THE DIGITAL DIVIDE AND ECONOMIC OPPORTUNITY:

DOES INTERNET USE MATTER FOR LESS-SKILLED WORKERS?

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Scholars have contended that the "digital divide" - systematic differences in technology access and skill based on education, income, race, ethnicity, gender and age – limits economic opportunity (Mossberger, Tolbert and Stansbury 2003; Warschauer 2003; Wilhelm 2004). This argument assumes, first, that technology skills make a difference for economic opportunity – for getting a job, for earning higher incomes, for advancing into better jobs, etc. Second, this assumes that digital skills are indeed important for less-educated workers, even though computer use is most prevalent in occupations requiring higher education levels, such as professional and managerial jobs (U.S. Department of Commerce/NTIA 2002). Low-skill workers are generally defined as those who have a high school education or less (Holzer 1996), and these are also more likely to be individuals who experience digital inequality. Do digital skills matter for this group in terms of their economic well-being? If so, those who are already disadvantaged in the job market because of discrimination and lesser skill may have this disadvantage compounded. Even if jobs are available for those who lack the ability to use information technology, those jobs may be limited in wages, benefits, and economic mobility.

To explore this issue, we first examine the literature on the effects of information technology on the economy, especially on wages. There has been some debate over the impact of computer use on income. Krueger (1993) and Brauer and Hickok (1995) have concluded that there is a "wage premium" for those who use computers at work, but DiNardo and Pischke (1996) argue that unobserved variables may account for this effect. These studies were early, and examined the use of computers before the widespread diffusion of the Internet. There is general agreement that information technology has had a much greater impact on the economy in the past ten years, resulting in productivity gains (Welfens and Jungmittag 2003; Litvan and Rivlin 2002), and research in the manufacturing industry has showed a positive effect for Internet use at work and employee income (Goss and Phillips 2002). More evidence is needed across sectors, examining any difference in impact for less-skilled workers.

Focusing on economic opportunity for low-skill and disadvantaged workers, we review recent evidence on digital inequality and prior studies on the importance of information technology skills for less-educated workers. Existing studies on skill requirements for less-educated workers are based on surveys or interviews with employers, or on firm-level data that are more than a decade old. Additionally, these findings on less-educated workers are restricted to a few cities, and are not nationally representative. Because of continued growth of information technology use in the workplace, more recent data are needed to reflect greater prevalence of computer and Internet use even in less-skilled occupations.

We employ the 2003 Current Population Survey (CPS) to test the significance of information technology use for employee earnings, first using a general sample, and then examining a separate sample of less-educated workers (with a high school diploma or less). The 2003 CPS is the most recent survey conducted by the U.S. Bureau of the Census that includes a supplement on information technology use, and the CPS contains a wealth of data that allows us to understand occupational as well as demographic differences in the impact of technology. We find that use of computers and the Internet at work is significant in predicting income for both less-educated workers (with a high school education or less) and for all workers – controlling for other factors. While information technology use is indeed more common in occupations demanding higher education, it is still prevalent in many "low skill" jobs and is associated with higher pay. This is the first study to examine CPS data for Internet use across industries, and also for less-educated workers. As such, it yields a more comprehensive picture of the economic impact of technology, and offers new evidence of the policy implications of the "digital divide."

INFORMATION TECHNOLOGY IN THE NEW ECONOMY

Information technology has grown in significance over the past 25 years, changing the economic landscape. Throughout the 1980s and the early 1990s, economists puzzled over the absence of any discernible stimulus from information technology, a mystery that they termed the "productivity paradox" (Blinder 2000). This paradox evaporated by the late 1990s, as it became clear that information technology was driving growth and productivity (Mishel, Bernstein and Schmitt 2001, 19-20; Barrington 2000). The appearance of web browsers in the early 1990s and the growing popularity of the Internet were not the only factors enhancing the use of information technology by businesses and consumers during the 1990s. Better and cheaper hardware and software increased the utility of computers in many other ways (Atkinson 2004). Broadband promises to accelerate productivity and growth, with projected impacts of $500 billion in GDP by 2006 estimated in an early study (Crandall and Jackson 2002). More recently, Lehr et al. (2005) conclude in preliminary findings that communities where broadband was available by 1999 "experienced more rapid growth in (1) employment, (2) the number of businesses overall, and (3) businesses in IT-intensive sectors" (Lehr, Osorio, Gillett, and Sirbu 2005).

Almost two-thirds of growth in investment can be attributed to information technology (Welfens and Jungmittag 2003, 15). Knowledge-intensive (and information technology-intensive) industries such as telecommunications, finance, business and insurance comprise more of the economic activity of the United States than ever before. In 2003, these knowledge-intensive industries accounted for 25 percent of value added in the United States (OECD 2005). The increased presence of knowledge-intensive industries suggests that the impact of information technology is concentrated in highly-skilled professions and in managerial positions rather than in low-skilled work.

Yet this is only one dimension of the changes wrought by technology. Experts predict that it is the "old economy" sectors that will account for future growth, and that this will be "not from new activities, but from faster, more efficient conduct of existing ones" (Litan and Rivlin 2002, 6). This includes applications that involve less-skilled workers in retail, manufacturing, transportation, and other economic sectors.

Information Technology and Economic Change

At the same time that the economy as a whole has clearly benefited from the introduction of new technologies, less-skilled workers have borne the costs of economic change. Wage inequality has expanded since the late 1970s, and information technology has been a contributing factor in this trend (Autor, Katz and Krueger 1998; Acemoglu 2002). Other explanations for this inequality and the simultaneous decline in real wages for less-educated workers include trade, globalization, the weakening of unions, and changes in the supply of skilled workers; but a consistent theme is the role of technological change and rising skill demands (see Katz 2000 and Acemoglu 2002 for reviews).

Information technology has had contradictory effects, raising the skills needed for some jobs and spurring the development of new occupations, while lowering the skills (and compensation) for other jobs or eliminating them entirely (Autor, Levy and Murname 2003; Capelli 1996) Work can be categorized as consisting of routine tasks that computers can perform at practical costs, or as exceptional tasks that entail a higher cost when performed through computers rather than human labor (Levy and Murname 1996).

In their study of wages and skills, Brauer and Hickok (1995) found that because highly-educated workers are more likely to employ computers, the growing use of computers alone accounts for as much as 40 percent of the increase in the return to education, or the “wage premium” enjoyed by more educated workers (Brauer and Hickok 1995). Using Current Population Survey (CPS) data from 1979 and 1989, the authors found that technological change had reduced the total of wages paid by industry for all skill levels, except for college graduates. This suggests significant displacement of low-skilled or less-educated workers in some industries (Brauer and Hickok 1995).

The overall effect of technological change has been to raise the level of skill in the workforce. The demand for college graduates has increased *within* industries, and is not just a reflection of a shift away from manufacturing. Occupations with higher average pay and higher educational requirements expanded more rapidly between 1984 and 1993 in those sectors that adopted computer technology at a faster rate (Autor, Katz and Krueger 1998; also Dunne, Haltiwanger, and Troske 1997). In a review of research from member countries of the Organization for Economic Cooperation and Development, Kim (2002) concluded that there has been a general effect of “upskilling” since the 1980s, and that there is a positive relationship between this upskilling of the workforce and the use of information technology in the economy.

Wage growth in occupations in the 1980s and early 1990s was associated with computer use (Card, Kramarz, and Lemieux 1996; Autor, Katz and Krueger 1998). Prior research examining computer use (but not Internet use) indicates that individual workers enjoy higher wages in return for computer use beyond what their education and occupation would predict. Krueger (1993) estimated the premium for computer use to be wages that were 15 percent higher than for similarly-situated workers who did not use computers. This research has been criticized by DiNardo and Pischke (1997), who pointed out that workers using pencils or sitting down on the job enjoy higher wages as well. Although Krueger (1993) controlled for observable differences such as educational attainment or industry characteristics, there may be unobservable factors other than computer use that contribute to higher wages (for example, more talented workers being assigned to jobs using computers). In fact, Entorf, Gollac and Kramarz (1999) found evidence that French workers who employed computers and other new technologies on the job tended to be the most qualified workers, and that controlling for this, the wage premium for computer use was approximately 2 percent rather than 15 percent. The French research contained some unique data, so it would be hard to replicate the same controls. However, these critical studies also focus on those employees who are in the vanguard during the early diffusion of technology. During a period of widespread use, unobserved individual differences among workers may be less of a threat to validity.

Similar studies have yielded initial evidence of benefits for Internet use at work. Goss and Phillips (2002) found that in the manufacturing sector, Internet users were paid more highly – a wage premium of 13.5 percent. Controlling for the intensity of technology use and other factors influencing pay, Internet use was still a significant predictor of higher wages.[1] This study was based on the 1998 Current Population Survey and was limited to one economic sector. Goss and Phillips suggested that the impact of Internet skills might fade over time, as more workers are able to go online.

Using more recent data, we can test whether Internet use leads to different returns in 2003, or in different occupations. We are also interested whether technology use is important for less-educated workers. Do disparities in technology use and skill matter for low-skill jobs, and for disadvantaged workers?

DIGITAL INEQUALITY AND DISADVANTAGED WORKERS

Survey data (e.g. U.S. Department of Commerce NTIA 2002 and 2004; Madden/Pew Internet and American Life Project 2006) and studies that have used appropriate statistical methods, such as multivariate regression, have demonstrated that Americans who are low-income, less-educated, older, African-American, and Latino are less likely to use computers and the Internet (Mossberger, Tolbert and Stansbury 2003; Katz and Rice 2002; Fairlie 2004). These disparities have persisted over time, with the exception of gender. The gender divide in Internet access has now closed (Katz and Rice 2002; Mossberger, Tolbert and Stansbury 2003), although men continue to be more intensive users of the Internet than women (Fallows 2005). There is a parallel skills divide as well, which affects the same groups, and may be even more critical for limiting economic opportunity. The ability to use the Internet entails technical skills using hardware and software, but also literacy and the ability to use and evaluate complex information (Mossberger, Tolbert and Stansbury 2003).

The Pew Internet and American Life Project (Madden 2006) reports that 73 percent of Americans go online, at least occasionally. One problem with this measure is that it does not reflect regular use, or more importantly, technical competence or skill in navigating the web. Moreover, the widespread growth of technology use within the population has not erased the problem of digital inequality. Sixty-one percent of African-American report having used the Internet, at least occasionally, in comparison with 73

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[1] Using data from the December 1998 Current Population Survey (CPS), researchers employed a logit model using wages as the dependent variable, controlling for the influence of personal, family and human capital variables, economic and job-related factors and work-related Internet use.

percent of whites. The Pew data show that English-speaking Latinos are not appreciably different from whites in Internet use, but these findings are subject to debate, because of the small sample of Latinos included in surveys. In contrast, the large-sample 2003 Current Population survey used here, conducted in both English and Spanish, revealed that only 37 percent of Latinos reported Internet use (in any location) in comparison with 65 percent of non-Hispanic whites. Latinos are nearly 30 percentage points less likely to use the Internet compared to white, non-Hispanics (U.S. Department of Commerce 2004, A1).

Education continues to be an important determinant of Internet use. Only 40 percent of Americans with less than a high school education use the Internet, in comparison with 64 percent of high school graduates, and 91 percent of college graduates. Low-income individuals are less likely to go online, even occasionally, as only 53 percent of adults living in households with less than $30,000 in annual income use the Internet, in comparison with 73 percent with the general population (Madden 2006).

While less-educated individuals are less likely to go online anywhere, there is a growing percentage of workers at differing levels who use computers and the Internet at the workplace. Frequencies from the most recent (2003) Current Population Survey data used in the multivariate analysis for this paper indicate that 72 percent of Americans who are employed and have more than a high school education use computers at work, and that 58 percent of employed Americans with more than high school use the Internet on the job. This compares with 35 percent of workers with a high school education or less who use computers at the workplace, and 21 percent of less-educated workers who use the Internet. There is about a 37-percentage point gap between high-skill and low-skill workers for both computer and Internet use. Still, more than a third of less-educated workers use computers at work, and more than a fifth go online at their jobs.

What does this mean for economic opportunity for those less-educated workers who do have technology skills and use them on the job? There is some evidence that supports the contention that computer and Internet use at the workplace benefits less-educated workers. Moss and Tilly (2001) conclude from a review of the literature that "skill needs are indeed rising," for jobs at all levels, not just managerial or professional jobs (2001, 49). These include hard skills such as technology skills, reading, writing, and math, and also soft skills or social and behavioral skills (Holzer 1996; Moss and Tilly 2001). In their telephone survey of employers, Moss and Tilly found that approximately 40 percent of employers mentioned some increase in the level of skills needed for jobs requiring high school or less, and computer use was cited by about 70 percent of these employers as the reason for rising requirements. Across occupations, computer use was mentioned as a reason for increasing skills in 92 percent of the clerical occupations that had experienced an increase, in 63 percent of customer service jobs with rising skills, and in 48 percent of blue-collar jobs with changing skills (Moss and Tilly 2001, 55). In a separate set of face-to-face interviews with employers, "the most common skill change reported" was computer skills, but basic and soft skills were also commonly cited as accompanying these changes (Moss and Tilly 2001, 63-64). Jobs requiring computer use have a higher proportion of women than men, and more white workers (Moss and Tilly 2001, 80).

A multi-city study of urban inequality used employer surveys from 1992-1994 to estimate the impact of computers skills and other skills for less-educated workers in four cities: Boston, Detroit, Atlanta, and Los Angeles. Holzer (1996, 116-17) found that computer skill requirements were a significant determinant of wages for non-college jobs across all racial, ethnic, and gender groups, but that white females were most heavily rewarded for computer use, and that computer use was least likely to influence wages for African-American and Latino males (1996, 125, 127-28). Other factors that were significant across the models for all workers were requirements for: reading and writing, a high school diploma, vocational training, and experience (1996, 116-117). The dependent variable in this study was the log of the weekly starting wage of the last person hired in each of the firms responding to the survey within the 4 metropolitan areas. While suggestive, these data are not as comprehensive as the national Current Population Survey, nor as precise as the CPS, which is based on the current wages of individual respondents. Additionally, there may have been considerable change since the early 1990's. With the emergence of the Internet and more widespread use of information technology in the workforce, a more recent assessment of the impact of technology is needed.

DATA AND METHODS: 2003 CURRENT POPULATION SURVEY

In order to explore the impact of technology access at work on wages, we turn to the most comprehensive and recent survey data available: the 2003 Current Population Survey (CPS) March Supplement on information technology conducted by the U.S. Census Bureau. The national random sample survey includes over 103,000 respondents. This very large sample (100 times larger than a typical national opinion survey), provides accurate estimates of the population as a whole, with detailed questions about occupations and employment, as well as technology use. This unique dataset allows a rigorous empirical test of whether computer and Internet use at work leads to increased income, especially among subpopulations, such as those with low education. We estimate multivariate regression models to predict weekly earnings for the population as a whole, and for less-educated Americans who may benefit the most from technology use.

We begin by filtering our sample population for only employed workers in the labor force. Of the 103,000 respondents in the sample, 62% (or 64,259) are employed at work and 2% (or 2,193) are employed/absent from the job. These individuals are included in the analysis. The remaining respondents in the sample are unemployed on layoff (.34%), unemployed-looking for a position (3%), retired—not in the labor force (17%), disabled—not in the labor force (4.5%) or other—not in the labor force (11%). These respondents were excluded from the analysis. Additionally, we include a binary variable in our models coded 1 if the respondent is employed full time, and 0 if the respondent is employed part time. We expect full time workers will earn more than those in the labor force part time.

The primary dependent (or outcome) variable measures weekly earnings of the respondent in dollars. A limitation of these data is missing values for the variable measuring income. Of the 103,000 respondents, 90% had missing values on the weekly earnings question, because the CPS rotates the percentage of panel respondents who are asked about earnings. Because of missing data on the dependent variable, our models included 14,851 cases/individuals. This is sample is still almost fifteen times larger than a typical 1000-person survey.

Three questions are used as the primary explanatory (independent) variables, each measuring technology use at work. Respondents were asked if they: 1) used a computer at work, 2) engaged in "computer use at work for internet or email," and 3) if they had used the Internet this year to take courses. The latter question was included to find out whether Internet use for increasing skills had any effect on wages. Affirmative responses to each question were coded 1 (yes) and 0 (no). These three binary variables serve as our explanatory variables, and separate our sample among those who use technology on the job and those who do not. Separate regression models are estimated for the three types of technology use on the job.

Beyond technology use at work, many other factors are known predictors of income/ earnings, especially occupation. An advantage of the CPS data beyond standard surveys is detailed employment information. We use the eleven industry and occupation job categories measuring a respondent's primary occupation. These include: 1) management, business, and financial, 2) professional and related, 3) service, 4) sales and related, 5) office and administrative support, 6) farming, fishing, and forestry, 7) construction and extraction, 8) installation, maintenance, and repair, 9) production, 10) transportation and material moving, and 11) armed forces. A series of binary (1/0) variables was created for each occupation, with production as the reference (left out category). Because of the low number of responses, a separate binary variable for armed forces was not included, with respondents whose occupation was armed forces coded 0. We expect that management and professional occupations will have the highest earnings. As an additional control, we include a binary variable measuring whether the respondent is employed in the job sector the U.S. Census defines as the "information industry," which includes technology/computing jobs, as well as publishing. We would expect those employed in the information industry to have a higher probability of using computers and the Internet at work.

Our models also include standard demographic controls given known earnings gaps based on gender, race, age and education. We expect that white males who are older with higher education will earn more than minority females who are younger with lower education. By including these demographic variables in the models we control, or hold constant, the effect of demographic factors on earnings. A binary variable measures gender, with females coded 1 and males 0. Compared to standard surveys, our national data include large and representative samples of African-Americans and Latinos. Of the 103,000 total sample, 10% (or 10,113) reported being of Hispanic origin, and almost 10%

(or 9,920) reported being black.[2] Additionally, almost 5% (or 5,037) were Asian-American. Three binary variables measure whether the respondent is an African-American (coded 1), Latino (coded 1) or Asian-American (coded 1) with white non-Hispanic as the reference group (coded 0). Age is measured in years. The educational attainment of the respondent is measured on a five-point ordinal scale ranging from 1 (less than high school degree) to 5 (bachelor's degree or higher). Geography/location is measured with binary variables for urban and suburban residents, with rural residents and those that did not identify their location as the reference group (coded as 0). Private sector and federal government jobs tend to pay more than local governments and non-profits. We use a series of binary variables to measure job sector (federal government, private, local government) with state government and non-profit sectors as the reference category coded 0. Including a different grouping of binary variables for job sector does not change the substantive findings reported here.

FINDINGS – OVERALL POPULATION

Since the dependent variables in Tables 1 and 2 are weekly earnings in dollars, ordinary least squares regression is reported, with robust standard errors to control for heteroskedasticity. Column 1 tests whether computer use at work is associated with increased income, holding other factors constant, while Column 2 includes an identical set of control variables, but swaps computer use at work for Internet/email use at work. Finally, Column 3 includes a variable measuring whether the respondent took courses online. Across the three models in Table 1 (total population sample) we see strong and consistent evidence that technology use at work leads to higher wages, even after controlling for a battery of factors known to increase earnings.

The substantive magnitude of the effects of technology use at work on economic opportunity is substantial. Average weekly earnings are $ 692.35 (standard deviation 519.32), which equals roughly $2768 a month or $33,000 a year before taxes. Holding other demographic, occupation, economic and job sectors factors constant, an individual who uses the computer at work is predicted to earn $101.00 more dollars per week, than the same individual who does not use the computer at work. This is a 14.5% boost in earnings based on technology use at work, and is consistent with Krueger's earlier (1993) findings of a 15% wage premium for computer use. Internet/email use at work creates a larger boost in wages, all else equal (See Column 2). Weekly earnings are $118.27 higher for those individuals using the internet at work than those employed individuals who do not use the internet on the job; a 17% boost in weekly earnings. Even taking courses online appears to increase weekly earnings by a predicted $39.00 a week over those who have not taken online courses (See Column 3).

Many of the control variables are in the expected direction, lending validity to our findings. Females earn on average approximately $200 less per week than their male counterparts, while older individuals earn more than the young. Racial and ethnic minorities (African Americans, Latinos and Asians) earn less than whites. Increased

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[2] In the 2003 CPS 9,695 respondents reported being black only. Also, the multiple race categories (with only two races) that included black were included in the construction of the variable for a total of 9,920 black respondents.

education boosts weekly income by a little under $100 dollars per week. Our findings suggest that technology use at work (computer/internet/email) leads to a slightly larger boost in earnings than increased education. Geographic location matters as well, with suburban residents earning roughly $100 dollars more per week than their rural counterparts, all else equal, while urban residents earn roughly $50 more per week than rural residents. Occupation also matters for income, with those in management and professional occupations earning considerably more than the reference category (production). Sales and construction occupations also earn more than our baseline occupation (production). As predicted, federal government and private sector employees earn between $200 and $100 more per week than those working in non-profits or state government. As expected, full time workers earn almost $400 more dollars per week than those who work only part time.

So far the analysis provides fairly robust evidence that technology use at work leads to increased economic opportunity among the employed segment of the American population, and that the substantive size of the effect rivals that of increased education, place (suburban/rural/urban), occupation, or job sector (working in the private sector or for the federal government). The models in Table 1 are robust, accounting for 41% of the variation in weekly earnings among the sample of 15,000 respondents.

FINDINGS – LESS-EDUCATED SAMPLE

The more important question, for our purposes, however, is whether technology use at work can increase the wages of the less-educated employees. Table 2 replicates the models in Table 1 but includes only those respondents in the CPS survey with a high school degree or less. Among this sub-group of the population, technology use at work was less common than for those with education beyond a high school degree. Yet, we see that technology use continues to have a positive and statistically significant effect in increasing weekly earnings. Less-educated workers who use the computer at work are predicted to earn $90 more per week, than the same less-educated worker who does not use the computer on the job. Again, Internet use at work leads to even larger economic gains - a $111.00 increase in weekly earnings. These dollar figure increases are comparable to those for the population as a whole, but because average weekly earnings are significantly lower for this population, these increases account for a larger percentage change. In contrast, less-educated workers who have taken online courses enjoy a larger gain in income than the general population, with less-educated employees experiencing a $63 per week increase in earnings from online courses, versus a $39 per week raise for the general sample. Both models, however, make it clear that varied types of computer use (including online learning) increase wages for lower-skilled workers as well as all employees.

Again, the control variables largely mirror the population as a whole, but with some notable exceptions that we would expect among less-educated Americans. While women and racial minorities continue to earn less than males and whites (although the gender and racial gaps are smaller among the less-educated), urban residents are now statistically no different than rural residents in earnings, while those in suburbs continue to earn roughly $50 more per week, all else equal. Management and professional occupations earn more than the baseline (production). But among the less-educated the trades earn higher wages (construction, repair, transportation), while those in service, sales and secretarial positions earn considerably less than the baseline (production) occupations. Full time workers earn almost $300 dollars more per week than part-time employees among the less-educated population.

In order to compare the magnitude of information technology's impact for different groups of workers, probability simulations were run varying race, ethnicity, and gender, with all other variables set at their modal or mean values. Among less-educated workers who use the Internet in their jobs, African-Americans and Latinos enjoy a higher premium for Internet use than similarly-situated whites, even though Internet use does not begin to compensate for otherwise lower wages. African-American men with a high school education or less earn 18.36 percent more than similarly-situated African-American men who do not use the Internet at work, while African-American women gain a bonus of 17.31 percent. For less-educated Latino workers, the wage premium is 16.99 percent for men and 16.11 percent for women. Among less-educated white workers, the Internet increases earnings 14.77 percent for men, and 13.56 percent for women. This demonstrates that information technology use at work does indeed increase economic opportunity for less-educated workers, and that the effects are slightly greater for minorities. In contrast to Holzer (1996), women do not enjoy the greatest advantage from technology use, at least not in terms of the percentage gain in wages. Differences based on gender, however, are slight.

CONCLUSION: TECHNOLOGY, ECONOMIC OPPORTUNITY AND INEQUALITY

Information technology skills should logically increase individual earnings, because they boost the productivity of workers. There has been some debate over the extent to which technology skills increase income, given the greater significance of education in knowledge-intensive jobs and the rising demand for skills other than technology even in lower-skilled occupations requiring a high school education or less. Demands are increasing for education and cognitive skills as well, with the adoption of technology-intensive practices within manufacturing and other "old economy sectors," and with the shift toward more knowledge-intensive industries such as finance. Some authors (Bresnahan 1999) argue that there is a greater return for soft skills than for computer skills, for many routine jobs have been automated. We see technology skills as being one part of the more complex picture of rising skills, and just one aspect of workforce development or "lifelong learning" that may be addressed by public policy.

Our findings build on earlier studies, demonstrating that computer and Internet use continue to matter for income. Such skills promote economic opportunity for all workers, and for less-educated workers as well. Employees enjoy a wage premium for computer use (of 13.5 percent) that is consistent with earlier studies (Krueger 1993), and earn even more for Internet use (approximately 17 percent more). Our data demonstrate this impact across industries, rather than in manufacturing alone (Goss and Phillips 2002). Returns for technology skill are substantial, rivaling the impact of education in our models for the general population. Probability estimates for less-skilled workers show that the technology wage premium for minority workers is somewhat higher than for white workers. Because the boost to income is fairly consistent across groups in terms of absolute dollars, less-educated workers and lower-paid minorities experience a larger percentage change in income due to ICT use. Technology skills do not counteract the disadvantage that minority workers still confront in the labor market, but clearly they are one strategy for narrowing the gap. African-Americans and to a lesser extent, Latinos, have been even more likely than other Americans to express the belief that technology is important for economic opportunity, controlling for other factors (Mossberger, Tolbert and Stansbury 2003), and our findings support their perceptions.

Rising skill levels in the new economy have lifted the fortunes of some, while undermining future stability for others. Here, the costs of economic change are unevenly distributed, and the price of exclusion is clear. Digital inequality does penalize less-educated workers, although the literature on wage inequality over the past decades makes clear that access to education is also important for economic opportunity. Public policy that increases technology skills among all Americans will enable the participation of the least-advantaged in the new economy. Job training programs, adult education, community colleges, and other venues for workforce development and continued education can enlarge the potential opportunities for less-educated workers if they encourage digital skills along with cognitive skills and further education, and target such programs to low-income communities, in particular. Many of those currently who do not use computers or the Internet, in any location, may also lack basic literacy skills; for the Internet, in particular, is a reading-intensive medium (Mossberger, Tolbert and Stansbury 2003). Residence in low-income communities also diminishes technology access and use beyond individual factors such as income and education (Mossberger, Tolbert and Gilbert 2006). While there are many jobs for less-educated workers that do not currently require computer or Internet use, continued diffusion of broadband and other technology promises to diminish their number in the future. In the meantime, those who have technology skills enjoy relatively better wages than their peers, and may have other opportunities for advancement over time.

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Table 1: The effect of technology use on weekly earnings (entire population)

	Computer Use at Work		Internet/email use at work		Computer Courses	
	b (s.e.)	p>z	b (s.e.)	p>z	b (s.e.)	p>z
Computer use at work	**101.60 (7.67)**	**.000**				
Internet/email use at work			**118.27 (8.12)**	**.000**		
Computer courses					**38.69 (17.35)**	**.026**
Female	-208.36 (7.86)	.000	-205.22 (7.82)	.000	-205.40 (7.88)	.000
Male (Reference Category)						
Age	4.86 (.24)	.000	4.83 (.24)	.000	4.90 (.24)	.000
Latino	-52.30 (9.23)	.000	-55.38 (9.20)	.000	-61.63 (9.30)	.000
Asian	-51.92 (15.05)	.001	-52.99 (14.97)	.000	-56.09 (15.18)	.000
Black	-65.17 (10.05)	.000	-64.12 (10.02)	.000	-74.23 (10.06)	.000
White (Reference Category)						
Education	88.68 (3.12)	.000	85.93 (3.14)	.000	96.65 (3.11)	.000
Urban	49.90 (8.90)	.000	48.55 (8.88)	.000	51.18 (8.94)	.000
Suburban	99.37 (7.44)	.000	98.33 (7.43)	.000	100.67 (7.48)	.000
Management	319.29 (16.65)	.000	311.82 (16.62)	.000	357.85 (16.36)	.000
Professional	163.05 (14.35)	.000	163.36 (14.14)	.000	193.12 (14.18)	.000
Service	-16.12 (14.35)	.129	-18.36 (10.58)	.084	-17.81 (10.77)	.098
Sales	75.11 (14.29)	.000	76.98 (14.14)	.000	98.85 (14.45)	.000
Secretary	-40.81 (11.42)	.000	-37.58 (11.19)	.001	-1.90 (11.08)	.863
Farming	-74.22 (22.47)	.001	-79.79 (22.74)	.000	-81.67 (22.93)	.000
Construction	67.36 (14.55)	.000	61.22 (14.74)	.000	54.09 (14.66)	.000
Repair	-.97 (15.27)	.949	3.98 (15.27)	.794	9.43 (15.44)	.541
Transportation	17.64 (14.78)	.233	16.22 (14.74)	.271	9.39 (14.87)	.000
Production (Reference Category)						
Federal Government	189.68 (27.57)	.000	195.96 (24.68)	.000	181.02 (24.68)	.000
Local Government	15.95 (16.82)	.343	21.19 (16.89)	.210	13.17 (16.91)	.463
Private Sector	88.76 (14.47)	.000	97.14 (14.56)	.000	81.69 (14.50)	.000
State Government and Nonprofits (Reference Category)						
Information industry	-15.50 (24.90)	.534	-14.92 (24.68)	.545	-13.00 (24.90)	.602
Fulltime	379.59 (7.15)	.000	373.93 (7.14)	.000	395.17 (7.14)	.000
Part time (Reference Category)						
Constant	-253.68 (23.42)	.000	-250.66 (23.36)	.000	-250.60 (23.60)	.000
N	**14851**		**14851**		**14851**	
F	389.96	.000	389.61	.000	379.35	.000
R^2	.4082		.4108		.4022	

Note: Unstandardized regression coefficients with robust standard errors in parentheses to control for heteroskedasticity. Probabilities based on two-tailed test. 2003 Current Population Survey data, March Supplement on Information Technology.

Table 2: The effect of technology on weekly earnings for the less-educated population (high school degree or less)

	Computer Use at Work		Internet/email use at work		Computer Courses	
	b (s.e.)	p>z	b (s.e.)	p>z	b (s.e.)	p>z
Computer use at work	**89.76 (8.81)**	**.000**				
Internet/email use at work			**111.33 (10.61)**	**.000**		
Computer courses					**63.11 (24.85)**	**.011**
Female	-133.73 (8.51)	.000	-133.78 (8.48)	.000	-126.95 (8.57)	.000
Male (Reference Category)						
Age	2.92 (.24)	.000	2.92 (.24)	.000	2.93 (.25)	.000
Latino	-72.15 (9.58)	.000	-74.13 (9.55)	.000	-84.40 (9.65)	.000
Asian	-46.45 (18.02)	.010	-50.98 (17.66)	.004	-52.02 (18.25)	.004
Black	-27.07 (11.49)	.019	-26.89 (11.50)	.019	-35.48 (11.54)	.002
White (Reference Category)						
Urban	12.15 (9.70)	.210	11.20 (9.70)	.248	13.05 (9.81)	.183
Suburban	44.68 (8.41)	.000	44.86 (8.38)	.000	45.98 (8.48)	.000
Rural (Reference Category)						
Management	223.69 (27.28)	.000	219.24 (27.08)	.000	258.94 (27.01)	.000
Professional	72.71 (23.60)	.002	78.39 (23.11)	.000	98.82 (23.35)	.000
Service	-70.22 (10.95)	.000	-73.51 (10.92)	.999	-73.41 (11.12)	.000
Sales	-2.98 (15.12)	.844	-23.96 (12.35)	.053	15.26 (15.54)	.326
Secretary	-26.02 (12.45)	.037	-23.96 (12.35)	.053	9.94 (12.01)	.408
Farming	-131.90 (22.50)	.000	-135.47 (22.85)	.000	-138.13 (22.80)	.000
Construction	61.15 (15.83)	.000	53.23 (15.85)	.001	51.34 (15.98)	.001
Repair	28.65 (18.49)	.121	30.57 (18.55)	.099	39.99 (18.58)	.031
Transportation	2.63 (15.43)	.864	-.12 (15.34)	.994	-2.04 (15.50)	.895
Production (Reference Category)						
Federal Government	76.71 (31.89)	.016	86.86 (31.86)	.006	66.81 (31.61)	.035
Local Government	-2.20 (23.34)	.925	2.60 (23.50)	.912	.07 (23.74)	.998
Private Section	1.48 (19.76)	.940	8.73 (19.93)	.661	-3.38 (20.11)	.866
State Government and Nonprofits (Reference Category)						
Information industry	1.20 (23.49)	.959	5.01 (23.23)	.829	3.31 (23.71)	.889
Fulltime	290.63 (7.31)	.000	289.01 (7.28)	.000	301.61 (7.34)	.000
Part time (Reference Category)						
Constant	180.45 (25.30)	.000	184.94 (26.38)	.000	195.50 (26.69)	.000
N	**5960**		**5960**		**5960**	
F	161.22	.000	158.44	.000	154.25	.000
R^2	.3161		.3188		.3038	

Note: Unstandardized regression coefficients with robust standard errors in parentheses to control for heteroskedasticity. Probabilities based on two-tailed test. 2003 Current Population Survey data, March Supplement on Information Technology.