No. 1040

Are Computers at Home a form of Consumption or an Investment? A Longitudinal Analysis for Japan

by

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May 2003

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May 2003

[1]The Japan Panel Survey of Consumers (*Shōhi Seikatsu ni Kansuru Paneru Chōsa*), published by The Institute for Research on Household Economics (*Kakei Keizai Kenkyūsho*), 1-3-13 Hirakawacho, Chiyoda-ku, Tokyo 102-0093, Japan, is used in this study. Due to a confidentiality agreement with the Institute, the data used cannot be released. The author would like to thank Tomomi Iwamoto and Akiko Nagai for their patient explanation of the dataset, and Jeff Biddle, Linda Bailey, Ali Berker, Yoko Kijima, and Kenji Moriyama, and participants of labor workshop at Michigan State University and the annual meeting of Japanese Economic Association for useful comments. The author especially thanks David Neumark and Fumio Ohtake for comments and encouragements. The usual disclaimer applies.

Abstract

This study examines the effect of computer possession at home on labor market outcomes using longitudinal data collected in Japan. There are positive correlations between computer possession and women's full-time employment and the salaries of men and women. In fixed effects analysis, however, no *temporal* effects of computer possession on labor market outcomes were found in causal sense. On the other hand, computer possession at home affects women's employment and hourly wages *with one-year lag.* These findings support the hypothesis that the computer possession at home helps computer skill acquisition among workers who do not work currently or marginally attach to the labor market. Since computer skill acquisition takes time, considering lagged effect is important for the identification of the

1 Introduction

Motivated by recent discussion on "Digital Divide," this paper examines the effect of computer possession at home on labor market outcomes. The recent rapid penetration of computers into people's daily lives has sparked public interest regarding the consequences of computer usage on people's economic success. On the positive side, IT is called the dynamo of the New Economy; according to a recent growth account study in the US, 1/3 of growth in national income during the 90s is explained by IT related investment (Jorgenson [2001]). On the other hand, some social critics point to the positive correlation between computer possession at home and household income, and claim that this is the dark side of the IT penetration (see Figure 1). They view this finding as evidence of a "Digital Divide" and express concern that the progress of an IT penetration might divide population into two groups, "the haves" and "the have nots." Reflecting this concern, for example, a recent piece of legislation in Japan, the so-called IT law, requires the government to ensure equal access to IT among its population (*Koudo Jōhō Tsushin Network Shakai Keisei Kihon Hō* [the IT law], Article 8). Here, lawmakers and social critics implicitly attribute a causal effect between computer possession at home and the subsequent labor market outcomes of workers who have mastered computer skills because they own computers. In this sense, lawmakers and social critics treat computers at home as investments that enhance human capital accumulation and, accordingly, future job market opportunities.

In other words, they claim that an access to computer or Internet *causes* better future job market opportunity. However, economists and lawmakers should avoid making causal statements from the observed correlation since it is also probable that workers with unobserved characteristics that positively affect labor market outcomes tend to have computers. For example, those who accommodate changes well may work efficiently and, at the same time, hold computers just as consumption goods to satisfy their taste. In this case, there is no causal relationship between computer possession at home and current or subsequent labor market outcomes. If this is the case, there is little point for the government to intervene in the market to ensure equal access to IT. Thus, determining the causal effect of computer possession on household income is crucial in order to derive policy recommendations, especially regarding government policy that seeks to assure equal access to IT.

To examine the causal effect of computer possession on various labor market outcomes, a recently published longitudinal data set of Japanese young women, the Japanese Panel Survey on Consumers (JPSC), is used. In previous studies for the US, it has been generally difficult to identify the causal effect in a credible manner since CPS computer supplements, which are cross section data, were used to study the effect. To deal with endogeneity of computer use or possession, researcher must have an exogenous variation that affects computer use or possession but do not affect labor market outcomes; however, it is usually very difficult to find such an exogenous variation. The issue of endogeneity is more effectively addressed with panel data since we can control the effect of unobserved individual characteristics. With a few exception of data set used for European studies (Bell [1996], Entorf et al. [1999]), individual level panel data with computer possession is rarely available and this data constraint have made credible study of computer effect difficult. JPSC is a rare panel data set that contains information on the possession of computers at home. Regardless of attractive panel feature of the data set, JPSC has several caveats to study the computer effect on labor market outcomes. Firstly, we can only focus on the labor market outcomes for young women and their husbands, namely (1) young women's labor force participation, (2) their earnings, and (3) their husbands' earnings. However, how computers at home affect young women's labor market outcomes is crucial since some argue that computers at home enable women to work while they stay home to take care of their household responsibilities. Secondly, only computer possession at home is available but not computer use at work in this data set. Thus, the return to computer use at work cannot be estimated in this study. However, as discussed in the following literature review, most of the previous studies interpret the return to computer use at work as the return for computer skill or the skill to process information, thus what matters here is the return to these skills rather than computer use. Although there are many studies that examined the return to these skills, surprisingly few study examined the way the skill is formed. Possessing a computer at home may be an important way to acquire computer skills, it is important to estimate the return to computer possession at home. Moreover, the discussion on Digital Divide focuses on computer possession at home rather than computer use at work; consequently, the return to computer possession is important in its own light.

The rest of this paper is organized as follows. The next section reviews literature on the effect of computers or new technology on labor market outcomes. The third section describes the data and empirical strategy. The fourth section presents the results of the estimation, and the last section offers concluding remarks.

2 Literature Review

Widely observed earnings dispersion during the 1980s and 90s in the United States and Western Europe stimulated an investigation for its cause. Among several possible explanations, skill-biased technological progress, which is represented by computerization, has been identified as a major cause of earnings dispersion (Katz [1999]). There are basically two strategies for identifying the effect of computerization on earnings inequality: (1) estimate the effect of how computerization changes the relative demand of skilled workers compared with unskilled workers, (2) estimate the return to computer skills through the estimation of wage regression using individual data.

The first strategy regresses the relative demand for skilled workers in industry or establishment on their computerization. In this analysis, the relative demand is typically represented by the wage bill share of skilled workers in the total wage bill or the share of skilled workers in the total number of workers. An industry-level study by Autor et al. [1998] showed that computerization had increased relative demand for skilled workers in the United States over a period of 20 years. Haskel and Heden [1999] found similar results for the United Kingdom through establishment and industry level analysis. However, an establishment-level study for the United States by Doms et al. [1997] doubted its causality; although they found a positive effect of computerization on relative demand for skilled workers in cross-sectional estimates, the effect disappeared in first difference estimation. Consequently, they suggested that establishments with highly skill workers adopt high technology rather than a causal relationship that moved from computerization to skill upgrading. Doms et al. [1997], however, focused only on the manufacturing industry, and thus their conclusion is only suggestive. Panel data that cover wide range of industries is needed to derive a definitive conclusion on the causal effect of computerization on the demand for skills.

The second strategy consists of the direct estimation of the wage regression with a computer use dummy. The first study by Krueger [1993] , which used U.S. cross- sectional data, found a 15 to 20% computer premium in wage regression with standard covariates , which the researcher interpreted as the return for computer skill. Reilly [1995] also found a 13% computer premium using Canadian cross-sectional data. Those cross-sectional studies were, however, criticized by DiNardo and Pischke [1997]. These researchers insisted that cross-sectional estimates of the computer premium do not necessarily reflect the return to computer skill because they also could find a premium for pencil use in Germany. Since writing is not scarce skill in Germany, they speculated that unobserved skill that is correlated with computer use and pencil use had rendered spurious premiums for their use. Thus, again, the main question is whether computer use causes skill acquisition or whether the possession of skill causes computer use.

Chennells and Reenen [1997] attacked this endogeneity issue using British establishment level cross-sectional data and the IV method[1] where computer use was instrumented with industry-level technology availability proxied by the ratio of R and D expenditure per sales or the number of patents. Although they found the computer premium in an OLS estimation, the premium was not found in the IV estimation and they concluded that the computer premium found in the OLS estimation was spurious. Panel data, another source typically used to work around the endogeneity problem, were used in two studies, to the best of the author's knowledge. Bell [1996] analyzed British panel data (1981 and 1991) and found a computer premium in the OLS estimation. This computer premium was found even after controlling for individual heterogeneity through first difference estimation. On the other hand, Entorf et al. [1999] found a 7% computer premium in an OLS estimation that disappeared in the first difference estimation using French panel data (1991 and 1993). Although the difference in the results may seem striking at the first glance, the difference in the length of panel period, in

[1]The model used in this method is more than simple IV estimation due to the non-linearity of the computer use equation; however, the issue of identification does not depend on the non-linearity of the functional form.

addition to the differences between the counties analyzed, may explain the dissimilarity of their findings. Considering skill acquisition over a ten year period, the assumption of time-constant unobserved skills employed by Bell [1996] might be too strong and the violation of this assumption might make the first difference estimator upwardly biased. In sum, wage regressions using U.S. and Western European data have found a computer premium in cross-sectional estimates; however, many studies have found that this computer premium is due to unobserved skills that increase both computer use and earnings.

Several notable studies estimate the return to PC possession at home using Japanese cross sectional data. Shimizu and Matsuura [1999a] found a 20% premium on computer possession at home using cross sectional data from 1994. To deal with the endogeneity issue, they estimated a structural model in which income and computer possession are simultaneously determined. The consistency of the system estimator, however, depends on the validity of the exclusion condition; in their study, the excluded variables from the wage equation were children's age, their school attendance as well as other variables. Since women were included in the sample, having small children, which is negatively correlated with computer possession, might be negatively correlated with the error term in the wage equation. Furthermore, children's high school or college attendance, which was positively correlated with computer possession, may be positively correlated with error in wage equation because the wage equation did not include educational attainment due to data restriction; also, the educational attainments of parents and children tend to have a positive correlation. Based on the potential positive correlations of the error term in the wage equation and the excluded variable from the wage equation, it is reasonable to suspect an upward bias in the system estimator found in Shimizu and Matsuura [1999a]. Shimizu and Matsuura [1999b] again found a 20% wage premium on computer possession using other cross sectional data from 1999 and a similar structural estimation. In this study, the excluded variables from the wage equation were computer use at work, which was positively correlated with the computer possession at home, and other variables. Since the positive effect of computer use at work on wages is rather obvious from evidence for the United States and Western Europe, it is fair to say the estimate was upward biased. Given those tenuous, excluded variable assumptions in the system estimations, the OLS estimate of a 7.4% premium, which appears in Shimizu [1999] based on the same data used by Shimizu and Matsuura [1999b], should be understood as the upper bound estimate of the premium.

Kohara and Ohtake [2001] examined the effect of computer usage at work on workers' wage using the panel data of workers who experienced job change in Osaka prefecture. They found around 0.06 (s.e. around 0.03) computer premium in OLS estimation, however, the estimated coefficient get as small as 0.047 with s.e. of 0.026 in fixed effects estimation. They concluded that the part of computer premium in cross sectional estimation (OLS estimation) was due to unobserved heterogeneity such as ability to adopt new technology.

3 Data

This section discusses data and empirical strategy used toidentify the effect of computers at home on labor market outcomes. The empirical analysis employs the third (1995) and fourth (1996) waves of the Japanese Panel Survey on Consumers (JPSC). The Research Institute of Household Economy (*Kakei Keizai Kenkyū-sho*) has conducted the survey since 1993 for the women between the ages 24 and 34 at the time of the survey. These individuals are national representatives of this demographic group due to the two steps clustering random sampling method that is designed to be equal probability sampling. The original sample consisted of 1500 individuals and those individuals are annually interviewed. The sample size was reduced to 1342 in 1995 and 1298 in 1996 due to attrition. The number of computers possessed by individuals (for single women) or married couples (for married women), which is available for the third and fourth wave, is used as the main independent variable in the following analysis. As labor market outcomes, whether the respondent is employed or not, full-time employed or part-time, monthly salary and hourly rate of pay were extracted. The distinction between full-time employment and part-time employment is based on respondent's response. The monthly salary is recorded for monthly and weekly paid workers and hourly rate of pay is recorded for hourly paid workers. The survey also asks married women their husband's monthly earnings and this variable is also used as a labor market outcome in this study. To control workers' back ground, variables usually included in the wage equation were extracted. The descriptive statistics for the sample appear in Table 1. From the table, we can see that married, educated, full-time employed women with higher salaries are more likely to have computers.

4 Empirical Model

Although various outcomes are considered, the same econometric strategy is consistently used for the identification of the effect of PC possession on labor market outcomes. As outcomes, young women's full-time and part-time labor force participation, salary and hourly rate of pay, as well as husband's salary are considered. In the model, possession of computer is assumed to help computer skill accumulation and accordingly enhance positive labor market outcomes. The labor market outcomes are assumed to be a function of skills:

$$y_{it} = f(h_{it}^{pc}, h_{it}^{other}), \tag{1}$$

where y_{it} is the labor market outcome of individual i at time t, h_{it}^{pc} is computer skill, and h_{it}^{other} is other human capital. The computer skill is accumulated through computer possession at home and other opportunities to use computers:

$$h_{it}^{pc} = g(pc_{it}, pc_{it-1}, pc_{it-2}, ..., train_{it}, train_{it-1}, ...), \tag{2}$$

where pc_{it} is the dummy variable for PC possession at home and $train_{it}$ is other oppotunities to acquire computer skills. Assuming only current possession of PC at home affect current computer skill (i.e. $h_{it}^{pc} = g(pc_{it}, train_{it}, train_{it-1}, ...)$)

and applying first order linear approximation, the labor market outcomes are specified as follows:[2]

$$y_{it} = \alpha \; pc_{it} + x_{it}\beta + c_i + e_{it}, \tag{3}$$

where i and t index individual and time respectively, y is labor market outcomes, pc is the dummy variable that takes one if the individual possesses a computer at home, x is the vector of variables that affects the labor market outcomes, c is individual unobserved heterogeneity, and e is the idiosyncratic error term. If two conditions, $E(c_i|pc_i, x_i) = 0$ and $E(e_{it}|pc_i, x_i, c_i) = 0$, where $x_i = [x_{i95}, x_{i96}]$, are satisfied, the pooled OLS estimator and the OLS estimator for each cross section are unbiased estimators. Since opportunities to accumulate computer skill other than PC possession at home is included in e, pc and e are likely to be positively correlated since those who possess computer at home are more like to have other opportunities to learn computer skill. However, if computer possession at home induces those opportunities, the estimated coefficient α estimates the *total or reduced* effect of computer possession at home on labor market outcomes. If unobserved individual characteristics such as "high motivation" or "skill to process information effectively" have a positive impact on labor market outcomes and positively correlated with computer possession at home, the first assumption $E(c_i|pc_i, x_i) = 0$ is violated and the pooled OLS estimator is an upward

[2]Although outcome may be a binary variable, liner probability model is employed here because of its simplicity to deal with unobserved heterogeneity. The marginal effects estimated through a probit model were essentially equivalent.

biased estimator. This possible upward bias can be avoided through the estimation of the first difference model:

$$\Delta y_{it} = \alpha \Delta pc_{it} + \Delta x_{it}\beta + \Delta e_{it}. \tag{4}$$

The first difference estimator is an unbiased estimator if $E(e_{it}|pc_i, x_i, c_i) = 0$. Again, if PC possession at home and other opportunities to accumulate computer skill are positively correlated, this assumption is violated, however, if PC possession induces those other opportunities, the estimated α is an unbiased estimator of the total effect. If the current idiosyncratic shock to the labor market outcomes is positively correlated with the current possession of computers, the OLS estimator of α is still upward biased since Δpc_{it} and Δe_{it} are positively correlated. This estimator, however, is useful to "tighten" upper bound of the α. As we can see from Table 2, 8.75% of the sample did not have computer in 1995 but had one in 1996. On the other hand, 1.78% of the sample did not have a computer in 1996 although they had one in 1995. Those observations, consisting of 10.53% of the sample, identify α in the first difference estimation.

The measurement error in *pc*, however, causes serious bias in the first difference estimator; the first difference estimator is more tenuous than the OLS estimator under measurement error in the independent variable.[3] Interviewees may miscount the number of computers at home and the tendency of miscounting may not be consistent over time. In this situation, Δpc is mea-

[3]See Griliches and Hausman [1986] for a general discussion and Freeman [1984] for the specific case in which the independent variable is dichotomous.

sured with error and the first difference estimator of α is seriously biased, since the variation in Δpc may mainly consist of variation in reporting error. The direction of bias cannot be determined a priori since measurement error cannot be classical in this situation. Suppose the recoded Δpc consists true variation and measurement error such as:

$$\Delta pc_{it} = \Delta pc^*_{it} + v_{it}, \tag{5}$$

where Δpc^*_{it} is true variation in PC possession and v_{it} is the measurement error. Since Δpc_{it} can take values, $-1, 0, 1$, $v_{it} = 0, -1 \text{or} -2$ if $\Delta pc^*_{it} = 1$. Similarly $v_{it} = 1, 0 \text{or} -1$ if $\Delta pc^*_{it} = 0$ and $v_{it} = 2, 1 \text{or} 0$ if $\Delta pc^*_{it} = -1$. Obviously, the measurement error and true variation are negatively correlated and usual discussion for classical measurement error does not hold. Since Δpc and ΔPC^* can have opposite sign, the measurement error is not an usual "regression to their mean" style. Therefore, we cannot determine the direction of the bias *a priori*.

Fortunately, the survey also recorded the number of PCs purchased within a year, and the measurement error in this flow variable may be less serious than the measurement error in pc, which is a stock variable. The difference between the stock variable, Δpc, and the dummy variable that indicate whether an individual had purchased more than one computer are positively correlated, although those two variables do not exactly match, due to the error in *pc* can be corrected through the estimation of the model:

$$\Delta y_{it} = \alpha \ \Delta pc_{it} + \Delta x_{it}\beta + \Delta e_{it}, \tag{6}$$

where Δpc_{it} is instrumented with the dummy variable that takes one if the individual has bought more than one PC in past one year, which is denoted as *ippc*. As mentioned in Black et al. [2000], when true variation of computer possession, Δpc^*, is negatively correlated with the measurement error v, the probability limit of IV estimator of α is upper bound of the true parameter α. Thus, if IV estimate of α is virtually zero, then it implies that computer possession does not change labor market outcomes in causal sense.

The other concern is the lagged effect of PC possession on labor market outcomes. Acquiring computer skill may take time and the effect of computer possession at home may affect labor market outcomes with time lag. The lagged effect is specified as

$$y_{it} = \alpha \ pc_{it} + \gamma \ pc_{it-1} + x_{it}\beta + c_i + e_{it}. \tag{7}$$

Then the following first difference model is estimated to deal with unobserved heterogeneity:

$$\Delta y_{it} = \alpha\Delta pc_{it} + \gamma\Delta pc_{it-1} + \Delta x_{it}\beta + \Delta e_{it}. \tag{8}$$

Since Δpc_{it-1} is not available because the number of computers at home is not available for 1994 survey, $ippc_{it-1}$, which is available from 1995 survey, is used in place of Δpc_{it-1}. To check the robustness of the result, the other specification in which Δpc_{it} is also replaced with $ippc_{it}$ is estimated.

5 Results

The first labor market outcome considered is women's full-time employment. The results of estimations appear in Table 4. Firstly, the result of a pooled OLS estimation, which appears in Column 1 of Table 4, tells us that computer possession at home increases the probability of full-time employment by 4 percentage points ($t = 1.75$). Thus, the cross-sectional estimate weakly exhibits the positive effect of computer possession on women's full-time employment. The estimates for the other independent variables are standard and there is no need for discussion. The positive effect of computer possession, however, disappears after controlling correlated unobserved heterogeneity through the first difference estimation. (The result is reported in Column 2 of Table 4). This is evidence that unobserved heterogeneity that encourages women's full-time employment is positively correlated with computer possession. In other words, a positive correlation between computer possession and full-time employment is observed in cross-sectional estimates because of reverse causality; women's full-time employment due to unobserved heterogeneity causes computer possession at home through income effects. As Column 3 in Table 4 indicates, the result of first difference IV estimation does not essentially change after instrumenting computer possession (Δpc) with the dummy variable of computer purchase in the previous year ($ippc$). The coefficient for computer purchase is still not statistically different from zero and this provides evidence that the first difference results are not due to measurement error in pc. The estimates with lagged effect appear in Columns 4 and 5 of Table 4. These estimates indicate that the PC possession in the previous year increased the probability of full-time employment by 8 percentage points ($t = 2.00$). To summarize the findings for full-time employment, a correlation between full-time employment and PC possession was found in cross-sectional estimates; however, the findings from first difference estimates indicate that the correlation is due to reverse causality. Although the contemporaneous causal effect of computer possession on full-time employment was not found, a lagged causal effect was indicated; computer possession at home encourages women's full-time employment with a one-year lag.

Secondly, the effect of computer possession on part-time employment is examined using individuals who were full-time workers in neither 1995 nor 1996. The sample is restricted in this way because the effect of computer possession on the choice between part-time employment and staying home is the main interest. The assumptions (1) $E(c_i|pc_i, x_i, full_i = 0) = 0$ and $E(e_{it}|pc_i, x_i, c_i, full_i = 0) = 0$ or (2) $E(e_{it}|pc_i, x_i, c_i, full_i = 0) = 0$ assure the unbiasedness of the pooled OLS and the first difference estimator respectively. The results of estimations appear in Table 5. The result of the pooled OLS, which appears in Column 1, indicates that the possession of a computer *negatively* affects part-time employment. This somewhat surprising result is not sustained in the first difference estimation whose result appears in Column 2. These two results imply that the unobserved factor that makes women work part-time is negatively correlated with computer possession. For example, mortgage loan payment by a household can increase wife's part-time work to supplement household income while reducing the probability of computer possession. The result that appears in Column 3 is not essentially different from the result in Column 2. Thus, the measurement error in *pc* does not drive the result for the first difference estimation. Although the specifications with lagged effect indicate that the lagged PC possession increases the probability of current part-time employment about 8 percentage points, however, the estimates are imprecise probably due to relatively small sample size. Regardless of the impreciseness of the estimates, the size of the estimated effect is too large to neglect. To summarize, no causal effect of computer possession on part-time employment is found, however, weak evidence of lagged effect were found.

Thirdly, the effect of computer possession on monthly salary is examined. The results in this analysis can be compared with the previous cross-sectional studies on the computer premium in Japan. The results of estimations appear in Table 6. As Column 1 indicates, the home computer premium on salary is 0.097 ($t = 2.26$) using the pooled OLS result. This number is comparable with 0.074 in Shimizu [1999] obtained from cross-sectional OLS. The difference of estimates seems to be in the range of sampling error, considering the relatively small sample size.[4] However, the result is not sustained in the first difference estimation as shown in the result appearing in Column

[4]The other interpretation for the difference would be a declining home computer premium over the period. The sample period used in this study is 1995-1996 and Shimizu [1999] uses the data of 1999.

2; the coefficient for computer possession is essentially zero. The findings of the pooled OLS estimation and the first difference estimation are hardly different when industry, occupation, and firm size dummies are included in the regression (Column 3 and Column 4). When Δpc is instrumented with *ippc* to caliber the effect of measurement error in *pc* on the first difference result, *negative* a coefficient of -0.130 ($t = 2.32$) is found (Column 5).[5] This somewhat surprising result shows that the possible measurement error in *pc* cannot explain the result obtained in the first difference estimation. Neither of the lagged effects of computer possession on salary are found (Columns 6 and 7). To summarize the result, the pooled OLS estimation finds a cross-sectional correlation of computer possession and high salary; however, the correlation does not imply the causal effect of computer possession on salary. The results from the first difference estimation instead imply that high salary *causes* computer possession at home. A natural interpretation of this result would be workers with high salary due to unobserved heterogeneity tend to have PC at home since PC is a normal goods.

Fourthly, the effect of computer possession on hourly rate of pay is examined using hourly or daily paid workers as a sample. The results of estimations appear in Table 7. No coefficients for computer possession or computer purchase are statistically significant except for the lagged effects. Lagged

[5]The IVFD estimator may be negatively biased because of the violation of the assumption $E(\Delta e_{it}|\Delta pc_{it}, \Delta x_{it}, ippc_{it}) = 0$. If positive earnings shock in the previous year causes computer purchase in this year, e_{it-1} and $ippc_{it}$ are positively correlated even after conditioning on Δpc_{it} and Δx_{it}, then $\text{Cov}(\Delta e_{it}, ippc_{it}|\Delta pc_{it}, \Delta x_{it}) < 0$.

computer possession increases current hourly rate of pay by about 11 percentage points ($t = 2.52$) as shown in Columns 6 and 7. These results contrast

6 Robustness Check

The effect of PC possession at home for women on labor market outcomes are examined so far assuming that the effects are identical for both single and married women. However, there is sensible concern that the effects are different for single and married women. For married women, the computer possessed at home may belong to husband and his wife does not use the computer often; while for single women, possession of PC are more likely to be their own choice. To address this concern, equations for single and married women are estimated separately. In addition, through separate estimation, the seriousness of endogeneity can also be calibrated. If husbands just buy PC independent of wife's decision, the home PC possessed by married women can be considered as "more exogenous" compared with that of single women's. Thus, the larger effect found among single women can be due to either larger *actual* computer effect or more serious *endogeneity* of PC possession among single women. For contemporaneous effect in particular, the larger effect found for single women is more likely to be an evidence of the endogeneity since better labor market outcomes are likely to induce *current* PC possession through positive income effect. On contrast, once individual heterogeneity is controlled, there is no obvious endogeneity problem for lagged PC possession. Thus the difference in lagged effect between single and married women is more likely due to *actual* difference in the effects.

The coefficients for PC possession and lagged PC purchase appear in Table 9. For the OLS estimate for the full time employment determination (Panel A, the first two columns), the size of coefficient for single women (0.093) is larger than that for married women (0.036). Rather than simply interpreting this finding as an evidence for the larger *actual* PC effect for single women, it is more plausible that the difference comes from the degree of endogeneity of PC possession. Since own employment status largely determines the family income for single women, the endogeneity of PC possession is more serious for single women through income effect. The same discussion may apply for the FD specification for which larger effect was found for single women than for married women. It is interesting that the lagged effect is 0.054 for single women and 0.075 for married women. Those estimates are close each other and this can be interpreted as evidence that the endogeneity of lagged PC purchase is not a serious problem. Although the effects are imprecisely estimated due to smaller sample size, the result for lagged effects with divided sample reinforce the conclusion that lagged effect of PC possession on women's full-time employment exists. Also the effects of PC possession seem almost identical for single and married women. For the part-time employment determination (Panel B), the coefficient for PC is positive for single but negative for married women in OLS estimates. This is again probably because of endogeneity. For single women, those who work as part-time workers are more likely to have a computer through income effect; but for married women, those who face high family expenditure such as the payment for mortgage loan are more likely to work to supplement family income but the expenditure may suppress the PC possession. The same pattern is found in the first difference model. Notable finding are positive coefficients for lagged PC purchase for both samples and even larger coefficient for married women than for single women. This may again imply the less serious endogeneity problem of lagged PC purchase. Since the lagged effect was originally estimated very imprecisely even for undivided sample, with divided sample, the effects are estimated even more imprecisely. The examination of Panel C reveals that the effect of PC possession on women's monthly salary does not exist in causal sense. Only the positive and statistically significant coefficient for PC possession is found for married women in the OLS estimation but the result go away once individual heterogeneity is considered in the FD model. Regardless of very small sample size, Panel D reveals that lagged computer purchase significantly affects hourly rate of pay for both single and married women. The lagged effect is larger for single women $(0.207, t = 2.915)$ than for single women $(0.141, t = 2.169)$. Again, we reconfirm that the lagged computer purchase affects hourly rate of pay with one-year time lag. Over all, the analysis of this section confirms that the lagged PC purchase seems to be less subject to endogeneity problem. In addition, the effects of lagged PC purchase on women's employment (both full-time and part-time) and hourly rate of pay were reconfirmed through divided sample analysis.

7 Conclusion

This paper analyzed the effect of computer possession at home on several labor market outcomes. As labor market outcomes, women's full-time/part-time employment, women's salary/hourly rate of pay, and men's salary were analyzed. Cross sectional analysis indicates that computer possession has a positive effect on women's full-time employment and on salary for both sexes; however, those positive effects disappear after controlling individual heterogeneity that is allowed to be correlated with computer possession. This evidence implies that individuals with unobservable characteristics that result in positive labor market outcomes tend to possess computers at home through the positive income effect. Putting it in different way, the positive correlation between income and computer possession is observed because higher income *causes* computer possession but not the other way around. However, drawing conclusion without considering the lag between PC possession and computer skill acquisition is fatally misleading.

Although the conclusion of this study is skeptical about the causal effect of *current* computer possession at home on *current* labor market outcomes, it should be emphasized that the lagged effect of PC possession on women's full-time employment, part-time employment (although not statistically significant) and hourly rate of pay were found. On the other hand, no effects were found on women's salary and husband's salary even lagged effects are allowed. These findings imply that current PC possession at home affects future labor market outcomes through acquisition of computer skills among the workers who are currently marginally attached to or not attached to the labor market. This is probably because the PC possession at home is a good opportunity to acquire computer skills for those marginal workers. In contrast, the lagged causal effects were not found among the workers with firm attachment to the labor market (monthly paid men and women) probably because those workers had other ways to acquire computer skills including trainings provided by their employer if the computer skill was needed.

Due to data limitation, this study could only address the possibility of one-year lagged effect. Since acquiring computer skill takes time, it is reasonable to consider a longer lagged effect. Addressing this possibility with longer panel data is promising for future research.

Furthermore, future research on the labor market impact of computers should seriously consider this dynamic effect. For example, considering this kind of dynamic effect using matched CPS files in the US would be a part of research agenda.

References

David H. Autor, Lawrence F. Katz, and Alan B. Krueger. Computing inequality: Have computers changed the labor market? *Quarterly Journal of Economics*, 113:1169–1213, 1998.

Brian D. Bell. Skill-biased technical change and wages: Evidence from a longitudinal data set. Nuffield College, Oxford, October 1996.

Dan A. Black, Mark C. Berger, and Frank A. Scott. Bounding parameter estimates with non-classical measurement error. *Journal of American Statistical Association*, pages 739–48, 2000.

Lucy Chennells and John Van Reenen. Technical change and earnings in British establishments. *Economica*, 64:587–604, 1997.

John E. DiNardo and Jörn Steffen Pischke. The returns to computer use revisited: Have pencils changed the wage structure too? *Quarterly Journal of Economics*, 112, 1997.

Mark Doms, Timothy Dunne, and Kenneth R. Troske. Workers, wages, and technology. *Quarterly Journal of Economics*, 112:253–290, 1997.

Horst Entorf, Michel Gollac, and Francis Kramarz. New technologies, wages, and worker selection. *Journal of Labor Economics*, 17:464–491, 1999.

Richard B. Freeman. Longitudinal analyses of the effects of trade unions. *Journal of Labor Economics*, 2:1–26, 1984.

Zvi Griliches and Jerry A. Hausman. Errors in variables in panel data. *Journal of Econometrics*, 31:93–118, 1986.

Jonathan Haskel and Ylva Heden. Computers and the demand for skilled labour: Industry- and establishment- level panel evidence for the UK. *Economic Journal*, 109:C68–C79, 1999.

Dale W. Jorgenson. Information technology and the u.s. economy. *American Economic Review*, 91(1):1–32, 2001.

Lawrence F. Katz. Technological change, computerization, and the wage structure. Harvard University, September 1999.

Miki Kohara and Fumio Ohtake. Computer siyou ga tingin kakusa ni ataeru eikyo (the effect of computer use on wage differentials. *Nihon Rōdō Kenkyū Zasshi*, 494:16–30, 2001.

Alan B. Krueger. How computers have changed the wage structure: Evidence from microdata, 1984-1989. *Quarterly Journal of Economics*, 108:33–60, 1993.

Kevin T. Reilly. Human capital and information. *Journal of Human Resources*, 30:1–18, 1995.

Masako Shimizu. Jōhōka to rōdō shotoku, gakkou kyōiku no kankei ni tsuite: Ankēto kekka no shūkei (on the relationship between computalization, labor eanings, and education: Introduction of the result of a survey). *Yusei Kenkyūsho Geppo, December*, 121, 1999.

Masako Shimizu and Katsumi Matsuura. Gijutsu kakushin he no taiō to howaito karā no chingin (adoption to technological progress and white collar's wage). *Nihon Rōdō Kenkyū Zasshi*, 467:31–45, 1999a.

Masako Shimizu and Katsumi Matsuura. Doryoku wa mukuwareruka: Pasokon to chingin, kyōiku no kankei (is effort rewarded? the relation between pc, wage and education). Yusei Kenkyūsho Discussion Paper Series No. 1999-04, 1999b.

Table 1 Descriptive Statistics (Sample: Women age 25-35 in 1993)

	1995 Panel			1996 Panel		
	Total	Without Computer at Home	With Computer at Home	Total	Without Computer at Home	With Computer at Home
N	1342	1146	196	1298	1021	277
Demographic						
Age	30.911	30.812	31.485	31.914	31.783	32.401
	(3.226)	(3.238)	(3.101)	(3.230)	(3.214)	(3.248)
Married	0.745	0.729	0.837	0.771	0.746	0.863
	(0.436)	(0.444)	(0.371)	(0.420)	(0.435)	(0.345)
Number of children	1.307	1.303	1.332	1.404	1.393	1.448
	(1.090)	(1.091)	(1.085)	(1.092)	(1.105)	(1.043)
Education						
High school	0.448	0.463	0.357	0.448	0.474	0.354
	(0.497)	(0.499)	(0.480)	(0.498)	(0.500)	(0.479)
Technical College	0.206	0.209	0.194	0.204	0.210	0.184
	(0.405)	(0.406)	(0.396)	(0.403)	(0.407)	(0.388)
Junior College	0.195	0.191	0.219	0.197	0.181	0.256
	(0.397)	(0.393)	(0.415)	(0.398)	(0.385)	(0.437)
4 yr College	0.122	0.107	0.209	0.123	0.106	0.188
	(0.328)	(0.310)	(0.408)	(0.329)	(0.308)	(0.391)
Graduate School	0.003	0.002	0.010	0.003	0.002	0.007
	(0.055)	(0.042)	(0.101)	(0.055)	(0.044)	(0.085)
School Misc.	0.004	0.004	0.005	0.005	0.005	0.004
	(0.067)	(0.066)	(0.071)	(0.068)	(0.070)	(0.060)
Labor Market						
Employed	0.580	0.589	0.526	0.567	0.574	0.540
	(0.494)	(0.492)	(0.501)	(0.496)	(0.495)	(0.499)
	[1342]	[1146]	[196]	[1292]	[1016]	[276]
Full time worker	0.602	0.588	0.702	0.567	0.548	0.652
	(0.490)	(0.493)	(0.460)	(0.496)	(0.498)	(0.478)
	[679]	[595]	[84]	[633]	[518]	[115]
Experience	7.792	7.744	8.074	8.277	8.344	8.031
	(3.843)	(3.823)	(3.955)	(4.024)	(4.051)	(3.922)
	[1337]	[1141]	[196]	[1294]	[1017]	[277]
Salary (Thousands Yen)	208.636	203.969	235.951	217.878	215.106	228.429
	(70.561)	(68.310)	(77.643)	(74.737)	(75.268)	(72.186)
	[418]	[357]	[61]	[370]	[293]	[77]
Hourly rate of pay (Yen)	875.059	859.376	1054.952	879.363	866.127	955.099
	(351.260)	(326.538)	(544.879)	(360.216)	(355.711)	(475.832)
	[212]	[195]	[17]	[242]	[206]	[36]
Husband's Annual Income (Ten Thousands Yen)	528.501	520.277	569.458	537.178	510.154	618.717
	(364.101)	(385.092)	(229.495)	(272.044)	(268.090)	(268.149)

Standard deviations are in parenthesis. The numbers of observations used to calculate statistics are in square bracket under the statistics. Employment statuses and actual labor market experiences are available for all observations except no response or invalid response. Full time working statuses are available for all employed observations. Salaries are available for all observations that are employed and monthly or weekly paid workers except the case of no response or invalid response. Hourly rate of pay are available for all observations that are employed and daily or hourly paid. Hours worked per day are not available for 1995 and 1996 observations, thus average hours workered per day in 1993 are used to impute hourly rate of pay in 1995 and 1996. US$1=JP101.50YEN (The average of inter bank spot rate at Tokyo between January 1995 and December 1996).

Table 2 Transition of PC holdings

			1996 Computer possession at home		
			No	Yes	
1995	Computer possession at home	No	76.78%	8.75%	85.53%
		Yes	1.78%	12.69%	14.47%
			78.56%	21.44%	100.00% (N=1292)

Table 3 Measurement error in the change of PC possession status.

		Purchased more than one computer in last year (ippc)		
		No	Yes	Total
Change in PC possession (Δpc)	-1	1.78%	0.00%	1.78%
	0	87.31%	2.17%	89.49%
	1	3.95%	4.80%	8.75%
	Total	93.03%	6.97%	100.00% (N=1292)

Note: χ^2 statistics under the null of independence of row and column = 438.634. (p-value less than 0.000)

Table 4 Determination of Full Time Employment (Linear Probability Models)
Dependent Variable: Employed Full Time
Sample: All Observations (Women)

	(1)	(2)	(3)	(4)	(5)
Estimation Method	OLS	F.D.	I.V.F.D.	F.D.	F.D.
Concern Addressed		Unobserved Heterogeneity	Unobserved Heterogeneity + Measurement Error	Unobserved Heterogeneity + Lagged Effect	Unobserved Heterogeneity + Lagged Effect
PC hold	0.041	-0.000	0.021	0.002	
	(0.024)	(0.032)	(0.055)	(0.032)	
PC Purchase					0.008
					(0.036)
PC Purchased				0.081	0.080
(Lagged)				(0.042)	(0.040)
Married	-0.329	-0.173	-0.179	-0.178	-0.178
	(0.046)	(0.079)	(0.079)	(0.078)	(0.078)
Number of Children	-0.066	-0.095	-0.095	-0.095	-0.094
	(0.011)	(0.032)	(0.032)	(0.032)	(0.032)
Log Annual Husband Income	-0.019	-0.004	-0.004	-0.003	-0.003
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Husband Income	0.000	0.000	0.000	0.000	0.000
Missing	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
<u>Education</u>					
High school	0.033				
	(0.069)				
Technical college	0.079				
	(0.072)				
Junior college	0.055				
	(0.072)				
College	0.175				
	(0.074)				
Grad. School	0.244				
	(0.188)				
Miscellaneous	0.147				
	(0.115)				
Age, Age^2, Age^3, Age^4	Yes	Yes	Yes	Yes	Yes
Regional size and Year dummies	Yes	Yes	Yes	Yes	Yes
First Stage F-Statistics			161.09		
			(<0.000)		
Wu-Hausman test (F-Stat.)			0.19		
			(0.664)		
R^2	0.28	-	-	-	-
N	1132	1132	1132	1132	1132

Note: Heteroscedasticity robust standard errors are in parenthesis. First stage F-statistics is calculated under the null that regression coefficients for the instrument are zero in the first stage-stage regression. Wu-Hausman statistics is calculated under the null that Δpc is exogenous in the second stage regression. The dummy that indicates computer purchase in a year is not differenced in the first difference estimation, since the variable is already a flow variable. For non-married observations, 10,000 yen (approximately, US$80) were assigned as husband annual income. For IV estimation, p-values are in parenthesis for first stage F-statistics and Wu-Hausman statistics.

Table 5 Determination of Part Time Employment (Linear Probability Models)
Dependent variable: Employed as a Part Time Worker
Sample: Not a Full time Worker neither in 1995 nor 1996 (Women)

	(1)	(2)	(3)	(4)	(5)
Estimation Method	OLS	F.D.	I.V.F.D.	F.D.	F.D.
Concern Addressed		Unobserved Heterogeneity	Unobserved Heterogeneity + Measurement Error	Unobserved Heterogeneity + Lagged Effect	Unobserved Heterogeneity + Lagged Effect
PC hold	-0.136	-0.059	-0.034	-0.055	
	(0.030)	(0.060)	(0.091)	(0.059)	
PC Purchase					-0.027
					(0.060)
PC Purchase (Lagged)				0.074	0.085
				(0.085)	(0.087)
Married	-0.286	-0.157	-0.158	-0.163	-0.163
	(0.064)	(0.193)	(0.194)	(0.193)	(0.194)
Number of Children	-0.077	-0.106	-0.106	-0.106	-0.107
	(0.015)	(0.046)	(0.046)	(0.046)	(0.046)
Log Annual Husband Income	0.003	0.021	0.021	0.021	0.022
	(0.008)	(0.009)	(0.009)	(0.009)	(0.009)
Husband Income Missing	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education					
High school	0.053				
	(0.073)				
Technical college	-0.017				
	(0.076)				
Junior college	0.002				
	(0.077)				
College	-0.075				
	(0.080)				
Grad. School	-0.248				
	(0.085)				
Miscellaneous	-0.093				
	(0.154)				
Age, Age^2, Age^3, Age^4	Yes	Yes	Yes	Yes	Yes
Regional size and Year dummies	Yes	Yes	Yes	Yes	Yes
First Stage F-Statistics			97.47		
			(<0.000)		
Wu-Hausman test (F-Stat.)			0.10		
			(0.751)		
R^2	0.11	-	-	-	-
N	716	716	716	716	716

Note: The same note applies as Table 4.

Table 6 Determination of Monthly Salary (Linear Models)
Dependent Variable: Log (Monthly Salary)
Sample: Weekly and Monthly Paid Workers (Women)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Estimation	OLS	F.D.	OLS	F.D.	I.V.F.D.	F.D.	F.D.
Concern Addressed	-	Unobserved Hetero.		Unobserved Hetero.	Unobserved Hetero. + Measurement Error	Unobserved Hetero. + Lagged Effect	Unobserved Hetero. + Lagged Effect
PC Holding	0.097	0.014	0.084	-0.007	-0.130	0.014	
	(0.035)	(0.050)	(0.035)	(0.039)	(0.056)	(0.050)	
PC Purchase							-0.091
							(0.037)
PC Purchase (Lagged)						-0.037	-0.020
						(0.038)	(0.038)
Experience	0.018	0.354	0.032	0.160	0.309	0.338	0.345
	(0.026)	(0.391)	(0.024)	(0.245)	(0.424)	(0.397)	(0.404)
$Experience^2$	-0.000	-0.003	-0.001	-0.004	-0.004	-0.003	-0.003
	(0.001)	(0.004)	(0.001)	(0.003)	(0.004)	(0.004)	(0.004)
Age	-0.164	0.000	-0.188	-0.231	0.000	0.000	0.000
	(0.112)	(0.000)	(0.112)	(0.291)	(0.000)	(0.000)	(0.000)
Age^2	0.003	0.001	0.003	0.003	0.002	0.001	0.001
	(0.002)	(0.004)	(0.002)	(0.003)	(0.004)	(0.004)	(0.004)
Tenure	0.038	-0.033	0.033	-0.030	-0.026	-0.031	-0.030
	(0.014)	(0.057)	(0.014)	(0.035)	(0.063)	(0.058)	(0.059)
$Tenure^2$	-0.001	0.001	-0.001	0.001	0.001	0.001	0.001
	(0.001)	(0.003)	(0.001)	(0.002)	(0.003)	(0.003)	(0.003)
Tenure miss	0.003	-1.127	0.084	-0.809	-1.080	-1.129	-1.124
	(0.088)	(0.426)	(0.084)	(0.319)	(0.451)	(0.431)	(0.430)
Married	-0.080	0.008	-0.092	0.028	0.032	0.017	0.015
	(0.043)	(0.034)	(0.041)	(0.034)	(0.036)	(0.034)	(0.034)
# Children	-0.047	-0.146	-0.045	-0.105	-0.094	-0.150	-0.148
	(0.025)	(0.120)	(0.023)	(0.082)	(0.126)	(0.121)	(0.116)
High School	-0.140		102				
	(0.138)		(0.122)				
Tech. Coll.	0.008						

Table 7 Determination of Hourly Rate of Pay (Linear Models)
Dependent Variable: Log (Hourly Rate of Pay)
Sample: Daily and Hourly Paid Workers (Women)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Estimation	OLS	F.D.	OLS	F.D.	I.V.F.D.	F.D.	F.D.
Concern Addressed	-	Unobserved Hetero.		Unobserved Hetero.	Unobserved Hetero. + Measurement Error	Unobserved Hetero. + Lagged Effect	Unobserved Hetero. + Lagged Effect
PC Holding	-0.001	0.043	-0.015	0.049	0.167	0.058	
	(0.102)	(0.045)	(0.079)	(0.048)	(0.134)	(0.049)	
PC Purchase							0.146
							(0.096)
PC Purchase (Lagged)						0.116	0.103
						(0.046)	(0.044)
Experience	0.021	0.276	0.031	0.589	0.305	0.271	0.282
	(0.027)	(0.331)	(0.030)	(0.245)	(0.325)	(0.332)	(0.328)
$Experience^2$	-0.001	0.005	-0.001	0.006	0.006	0.006	0.006
	(0.001)	(0.006)	(0.001)	(0.005)	(0.006)	(0.006)	(0.006)
Age	-0.139	-0.057	-0.203	0.000	0.000	0.000	0.000
	(0.142)	(0.384)	(0.139)	(0.000)	(0.000)	(0.000)	(0.000)
Age^2	0.002	-0.005	0.003	-0.003	-0.005	-0.005	-0.005
	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Tenure	0.006	-0.006	0.009	-0.037	-0.009	-0.007	-0.007
	(0.026)	(0.033)	(0.019)	(0.031)	(0.033)	(0.033)	(0.033)
$Tenure^2$	-0.001	-0.002	-0.002	-0.001	-0.002	-0.002	-0.002
	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)
Tenure miss	-0.098	-0.188	-0.028	-0.379	-0.203	-0.190	-0.208
	(0.044)	(0.099)	(0.052)	(0.113)	(0.099)	(0.099)	(0.099)
Married	-0.070	-0.297	-0.099	-0.382	-0.299	-0.300	-0.306
	(0.071)	(0.053)	(0.059)	(0.085)	(0.054)	(0.052)	(0.050)
# Children	-0.029	0.086	-0.018	0.110	0.087	0.086	0.088
	(0.031)	(0.027)	(0.022)	(0.040)	(0.026)	(0.026)	(0.026)
High School	0.129		0.069	0.000			
	(0.085)		(0.104)	(0.000)			
Tech. Coll.	0.157		0.078	0.000			
	(0.097)		(0.107)	(0.000)			
Junior Coll.	0.215		0.096	0.000			
	(0.090)		(0.123)	(0.000)			
College	0.710		0.658	0.000			
	(0.159)		(0.177)	(0.000)			
Grad. School	0.000		0.000	0.000			
	(0.000)		(0.000)	(0.000)			
Miscellaneous	0.000		0.000	0.000			
	(0.000)		(0.000)	(0.000)			
Region Size and Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind., Occ., Firm Size Dummies	No	No	Yes	Yes	No	No	No
First Stage F-Statistics					47.38 (<0.000)		
Wu-Hausman test (F-Stat.)					2.25 (0.136)		
Observations	138	138	135	135	138	138	138
R-squared	0.37	-	0.53	-	-	-	-

Note: The same note applies as Table 4.

Table 8 Determination of Husband's Monthly Salary (Linear Models)
Dependent Variable: Log (Husband's Monthly Salary)
Sample: Weekly and Monthly Paid Workers (Men)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Estimation	OLS	F.D.	OLS	F.D.	I.V.F.D.	F.D.	F.D.
Concern Addressed	-	Unobserved Hetero.		Unobserved Hetero.	Unobserved Hetero. + Measurement Error	Unobserved Hetero. + Lagged Effect	Unobserved Hetero. + Lagged Effect
PC Holding	0.077	-0.003	0.062	-0.007	0.034	-0.006	
	(0.021)	(0.021)	(0.020)	(0.022)	(0.043)	(0.022)	
PC Purchase							0.023
							(0.025)
PC Purchase (Lagged)						-0.024	-0.027
						(0.038)	(0.037)
Experience	0.021	0.046	0.023	0.000	0.032	0.049	0.042
	(0.013)	(0.130)	(0.013)	(0.128)	(0.133)	(0.130)	(0.130)
Experience^2	-0.000	0.001	-0.001	0.001	0.001	0.001	0.001
	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Age	-0.040	0.094	-0.041	0.101	0.106	0.092	0.101
	(0.037)	(0.102)	(0.037)	(0.107)	(0.103)	(0.103)	(0.102)
Age^2	0.001	-0.001	0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Tenure	0.004	0.000	0.002	-0.000	-0.000	0.001	0.001
	(0.005)	(0.018)	(0.005)	(0.018)	(0.018)	(0.018)	(0.018)
Tenure^2	0.000	-0.000	0.000	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Tenure miss	-0.064	0.058	-0.073	0.073	0.056	0.059	0.057
	(0.055)	(0.191)	(0.052)	(0.193)	(0.189)	(0.191)	(0.190)
Married	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
# Children	0.007	0.013	0.010	0.011	0.013	0.011	0.013
	(0.012)	(0.024)	(0.011)	(0.025)	(0.025)	(0.025)	(0.025)
High School	0.113		0.084				
	(0.067)		(0.066)				
Tech. Coll.	0.153		0.109				
	(0.073)		(0.071)				
Junior Coll.	0.080		0.027				
	(0.092)		(0.089)				
College	0.280		0.188				
	(0.073)		(0.073)				
Grad. School	0.434		0.364				
	(0.096)		(0.099)				
Miscellaneous	0.687		0.683				
	(0.082)		(0.097)				
Region Size, Year, Weekly Hours Worked Category Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind., Occ., Firm Size Dummies	No	No	Yes	Yes	No	No	No
First Stage F-Statistics					73.75		
					(<0.000)		
Wu-Hausman test (F-Stat.)					0.92		
					(0.337)		
Observations	584	584	583	583	584	584	584
R-squared	0.29	-	0.36	-	-	-	-

Note: The same note applies as Table 4.

Table 9: The effect of home PC on women's labor market outcomes by marital status

Panel A: Full-time employment determination (Single obs. = 266, Married obs. = 813)

	OLS		FD		FD	
Sample	Single	Married	Single	Married	Single	Married
PC hold	0.093	0.036	0.095	0.001	0.098	0.003
	(0.057)	(0.026)	(0.083)	(0.032)	(0.084)	(0.032)

Figure 1. Ratio of PC Possession at Home by Husband's Income Category
Source: Author's Calculation from JPSC, 1996 Wave, N=924