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# Technology, Computers, and Wages

## Evidence from a Developing Economy

*Chris N. Sakellariou*
*Harry A. Patrinos*

The World Bank
Latin America and the Caribbean Region
Education Sector Unit
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## Abstract

Increasing returns to schooling and rising inequality are well documented for industrial countries and for some developing countries. The growing demand for skills is associated with recent technological developments. Sakellariou and Patrinos argue that computers in the workplace represent one manifestation of these changes. Research in the United States and industrial countries documents a premium for computer use. But there is recent evidence suggesting that computer skills by themselves do not command a wage premium. The authors review the literature and use data from a survey of higher education graduates in Vietnam. The results support the unobserved heterogeneity explanation for computer wage premiums. They suggest that computers may make the productive workers even more productive. However, given the scarcity of computers in low-income countries, an operational strategy of increasing computer availability and skills would seem to offer considerable hope for increasing the incomes of the poor.


This paper—a product of the Education Sector Unit, Latin America and the Caribbean Region—is part of a larger effort in the region to document the determinants of earnings. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Nelly Vergara, room I7-004, telephone 202-473-0432, fax 202-522-3135, email address nvergara@worldbank.org. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The authors may be contacted at acsake@ntu.edu.sg or hpatrinos@worldbank.org. March 2003. (23 pages)

# Technology, Computers and Wages:

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**Chris N. Sakellariou**
B2-B64, Nanyang Business School
Nanyang Technological University
Singapore, 639798
Email: acsake@ntu.edu.sg

**Harry A. Patrinos**
The World Bank
Washington, D.C.
Email: hpatrinos@worldbank.org

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## I. Introduction

Increasing returns to schooling and rising inequality is well documented for developed countries and for some developing countries. Many believe that a fundamental change has occurred in the relationship between education and earnings, reflecting increased and high demand for skilled workers. The demand for educated labor is associated with important technological developments that have taken place in recent years. It has been argued that computers in the workplace represent one manifestation of these changes. Researchers in the United States and other developed countries have documented a substantial premium for computer use. However, there is recent evidence suggesting that computers in the workplace are not responsible for the change in wages, despite the fact that significant changes have occurred in the workplace reflecting technological and organizational changes that have resulted in increased demand for skilled labor. This paper reviews the literature from developing countries and the scant work on this topic for developing countries. Survey data taken from surveys of higher education graduates in Vietnam is used to test various hypotheses about the impact of computer use on wages and the determinants of computer use.

## II. What do computer wage premiums reflect?

The computer is an example of an organizational change that requires workers with an enhanced ability to learn. This change, it is argued by many, has caused an increase in the demand for educated labor and, consequently, an increase in the returns to schooling and rising earnings inequality. For the years between 1984 and 1989, the percentage of workers who reported using a computer at work increased by over 50 percent (Krueger 1993), in the United States.

In an attempt to empirically examine whether employees who use a computer at work earn a higher wage rate than otherwise similar workers who do not use a computer, Krueger (1993) shows that workers who use computers at their job earn roughly a 10 to 15 percent higher wage rate (see Table 1). Therefore, the expansion in computer use during the decade of the 1980s can account for between one-third and one-half of the observed increase in the rate of return to education (Krueger 1993). Moreover, the premium is associated with the use of computers for productive purposes, such as email, bookkeeping, desktop publishing and inventory control.

However, there is some doubt cast on these estimates. It is argued that computers have not changed the wage structure in the sense implied by Krueger and others. Rather, it is asserted that more productive workers use computers. In other words, computers in the workplace do not themselves create a wage premium for a given worker. Rather, more able workers tend to work at jobs that require the use of a computer. The results would suggest that computer users possess unobserved skills that are rewarded in the labor market or that computers were first introduced in higher paying jobs.

In a re-analysis of Krueger's original paper, using German data, DiNardo and Pischke (1997) confirm that estimated wage differentials associated with computer use in Germany are very similar to the United States differential. But they also find large differentials for on-the-job use of calculators, pens or pencils, or for those who work while sitting down. They conclude that wage differentials associated with on-the-job computer use are the result of unobserved heterogeneity.

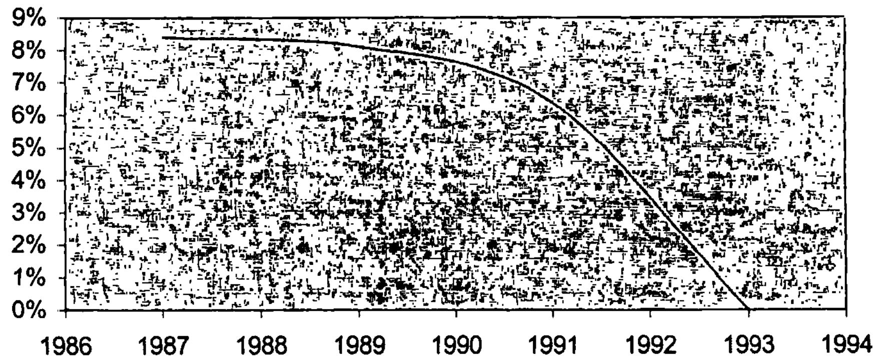
Table 1: Wage Impacts of Computer Use

| Author | Country | | Wage Impact (% increase over non-user) |
|---|---|---|---|
| Krueger 1993 | United States | 1983 | 15.0 |
| | | 1989 | 18.0 |
| Boozer, Krueger and Wolkon 1992 | United States | | 22-23 |
| Hamilton 1997 | United States | | 13-25 |
| Handel 1999 | United States | | 7 |
| Krashinsky 2000 | United States | | 0 |
| Borland, Hirschberg and Lye 1999 | Australia | | 10-18 |
| Miller and Mulvey 1997 | Australia | | 10-15 |
| Reilly 1995 | Canada | | 15.5 |
| Morrissette and Drolet 1998 | Canada | | 14 |
| Entorf and Kramarz 1997 | France | | 2-10 |
| Entorf and Kramarz 1998 | France | | 2-20 |
| Entorf, Gollac and Kramarz 1999 | France | | 1-18 |
| Asplund 1997 | Finland | 1987 | 8.4 |
| | | 1989 | 8.1 |
| | | 1991 | 6.4 |
| | | 1993 | 0 |
| Dinardo and Pischke 1997 | Germany | | 17 |
| Haisken-DeNew and Schmidt 1999 | Germany | | 1-7 |
| Oosterbeek 1997 | Netherlands | | 11 |
| Arabsheibani, Emami and Marin 1996 | United Kingdom | | 20-23 |
| Arabsheibani and Marin 2000 | United Kingdom | | 19 |
| Bell 1996 | United Kingdom | | 13 |
| Green 1998 | United Kingdom | | 13-18 |
| Borghans and Ter Weel 2000a | United Kingdom | | 21 |
| Sakellariou and Patrinos 2000 | Vietnam | | 10-14 |

Borghans and ter Weel (2000d), however, suggest another interpretation. They argue, based on analysis of German and United Kingdom data, that the computer wage premium does not reflect returns to computer skills. Rather, the wage premium merely reflects the fact that computer costs are more easily recovered from high wage workers. Also, they argue, the wage premium associated with pens reflects returns to specific writing skills, such as writing documents. In an analysis of a sample of twins, Krashinsky (2000), after controlling for selection, finds that computers do not have a significant effect on wages. Using Australian data, and disaggregating by a number of factors and controlling for worker's computer knowledge, Borland, Hirschberg and Lye (1999) get mixed results on the impact of computers on earnings. In an attempt to control for individual heterogeneity, Haisken-DeNew and Schmidt (1999) use panel data, and control for computer-related skills, and find that computer use at work increases earnings by only 1 percent, down from 7 percent when individual heterogeneity is not controlled for in the model. This confirms the results of Entorf, Gollac and Kramarz (1999) and Entorf and Kramarz (1997, 1998), who use French panel data to control for individual ability, and find a very small computer wage premium. When other factors associated with earnings are introduced in the wage equation, the returns to computer use fall to 7 percent using United States data (Handel 1999).

However, Bell's (1996) attempt to control for individual heterogeneity does not lead to the same conclusion. Bell (1996) uses British panel data and controls for ability and test scores in mathematics and reading comprehension, as well as planning ability and organizational capabilities. He finds a computer wage premium of 13 percent. Green (1998) also finds a computer wage premium of 13 percent, and although panel data is not used, this holds after controlling for a great number of different measures of skill, such as professional communication and problem-solving skills, variety of tasks, participation in "quality circles," and learning time. Reilly (1995) examines the earnings impact of computer use in Canada with a sample of 607 employees working in 60 establishments in 1979, a period perhaps before the personal computer "revolution." Without controlling for establishment size, Reilly (1995) finds employees who have access to a computer earn 15.5 percent higher pay. In Finland, the computer premium declines over time (Asplund 1997). In fact, the premium becomes insignificant (see Figure 1).

Figure 1: Computer Wage Premium over Time in Finland




Source: Asplund 1997

Bresnahan (1999) argues that ICT is changing whole organizations, by leading to the replacement of back-office jobs and increasing the importance of front-office skills and leadership. Individual personal computers (PCs) are not changing the market, but networks of PCs and office automation are changing the way people work and are being rewarded. The nature of work is being restructured in workplaces in industrial countries, whereby multitasking is rewarded and broad-based education is preferred (Lindbeck and Snower 1996). Cappelli and Carter (2000) show that while computer use has an effect on wages of managers and supervisors, it is computer use by their subordinates that is the important factor, lending support to Bresnahan's theory that it is computers and workplace organization changes that are responsible for wage structure changes. In a very interesting and innovative case study, Autor, Levy and Murnane (2000) document the impact of technological change on two departments within the same commercial bank. They show that the same technological change can result in both computer-labor substitution and in computer-skill complementarity (skill-biased technological change), depending on the nature of work and organization of the workplace. They also show that technological change and organizational change are interdependent. The results also suggest that conceptual and problem-solving skills are one set of skills that are likely to be made more valuable by technology. In an attempt to examine how computer technology complements skilled labor, Autor, Levy and Murnane (2001) look at what computers do in order to model and test how computers alter the demand for skilled labor. They find that computers are associated with declining relative industry demand for routine skills and increased demand for non-routine cognitive skills.

The belief that computers represent skill-biased technological change and that computer skills are being rewarded in the labor market is challenged by Borghans and ter Weel (2000b) using a unique British survey that collected information on a number of skills. They conclude that it does not require high level computer skills to operate computers for the majority of workers. Controlling for computer usage (ranging from "essential" to "not very important"), sophistication of usage ("advanced" to "simple") and computer skills ("very high" to "very low"), they show that there are returns to usage and sophistication, but to not to skills. They argue that the use of computers is associated with high wage workers, who could save time on some tasks. Eventually, all workers will receive computers, once the cost goes down sufficiently (see also Borghans and ter

Weel 2000c). There are implications for these findings, argue the authors. Among these, it may not make sense to invest heavily in computer skills when educating pupils.

Research on these issues in developing countries is sparse. In Korea, workers are paid more in industries where technology changes rapidly than in industries where technologies change slowly (Choi 1993). More skilled workers benefit more from changes in technology. In Mexico, Taiwan, Colombia (Tan and Batra 1995) and Malaysia (Tan and Batra 1997), workers are more likely to get training the higher is the rate of technical change in the workplace, and be paid a wage premium. Investments in technology at the firm level leads to large wage premiums for skilled workers, but not for unskilled workers. Sustained high returns to education over time in Singapore are posited to be the result of a growing "knowledge economy" and increasing demand for highly skilled graduates (Sakellariou 2001). In Vietnam, it is found that earnings increase if the current job required language or computer skills by 10 to 14 percent (Sakellariou and Patrinos 2000). Among various computer skills, knowledge of word-processing and spreadsheets increases earnings by 17 and 18 percent.

## III. Data

The data were obtained from the Higher Education Graduate Tracer Survey (HEGTS), implemented in 1996 by the Ministry of Labor, Invalids and Social Affairs (MOLISA) as part of the World Bank-Vietnam Education Financing Sector Study (VEFSS). The sampling framework was designed to ensure representation by region and institutional specialization. From lists provided, there were names for 42,754 graduates from 60 institutions. Of those, 1,829 graduates were traced. The questionnaire consisted of 18 major and 60 detailed questions including:

(1) Field of study, specialization, performance and related information

(2) Individual characteristics

(3) Student expenses and source of finance during the study years

(4) Foreign language and computer skills

(5) Occupation

(6) Location

The information on computer skills allows for the identification of the graduates who, first, have computer skills (one of word processing, spread sheet, data base, programming and "other") at various levels of skill (low, intermediate, high and very high), and second, whether they work at a job which requires the use of computers or not. The following dummy variables related to computer skills were created for use in the analysis:

CREQ: Computer required at work

CNREQ: Computer not required at work

USE: Knowledge of computers (any level or type of skill) and use required at work

KNOWNREQ: Knowledge of computers (any level or type of skill) but use not required

USELOW: Uses computer at work (any type of skill) and computer skill level is low

USEINTER: Uses computer at work (any type of skill) and skill level is intermediate

USEHIGH: Uses computer at work (any type of skill) and skill level is high

USEVHIGH: Uses computer at work (any type of skill) and skill level is very high

WP: Best skill type is word processing

SS: Best skill is spread sheet

DB: Best skill type is data base management

PROG: Best skill type is programming

OTHER: Best skill type is "other"

The set of other control variables is rich, including: age, sex, marital status, duration of studies, performance in university, work experience while studying, English language skills, sector of employment, specialization in university and occupation.

## IV. Empirical Findings

Mean monthly earnings of graduates who use computers at work, those who have computer skills but their use is not needed at work and those who do not have computer skills, are presented in Table 2. The ratio of mean earnings of those who use computers over that of those who do not is about 1.5, while the ratio for those who use computers to those who do not have such skills is about 2.5.

Table 2: Mean monthly earnings from main job (in Vietnam Dong)

| | N | Mean Wage |
|---|---|---|
| Uses computers | 305 | 1,112,000 |
| Knows but not required | 453 | 716,000 |
| No computer skills | 979 | 444,000 |
| All | 1,737 | 632,000 |

Source: HEGTS
Note: In 1996, $1 equaled 11,000 Vietnam Dong

Wage regressions which include dummies for computer use are reported in Table 3. All five columns include the computer use (USE) dummy. In column 1, and without adjusting for anything else, those who use computers earn 110 percent (exp(0.745)-1) more than those who either do not have computer skills or do not use computers at work. This wage differential estimate is significantly higher than the corresponding estimates obtained in industrial countries. For example, the corresponding computer skills differential using United Kingdom data was about 56 percent (Borghans and ter Weel 2001).

Column 2 reports the differentials for those who use computers and those who have computer skills but computers are not required at work. The estimate of the wage premium for those who use computers from this equation is 145 percent while the corresponding premium for those with computer skills who do not use them at work is still substantial at 62 percent. The size of the second differential suggests that there are unmeasured characteristics that make graduates who have computer skills particularly productive compared to graduates with no computer skills. This constitutes direct evidence in favor of the argument that computer users (along with those with computer skills not required at work), possess unobserved skills that are rewarded in the labor market.

Column 3 includes personal characteristics (age and its square, gender, marital status, duration of studies, performance in university, whether the graduate worked while studying and English language skills) and field of study.[1] The observed computer use

[1] Some of the coefficients on field of study (as well as some of those related to occupations) do not conform with prior expectations and are related to the public sector's remuneration policies which do not rely on market signals to allocate educated labor. Reliance on market signals to allocate labor was announced, however, at the 1991 party congress (Ronnas and Sjoberg 1995). In 1993 the Government announced plans to set salaries according to market rates. This salary structure will compensate government

premium decreases to 53 percent. In column 4 sector of employment (private sector, self-employment and working for a foreign firm) is added, which decreases the wage premium to 35 percent. Finally, column 5, in addition to all other regressors, includes occupation dummies and the earnings premium decreases to 26 percent.[2] Overall, after using a variety of covariates the computer use premiums remain high, and larger than the corresponding premiums obtained for industrial countries.

Table 3: OLS estimates of the effect of computers on earnings

| Dependent variable: log of monthly earnings from main job | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| USE | 0.745<br>(16.3)* | 0.898<br>(19.7)* | 0.429<br>(9.2)* | 0.297<br>(6.9)* | 0.232<br>(5.4)* |
| KNOWNREQ | | 0.483<br>(12.2)* | | | |

Source: HEGTS
Note: Model 3 also includes personal characteristics and field of study dummies; Model 4 includes personal characteristics, field of study and sector of employment dummies; Model 5 includes personal characteristics, field of study, sector of employment and occupation dummies.
+ For the complete results, see Table A1 in the appendix.
t-values in parentheses; * indicates significance at the 1% level.

Two sets of dummies for computer use are employed in Table 4, one for different types of computer skills (word processing, spread sheets, data base, programming and "other" computer skills) and the other for different level of skills (low, intermediate, high and very high).

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workers according to education level, job responsibility and performance. The full impact of these reforms may not be seen for years, however, since those hired prior to 1994 are largely exempted (World Bank 1997).

[2] Use of province dummies, along with all other regressors in Model 5, further reduces the computer

Table 4: OLS estimates of the effect of skill type and level of skill on earnings (dependent variable: log of monthly earnings from main job)

| Model | 1 | 2 |
|---|---|---|
| WP | 0.322<br>(4.6)[a] | |
| SS | 0.364<br>(1.3) | |
| PROG | -0.015<br>(-0.14) | |
| DB | 0.058<br>(0.56) | |
| OTHER | -0.140<br>(-0.50) | |
| USELOW | | -.009<br>(-0.07) |
| USEINTER | | 0.425<br>(7.2)[a] |
| USEHIGH | | 0.312<br>(5.0)[a] |
| USEVHIGH | | 0.194<br>(1.55) |
| No computer use (Reference category) | | |
| Adjusted R square | 0.366 | 0.371 |
| N | 1,737 | 1,737 |

Source: HEGTS
Note: Both models include dummies for personal characteristics, education, and occupation dummies.
t-values in parentheses; [a] Indicates significance at 1% level.

In looking at the effect of skill level (column 2), the interest is to test whether premiums increase with the skill level as one might expect, or higher skills do not lead to increased premiums, which would provide support for the argument that the wage premium is not a reward for computer skills. Intermediate computer skills result in the highest premium and premiums do not increase with skill level. In particular (column 2), an intermediate level of skill results in a premium of 53 percent, a high level of skill

earnings premium to about 15-16 percent.

results in a premium of 37 percent (both statistically significant), while very high skill results in a premium of 21 percent which is significant only at the 10 percent level. Finally, there is no premium for low computer skill.

Looking at column 1 of Table 4, the relatively routine skills of word processing (and to a lesser extent spread sheet), command the highest premium. This result seems to be in support of the explanation given for the results on skill level: namely, it is not the skills themselves that are rewarded, rather, as the worker rises within the firm at some point it becomes cost effective to be given a computer and more often than not, the worker will be using it for tasks like word processing and other routine tasks, rather than tasks involving "real" computer skills, such as programming.

Table 5: The wage premium for computer skill level for different types of skills

| Skill level | WP | SS | PROG | DB | OTHER |
|---|---|---|---|---|---|
| Very high | 0.620<br>(1.3) | + | 1.568++<br>(2.4) | 0.316<br>(0.68) | 1.510<br>(2.4)++ |
| High | 0.892<br>(5.8)* | + | 0.781<br>(4.5)* | 0.492<br>(2.1)** | 0.881<br>(1.4)++ |
| Intermediate | 0.946<br>(8.7)* | + | 0.507<br>(2.7)* | 0.638<br>(4.2)* | 0.121<br>(0.19)++ |
| Low | 0.395<br>(2.1)** | + | 0.078<br>(0.2) | 0.542<br>(1.4) | 0.391<br>(0.87) |

Source: HEGTS
* indicates significance at the 1% level; + all observations concentrated at the intermediate skill level, with 0 observations in other levels and, therefore, no estimates could be obtained; ++ less than 5 observation in cell

To obtain further evidence about the nature of computer premiums, the returns to computer use by skill level within each type of skill are estimated (Table 5). For the most sophisticated type of computer use (programming), the highest premium corresponds to those with "high" level of skill. The coefficient for the "very high" skill level is even higher but the small cell number does not permit further comment. Small cell numbers did not allow the estimation of coefficients for spreadsheet skills and does not allow for interpretation of the coefficient estimates for "other." However, for the moderate to low sophistication use of word processing, the returns peak at the intermediate level of skill, followed by high level. The lowest returns are for very high skills, which are not statistically significant. For word processing, the coefficient for intermediate skills (0.946) is statistically different from the coefficient for very high skills (0.620), but not different from the other two coefficients (0.892 and 0.395 for high and low skill level). For data bases, the coefficient for intermediate skills (0.638), while the highest and significant at the 1 percent level, is not statistically different from the coefficients for other skill levels. For programming, the two statistically significant coefficients (for high and intermediate skills) are not statistically different from one another. Finally, for other skills, low cell numbers do not allow any meaningful analysis.

These results suggest that the computer skill itself does not seem to be the explanation for the computer earnings premium, except for sophisticated uses of computers, and that too high computer skills for moderate or low sophistication of use (such as word processing) result in insignificant returns, a finding previously reported using data from the United Kingdom (Borghans and ter Weel 2001).

Determinants of Computer Use

The picture painted from the evidence given above is further explored by looking at the determinants of computer use. If no specific skills are required for computer use, it will be the tasks performed by the worker along with her wage that will determine computer use. To test this argument, a probit equation with instrumental variables (since earnings must be treated as endogenous) is estimated.

From Table A2 in the appendix we see that the most significant determinants of computer use are:

- speaks English
- earnings
- working in an economics/finance/accounting, technology and administration related occupation.

All of the above increase the probability of computer use.

Therefore, in Vietnam, those who use computers at work tend to be those who receive higher salaries (and presumably, higher up in the hierarchy of the organization), have additional skills – such as English language skills – and work in occupations where such skills are more frequently required. One could argue, therefore, that computers make the more productive workers even more productive, while having computer skills before being given a computer is of no particular importance.

## V. Conclusions

Many believe that a fundamental change has occurred in the relationship between education and earnings, reflecting increased and high demand for skilled workers. The demand for educated labor is associated with important technological developments that have taken place in recent years. It has been argued that computers in the workplace represent one manifestation of these changes. Researchers in the United States and other developed countries have documented a substantial premium for computer use. However, there is mounting evidence suggesting that computer skills by themselves do not command a wage premium. It has been suggested – based on analysis of United Kingdom and German data – that the computer wage premium does not reflect returns to computer skills, but merely the fact that computer costs are more easily recovered from high wage workers.

For higher education graduates in Vietnam, substantial wage premiums for computer use are present, higher than those obtained in advanced, market economies. Evidence is found in support of the unobserved heterogeneity explanation, given that even workers with computer skills, which are not required at work, enjoy substantial wage premiums (about half of the premiums enjoyed by computer users), compared to those without computer skills.

Higher skills do not always lead to higher premiums. Rather, an intermediate level of skill results in the highest premium. Furthermore, relatively routine skills (such as word processing) command a higher premium compared to programming, database and other computer skills. Further evidence was obtained by estimating returns within each type of skill, suggesting that for word processing and database skills, premiums peak at the intermediate level, while for the more sophisticated type of skills (programming), the highest premium is associated with a high level. Finally, results from a probit model with instrumental variables explaining the probability of computer use indicate that using English at work, the earnings of the worker, and being in certain occupations are the most important determinants of computer use. This may suggest that computers make the more productive workers even more productive, while having computer skills before being given a computer is of no particular importance.

The evidence presented here does not suggest that computers are not important for the workers using them at work. On the contrary, they are very important. Rather, the evidence and theory would suggest that eventually all workers will be given computers, once the cost decreases sufficiently. But for developing countries, especially growing low-income countries such as Vietnam, but also for many other countries, there is much that can be done now to raise the incomes of the less well off. More education is obvious. For example, learning to speak and use English gives workers a huge advantage. Beyond that, ensuring that workers have access to technology would raise incomes considerably, as the evidence here suggests. More importantly, putting technology in the hands of the poor will not only increase incomes, but also reduce poverty. The important point is that it is not just skills – and therefore, not just teaching students how to use computers – that are important, but the use of technology on the job that will raise the incomes of the poor.

Given the scarcity of computers in lower income countries, an operational strategy of increasing computer availability and skills would seem to offer considerable hope for increasing the incomes of the less well off. In fact, the wage premiums are so large now in Vietnam (and presumably in many low-income developing countries) that investing in skills and, more importantly, access to computers, has a huge payoff. A huge payoff to the individual of course, but if technology could be targeted at the less well off, then the result could be a substantial narrowing of wage differentials and therefore a contribution to the reduction of poverty.

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Appendix

Table A1: OLS estimates of returns to characteristics
(dependent variable: log of monthly earnings from main job; significant variables only)

| Variable/Model | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| USE (excluded category: no computer skills) | 0.745 | 0.898 | 0.429 | 0.297 | 0.232 |
| | (16.3)* | (19.7)* | (9.2)* | (6.9)* | (5.4)* |
| KNOWNREQ (excluded category: no computer skills) | | 0.483 | | | |
| | | (12.2)* | | | |
| *Personal characteristics:* | | | | | |
| MAR | | | -0.107 | -0.080 | -0.081 |
| | | | (-2.3) | (-1.92) | (-2.0) |
| DURSTUD > 4 | | | 0.216 | 0.197 | 0.190 |
| | | | (5.1)* | (5.1)* | (4.9)* |
| EXCELLENT | | | 0.317 | 0.314 | 0.348 |
| | | | (4.4)* | (4.8)* | (5.4)* |
| WORKED | | | 0.147 | 0.151 | 0.145 |
| | | | (3.8)* | (4.4)* | (4.3)* |
| ENGL | | | 0.247 | 0.214 | 0.178 |
| | | | (6.6)* | (6.3)* | (5.3) |
| *Field of study:* | | | | | |
| NAT | | | --- | 0.180 | 0.251 |
| | | | | (2.5) | (3.4)* |
| TECH | | | 0.213 | 0.221 | 0.194 |
| | | | (3.6)* | (4.2)* | (3.2)* |
| MED | | | -0.304 | -0.213 | -0.267 |
| | | | (-5.2)* | (-4.0)* | (-3.0)* |
| LIT | | | --- | 0.138 | 0.218 |
| | | | | (1.93) | (2.9)* |
| PEDAG (excluded category: Agriculture-related) | | | -0.244 | -0.127 | --- |
| | | | (-4.8)* | (-2.7)* | |
| *Sector:* | | | | | |
| PRIV | | | | 0.582 | 0.477 |
| | | | | (10.1)* | (8.2)* |
| SELF | | | | 0.404 | 0.318 |
| | | | | (7.2)* | (5.0)* |
| FOREIGN Reference category: Works for government | | | | 1.096 | 0.995 |
| | | | | (17.2)* | (15.7)* |
| *Occupation:* | | | | | |
| EFA | | | | | 0.163 |
| | | | | | (2.7)* |
| TECHAGR | | | | | -0.215 |
| | | | | | (-2.5) |
| SCIENCE | | | | | -0.316 |
| | | | | | (-5.1)* |
| LEGIS (reference category: manual labor) | | | | | -0.365 |
| | | | | | (-2.7)* |
| Adjusted R square | 0.132 | 0.201 | 0.294 | 0.425 | 0.457 |
| N | 1,737 | 1,737 | 1,737 | 1,737 | 1,737 |

Source: HEGTS
t-values in parentheses; * indicates significance at the 1% level

Table A2: Determinants of Computer Use (USE): Probit with instrumental variables*
(significant variables only)

| Dep. Variable: USE | df/dx | z |
|---|---|---|
| Log(salary) | 0.117 | 3.00 |
| English language: | | |
| Required | 0.348 | 7.71 |
| (excluded: no knowledge or not required) | | |
| Occupation: | | |
| Econ./Finance/Accounting | 0.138 | 4.04 |
| Technology | 0.102 | 2.75 |
| Administration | 0.116 | 2.29 |
| (excluded: manual labor) | | |
| N | 1,737 (305 at 1 and 1432 at 0) | |
| Log Likelihood | -440.8 | |
| Pseudo R-sq | 0.454 | |

Source: HEGTS

* Instruments used to instrument for log of salary were: age, age square, gender, marital status, presence of children, duration of studies, performance in university, field of study as well as dummies for education of father and mother

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