward in productivity outside the durables manufacturing sector. He disaggregates the recent uptick of 1.35 per cent in US TFP growth into 0.54 per cent of cyclical effects and 0.81 per cent of trend growth accounted for by the durable manufacturing sector—including computers, peripherals and telecommunications.[5] In the 88 per cent of the private economy outside of durables, TFP growth has actually *decelerated*—suggesting that there is no evidence of a spillover effect from computers.

Looking at labour productivity over a slightly longer span, IT-intensive industries outside the IT sector itself are some of the worst performing.[6] America's TFP change has averaged around 4 per cent in mining over the 1987-97 period, compared to close to -4 per cent per year in the banking sector; this despite the fact that IT spending as a percentage of output was highest in banking amongst the industries covered and second lowest (after construction) in mining (*Economist*, 23 September 2000).[7] This all suggests the 'Solow paradox'—widespread evidence of computer use, little evidence of (widespread) productivity growth—continues, at least in modified form.

It should also be a concern that the share of ICTs in capital stock is fairly significant in a number of other OECD countries, and yet they have seen no increase in productivity. Broadly, the evidence from a recent study of OECD countries by Paul Schreyer (2000) finds that, as with the United States, ICT capital goods have seen rapid improvements in the ratio of price to performance and as a result there has been a significant substitution of ICT capital for other types of capital and labour inputs. ITC's share of nominal productive capital stock increased from 2.4 to 3.2 per cent in France, 1.2 to 2.3 in Japan, and 3.6 to 5.2 in the UK in the 1985-96 period (compared to 6.2 to 7.4 in the US). However, there is no evidence that in the 1985-96 period there was the increase in TFP growth that would be expected in OECD countries if there were spillovers from ICT investment. The UK, with the second largest share of ICT in total capital stock behind the US, has actually seen a productivity *slowdown* in the last few years (Bank of England 1999).

Regarding the Internet in particular, the US productivity uptake's timing was too early to be accounted for by e-commerce (*contra* Nezu 2000). In 1995, one estimate (from NUA, at www.nua.ie) suggests that sales generated by the WorldWideWeb in that year

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4 Greenan, Mairess and Topiol-Bensaid (2001) find no evidence of increasing computerization and R&D over time having a significant impact on firm performance.

5 Even this uptick within the durable goods sector is, in part, the result of measurement bias (see Schreyer 2000).

6 Gross product originating per worker in IT-using goods and services fell an average of 0.1 per cent 1990-97, compared to a 1.1 per cent rise in non-IT intensive industries (Department of Commerce 1999).

7 See also Stiroh (1998) for a similar result.

were but US$436 million. Even in 1998, e-transactions were only worth US$43 billion (*Economist*, 24 July 1999), or equivalent to 0.5 per cent of US GDP.[8]

Again, because of the broad definition of TFP, a number of other factors could be behind the recent improvement in economic performance and what limited uptick in TFP outside the durable manufacturing sector there might have been. Perhaps it is the result of the strong dollar, unrecorded increased labour, better monetary and fiscal policies, cheap commodities, the strength of Wall Street, low pressure on non-wage labour costs, the Asian crisis, or unsustainable corporate and consumer borrowing

For the future, there are many bold predictions. As a result of developing Internet-based applications for company procedures, Oracle plans to cut US$2 billion out of US$7 billion of global corporate expenses, for example (*Economist*, 11 November 2000). The empirical evidence to date has been less reassuring, however. Roberti (2001) notes that savings from companies that have moved earlier and more aggressively to the web have been smaller than expected. IBM, for example, bought US$27.7 billion dollars of goods electronically in the first three quarters of 2000 and saved but US$247 million (or a little under one per cent) by doing so. On the sales side, 66 million customer service transactions were handled via IBM.com, but the headcount in call centres has remained exactly the same.

More sober evaluations of the real potential gains to e-commerce might account for the collapse in e-commerce growth—between 1998 and the end of 2000, the FEI/Duke Corporate Outlook Survey (www.duke.edu/~jgraham) suggests that the percentage of sales made online by surveyed companies remained unchanged at 5 per cent.

All of this evidence suggests that the impact of the Internet to date at the micro level has been marginal. A specific example of a widely-used technology over which the Internet is but a marginal evolutionary advance is electronic data interchange (EDI). EDI systems use proprietary software to connect purchaser's and suppliers' computers to automate transaction and processing exchange. Such systems are already estimated to support about US$3 trillion in economic activity in the US alone. While Internet-based systems are estimated to have operating costs of about 1 per cent of EDI systems, the cost of conversion to Internet-based systems is itself high enough to have discouraged the bulk of EDI users from so far switching to the Internet (World Bank 2000). This suggests that the marginal improvement of using the Internet over EDI is in fact not that large.[9]

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8 The productivity impact was also surprisingly late to be credited to straightforward computer investments. Already by 1990, 28 per cent of business expenditure on equipment was on hardware. Overall, corporations spent US$1.1 trillion on computer hardware between 1990-96, yet productivity grew by only 0.8 per cent per year (Perkins and Perkins 1999). The slowing of growth in the nominal share of computers in the economy suggests some macro evidence of a declining marginal return to computer ownership coinciding with the expansion of the Internet. The nominal share of computer hardware in the economy rose rapidly *before* 1997. Growth since 1997 has continued the unit-elastic response to the decline in computer prices prevalent prior to 1995—the share of nominal spending on computers has been stable since 1997 (Gordon 2000). Recent figures suggest that growth might have slowed even below that. Company IT budget growth in the US might slip below 5 per cent this year from about 11 per cent in 2000 (*Financial Times*, 4 January 2001).

9 To take an example on the B2C side, forecasters' estimates for B2C e-commerce growth suggest that it might reach 10 per cent of the total retail market by 2003—this is still less than today's share of

At the macro level, returns might be even lower than company-level returns because of two negative externalities linked to e-commerce sites. First, the Internet allows businesses to force other companies and individuals to perform part of the service previously provided by the newly networked business. For example, Expedia.com encourages the customer to search for cheaper flights through the air ticket database rather than its travel agents. This leads to savings for Expedia, but does not necessarily increase economic efficiency.

Second, and perhaps of greater concern to LDC companies with less access to the new technologies, micro studies might find supra-normal returns to investment absent in macro studies because Internet investment (by, for example, Borders.com) involves defending market share (against Amazon.com)—so that social returns to this investment are lower than private returns.[10]

The above discussion suggests at least two concerns for LDCs. First, if there is limited evidence of a past spillover impact of investment in computers and the Internet on economic growth in the US, and the case for a dramatic increase in productivity in the future is at least mixed, this suggests any benefits from the Internet in LDCs are likely to be greatly delayed and comparatively small. As we shall see, access to the capital required to use the Internet is very limited in LDCs; present use is a fraction of that in the developed world, and this is a state of affairs unlikely to change significantly in the near term. In other words, the present level of usage in the United States is not promoting growth, and this level of usage is already far higher than can be expected in developing countries for many years to come.

A second reason for concern is that the discussion above suggests that, in the US, moving online *has* become important to protect market share. If this becomes true on a global level, those companies least equipped to move online are likely to lose market share to those better-placed. It is likely that the least-equipped companies will be concentrated in the developing world.

4 The Internet in LDCs

Turning back to the production of IT, as we have noted, this is the one sector of the US economy that has seen undoubted productivity gains. However, it is not a sector that is prevalent in many developing countries. That the picture is not totally bleak is proven by the fact that high technology exports account for 28 per cent of East Asia's manufacturing exports. There is also the example of India's thriving IT export industry. But India is very much the exception, and most LDCs import far more high technology equipment and services than they export. The ITU estimates that exports of telecommunications equipment are only worth 8 per cent of imports of such equipment in low-income and 40 per cent of imports in middle-income countries, for example (ITU

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mail-order catalogues (Almasy and Wise 2000), which, for many, must be a reasonably good substitute.

10 Winners in the battle for market share become 'supersites', which dominate the web. This has already occurred in the case of news sites, for example, where the top three sites (MSNBC, CNN and the New York Times) account for 72 per cent of all news site visits on the web (*New York Times*, 29 August 2001).

2000). Overall, low-income countries are responsible for but 0.3 per cent of the world's high-technology exports.

A related phenomenon is that LDCs have far lower expenditures on developing new technologies. Expenditure on R&D in low-income countries combined totalled approximately US$5 billion in 1999, compared to the figure for the US alone of US$234 billion. Not surprisingly, this translates into OECD dominance of world patent applications. Some 1,114,400 patent applications were filed in low-income countries in 1998. Under 10,000 of these applications—or under one per cent—were filed by residents. In turn, royalty and license fee payments by low-income countries were nine times royalty receipts, whereas in the US, royalty receipts were 2.7 times payments (calculated from World Bank 2001).

These are significant figures because it appears that the major profits in the IT sector are made by patent owners rather than licensees (suggested by the fact that US companies produce 56 per cent of the revenues yet garner 96 per cent of the profits from the global IT industry [Heeks and Kenny 2001]). Perhaps because of this, evidence from LDCs with significant IT industries does not suggest a productivity impact from that industry of the kind seen in the US. East Asia, the developing region with the largest IT industry, suggests no correlation between the proportion of high-tech exports in total exports and productivity growth (APEC 2001). Overall, LDCs are largely importing goods in the IT sectors, not inventing or even producing them. Given this is where the profits and productivity increases of the Internet revolution appear to be concentrated, this is a significant problem.

Turning to the potential spillover effects and wider productivity gains from use that proponents suggest will provide the more significant long-term impact of the Internet, LDCs appear in a weaker position to garner these benefits, as well. First is the simple question of access to the network. Most producers and consumers in the US had telephone and computer access prior to the expansion of the Internet, making the cost of connectivity the purchase of a modem and an ISP account marginal. In LDCs, the picture is markedly different. Telephone lines per capita average 2.6 per 100 people in low-income countries as compared to 66.4 in the United States. Albouy (1999) estimates that about 2 billion people, the vast majority in LDCs, lack access to electricity (in rural Tanzania, it is 99.2 per cent of the population). Computer ownership is 4.4 per thousand people in low-income economies compared to 511 per thousand in the US (calculated from World Bank 2001).

Further, while technological change is making both network and computer access cheaper, serving LDC populations will remain more expensive than serving OECD populations. Fifty-nine per cent of the population in low- and middle-income countries are rural, compared to 24 per cent in high-income economies. It is more expensive to provide networked services such as electricity and telephony to rural areas because the amount of infrastructure required per customer is higher than in urban areas. The physical costs of computer and telephone access are unlikely to drop below US$1,000 even in relatively population-dense rural areas with electricity access (Kenny 2002). In low-density areas without networked services, costs of Internet infrastructure can rise as high as US$20,000 per computer.[11] Not only is this more than 38 times the average

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11 These are the costs reached in a rural access programme in Costa Rica discussed by Shakeel *et al.* 2001).

income per capita of low-income countries, it also suggests that Internet infrastructure investments in LDCs will generate lower returns in terms of network access than they do in the OECD (where costs are far less). In turn, this might suggest lower returns to investment in terms of economic impact, as well.

Physical access, however, is but the first, and perhaps least significant barrier to exploitation of the new technology. This is suggested by low Internet usage rates even where access is available in developing countries. For example, Pigato (2001) finds in a survey of Tanzanian firms that computer usage remains very low even in firms that own a computer (only about 20 per cent had actually computerized basic business functions such as invoicing). Internet use was also low; amongst the 30 per cent who had access, less than half used it frequently and only 13 per cent rated it as an effective product promotion tool. Even in wealthier countries in East Asia, while over 90 per cent of the populations of Korea, Singapore and Hong Kong know where to access the Internet if they choose to, only one third to one half of the populations of these countries actually use the technology (calculated from Rose 2001).[12]

The non-physical costs of Internet use might help to explain these numbers. David (2000) estimates that in the US, only 10 per cent of the cost of computer ownership to a company is accounted for by the purchase of the physical equipment itself—the other 90 per cent is made up of factors such as training and support. Where human capital is rare, these non-physical costs use are likely to be an even more significant barrier to use. General education, specific technical and language skills and the broader institutional environment are all factors that might explain low usage rates.

Turning first to education, evidence from both the US and India suggests that those benefiting most from IT investments are the better educated and more highly skilled—who are being hired in greater numbers and increasing their pay differentials over unskilled, less educated colleagues (Autor, Katz and Kreuger 1998; Lal 1996). And the great majority of users in the developing world are from the most educated sector of the population (in Ethiopia, 98 per cent of Internet users had a university degree in 1998 [CABECA 1998]). Yet, the stock of 'tertiary human capital' in LDCs, on average and as a percentage of US stocks, is about as small as the stock of physical capital (Heeks and Kenny 2001). Advanced education—of the greatest value in a 'global knowledge economy'—is rare in LDCs. Indeed, approximately one third of adults in low-income countries cannot even read, a vital skill for meaningful use of the Internet.

Looking more specifically at skills related to the Internet, the technical skills gap is frequently highlighted as at least as serious barrier to Internet use as lack of access to the Internet itself (G-8 2000). The extent to which basic computer skills are lacking in LDCs is suggested by a report from Wa in Northern Ghana that locals trained in computer skills and management could fetch US$6,000 per year—this in a country with an average GNP per capita of US$390 (Hirsch 1998). Further, these skills gaps are likely to remain in the population at large—not least because, with per-student discretionary expenditures in secondary schools running as low as twelve dollars a year,

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12 As a further example regarding more advanced use of the Internet, connectivity is already common in Argentine and Chilean firms—60 per cent of (non-micro) enterprises in Chile are connected to the Internet as well as 87 per cent of Argentina's SMEs. Nonetheless, only 15 per cent of Chilean firms have their own website and only 20 per cent of Argentine firms have bought goods on line (Hilbert 2001).

the majority of schools in developing countries could not afford to install IT labs (Grace and Kenny 2001).

As important, there is a significant language skills gap, with perhaps one half of the populations of the least developed countries not speaking an official language of their own country—let alone English, the predominant language of the Internet. Language remains a significant barrier to use, as is suggested by a study of users in Slovenia, which found that 75 per cent of those who considered themselves fluent in English used the Internet compared to one per cent of non-English speakers (Kenny 2002). More generally, Guillen and Suarez (2001) find that, across country and allowing for a range of other factors, countries where English is the official or most widely spoken language see significantly higher Internet users per capita. This is hardly surprising given the quality and quantity of non-English web material. In 1999, 72 per cent of websites were in English. Conversely, the number of sites that can be found in languages such as Quecha (spoken by 10 million people in Bolivia, Ecuador and Peru) or Ibo (spoken by 15 million in Nigeria) can be counted on the fingers of one hand—and none of them offer interactive features (Kenny 2002).

Beyond the scarcity of physical and human capital needed to benefit from the development of the Internet, the institutional environment in LDCs is inconducive to rapid and successful exploitation of the technology. Mirroring microeconomic results, weak institutional capacity has been found to correlate across countries with lower access to networks and lower host site development (Kenny 2001; Oxley and Yeung 2000).[13] Weak institutions also lower consumer trust in e-commerce, perhaps the most important factor in determining willingness to purchase online.[14]

Poorly developed financial systems in particular, especially when combined with poor physical communications infrastructure, can significantly reduce the potential for e-commerce in LDCs. For example, a recent survey of business trust in the postal service (Kirkman *et al.* 2002) found that willingness to entrust the postal network with a package worth US$100 was strongly correlated with GNP per capita, with Finland, Japan and Switzerland at the top and Venezuela, Honduras and Nigeria at the bottom. Regarding credit cards, results from Latin America suggest that only 28 per cent of online transactions in the region use credit cards, compared to 54 per cent using cash—and this is more a result of lack of trust in than lack of access to the credit card system (Hilbert 2001). Miller (2001) argues that such weaknesses account for the fact that only 2.2 per cent of India's Internet subscribers have engaged in e-commerce activities.

The combination of low network rollout, low skills and a poor institutional environment, when combined with the feature of network externalities, might leave LDCs stuck in a low-use low-utility trap regarding the Internet. With few employers, customers or suppliers with skills access, with little relevant (or comprehensible) content, firms and individuals will have little incentive to make little use of the

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13 In a related finding, Guillen and Suarez (2001) find that a democracy index is significantly correlated with Internet users and hosts per capita after allowing for a range of other factors.

14 Jupiter Communications (2001) found that four of the top five selection criteria for on-line purchases were connected with recognition, trust or experience of the retailer—in fourth place was 'I can find bargains'.

technology. With few firms and individuals induced to move online, the utility of the Internet will remain low.

There is some evidence that this Internet trap exists in LDCs. Pigato (2001) argues that the low IT usage she found in the Tanzania survey was due in part to entrepreneurs simply not knowing how to make use of it, but also because of scale effects, suggested by the fact that use was much higher amongst tourism enterprises, the one sector where a considerable part of the customer base was likely to be on line.

The above factors help to explain the extent of the 'digital divide' in terms of access to the Internet. Low-income countries account for 40 per cent of the world's population and 11 per cent of its gross national income (calculated from World Bank 2001).[15] Yet, of 242 million Internet users worldwide in 1999, only 5 million, or about 2 per cent, were in low-income countries. Of 110,498 secure servers worldwide that use encryption technologies in Internet transactions (commonly used for e-commerce), only 224, or 0.2 per cent, are in low-income countries.

Turning to the upside potential for LDCs to trade more and different products due to 'the death of distance', Venables (2001) suggests that these opportunities are much over-rated. Many 'knowledge goods' remain embodied in human or physical capital, that is still expensive (and difficult) to transport across international boundaries. Venables also notes that as goods become weightless, they also tend to be subject to dramatic productivity increases and price reductions. Taking the example of airline ticketing, he notes that the major impact of ICT has been to replace labour by computer equipment—and only secondarily to allow remaining workers to be employed in remote locations.

Looking at the type of 'low-tech' service jobs that are now exportable, it is doubtful that there are enough to make a significant difference to LDCs as a whole. Data entry (the low-skills end of the information processing sector) is a US$800 million industry in the United States. Imagine (generously) that the US only has its share in global GDP of the data entry market (about 27 per cent of the world total) so that, worldwide, the industry is worth approximately US$3 billion. This is equal to a little less than the yearly exports of Estonia (Schware and Hume 1996; World Bank 2000b). More generously, the ILO (2001) reports that perhaps 5 per cent of all service sector jobs in industrial countries are 'contestable' by LDCs—nonetheless, this totals but 12 million jobs, or 0.24 per cent of the population of the developing world (calculated from World Bank 2001).

There is even the potential for the Internet to act as a tool for divergence in incomes between rich and poor. The fact that general technologies are important for growth, and that rich countries today are by and large the countries that were rich fifty or one hundred years ago (see Kenny 1999), suggests that 'the average' technology probably has a larger impact on growth prospects in wealthy countries than in poor countries (Heeks and Kenny 2001). Venables (2001) also suggests that innovations in communications technologies in the past have further concentrated income in a few geographic areas.

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15 The quality of that access is also significantly lower—44 per cent of Brazil's Internet connections run at 33kbps, for example, response time is four times longer in Latin America than in the US and packet loss three times higher (McKinsey 2001).

A number of studies based on US and European countries also suggest that backwards companies and regions are benefiting less from the Internet as well, as would be expected if network externalities and low-utility traps were at work. Indeed, the firms that are benefiting most from the introduction of IT are those that were already thriving in the 'old economy' (World Bank 2000; Doms, Dunne and Troske 1997; Greenan, Mairess and Topiol-Bensaid 2001). At the regional level, advanced regions in Europe have also benefited more from the rollout of communications infrastructure than backward regions (Cornford 2001).[16] Looking at production of high value-added 'knowledge goods' in particular, this has remained concentrated in wealthier regions in the UK, for example, despite falling communications costs (Cornford 2001). Finally, there is global evidence that 'dot.com' firms are also highly concentrated, and concentrated in regions that were wealthy prior to their creation (Gillespie, Richardson and Cornford 2001).

LDCs face high costs to access ICTs, a number of barriers to exploit that access, limited opportunities if those barriers are overcome, and some threat that wider access to ICTs might actually speed divergence, then. It is perhaps for such reasons that even studies that find a historical link between IT investment and growth in developed countries fail to find such a link in LDCs (see Pohjola 2001 and Meyer 2000).[17]

5 Estimates of the future impact of the Internet on economic growth

We have seen that a range of businesses and economists are predicting significant savings and productivity increases from moving processes on line. We have also seen early evidence that there is a risk that much of these savings might be swallowed up by competing for market share, with little impact on the strength of the national economy. This paper has presented a range of further arguments for caution in predicting a significant positive impact of the Internet on LDC economies. Nonetheless, this section suggests that even the more optimistic voices on the economic effects of the Internet lay out a scenario of comparatively little impact on the course of divergence, and that evidence from past 'revolutions' in transactions costs reductions support this conclusion.

A range of estimates for OECD countries suggest an impact of e-business on growth as small as perhaps one third of one per cent by 2005. Taking the US alone, one more generous estimate by Goldman Sachs is perhaps 5 per cent by 2010 (*Economist*, 1 April 2000).[18] More optimistic still, it has become common to assume that investments in

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16 Greenan, Mairess and Topiol-Bensaid (2001), for example, find that while there is no relationship between increasing expenditure on R&D and computerization and French firm performance, firms that perform better tend to have higher R&D and computing expenditure.

17 Bedi's (1999) survey on this topic could find only one study with a significant result, which found a positive relationship that was likely to be plagued by an endogeneity bias.

18 Forrester research predicts that, by 2003, e-business will reach US$1.5 trillion, or equal to about 13 per cent of US GDP. If we assume the value added by this business being conducted online is 10 per cent, this would increase the country's GDP by 1.3 per cent (*Economist*, 30 October 1999). The OECD is less positive in its estimates. Its most generous forecast is that, for the whole of the OECD in 2005, e-commerce will equal US$1 trillion (Nevens 1999). Again, assuming a 10 per cent impact on value added, this suggests that by 2005, the OECD will have increased GDP thanks to e-commerce by

telecommunications and IT, which account for the same proportion of today's capital stock as railways did in the late nineteenth century (a little over 10 per cent), will have a similar impact on US economic growth as is generously estimated for the railways—around 10 per cent (although Fogle (1964) would estimate one third of that impact for railways). If this were gained over the next twenty years, it would be at a rate of a little under 0.5 per cent per year.

However, even assuming such a generous growth impact in the US, there are good reasons to believe that the impact of the Internet on growth in LDCs will be much less significant. Indeed, it is widely accepted even by Internet optimists that the impact of the Internet on developing countries at least over the near term is likely to be smaller than that in developed countries—and this paper presents a range of evidence suggesting that the impact will remain muted. The consulting firm e-Marketer estimates that e-commerce revenues of 'the rest of the world' (outside North America, Europe and East Asia) will be 2 per cent of the global total in 2003, which equals US$29 billion. Assuming that 10 per cent of revenues add to gross product, this suggests that e-commerce will add the equivalent of Guyana's GDP (a poor country with a population of a little under one million) to total 'RoW' GDP by 2003.[19] One recent global estimate suggests that over the longer term, 'effective' e-commerce policies could increase Latin America's GDP by about US$45 billion—or about 2 per cent. However, the same source provides other estimates that are as low as 1.2 per cent for Latin America and one per cent for Asia (Mann, Eckert and Knight 2000).

These general estimates of the income impact of the Internet by ICT optimists are thus very small compared to the rich-poor gap. The US' GNP per capita is about US$30,000 compared to Sudan's GNP per capita of about US$300, or about a 10,000 per cent difference (World Bank 2000b). Compare this figure to the 10 per cent additional income that the Internet might most optimistically provide.[20]

Taking the past as prologue, these figures should, perhaps, not come as a surprise. Despite sharing the networking and transactions-reducing features of the Internet, and despite human and physical capital requirements far less demanding than the Internet, it appears that telecommunications has had a fairly limited growth impact, as well.[21] Although there is some econometric evidence that increasing access to telephony has an impact on future growth rates, the size and geographical extent of that impact is arguable. Roller and Waverman (2000), Canning (1997), and Madden and Savage (1998) are three recent studies that find some sort of link (although Roller and

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about one-third of one per cent. See also the *Economist* Survey 2000 (23 September); World Bank 2000a; OECD 2000.

19 A third study by Goldman Sachs (2000) estimates that online commerce outside North America, Europe and Asia will generate gross revenues of US$59 billion by 2003, rising to US$178 billion by 2005.

20 World Bank (2000b).

21 A similar story can be told for the railroad. Fogel's (1964) study of the impact of the railroad on the US economy estimates that the level of per capita income reached in the US on 1 January 1890 would have been reached by 31 March 1890 if railroads had never been invented. The problem here, as frequently noted, is that Fogle only looked at the static rather than the dynamic impact of the railroads on the US economy—and those dynamic impacts could have been large, even if they are hard to measure.

Waverman only find that link in more advanced economies), Holtz-Eakin (1993, 1994) and Garcia-Mila and McGuire (1992) dispute it. Even if there is a link, the evidence suggests that it cannot be all that significant. Over the last forty years—and particularly since the spread of mobile telephony—poor countries have seen a far more rapid growth in telephone networks than have developed countries. Nonetheless, there has been a divergence in income between rich and poor countries over the last forty years, and LDC growth rates have slowed even as networks have expanded (calculated by the author from World Bank 2001).[22] As suggested at the start of this paper, given the broad definition of technology, the impact on growth of one new invention, however impressive that invention, is likely to be small.

6 Conclusion

This paper has taken a very narrow look at the likely impact of the Internet on development. And it should be remembered that even this narrow look suggests that there will be significant changes in the way business is done in LDCs—changes that have already begun. The same transactions savings that are available in developed counties from the Internet are available in LDCs—for example, Reliance Industries, a chemical firm in India, has linked its major customers through an Internet-based market exchange, reducing receivables delays by two thirds and speeding order deliveries (Miller 2001). More broadly, the technology offers exciting possibilities in education delivery, for improving health services or the access of the poor to the tools of governance.

Relatedly, much of the analysis in the paper has been ‘static’—looking at the direct impact of the Internet on the costs of doing business, not the knock-on effects that the technology might have on creating new business models, or through its support for the development of a better-educated workforce. The Internet is a powerful technology that will have a long-term impact on the quality of life in developing countries.

Having said that, our record in predicting the dynamic impact of technologies on development in the past has been very weak. To take three communications-related examples, the railway was predicted to spark the dictatorship of the proletariat, the telegraph was predicted to engender world peace and the television to revolutionize education. Broadly, it appears that even while the role of technology in economic growth cannot be questioned, the dynamic impact of a particular, invented technology is never very large. It looks increasingly as if the impact of the computer on US

22 Regarding the role of reduced transactions costs in making LDCs more competitive in trade, evidence regarding progress in international trade-talks suggests that this is not enough to spark LDC growth, either. Assuming generously that the Internet might reduce transactions costs on goods and services by perhaps 10 per cent (see Goldman Sachs 2000), compare this marginal improvement to the scale of changes in ‘institutional technology’ over the past forty years. Looking at the impact of the GATT and WTO trade rounds, for example, average tariffs in industrial countries fell from 40 per cent in 1947 to 5 per cent in 1988—and have fallen further since (Law Journal Extra 1996). Falling transport costs and more rapid transport systems might have added a further 10 per cent cost reduction on top of this (Hummels 1999, 2001). Again, despite (or perhaps because of) such dramatic improvements, LDC income growth has fallen over that period, and fallen even further behind that of developing countries, suggesting that reduced transactions costs alone will not allow LDCs to ‘close the gap’.

productivity will be a good example of this. The impact has been limited so far, and might not increase in the future.

Hard choices should be made based on an understanding of our comparative ignorance of the potential impact of the Internet. For example, if the Internet is considered necessary to ensure that businesses remain internationally competitive, does government policy focus on ensuring business access at the cost of equitable access? Similarly with education: if exploiting the Internet requires tertiary education, do governments re-channel resources from primary education for the many to university funding for the few? I would argue that, given the limited evidence of benefits, the great state of uncertainty and the immediate equity costs of such actions, the answer should be to support equitable access and primary education.

Overall, the largest determinant of the impact of the Internet in developing countries is likely to remain the broader environment outside the information infrastructure sector. This environment will also play by far the predominant role in determining the quality of life of LDC populations. For this reason, Microsoft Chairman Bill Gates' argument about the place of *direct* support to the Internet in development priorities might well be correct: 'I am suggesting that if somebody is interested in equity that you wouldn't spend more than 20 per cent of your time talking about access to computers, that you'd get back to literacy and health and things like that. So the balance that makes sense is that more money should be spent on malaria' (Gates 2000).[23]

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23 From within the development community, Amartya Sen notes similar skepticism regarding Bangalore's software export industry: 'even 100 Bangalores would not solve India's poverty and deep-seated inequality. For this to happen many more people must participate in growth. This will be difficult to achieve across the barriers of illiteracy, ill health and inequalities in social and economic opportunities' (quoted in Oxfam 2000).

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