The Economy and the Internet: A Preliminary Assessment

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The Internet has already had a big impact on how most Americans communicate and spend their time, both at home and at work, and this impact is likely to grow. But a key question that many ask is how will the internet affect the performance of the economy and the future standard of living of Americans? Is the Net just a different way to communicate—an alternative to phone or fax or airmail – and thus not likely to have much impact, as some skeptics have claimed? Or will it profoundly affect the structure of industries, the size of companies, the variety of products and services available to consumers, productivity, prices, and the prosperity of average Americans?

We believe there are many reasons to side with the optimists, or at least those who claim that at the very least the Internet creates the *potential* for raising the standard of living and significantly affecting the structure of the economy. We come to this conclusion not only after surveying the extensive and growing literature about the Net and its likely impact, but especially after organizing a two-day conference on the subject in late September with the Berkeley Roundtable for the International Economy, the Department of Commerce, the Internet Policy Institute and the Organization for Economic Development. Among the many experts at this conference were academic experts who projected the likely economic impact of the Internet on various sectors of the U.S. economy and presented their preliminary findings.

In this paper, we summarize some of the preliminary results for many of the sectors that our authors examined; put the results in context of the larger debate about the impact of the information technology revolution on the economy; identify factors that should influence how much, and how rapidly, the benefits of the Internet revolution in particular, are likely to be realized; and offer some thoughts about how other countries should view the Internet and the IT revolution as part of their economic growth strategies.[2]

Why The Estimates Matter

Although projecting future productivity growth is difficult under any circumstances, it is also necessary, in both the public and private sectors. The Federal Reserve, for example, must estimate, among other things, the likely *potential* growth rate of the economy in deciding how much money to create and what short-term interest rates to target. Similarly, both the President and the Congress must estimate the potential growth rate of the economy when setting both near term and long term budget policy. The revenues, and to a lesser extent, the expenditures of the federal budget are tied to the pace at which the economy grows. The Congressional Budget Office, for example, estimates that for every one tenth of a percentage point increase in GDP, the surplus will be $46 billion larger in the year 2010.[3] With this kind of leverage, plus the magic of compounding, it doesn't too much extra growth beyond what is currently projected for

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[2] The papers whose results are briefly described here will be published in volume by the Brookings Institution and the Internet Policy Institute in the spring of 2001, together with a companion volume of papers commissioned by the Berkeley Roundtable on the International Economy on the impact of the Internet on market structure in six other sectors of the economy, also to be published by Brookings.

[3] Congressional Budget Office, The Budget and Economic Outlook, Fiscal Years 2001-2010, January 2000 (Washington, DC).

the ten-year “on-budget” surplus (excluding the social security surplus) to rise above the latest estimate of $2.2 trillion by another trillion, or even more.

Productivity growth forecasts are not just important for policy makers, but also to individuals and firms. For individuals, faster productivity growth means faster growth in compensation and thus living standards. For firms making long-term investment plans, it is important to project future productivity growth because that will determine the economy’s purchasing power in the years ahead. For the nation as a whole, meanwhile, faster growth in productivity means more resources available to address pressing social needs, or tax cuts, or both.

For almost the first three decades after World War II, labor productivity grew at roughly 2.5 percent annually, a pace that enabled the standard of living of the average American to double about every 30 years. From 1973 to 1995, annual productivity growth slowed dramatically, to 1.4 percent (until the GDP accounts were revised in the mid-1990s, the growth rate was even lower, closer to 1 percent). Analysts pointed to various culprits for the slowdown -- higher energy prices (but this became less convincing when oil prices fell sharply after the early 1980s), an influx of baby boomers into the workforce, variable rates of inflation which allegedly deterred investment, and so on – but none of the explanations proved have proved very convincing. And then, just when most economists were resigned to enduring a permanent “Age of Diminished Expectations” – the title of one of MIT economist Paul Krugman’s many books – productivity began soaring, averaging about 3 percent a year since 1995, an outcome virtually no one anticipated, either inside or outside government.

Yet just as we don't fully understand why productivity growth slowed down after 1973, the dramatic pickup since 1995 is also something of a mystery. But not completely. It is clear that heavy investment in computer and telecommunications technology in the 1990's – accounting for as much as a half of all plant and equipment investment in recent years -- is a large part of the story. Although the computer and telecommunications revolutions began earlier, they apparently did not have enough impact on business processes, practices and organization to show up in aggregate productivity growth until the second half of the l990's. The macro-economic conditions of the late l990's—tight labor markets, low inflation, and fierce global competition—also encouraged firms to use new technologies as a way of economizing on labor while surviving in a fiercely competitive marketplace.

The big question is whether the recent rapid pace of productivity growth will continue. Official government forecasts suggest it can't. Both the CBO and the Office of Management and Budget project the growth path slowing to an average of about 2 percent through 2010 – faster than the dismal period of 1973-95, but much slower than the pace of recent years and even somewhat slower than the growth of the previous "Golden Age" of 1948-73. Optimists point out, however, that the official forecasters missed the 1995-2000 productivity boom, which as we discuss further below, has been heavily driven by the information technology (IT) revolution, and suggest that the good times will continue to roll. They now pin much of their hopes not only on the continued productivity-enhancing impact of IT but also on the Internet revolution in particular, which as revolutions go, is really in its infancy.

At this writing, the volume of e-commerce – now somewhere in the $100-200 billion range billion – is too small in relation to the overall size of the economy to have had much impact on productivity growth yet. But looking forward, all that could – and we believe will – change, especially as use of the Internet becomes more pervasive, as is widely projected to happen.

The Economic Potential of the Internet Revolution

Enthusiasts of the Internet point out that it has the *potential* to increase productivity growth in a variety of distinct, but mutually reinforcing ways:

- By significantly reducing the cost of many transactions necessary to the production and distribution of goods and services
- By improving the efficiency with which goods and services are produced and delivered, enabling firms to carry lower levels of lower inventories of supplies and finished goods, while facilitating restructuring of companies and internal processess
- By increasing the effectiveness of marketing and pricing
- By increasing consumer choice, convenience and satisfaction in various ways
- By increasing competition, making prices more transparent, and broadening markets for both buyers and sellers

The papers produced for this project suggest many examples of ways in which these claims might be prove true, although it is too soon to know what the actual impact on productivity will be, even in leading-edge firms, or how fast best practices will spread to other firms and other industries.

Reducing the Cost of Transactions

The most important attribute of the Internet also may be the most obvious: it provides a cheap way of transmitting a lot of information quickly and conveniently. Many routine transactions—making payments; processing and transmitting financial information; record keeping; search and analysis; ordering, invoicing and recruiting; getting information to suppliers, employees and customers—can simply be handled less expensively with web-based technology than on paper or in other electronic ways. Many firms, especially those in data intensive industries, such as financial services and medical care, can reduce their cost of production without doing anything new or different—just by doing the same things cheaper using Internet technology.

Within manufacturing firms, Intranets and other web-based technology allow management to share information easily and cheaply across the organization, cut the cost and improve the accuracy of accounting, ordering, tracking, invoicing, recruiting and other routine functions. Net-based communications also enable employees in different parts of the firm to work together on product development, marketing and other projects. Firms, such as Cisco systems and Oracle, that rely heavily on web-based technology for their internal communications and management, claim significant savings from this source. Andrew McAfee of the Harvard Business School, who examined the manufacturing sector, projects that additional reductions in cost should materialize as more and more firms shift to web-based technologies for information flow and back-office functions.

Patricia Danzon and Michael Furekawa from the Wharton School at the University of Pennsylvania note that the potential for transactions cost savings from

transition to the Internet is especially high in the health care sector, because it is so large (14 percent of GDP), so information-intensive, and still so dependent on paper based records. Moving health insurance claims processing from the current mix of paper and Electronic Data Interchange (EDI) onto the Internet would require aggressive efforts to standardize claims formats, but savings could be large. EDI providers allege that they can reduce the cost of processing from $10-15 per paper claim to $2-4 per EDI claim. Web-based processors may be able to deliver the same service for 2-4 cents per claim. Only about 40 percent of doctor's claims are now processed electronically. Perhaps $20 billion a year could be saved if health insurance claims processing were shifted to the web, with speed and convenience improved into the bargain.

The management of medical records is another area in which the internet offers great potential, not only for cutting costs, but for improving the quality and effectiveness of care. Assuming that privacy concerns can be adequately addressed, patients and providers would benefit enormously from conversion of current, mostly paper, medical records, into an electronic medical record (EMR) in standard format. Providers would then be able to access the patient's full medical history quickly and enter their own observations and treatments. The instant availability of the EMR would save time for the patient as well as the provider, reduce the costs of sending records, and avoid duplicative or medically inconsistent treatment. Prescriptions could be entered on the EMR and simultaneously sent directly to the pharmacy, reducing both cost and error rates in filling prescriptions. Full utilization of the EMR by physicians requires standardization of formats and development of convenient hand-held devices for entering treatment information and prescriptions easily as doctors walk around the hospital or office.

In the financial services arena, Eric Clemons and Loren Hitt, also from the Wharton School, argue that most of the savings from automating internal transactions may have already been realized from the pre-Internet era. Nonetheless, the Net should enable financial institutions to further lower their processing costs, while customers will enjoy reducing waiting and travel time and well as mailing costs.

Substantial costs also could be saved by the economy as a whole if on-line banking replaced not only face-to-face transactions with bank tellers, but also the whole system of payment by check. Checks have to be sorted and transported back to their original writers—an archaic and are expensive process compared to sending payments over the Internet (some estimates put the difference in cost at 10 to 1 or even higher). The transition to on-line small-value payments, however, may be slow. Many customers like interacting with a real person, and continue writing checks, not just out of habit, because their true costs are not visible to them, or because they regard a cancelled check as a tangible proof of payment not reliably replaceable anything electronic. Hence, the need to maintain dual technologies for retail banking may limit the realization of the potential savings from on-line banking for some time.

Retail banking is an example of a major tension exhibited across the financial services industry. This tension is between financial services based on customer-provider relationships tied to geography and the provider's knowledge of the customer and the savings offered by on-line markets for standard financial products that by-pass traditional intermediaries. The tension is perhaps most evident in brokerage services, where the advent of the Internet has precipitated a split between the relationship-dependent services of investment advising and portfolio management and the standardized service of stock

trading. Customers benefit from the lower transactions cost of on-line trading, if they are willing to do their own research and forego advice, as well as from their ability to shop for lower commissions by searching the web. Some of the cost reduction is offset by increased advertising and marketing costs as on-line brokers compete with other.

In the mortgage lending industry, customers are using the Internet to shop for information and compare rates, although only a tiny fraction of mortgages now originate on-line. However, a substantial portion of mortgage originations may shift on-line over the next few years as consumers grow more comfortable using the newly authorized "digital signatures." If this occurs, consumers will save through lower margins in this part of the business, plus lower costs in processing mortgage applications.[4]

Another source of potentially significant transactions costs savings, perhaps surprisingly to some, come from the government sector. As Jane Fountain notes in her study, governments at all levels spend substantial resources answering questions—where to get services, who is eligible for benefits, what laws and regulations apply—or gathering information from citizens who want to report a pothole, apply for a permit or give their views on a public issue. The Internet has enormous potential, now only beginning to be realized, for dispensing information to citizens less expensively and more accurately than telephone inquiries. A website can be updated more easily and cheaply than a paper publication, and can be designed for quick, user-friendly retrieval of the information needed for a wide variety of purposes. In particular, filing tax returns on-line cuts costs both to the government and to the taxpayer and the same can be said for filing

[4] Insurance sales offer another potential area for on-line sales of standardized financial products, although the insurance market has so far been largely unaffected by the Internet largely because insurance is typically bought infrequently, many insurance products are complex and the regulation of them is fragmented by a state-based system.

many kinds of applications, for benefits, permits, licenses, and the like. Building contractors can file architectural drawings on-line in many jurisdictions and avoid walking around from one government office to another with huge rolls of blueprints. Students can apply for scholarships and loans on-line; workers who lose jobs, for unemployment benefits; seniors for retirement benefits and other services.

Fountain correctly notes that the e-government revolution nonetheless has a long way to go. Some state governments, such as Washington and Georgia, offer significant services on the Internet; others are just beginning to move into the digital age. Most federal agencies and local governments are just beginning to explore the Internet's potential usefulness to them. Realization of savings will be hampered by the need to maintain alternative systems for those unable or unwilling to use the Internet. Moreover, ease of access to government information and services may generate more inquiries and more demands for service. To the extent that the Internet reduces the cost of interaction between government and citizens, part of the benefit will show up in lower government expenditures and part in greater citizen satisfaction, neither of which enter explicitly into productivity statistics.

The Internet and Efficient Management

So far we have been identifying potential savings from cutting the costs of carrying out the same transactions, not reorganizing processes to make operations work better as well as cost less. However, use of the Internet as a management tool may have considerable potential for improving efficiency in many sectors of the economy and may cause significant restructuring of those sectors in the process.

Many of the potential efficiency gains come from use of Web-based technology to manage supply chains more effectively and reduce inventory. These savings may show up within the firm, from better scheduling for information-sharing across the company, or in more efficient interaction with other firms in the supply chain. Cisco systems has been a leader in dealing with suppliers on the Web to enhance efficiency of its procurement. Indeed, Cisco has changed the definition of what it means to be a "manufacturer," since it outsources most of its manufacturing operations to other companies in its Net-based supplier community. Some of the savings to Cisco come from competitive bidding by suppliers which reduces the price to the buyer (but whose ultimate effects we view cautiously, as discussed below), but the company also realizes savings from improved information flow and the ability to coordinate schedules to eliminate waiting and inventory accumulation at every stage.

The Internet is also being used effectively in other industries to link partners in joint enterprises across large distances, enabling partners to share production schedules and integrate their operations. One of the benefits of the closer linkage is speeding up decision-making when problems arise. The Net-based information flow can reduce the phenomenon known as the "bull whip effect," which arises when small changes in consumer demand get magnified by poor information flow and cause delays and inventory accumulation up the supply chain.

Perhaps not well recognized, a team of researchers at the University of Michigan point out in their study that the Internet is also in the process of radically transforming the trucking industry, which depends heavily on timely information for efficient operation. Customers need a low-cost way of finding the truck capacity that they need when they

need it and of comparing rates to get the best deal. Truckers need to find customers that will use their capacity fully, so that they can avoid costly downtime and empty backhauls. The Internet is proving to be an inexpensive tool for matching these needs, and use of the Internet by both large and small trucking companies has risen rapidly since the mid-1990's. Traditional freight brokers are rapidly being replaced by electronic brokers, some set up by groups of carriers in search of the greater efficiencies made possible by integrating their fleets and schedules on the Net.

Moreover, the Internet has made it possible for truckers to offer additional services to their customers, such as tracking shipments, rerouting them if necessary, and providing quick access to all relevant documentation. As a result, some trucking companies have been evolving into transportation managers offering a wide range of services customized to their users' particular needs. This transformation of traditional truckers into firms offering more comprehensive services makes it hard to identify the potential contributions of the Internet to productivity growth in trucking per se. Greater efficiencies in transportation management will ultimately enhance the productivity of the many industries that use trucking services.

Making Markets More Competitive

One of the major features of the Internet revolution is its potential to enhance productivity by making the whole economic system, nationally and internationally, more competitive. If prices of well-specified goods and services are available on the Net, buyers can shop for the best deal over a wide geographic area and sellers can reach a larger group of buyers. The Internet has the potential to bring many markets closer to the economists' textbook model of perfect competition, characterized by large numbers of

buyers and sellers bidding in a market with perfect information. The results should be lower profit margins, more efficient production and greater consumer satisfaction.

Part of the benefit of on-line supply-chain management comes from increasing the pool of bidders, often across national boundaries, and finding the most efficient suppliers. Firms and groups of firms are increasingly organizing such e-markets in hopes of realizing such efficiencies. The major automobile firms are among the highest profile examples. Governments and non-profits are seeking similar savings from on-line procurement.

It is important, however, not to get carried away by claims of savings from added competition. For example, in one widely cited study, two Goldman Sachs analysts project that B2B commerce alone should generate annual productivity gains of 0.25 percent, which if true, would represent a rather significant gain in light of the fact that economy-wide productivity growth rate before the recent spurt in productivity growth was just 1.4 percent.[5] Much of this benefit appears to derive from the authors' estimates of the added competition provided by the Internet, not from savings in labor and other inputs, which are the real sources of gains in productivity. Lower profit margins, in contrast, represent a transfer of income from those affected ultimately to consumers, and thus should lower prices paid by consumers. This is a real benefit, but not an improvement in productivity. The only qualification, which we discuss below, is that the added competition made possible by the Internet may *indirectly* encourage firms to be become more productive by taking advantage of the Internet.

[5] See, for example, Martin Brookes and Zaki Wahhaj, "The Shocking Economic Impact of B2B," Global Economic Paper, 37, Goldman Sachs (February 3, 2000).

Furthermore, there is reason to believe that the Goldman estimates also overstate what they purport to measure, namely the reductions in profits. The fact is that in many, if not most, industries competition is already heavy and profit margins are low, hence the potential for further reductions in those margins is limited.

Marketing, Pricing and Customization

A different potential outcome of the Internet—seemingly antithetical to the forces increasing competition—is its potential for increasing the effectiveness of marketing and enabling firms to divide their market into segments and practice price discrimination. IN late September, 2000, the media widely reported that Amazon was testing the use of the Internet to discriminate in the prices they charge to different customers: in particular, loyal customers (repeat visitors) reportedly were being charged more than irregular or new customers. At this writing, it is not clear if Amazon will go ahead with this policy, given the customer outrage it appeared to trigger. Nonetheless, a less controversial and certainly more clearly beneficial use of the Net already has been and will be the improved tailoring of products and services to the individual tastes of consumers. To be sure, the privacy issues that tracking of Net usage by individuals will have to be resolved. Once they are, we suspect that many consumers will find that they benefit from more targeted advertising and customization (while many others might not).

Adding It All Up

We understand that many readers and policy makers want to know the ultimate "bottom line", and preferably right away. How much overall productivity improvement is likely from the Internet? We are still at a preliminary stage in refining the estimates and so cannot yet provide a single answer or range. Moreover, some of the savings may be

difficult or impossible to attribute to the Internet per se. For example, to the extent that the Internet simplifies and speeds up interactions between companies and governments, some of the benefits will make their way into private sector productivity growth, although these benefits may be hard to trace directly the Internet.

Nonetheless, Andrew McAfee performs one useful exercise in calculating the potential impact of the Net on the manufacturing sector in particular, by drawing on the example of Cisco Systems, which estimates its cost savings at something in excess of 5 percent. Even making the conservative assumption that Cisco remains reasonably well ahead of the rest of the manufacturing sectort, McAfee preliminarily projects cost savings for manufacturing as a whole in the 1-2 percent range over the next five years, which would translate into annual productivity improvements in this sector alone of 0.2-0.4 percent. In absolute magnitudes, by the time they are fully realized, these estimated savings are in the order of $50-100 billion. Of course, it would be natural to expect significant variations across industries in cost savings. Charles Fine and Dan Raff estimate the potential costs savings in the automobile industry (exclusive of dealership savings) alone of about 11 percent, although they caution that these savings are likely to be realized in “one shot” rather than in continued improvements. Even so, as long as they don’t occur all at one time in all firms, the gradual one-time improvements nonetheless should improve measured productivity growth in that industry during the period of adjustment.

What about the service sector, which accounts for most value added and employment in the economy? Here, most of the estimates are too preliminary to report at this time. However, as already noted, the transactions cost savings may be on the order of $20

billion annually. Jane Fountain projects that potential savings in the government sector may be somewhat less, but still quite substantial. A team of scholars from the University of Michigan estimate that the improvements afforded by the Internet in the trucking industry could lead to annual cost savings of as much as $50 billion.

However large the productivity savings turn out to be – and the accumulated preliminary estimates reported here suggest the annual economy-wide cost savings, once fully realized, could reach as much as $200 billion annually within five years-- there should be no mistake about who the ultimate beneficiaries will be: consumers, not businesses. In our highly and increasingly competitive market, most temporary market advantages – reflected in high profit margins – get competed away (unless firms accumulate and then abuse their monopoly positions). Perhaps the best evidence for this is that relative shares of national income going to labor, on the one hand, and capital (interest payments, dividends and retained profits) on the other, have been remarkably stable for several decades. Why then will firms invest and make increasing use of the Internet if they cannot permanently enjoy the extra profits? Very simply, because they have no other choice. If they don't stay at the cutting edge, then someone else will. Andrew Grove of Intel couldn't have put it any better than in his famous book title, *Only The Paranoid Survive*.

It is also very important to emphasize that not all of the benefits from the Internet will show up in the productivity and output statistics. While it is relatively easy to count how much it costs to manufacture goods or deliver services – and specifically to measure how much labor input is required to generate this output – measuring the output itself can be, and often is, quite difficult, especially for services that make up most of the GDP.

Statisticians make valiant efforts to adjust prices of goods and services for improvements in quality and convenience, but they cannot always capture these impacts with great precision. This is likely to be true for the added convenience and choice that the Internet will make possible. Users are likely to be happier, but this increased satisfaction may not show up in the GDP data. Nonetheless, these benefits are likely to be real and arguably just as important as those benefits that statisticians can count.

Cautions from the Skeptics

Not all economists who have been studying the impact of the Internet, and indeed the information technology revolution more broadly, agree that the Net promises benefits anywhere close to those that have just been suggested. Several warning flags have been raised and it is important to understand the basis for them.

First, as everyone concedes, e-commerce that the Internet has made possible still accounts for a relatively trivial part of overall U.S. economic activity. Business-to-consumer (B2C) transactions are running at an annual pace of about $20 billion, or less than one percent of total retail sales. Business-to-business (B2B) transactions are much larger, in the $100 billion range, but they also account for a small fraction of total $6 trillion in private sector economic activity. Even if the sharply increased totals for both B2C to B2B transactions are realized – in excess of $1 trillion for both combined in several years – they still will remain a relatively small part of the overall economic landscape. It is unrealistic under these circumstances, say the critics, to expect giant gains in either measured productivity or non-measured consumer welfare any time soon.

Second, as hard as our team tried in making their projections, it is difficult to know the baseline or benchmark against which to measure the impact of the Internet.

How can we be certain how productive firms would be in the absence of the Net – that is, if they had were computers and proprietary communications networks? The short answer is: we can't. Put differently, even if the Internet makes an indentifiable contribution to productivity growth, it is quite possible that this will not produce an *acceleration* in the growth that was already occurring.

Third, the skeptics can point to some empirical evidence that appears to back up these theoretical cautions. For example, using research developed by our Brookings colleagues Jack Triplett and Barry Bosworth, *The Economist* magazine recently compared the intensity of investment in IT in various industries with their growth rates of "total factor productivity" or TFP (which measures the increase in the ratio of output to the sum of capital and labor inputs).[6] The study found essentially no correlation. Indeed, certain industries where IT investment was especially strong in relation to total output -- communications, education and banking – had either low or negative growth in TFP. While this result may be due in part to mismeasurement of the output of these industries, especially the latter two, the study does lend a note of caution before taking projections of the large economic gains from the Internet in particular as a given.

Northwestern economist Robert Gordon, one of the world's leading experts on productivity growth, is even more pessimistic. Not only does Gordon claim that the benefits of the IT revolution have been largely confined to the IT sector itself – primarily computer manufacturers, where Moore's Law has led to annual price reductions of 30 percent – but he goes further to argue that the Internet in particular ranks relatively low, at 13th place, in the pantheon of major innovations of the past century. Much more

[6] See Pam Woodall, "Untangling the e-conomics of the Internet, "Untangling e-conomics," The Economist, September 23, 2000, at 19.

important, in his view, have been electrification, the automobile, the airplane and spacecraft, radio and TV, air conditioning, and improvements in the water supply and its distribution, among others. In fact, Gordon argues that the Internet might even detract from productivity growth, by diverting employees from doing essential work on the job to surf the Net for their own personal use instead.[7]

While the skeptics provide useful cautions to the exuberant claims of the Net's economic potential, we are not so pessimistic. For one thing, others who have estimated the impact of IT on productivity growth disagree with Gordon's claim that the IT revolution has produced no "spillover" effects on sectors outside IT and manufacturing. Daniel Sichel and Stephen Oliner of the Federal Reserve Board, who once calculated the impact of the computer revolution on economy-wide productivity to be relatively small, have altered that conclusion in their most recent empirical work.[8] Harvard's Dale Jorgenson and Kevein Stiroh of the Federal Reserve Bank of New York also find higher TFP outside the IT sector, although they find little evidence that the added impact is due to IT.[9] Both studies, however, cast doubt on Gordon's sweeping pessimism about the sustainability of recent improvements in productivity growth.

Moreover, one of the reasons Gordon's study differs from the others is that Gordon attempts to explain the performance of productivity *adjusted for the impact of the economic cycle*, an adjustment that we and others believe is implausible. The economy

[7] Gordon's wide-ranging and thought-provoking analysis is expected to appear in a forthcoming issue of the Journal of Economic Perspectives under the title "Does the 'New Economy' Measure up to the Great Inventions of the Past?"

[8] Stephen D. Oliner and Daniel E. Sichel, "The Resurgence of Growth in the Late 1990s: Is Information Technology the Story?", unpublished paper, February 2000

[9] Dale W. Jorgenson and Kevin J. Stiroh, "Raising The Speed Limit: U.S. Economic Growth in the Information Age," Brookings Papers on Economic Activity, 2000:1, pp. 125-211.

has been running near or at its productive capacity throughout the post-1995 period when productivity has grown so rapidly. Indeed, it is at the end of cycles that one normally expects productivity to *fall* rather than increase (because less productive workers presumably are being drawn into the labor force). The fact that productivity growth has *accelerated* during the past five years is strong evidence, at least to us, that the improvement has *not* been cyclical in nature, but something stemming from structural changes in the economy. Of course, it is another matter whether those structural changes will persist to generate productivity growth rates in the future of the kind we have witnessed in the recent past.

In our view, the potential for the Internet to have transformative impacts on our economy is real, even if at this point those impacts are largely unrealized. Firms, governments, and individuals are just beginning to absorb the many ways in which the Internet can enhance their economic welfare, and in many cases, reduce cost. This process will take time, but that is precisely why the potential impacts that the authors on our team have identified are likely to improve the growth of productivity for some period. The best practices that the Net makes it possible are unlikely, in most cases, to be realized immediately by those that adopt them, but instead should produce benefits over some period.

So far, we have concentrated in this essay on the impact of the Internet on labor productivity. There are three channels through which this impact could be realized. One is through an increase in capital, which would treat the Internet like any other capital good, producing the same risk adjusted rate of return that is realized on other capital investments. Certainly, this impact exists, but we have not for purposes of this paper

broken out exactly how much investment in Internet-related activities, as distinguished from information technology more broadly, will occur in the future.

A second channel is through supra-normal returns on Internet-related investments – that is, such investments by firms may generate returns well above those earned on other investment of comparable risk, and thereby add to output and labor productivity more than could be expected from ordinary investments. In fact, there is some evidence that past IT investments have generated supra-normal returns.[10] Given the fact that the share of overall investment in the U.S. economy devoted to IT, and almost certainly to the Internet, has been rising over time, this too is evidence that such supra-normal returns are likely to exist with Internet-related investments.

The third possible channel of impact is if the Internet generates externalities, or returns beyond those that are not realized by any single firm. There is a good reason for believing this to be the case. After all, the Internet itself seems to represent the epitome of an activity characterized by "network externalities" – the term economists have coined to describe the fact that the benefits of using a particular technology rise as more users are hooked into the network.

For all these reasons, therefore, we believe that the productivity estimates provided earlier – as preliminary as they are – are probably of the right order of magnitude, and may even be conservative, provided that the actors involved (firms, individuals, and governments) fully take advantage of the Internet in the ways we have described. That is, it is certainly conceivable that increasing use of the Internet could

[10] See Daniel E. Sichel, The Computer Revolution: An Economic Perspective (Brookings Institution Press, Washington, D.C.), pp. 85-90.

raise productivity growth by several tenths of a percentage point over the next five years. Whether that will occur is the subject to which we next turn.

Realizing The Potential of the Internet

One way to think about assessing the magnitude and pace at which the projected benefits of the Internet will be realized is to distinguish between the effects that are likely to grow out of the increased penetration of the Internet throughout the rest of the population (the "width" of the Internet revolution) and those likely to stem from the benefits realized within individual sectors and activities taking existing penetration rates as a given (the "depth" of the Internet revolution). Mindful of the difficulty of projecting anything about the Internet, we offer the following impressionistic judgments about the differences between these two types of effects.

First, as a broad generalization, we suspect that the growing "width" of the Internet revolution will have more effect, as it should, on the *distribution* of the benefits of the Internet than on the total amount of those benefits economy-wide. More specifically, when we speak of the width of the revolution, we are concentrating primarily on individuals rather than businesses, most of whom we presume already are making extensive use of the Internet or will do so in the near future. For individuals, however, the Internet still is very much at the center of the "digital divide", one that runs primarily along income (and to a lesser extent racial) lines.[11] As Internet access devices ("thin client" computers, cellular telephones and possibly other types of hardware, including PCs) become cheaper, the divide will gradually close. As it does, the total amount of benefits – primarily the non-quantifiable benefits of convenience, quality and

[11] National Telecommunications and Information Administration, Department of Commerce, Falling Through The Net II: New Data on the Digital Divide (Washington, D.C., July 28, 1998).

customization – will surely rise, but it is not clear how much, or any, of these benefits will show up in the GDP accounts and therefore in the productivity statistics.

To be sure, the more pervasive Internet commerce becomes, the greater will be the pressure on firms to adopt cutting edge cost savings techniques that the Internet makes possible or will force. At this point, however, we have no way of projecting how significant this indirect impact of B2C commerce will be.

We are more sure, however, that a key to realizing the potential productivity gains identified by our authors will be whether the Internet turns out to be as "deep" as they project. That is, will the firms and other actors in each of the sectors actually use the Net more intensively and, in the process, change their ways of doing business – reducing their transactions costs, changing their supply chain management practices, reducing their inventories, cutting their customer service costs, and changing their organizational structures – in the ways and to the extent that have been projected? The answers will depend heavily on the speed and manner and adjustment of individuals within these organizations, or changes in "corporate culture." If past experience with many IT investments is any guide, this is a serious qualification: the business landscape is littered with many examples of poorly planned IT projects. Fortunately, competition should supply a positive countervailing force, provided that markets are not unduly constrained by anticompetitive practices and the antitrust laws are enforced. Firms on the cutting edge, the ones that are realizing the projected gains, will gain market share at the expense of those who aren't and thereby speed up the diffusion process. But, still the improvements will take time, and we cannot be confident at this point at the pace at which the process will play out.

What about the impact of broadband – faster cable, telephone (DSL), and wireless – hookups to the Net? Shouldn't the increase in speed, exceeding 20 times current modem rates of 56 kilobits per second, accelerate the projected productivity impacts, or even magnify them? To be sure, broadband should make life on the Net far easier for existing users – as it already has for the approximately 3 percent of the population who have it -- and that will increase convenience and promote more use. But to the extent that the benefits of B2C already largely consist of non-quantifiable gains that do not show in the national income accounts, then the benefits of broadband will be no different in character. One possible exception will be for the millions of Americans who are now telecommuting, and perhaps many more, if broadband comes to their homes. To the extent that workers are more productive at home than at places of work, as some anecdotal evidence suggests, then business quality speed at the home could help improve measured productivity. But as for businesses themselves, most already have or will soon have faster T1 or T3 connections – the equivalent of broadband at the home – and thus the diffusion of broadband access to residential customers should not affect the gains they realize through B2B transactions, except indirectly: through the added competitive pressure at the retail end that more intensive use of the Internet should make possible.

Finally, what about the role of policy in helping to realize the projected benefits of the Net? In particular, isn't is true that if more people had confidence in the security and privacy of their e-transactions, then e-commerce would grow faster, thereby increasing the benefits from its use? No doubt this is true, but our answer here is the same as with B2C more generally: the benefits of more intensive retail use of the Net are likely to be non-quantifiable and thus not evident in the productivity statistics. Meanwhile,

working against this effect would be a resolution to the current controversy surrounding taxation of Internet transactions. Forced collection on such transactions also would have effect of slowing down the growth rate of e-commerce (not absolutely, but from what It would otherwise be). On the other hand, it would help rectify an imbalance between the treatment of off and on line commerce, and thus probably would not have a material impact on overall productivity, or at best only a small negative one (to the extent on line retail proves marginally cheaper than off line).

A different story might emerge, however, if new laws, or even better – enhanced technology – to secure intellectual property rights for music, videos, books, and software, encouraged more Net-based distribution of content and thereby reduced distribution costs. Such an outcome would show up in the national income account data and improve productivity. But at this point, it is not clear that the answer to the IP dilemma posed by the file-sharing movement launched by Napster and its successors lies in better policy, but instead through new technologies, whose emergence is inherently difficult to predict.

One area where policy change would have clear effect on consumers, through lower distribution changes, is through elimination of state franchise laws that now require automobiles to be sold through dealers. The Internet not only makes it possible for consumers to search for the car most suitable for them at the lowest price, but if state allow were to allow it, to purchase the car directly through the manufacturer. Charles Fine and Dan Raff estimate that the savings in cutting out the middlemen in these transactions would amount to nearly $400 per car, or about 1.5 percent of the purchase price of the average automobile.

Application to Other Countries

How do our results apply to other countries? We have some preliminary, speculative thoughts on this subject, based on our knowledge of economies elsewhere and the extent of Internet penetration outside the United States.

The chart attached to this paper sheds some light on the subjection of Internet penetration itself. It is worth bearing mind that there is no central repository of this data. We have seen various surveys that report differing results, which themselves seem to change with each new publication. The data in the chart are shown merely to be suggestive, based on recently reported data in *The Economist*.[12] In brief, they show what is widely known: that roughly half of Americans and Swedes were users of the Internet in 2000; that Internet usage in Canada and Singapore now exceeds 40 percent; in Japan, the penetration rate is slightly over 30% (we suspect much of it wireless, as in Sandinavia); with Internet penetration rates below 5 percent elsewhere in the world, notably Brazil, China and even India (which despite the well-known presence of Bangalore as a producer of software, still only has a penetration rate of about one percent).

The first questions that flow naturally from this chart is whether the countries at the cutting edge of Internet usage will remain ahead, whether the gap between them and the developing world will close, and if so, what steps are likely to be taken to make that happen?

Our educated best guess is that the gap – or the overused term “digital divide” – will gradually close, for several reasons, although the pace at which this happens will be determined both by the continued pace of technological advance and the adoption of appropriate government policies. Perhaps the most important equalizing force will be the

steady march of technology, which is producing cheaper hardware for accessing the Internet, especially in wireless form abroad where fixed wireline service is inferior to that of the United States. But policy can and should help. Countries that have not yet privatized and demonopolized their telecommunications sectors must do so in order to promote competition, which in turn will lower regular access charges. Moreover, policy should encourage flat rate pricing of Internet usage, which has been a huge boon to Internet penetration in the United States. Where individuals must pay by the time they spend on the Internet, they will have far less incentive and capability of doing so.

At the same time, however, technology doesn't sit still, by its nature. There could be no better evidence of this than in the Internet field, where broadband services capable of allowing much more rapid transmission of data (and ultimately voice over the Internet) than over conventional copper wires now used for wireline telecommunications are now just beginning to make their appearance in the United States. As noted already, broadband technologies – whether through advanced digital services over existing copper wires (DSL), cable televison over coaxial cables, or through satellite and cellular services – should become increasingly important in the United States and other industrialized countries. As this happens, a new "digital divide" is likely to open up, perhaps for some significant period: between those with "speedy" and those with "slow" Internet access. The width of this divide will be minimized to the extent that advanced wireless services become the main means of Internet access elsewhere around the world. But given the state of current and projected Internet technologies, this is not a sure thing.

How important will the Internet be for growth in countries where it has not yet penetrated widely? We believe the answer will be at least as important, if not more

[12] "Untangling e-conomics", p. 47.

important, than in the United States. Our major reason for making this claim is that, as a general proposition, firms in both services and manufacturing are less efficient (in an absolute sense) than those in the United States. There are noted exceptions to be sure: automobiles and electronics in Japan, certain manufacturing activities in Europe. But on the whole, economies outside the United State have more room to take advantage of the Internet to streamline their production costs – and deliver benefits to consumers – than is true of the United States, which to a broad degree, is already at the cutting edge of technology.

Furthermore, we project that the Internet will become increasingly important – indeed essential – for firms in other countries that want to export to the United States and other industrialized countries. This is because firms in the West and Japan increasingly will be using the Internet for purchasing supplies, whether through the B2B exchanges which are now in use or planned, or through direct communication (which some believe may ultimately replace the exchanges). If exporters do not participate on-line in making bids, they may effectively be shut out of the market.

This isn't to say that the Internet will rectify trade imbalances between countries It won't because trade balances are determined by relative savings and investment behavior in individual countries. The Internet will not repeal that iron law of macroeconomics. However, to the extent that developing country firms in particular miss export opportunities because they are not on the Net, suppliers in the West will turn to other sources – in each other's economies – and thus change the *composition* of overall exports and imports. Other things being equal, therefore, countries whose firms are not participating in e-commerce may find their exchange rates under downward pressure,

raising the costs of their imports and reducing their growth in living standards from it might otherwise be.

Finally, we can't conclude this essay about the economic impact of the Internet and information technology more broadly without offering some comments on economic growth policies other countries should take with respect to these developments. Given the extraordinary success of Silicon Valley and other high-tech regions in the United States, it is tempting for countries outside the United States to conclude that recreating such centers of high-tech activity represent the "magic bullet" for improving economic growth. Indeed, the success of Bangalore in India in supplying software services to the United States and elsewhere, the extraordinary number of high-tech startups in Israel, and the success in Ireland in building a strong high-tech sector, seem to validate this view.

We draw some different conclusions from these patterns of economic activity, both inside and outside the United States, however. The success of the regions at the cutting edge of the Internet and IT revolution seems to be based on a combination of factors: a well-trained work force, *fully proficient in English* (the dominant language of the Internet) and in computer software or hardware technology; an openness to foreign investment and to foreign workers (in the United States); the ability to attract venture capital. Broadly speaking, the various regions have followed two models: either they have acted as sub-contractors for firms outside the region (Ireland and India being excellent examples) or have been at the cutting edge themselves (various high-tech centers in the United States, Scandinavia, and Israel). These two models are not mutually exclusive. Regions such as Bangalore in India can start out as sub-contractors, but over

time, attract venture capital of their own, as local technically trained people leave foreign firms located in the region to start their own businesses.

What has worked for these high-tech "hot spots" cannot necessarily be replicated everywhere else, for several reasons. One is that, for the time being, there is a shortage of trained labor. A second is that in most of the world English is not only not the first language but not the second or third. Third, it is not clear to what extent the benefits reaped by the firms and workers in these high-tech hot spots have "leaked out" or benefited others in the rest of the country. There seems to be little evidence of this in India, but more of it in Ireland. The obvious difference between the two countries, of course, is size of population. It is much easier to generate locational externalities in smaller countries than in countries with a billion people, only a very small proportion of which are employed in the "New Economy."

The key lesson for most of the world, therefore, is to view the Internet revolution like any other technological advance, and seek to incorporate it as fast as possible in firms *outside the IT* sector. That is, make use of the technology, do not spend resources trying to advance it. This simple lesson would counsel against grandiose national champion investments of the kind sponsored by Malaysia, and emphasize instead openness to foreign direct investment, which can provide needed technological transfer, and a strong commitment to technical education (which also can be facilitated by joint venturing with universities in the advanced countries).

Conclusion

As is the case with many things in life, the likely economic impact of the Internet will be somewhere between the extremes: not nearly as minimal as the pessimists claim,

and probably not nearly as great as many cyber-enthusiasts suggest. Nonetheless, there are reasons for believing that the ultimate impacts will be important. It is not unrealistic for the Internet, primarily through its impact on business-to-business transactions, to produce significant cost savings in many sectors of the economy, which will show up not only in faster growth in productivity than would otherwise occur, but also lower prices for consumers, and hence faster growth in living standards. Perhaps equally important, however, the Internet should generate a variety of benefits to users, in their capacities as consumers and citizens, that are not readily quantifiable but nonetheless real: savings in time, added convenience, and products and services tailored specifically for them. In an era when consumers are aware more than ever than "time is money", these benefits to many may be for more noticeable and appreciated than the numbers that we economists like to count. The benefits elsewhere in the world may be even larger.

High-wire artists

Internet users as % of population, 2000