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Short-term effects of breast cancer on labor market attachment: results from a longitudinal study

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Abstract

In this longitudinal study, we examine the consequences of breast cancer for women's labor market attachment for the 6-month period following diagnosis. Women with breast cancer, with the exception of those having in situ cancer, were less likely to work 6 months following diagnosis relative to a control sample of women drawn from the Current Population Survey. Breast cancer's non-employment effect appears to be twice as large for African-American women. Women with breast cancer who remained working worked fewer hours than women in the control group.

JEL classification: I1; E61; J21

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1. Introduction

Nearly 140,000 women under the age of 65 were diagnosed with breast cancer in 2001 (American Cancer Society, 2003). The number of working age women diagnosed with

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breast cancer is not likely to diminish in the future as screening is recommended annually for women age 40 and over, and as screening technology improves, tumors of smaller size that would have gone unnoticed will be detected and treated. In addition, treatment for breast cancer has become considerably more aggressive, even for early stage tumors (Fisher et al., 2001). Due to these changes in detection and treatment, women are likely to bear the consequences of breast cancer during their working years when they may have otherwise lived and functioned for some time without knowledge or effects of their disease. In this paper, we study the consequences of breast cancer for women's labor market attachment for the 6-month period following diagnosis.

In a review of studies addressing cancer survivors' abilities to return to work, Spelten et al. (2002) concluded that there is a lack of systematic research regarding the return to work for cancer patients and that future studies need to adopt a longitudinal and prospective design. As the United States' health priorities focus on early detection and turning once life-threatening conditions into chronic conditions, a better understanding of labor market outcomes in a chronically ill population is critical. Our study answers this call for research. By using a longitudinal dataset collected for the purposes of studying labor market outcomes of women newly diagnosed with breast cancer, we examine the immediate post-treatment changes in labor supply among women, most of whom were working prior to their breast cancer diagnosis, relative to a control group of women.

Breast cancer's short-term labor market outcomes are not well understood, but are important since screening guidelines for working age women are in place, and if cancer is detected and treated in working women, then return to work is an objective indicator of recovery from treatment. The National Comprehensive Cancer Network (NCCN)[1] treatment guidelines for breast cancer recommend a combination of surgery, radiotherapy, and chemotherapy depending on cancer stage, histology, and other clinical factors. These aggressive treatment regimens are believed to reduce the chances of recurrence and thus prolong survival (Fisher et al., 2001), but can also cause impairments such as loss of range of motion in the arm on the affected side, lymphadema, reduced concentration and cognition, pain, and fatigue (Ahles et al., 2002; Lippman and Hayes, 2001; Olin, 2001). It is estimated that as many as 80% of women who undergo breast conserving surgery, axillary dissection, and breast radiation experience arm and psychological distress (Maunsell et al., 1993; Yap et al., 2002). Women, physicians, and employers need to be informed about possible periods of non-employment that may have long-term consequences such as limiting one's ability to return to the labor force, obtaining or retaining health insurance, and reducing earnings. An examination of breast cancer's short-term effects on labor supply is largely absent from the literature.

This paper is organized as follows: first, we review breast cancer survivorship in the context of labor supply; second, we describe the cancer and control samples for this investigation; third, we present methods for the empirical analysis; fourth, we show our results; and finally, we discuss our findings and identify areas for future research.

[1] The National Comprehensive Cancer Network (NCCN) is a not-for-profit, tax-exempt corporation that is an alliance of 19 leading cancer centers. The NCCN Practice Guidelines in Oncology are the recognized standard reference for appropriate practice in the field of oncology.

2. Breast cancer and labor supply

In recent years an awareness of the economic consequences of health and health interventions has given rise to studies aimed at exploring the return to work of individuals with chronic diseases.[2] Health-related labor supply declines are thought to arise from diminished tastes for work, higher relative marginal value of leisure time, reduced productivity, and increased time required for health maintenance (Grossman, 1972). Nevertheless, the factors that shape breast cancer's influence on labor supply are somewhat ambiguous—perhaps due to the complex reaction cancer evokes on the part of patients and employers alike.

In this section, we outline recent findings and gaps that exist with regard to breast cancer and labor supply.[3] Chirikos et al. (2002), in their study of 5-year breast cancer survivors, reported that 41% required special accommodations to perform their jobs. These survivors were nearly three times more likely to be impaired relative to their non-cancer peers, suggesting that breast cancer has a substantial negative effect on survivors' labor supply. Breast cancer survivors also experienced a decline in annual hours worked and earnings relative to their non-cancer peers. We interpret these findings cautiously, however, since the peer group in the Chirikos et al. (2002) study was identified (and chosen) by survivors, and may have had commitments to the labor market that are different from a randomly chosen comparison group.

Our previous research using data from the HRS, with and without respondents' Social Security earnings data, examined labor market participation, wages, and earnings of breast cancer survivors relative to a nationally representative non-cancer control group (Bradley et al., 2002a,b). The majority of breast cancer survivors in our sample had survived 3 or more years. We found that these women were statistically significantly less likely to work (by approximately 9 percentage points) relative to women who never had cancer. This may have been due to morbidity imposed by the disease and/or perhaps changes in tastes for work. Surprisingly, we also found that women with breast cancer who were employed after their diagnosis worked more hours (between 3 and 4 additional hours per week) and had higher wages and earnings relative to the non-cancer control group. We speculated that breast cancer's influence on labor supply is multifaceted, involving physical impairments (i.e., morbidity imposed by the disease and treatment) that produce a negative labor supply effect, as well as attitudinal and financial components that could lead survivors who remain in the workforce to work additional hours.

[2] For a comprehensive review of studies exploring how health affects labor supply, see Currie and Madrian (1999).

[3] Studies addressing health effects on labor market outcomes should also consider the influence of the health insurance as a mediator in labor supply decisions (see Currie and Madrian, 1999). The availability of health insurance influences an array of labor market decisions including retirement (Currie and Madrian, 1999), job change (Madrian, 1994; Cooper and Monheit, 1993), and labor supply (Buchmueller and Valletta, 1999; Chou and Staiger, 2001; Gruber and Madrian, 1994). We do not address the role of health insurance in this paper because we use the monthly Current Population Survey (CPS) data, matching the time period of the cancer sample interviews, as a control group. The CPS includes health insurance data only in the March supplement; its use would deviate from the cancer sample interview period and sharply reduce the control group sample size.

In a study that did not involve a control group, Ganz et al. (2002) reported that 80% of 5–7-year breast cancer survivors had no change in employment. The authors reported that the 20% of women who had a change in work status went from full-time to part-time employment or retired. Ganz et al. (2002) also found that survivors' long-term physical functioning had not diminished over time.

Other researchers have touched upon factors such as a supportive work environment that facilitated return to work, whereas manual work was negatively associated with return to work for cancer survivors (Greenwald et al., 1989; Satariano and DeLorenze, 1996; Spelten et al., 2002). The influence of job characteristics on labor market outcomes raises concern that breast cancer's impact may not be equal across racial, ethnic, and income groups. Women from racial and ethnic minorities and low-income women are more likely to be employed in physically demanding jobs, and persons employed in physically demanding jobs are more likely to leave the workforce than are white collar workers when health problems arise (Currie and Madrian, 1999). The only breast cancer study to offer some insight into this issue found that African-American breast cancer survivors were twice as likely to take medical leave relative to white breast cancer survivors (Satariano and DeLorenze, 1996). However, once job type was considered in the analysis, the relationship between race and return to work was no longer statistically significant.

Based on findings from our previous research and that of others, we formulated our data collection effort and analytical approach. We designed and implemented a study of the effects of breast cancer on survivors' labor market outcomes that improves upon past research in the following ways. First, to understand the immediate effect of breast cancer and its treatment, we collected longitudinal primary data on a variety of labor market outcomes from subjects 3 months preceding diagnosis and 6 months following diagnosis.[4] Second, we compared changes in labor supply initiated by women with cancer to changes observed in a non-cancer control group; the control group helps to account for changes in labor market outcomes attributable to general changes in the labor market from which the breast cancer sample was drawn. Third, our study includes data on cancer stage that is a measure of cancer severity and is highly correlated with aggressiveness of treatment. And finally, detailed information regarding patient reported reasons for making labor supply changes (if applicable) is collected from the cancer sample.

Ideally, we would like to know breast cancer's effects over the life cycle. Nevertheless, the short-term labor supply effects of breast cancer are important to understand. By examining short-term labor supply, we observe the "negative shock" response to a potentially life-threatening disease. This response is due in part to the disease and its treatment and in part due to emotionally- and psychologically-based decisions that serious medical conditions evoke from patients. Our study offers a unique opportunity to view this response, which is particularly important as screening for cancer (and other diseases) occurs more and more frequently in working age people.

[4] The study continues to follow women and track their labor market outcomes 12 and 18 months following diagnosis.

3. Data

Women newly diagnosed with breast cancer were identified from the Metropolitan Detroit Cancer Surveillance System (MDCSS), a participant in the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) program. MDCSS is a population-based registry that covers over 4 million people within the Detroit Metropolitan area (Wayne, Macomb, and Oakland counties). As a participant in the SEER system, the MDCSS is held to high standards of completeness (99% complete), and records information on cancer stage, histology, laterality, and first cancer-directed treatment along with patient information such as sex, age, race, and contact information (e.g., addresses and telephone numbers).

Study eligibility criteria were age range of 30–64, English-speaking, and either employed or with an employed spouse at the time of diagnosis. The lower age bound of 30 was chosen because breast cancer occurs more frequently after age 30 and the upper age bound was chosen to select women prior to the traditional age of retirement. We enrolled employed women or non-employed women with an employed spouse because we were primarily interested in how breast cancer affected working individuals or families with at least one working individual. Our underlying assumption was that individuals who lose their jobs, as a result of cancer, experience the greatest economic loss and interruption in their lives relative to those who are not in the labor force when diagnosed with cancer. Furthermore, non-employment tends to be a persistent state—especially for older women. Nevertheless, it is possible that cancer discourages potential workers from entering the labor force, and in other cases prompts entry into the labor force to gain access to health insurance and wages to pay for future treatments (although we suspect that the latter case occurs infrequently 6 months following diagnosis).

Fig. 1 summarizes how the breast cancer sample was obtained. After an initial start-up period, all phases of case ascertainment (e.g., case abstraction, physician notification, subject mailings, and screening) occurred simultaneously. Subjects in various phases of case ascertainment who had not been contacted by an interviewer when the desired sample size was reached were removed from the subject pool. Over a period of 16 months, SEER case abstractors identified 2424 incident breast cancer subjects potentially eligible for the study. Of these subjects, 551 had a previous cancer and 439 were excluded because either they lived outside of Wayne, Macomb, and Oakland counties (in which case SEER collected no more data), or because study accrual was complete. Forty-three subjects had physicians that instructed MDCSS personnel not to contact their patients and 122 subjects did not have a physician identified. We mailed notification letters explaining the study to the physicians of the remaining 1269 subjects.[5] Physicians of 37 subjects refused us contact with their patients, 19 subjects were removed from the sample because study accrual was complete, and 6 subjects had incomplete address information. We then mailed letters and consent forms to 1207 women explaining the study and inviting them to be interviewed by telephone on three separate occasions (6, 12, and 18 months following diagnosis). Subjects were offered a US $25 incentive payment to complete all three interviews. If no response was received from subjects within 1 week of the mailing date, interviewers telephoned them to determine their willingness to participate and study eligibility.

[5] The Institutional Review Board required subjects' physicians to be informed of potential patient contact.

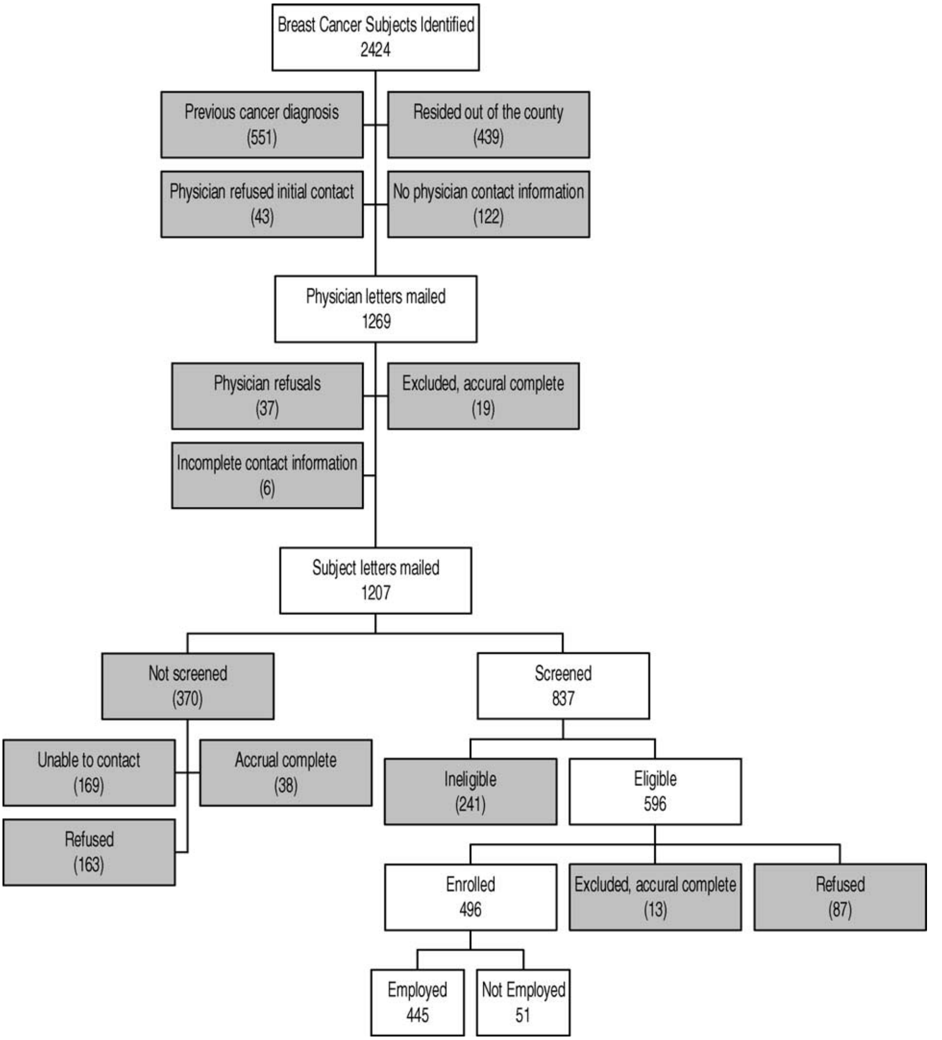

Fig. 1. Enrollment in labor market study of breast cancer survivors.

Interviewers successfully telephoned 837 women.[6] Of these 837 women, 241 were ineligible for the study, 13 were excluded because study accrual was complete, and 87 women refused participation. The interviewers enrolled 445 women who were employed 3 months prior to diagnosis. The response rate for subjects who were screened and determined to be eligible was 83%.

[6] 370 subjects were not screened for the following reasons: (1) incomplete address ($n = 169$), (2) refused to be screened ($n = 163$), and (3) study accrual complete ($n = 38$).

We extracted demographic and clinical data from the SEER registry for all potentially eligible patients. Enrolled subjects were compared in terms of age, race, and stage at diagnosis to subjects without a physician contact or with a physician refusal, subjects we were unable to contact, subjects who refused after having been determined to be eligible for the study, and subjects who refused participation prior to an eligibility determination (Table 1). Enrolled subjects were generally comparable to the subjects we did not enroll with few exceptions. Subjects who refused participation prior to an eligibility determination were, on average, 2 years older than the enrolled subjects. A greater percentage of subjects we were unable to contact (32%) were African-American relative to the percentage found in the enrolled sample (21%), and there was a lower percentage of local stage cancers and a higher percentage of unknown cancers among the subjects we were unable to contact relative to enrolled subjects.

The first interview, which is the one we use in this analysis, was conducted in two parts: (1) a set of questions regarding demographic information, and retrospective questions on labor market participation corresponding to the period 3 months prior to diagnosis; and (2) a nearly identical set of questions on labor market participation corresponding to the current work situation (as close as possible to 6 months after diagnosis). In the retrospective portion of the interview, breast cancer subjects recalled their labor supply (employment and average weekly hours worked) approximately 9 months prior to the interview. The literature suggests that subjects are able to reliably recall these data. Results from a validation study in which employer administrative records were used to validate survey responses from a sample of workers found that workers could accurately recall the most recent year's data on employment and non-employment, but less accurately recalled these data 2 years past their occurrence (Duncan and Hill, 1985). However, with regard to the most recent year, workers tended to over-report past hours worked. The absolute error in reports of work hours was nearly 10% of the actual mean number of work hours in the prior year (Duncan and Hill, 1985).

In our sample, the earliest diagnosis month and year was June 2001 and the latest diagnosis month and year was April 2002. The period covered by the retrospective part of this study was between March 2001 and January 2002. We aimed to conduct the interview 6 months following diagnosis, but allowed subjects to be between 4 and 7 months past diagnosis at the time of the interview. A third (35.5%) of the subjects were interviewed 5 months following diagnosis with the remaining subjects interviewed 4 months (10.4%), 6 months (30.8%), and 7 months later (22.0%).[7]

To avoid confounding the effects of cancer with changes in labor market conditions over the course of the study, we constructed a control group from respondents to the Current Population Survey (CPS) residing in the Detroit Metropolitan Area.[8] In addition, some of

[7] Six interviews (1.2%) were conducted outside of the desired time frame. Four interviews were conducted approximately 3 months and 2 weeks following diagnosis and two interviews were conducted approximately 6 days following the 7-month window because of scheduling difficulty. It is not believed that the quality of interviews was affected so we retained these individuals in the study sample.

[8] To illustrate this point, the interviews started a few months before the attacks on the World Trade Center on September 11, 2001, and we continued collecting data for more than a year afterwards. The Detroit Metropolitan Area, like most industrialized areas in the country, experienced declines in employment in the time period following these attacks.

Table 1
Comparison of enrolled patients to all potential patients

	(1) Subjects enrolled ($n = 496$)	(2) Physician refusal, no contact ($n = 159$)	(3) Not able to contact ($n = 169$)	(4) Eligible, refused ($n = 87$)	(5) Not screened, refused ($n = 163$)
Mean age (S.D.)	50.54 (7.60)	51.9 (7.97)	50.06 (8.77)	50.52 (7.87)	52.17 (8.01)[**]
Race					
White, Hispanic, non-African-American	392 (79.0)	113 (71.1)	97 (57.4)[***]	64 (73.6)	118 (72.4)
African-American, non-Hispanic	104 (21.0)	34 (21.0)	54 (32.0)[***]	21 (24.1)	32 (19.6)
Stage					
In situ	125 (25.2)	34 (21.4)	49 (29.0)	21 (24.1)	35 (21.5)
Local	203 (40.9)	71 (44.6)	51 (30.2)[**]	33 (37.9)	63 (38.6)
Regional	138 (27.8)	40 (25.2)	42 (24.8)	28 (32.2)	44 (27.0)
Distant	13 (2.6)	7 (4.4)	9 (5.3)	3 (3.4)	9 (5.5)
Unknown	17 (3.4)	7 (4.4)	18 (10.6)[***]	2 (2.3)	12 (7.4)[**]

Note: SEER: Surveillance, Epidemiology, and End Results, S.D.: standard deviation, shown in parentheses for age. Percentages are shown in parentheses for race/ethnicity and stage categories. Missing data: age—physician refusal ($n = 7$), not able to contact ($n = 17$), refusals ($n = 1$), not screened subjects ($n = 11$), and ineligible ($n = 13$); and race—physician refusal ($n = 11$), not able to contact ($n = 18$), refusals ($n = 2$), not screened subjects ($n = 13$), and ineligible ($n = 13$). Sample sizes for columns (2) through (4) do not match Fig. 1 due to missing data in the SEER registry. Percentages in columns (2) through (4) do not add to 100 due to missing race data.

** Statistically significant from enrolled subjects $p < 0.05$.

*** Statistically significant from enrolled subjects $p < 0.01$.

our analyses condition on employment prior to diagnosis. For such analyses, the control group is also essential to avoid confounding the effects of cancer with life cycle changes as well as typical employment dynamics entailing transitions out of the labor force.

The CPS is a monthly survey of households conducted by the Bureau of the Census for the Bureau of Labor Statistics and is the primary source of information on labor force characteristics and behavior of the U.S. population. Respondents are interviewed to obtain information about the employment status of each member of the household 15 years of age and older. Households participating in the CPS are in the survey for 4 consecutive months, out for 8 months, and then return for another 4 consecutive months before leaving the sample permanently (U.S. Department of Labor, Bureau of Statistics and U.S. Department of Commerce, 2002). We selected CPS respondents in their fourth month (denoted as “month-in-sample” (MIS) 4) and in MIS 5, which occurred 9 months after MIS 4, to be as consistent as possible with the 9-month span between the cancer interviewees’ pre- and post-diagnosis information. Specific questions regarding diseases such as cancer are not part of the CPS, and so a few respondents in the control population may have cancer. The presence of women with cancer in the control population would tend to diminish differences observed between the cancer and control groups, but we suspect this problem is trivial.

To the extent possible, patients in the cancer sample were asked demographic and labor market questions identical to those found in the CPS in a similar order and following similar skip patterns. The first section of the CPS part of the questionnaire covered demographic characteristics and the second section asked questions about the respondents’ employment (e.g., status, hours worked, type of job, and earnings).[9]

Two Detroit CPS samples were available as potential control groups; neither of these samples corresponded exactly to Wayne, Macomb, and Oakland counties where the cancer sample was drawn. The first sample was the Detroit Primary Metropolitan Statistical Area (PMSA) that included residents from Wayne, Macomb, Oakland, Monroe, Lapeer, and St. Clair counties. Only Macomb and Monroe county residents were identified, so we excluded respondents living in Monroe County to create a sample more closely matching the cancer sample’s counties of residence. This sample contained 3436 records or 47% of the 7254 records in Michigan from March 2001 to January 2002. The second sample consisted of Detroit city (Macomb county plus part of Wayne county, but excluding Oakland county), and contained 1309 records or 18% of the full Michigan sample for the corresponding time period.

We matched CPS respondents across MIS 4 and 5 for the time period covered by the cancer sample—taking all MIS 4 observations in the period March 2001 through January 2002. Because the CPS samples street addresses rather than individuals, we matched CPS respondents from one MIS to the next and pooled the observations. Subjects were matched across surveys by comparing individual records within households. To ensure a correct match, first we matched records by household number, which changes if one household moves away and another takes its place. Second, within households we matched individual roster numbers that are retained from one MIS to the next. Third, we matched sex, race, and age from one roster number to the next to ensure that the correct individual answered each survey. In most cases, unmatched subjects occurred when the entire household did not

[9] The questionnaire is available from the authors upon request.

respond to MIS 5. Approximately 80% of the subjects present in MIS 4 had a matching MIS 5 record.

We selected female members of households, within the age range of 30–64. The Detroit PMSA sample had 613 respondents meeting our selection criteria and the Detroit city sample had only 220 respondents meeting our selection criteria. The larger Detroit PMSA sample more closely resembled the socioeconomic characteristics of the cancer sample than did the Detroit city sample. We therefore report our findings relative to the respondents in the Detroit PMSA. Results from analyses using the Detroit city CPS sample were qualitatively similar and are available from the authors upon request.

4. Empirical approach

4.1. Specifications

The primary study outcomes were: (1) the probability of employment 6 months following diagnosis or at MIS 5 and (2) weekly hours worked 6 months following diagnosis or at MIS 5. These outcomes can be expressed as functions of the incidence and stage of breast cancer, denoted simply as BCA,[10] control variables (X), and random or unobserved influences (ε). Generically, we write the employment equation as

$$E^*_{\text{it}} = f(\text{BCA}_{\text{it}}, X_{\text{it}}, \varepsilon_{\text{it}}), \tag{1}$$

where E^*_{it} represents a latent variable for the propensity for employment at 6 months following diagnosis or at MIS 5 for the CPS control sample. We observe a woman working if E^*_{it} exceeds some critical value. We estimate the probability of employment 6 months following diagnosis or at MIS 5 (period 2) for all women regardless of their employment status prior to diagnosis or at MIS 4 (although we control for employment in period 1, E_{i1}) and then estimate a second equation conditional on being employed in the earlier period (period 1), using

$$Pr(E_{i2} = 1|\text{BCA}_{\text{it}}, X_{\text{it}}, E_{i1}, \varepsilon_{\text{it}}), \tag{2}$$

$$Pr(E_{i2} = 1|E_{i1} = 1, \text{BCA}_{\text{it}}, X_{\text{it}}, \varepsilon_{\text{it}}). \tag{3}$$

We define employment status as a binary variable (E_{i2}) that equals one if a woman reports that she was employed 6 months following diagnosis/MIS 5 and estimate Eqs. (2) and (3) as

[10] We use a single variable for breast cancer here, but in some analyses breast cancer will also be specified categorically to represent in situ, local, regional, and distant stages. These four stages are the SEER summary stages indicating progression in metastases. In situ cancers are noninvasive or intraepithelial, local cancers are confined to tissue in the breast, regional cancers are present by direct extension to the tissue underlying the breast and/or present in an ipsilateral lymph node, and distant cancers have metastasized to either a distant lymph node or to other organs of the body. We hypothesize that more severe stages will have a greater negative effect on labor supply relative to early stage cancers and/or being cancer free.

probit models. For ease of interpretation, the probit estimates are translated into derivatives of the probability of working with respect to the independent variables.[11]

In our estimation of the effect of breast cancer on weekly hours worked (*H*), we assume that the same variables that affect employment also affect weekly hours worked. We estimate two different models for hours, one that conditions on employment post-diagnosis, and one that does not, using

$$H_{i2} - H_{i1} = \alpha_H + \beta_H \mathrm{BCA}_i + X_i\gamma_H + \eta_{i2} | E_{i1} = 1 \text{ and } E_{i2} = 1, \quad (4)$$

$$H_{i2} - H_{i1} = \alpha_H + \beta_H \mathrm{BCA}_i + X_i\gamma_H + \eta_{i2} | E_{i1} = 1. \quad (5)$$

Eq. (4) conditions on employment in periods 1 and 2 whereas Eq. (5) does not. We also report results from a closely related model that shows the percent change in hours worked relative to the onset of breast cancer.

There are some potential sources of selection bias in these hours estimates. First, it is possible that the most dedicated workers remain at work regardless of their cancer diagnosis, whereas those who already tended to work less are more likely to reduce their hours. This is the reason for studying changes in hours from the pre-diagnosis to the post-diagnosis period, netting out the fixed unobservables that may be associated with post-diagnosis employment. On the other hand, suppose only a select group of women (i.e., those who are minimally affected by the disease and/or its treatment) remains at work. If this were the case, these women may work fewer weekly hours relative to the non-cancer controls, but work more hours per week than randomly selected women 6 months following a breast cancer diagnosis. Because the selection in this case is not based on fixed unobservables, but instead on unobservables related to the disease or treatment, differencing does not solve the problem. Selection bias, under this scenario, will bias the negative effect of cancer on hours worked toward zero. However, in sections that follow, we find that cancer has a statistically significant negative effect on hours worked—a finding that would only be strengthened if there were a compelling way to correct for this type of selection.

4.2. Sampling issues

We chose a longitudinal cohort study design that follows cancer and non-cancer control subjects over time to study the effects of cancer on labor market outcomes. However, if the cancer and control samples differ in observed characteristics (e.g., age, education, income), these differences can lead to biased estimates of the effect of cancer on employment and hours worked (D’Agostino, 1998). Had we recruited our cancer sample first and then, for example, randomly selected control subjects from the same census blocks as cancer subjects, we may have found non-cancer controls whose socioeconomic, demographic, and employment characteristics more closely resembled those of the cancer subjects. Such a strategy was cost-prohibitive for our study and was not guaranteed to substantively improve

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[11] The “derivatives” are computed as the difference in probabilities as the dummy variables take on the values 0 and 1, with the other variables at the sample means.

over what could be generated from the CPS. Therefore, we investigated propensity score methods to partly compensate for less than perfect control subjects (Rosenbaum and Rubin, 1983).[12]

4.3. Control variables

We control for individual characteristics including age, marital status (never married, separated/widowed/divorced, married), education (no high school diploma, high school diploma, some college, college degree), number of children under age 18, and household income. Age is specified as a continuous variable. We include variables for household earnings in the year prior to diagnosis (or the corresponding year for the control sample), and month and year of interview. Household income was categorized as: household income greater than or equal to US $75,000; household income between US $20,000 and US $75,000; and household income less than or equal to US $20,000. The maximum household income category recorded in the interview was US $75,000 or more and a household income of less than US $20,000 approximates poverty or near poverty, although this depends on the number of household members.

A propensity score was estimated to balance the observable characteristics of the treatment (in our case, cancer) and control groups (Rosenbaum and Rubin, 1983). For an individual, the propensity score (p) is the probability of being treated (or in this case, having cancer) based on observed characteristics (Z) as shown in Eq. (6):

$$p(Z) = Pr(\mathrm{BCA} = 1|Z) = E(\mathrm{BCA}|Z). \tag{6}$$

The propensity score is estimated using a probit model. The sample is then split into k intervals of the estimated propensity score by using methods such as nearest-neighbor, radius matching, and kernel matching.[13] Within each interval, we test if the propensity score between the treated (cancer) subjects and control subjects differ. This is the "balancing" test, which must be satisfied before the propensity score can be used (Becker and Ichino, 2002). Once the balancing condition is met, for a given specification of disease in Eq. (6), the propensity score $\hat{p}(Z)$ is included in equations estimating the probability of employment and in equations estimating the change in weekly hours worked. We report our results with and without adjustments to the estimates using propensity scores.

[12] Indeed, these methods are potentially useful for all sampling strategies, with the exception of random assignment, which is of course inapplicable in studying the effects of cancer.

[13] We tested several matching methods including nearest neighbor, 1-to-1 matching with replacement, kernel matching with bootstrap standard errors, local linear regression, and spline matching. These methods yielded comparable results. We use the kernel method where all cancer subjects are matched with a weighted average of all controls with weights that are inversely proportional to the distance between the propensity scores of the cancer and control observations. For a review of matching methods see Becker and Ichino (2002) and Smith and Todd (2003).

5. Results

5.1. Descriptive statistics

Table 2 presents descriptive statistics for the independent and dependent variables from the cancer and control samples. The first two columns cover the full samples at baseline/MIS 4, while columns (3) and (4) are specific to the employed samples. In the breast cancer samples (columns (1) and (3)), most women were diagnosed with early stage cancers (either in situ or local stages). The majority of the women were white, non-African-American.[14] Approximately one-fifth of the women were African-American.

Along other dimensions, the breast cancer sample differed from the CPS sample in some important ways. Women with breast cancer were older (by about 5 years), a higher percentage were divorced, separated, or widowed, fewer had children under age 18, and a greater percentage had attended college. Column (1) relative to column (2) shows that women with breast cancer had higher household incomes relative to women in the CPS. Each of these characteristics – age, marital status, number of children, education, and income – can affect labor supply, which we address through control variables and propensity score methods.[15]

We observed that the breast cancer sample (Table 2, column (1)) had a much higher employment rate at baseline relative to the CPS sample (90% versus 61%). Part of this difference is due to sampling from the SEER only employed women or those with an employed spouse. In addition, the study interviewers reported that non-employed subjects were less willing to discuss their spouses' employment situations, which may explain the remaining differential in employment. Among women who were employed 3 months prior to diagnosis/MIS 4, approximately 16% of women in the CPS sample were non-employed when they were interviewed 9 months later, whereas approximately 31% of the employed breast cancer sample was non-employed at the time of the second interview.

This illustrates the important role of the control sample when we condition on initial employment. Over time, many women make a transition from employment to non-employment. We only want to infer a causal effect of breast cancer if women with the disease make employment to non-employment transitions at a higher rate than the control sample. Based on the univariate analysis, only half of the observed transition from employment to non-employment can be attributed to cancer. Moreover, although employment rates at 6 months post-diagnosis/MIS 5 are similar for the cancer and control groups, taking into account the much higher initial employment rate in the cancer group indicates that, overall, cancer reduces the probability of employment considerably.

Women in the control group who remained working had virtually no change in the number of hours worked per week. Among women with breast cancer who remained working, their

[14] For simplicity, we refer to all women in this category as "white" although it includes women who are Hispanic, Asian, and American Indian.

[15] It is unclear why the CPS was not a better match to the cancer sample, which was drawn from a population-based registry. Perhaps a low-income segment of the population is left out of the SEER registry because their cancers are either not detected or perhaps their cancers are detected very close to the time of death, which would pre-empt enrollment in a study that did not attempt patient contact until 6 months following diagnosis.

Table 2
Descriptive statistics for the cancer and Detroit CPS sample

	(1) All breast cancer sample ($n = 496$)	(2) All Detroit PMSA MIS 4 ($n = 613$)	(3) Breast cancer sample employed ($n = 445$)	(4) Detroit employed PMSA MIS 4 ($n = 372$)
Breast cancer				
In situ	25.20%	N/A	25.84%	N/A
Local	40.93%	N/A	42.02%	N/A
Regional/distant	30.44%	N/A	28.99%	N/A
Invasive/unknown	3.43%	N/A	3.15%	N/A
Mean age	50.54 (7.60)***	46.06 (9.11)	50.62 (7.57)***	44.59 (7.88)
Race/ethnicity				
White, Hispanic, non-black	79.03%	79.61%	77.98%	78.76%
African-American, non-Hispanic	20.97%	20.39%	22.02%	21.24%
Marital status				
Married	63.91%***	65.25%	60.22%***	64.52%
Divorced, separated or widowed	27.22%***	20.55%	29.89%***	20.43%
Never married	8.87%***	14.19%	9.89%***	15.05%
Number of children ≤18	31.85%***	46.17%	31.24%***	49.19%
Education				
No high school diploma	4.64%***	8.97%	4.94%***	5.91%
High school diploma	22.38%***	36.84%	22.25%***	35.22%
Some college	37.30%***	24.47%	38.43%***	25.81%
College degree	35.69%***	29.69%	34.38%***	33.06%
Household income				
≤ US $20,000	6.53%***	14.21%	7.21%	10.31%
≥ US $75,000	42.74%***	34.58%	41.16%	39.38%
Employment characteristics				
Employed at first interview	89.72%	60.70%	100.00%	100.00%
Employed at second interview	61.69%	59.54%	68.54%***	84.14%
Mean hours worked per week first interview (workers only)	39.47 (12.30)**	37.67 (10.30)	39.47 (12.30)***	37.67 (10.30)
Mean hours worked per week second interview (workers only)	33.42 (12.35)***	37.06 (10.77)	33.49 (12.30)***	38.09 (9.80)

Note: Standard deviations are in parentheses for continuous variables. "PMSA" denotes Primary Metropolitan Statistical Area, and "MIS" denotes month-in-sample. Other race/ethnicity included as "white": American Indian (1 cancer, 0 control), Asian (7 cancer, 20 control), other/unknown (4 cancer, 0 control).

** Significantly different from the Detroit PMSA sample (column (1) compared to column (2) and column (3) compared to column (4)) at $p < 0.05$.

*** Significantly different from the Detroit PMSA sample (column (1) compared to column (2) and column (3) compared to column (4)) at $p < 0.01$.

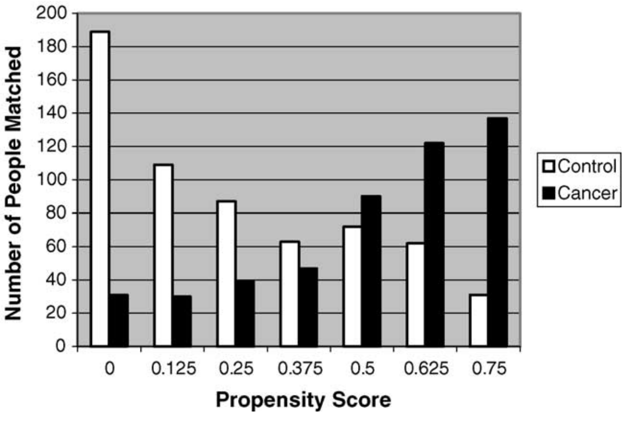

Fig. 2. Histogram of estimated propensity score, unconditional on employment in first period.

average number of hours worked per week decreased by nearly 6 h from pre- to post-diagnosis. Thus, based on these univariate analyses alone, it appears that breast cancer leads to reductions in both employment and in hours worked among those employed.

To avoid bias in subsequent estimations of employment and hours worked that might be introduced by the differences between the cancer and control groups, we used the propensity score approach to balance the observed characteristics in the cancer and CPS samples. The best balance between the covariates in the cancer and control group was achieved when the sample was partitioned into eight or seven strata, depending on whether or not we condition on employment 3 months prior to diagnosis/MIS 4.[16] Thus, each stratum included subjects who were relatively homogenous with respect to their likelihood of being diagnosed with cancer. The mean propensity score for the cancer group was 0.62 (S.D. = 0.18), and for the control group the mean propensity score was 0.44 (S.D. = 0.21). Fig. 2 shows the histogram of the number of subjects matched by propensity score in the sample that does not condition on employment in the first period. The histograms for the other samples we study were qualitatively similar. These figures reveal that there are some substantive differences between treatment and control groups, consistent with earlier discussion of Table 2.

5.2. *Probability of employment*

Table 3 reports estimates for the probability of employment 6 months following diagnosis/MIS 5. In this table we do not condition on initial employment, but instead we control for employment at baseline/MIS 4 in addition to other independent variables. We find that women with breast cancer were 25 percentage points less likely to be employed than women in the CPS control group (column (1)). In column (2), we find that women with local stage cancer were 24 percentage points less likely to be employed and women with regional/distant stage cancer were 39 percentage points less likely to be employed

[16] That is, with these numbers of strata, the balancing test discussed earlier was satisfied.

Table 3
Probability of employment, $n = 1006$

Independent variables	(1) Base model	(2) Stage included	(3) Propensity score included
Employed at baseline/MIS 4	0.66 (0.03)***	0.66 (0.03)***	0.53 (0.07)***
Propensity score	N/A	N/A	0.25 (0.18)
Breast cancer yes/no	−0.25 (0.04)***	N/A	−0.18 (0.03)***
In situ	N/A	−0.07 (0.07)	N/A
Local	N/A	−0.24 (0.05)***	N/A
Regional/distant	N/A	−0.39 (0.05)***	N/A
Unknown cancer stage	N/A	−0.21 (0.15)	N/A
African-American	−0.15 (0.05)***	−0.14 (0.05)***	−0.12 (0.03)***
Age	−0.01 (0.003)*	−0.005 (0.003)	−0.01 (0.00)**
Never married	0.06 (0.06)	0.08 (0.06)	0.06 (0.05)
Separated, widowed, divorced	0.05 (0.05)	0.05 (0.05)	0.04 (0.04)
High school	0.01 (0.08)	0.003 (0.08)	0.01 (0.06)
Some college	0.12 (0.07)	0.12 (0.07)	0.06 (0.06)
College graduate	0.12 (0.08)	0.10 (0.08)	0.06 (0.06)
Number of children ≤18	−0.05 (0.02)**	−0.04 (0.02)*	−0.02 (0.02)
Household income ≥ US $75,000	0.04 (0.05)	0.04 (0.05)	0.02 (0.03)
Household income ≤ US $20,000	−0.07 (0.07)	−0.07 (0.07)	−0.03 (0.05)

Note: Partial derivatives of probability with respect to independent variables are reported with standard errors in parentheses. Omitted categories are non-cancer, married, white/other, no high school diploma, household income between US $20,000 and US $75,000. Coefficients for month and year of interview are not reported. In column (3), the balancing property was satisfied in the propensity score estimations. The propensity score was estimated based on control variables shown in Table 3. Missing data for income ($n = 98$) reduced the sample size. In estimations without income including these subjects, the results were robust.

* Significant at $p < 0.10$.

** Significant at $p < 0.05$.

*** Significant at $p < 0.01$.

relative to women without cancer. Women with in situ cancers were not statistically different from the non-cancer controls 6 months following diagnosis. Thus, the likelihood of employment diminishes with more severe disease stages. In column (3), we add a variable for the propensity of being in either the cancer or control group. The results were similar although the estimated effect of cancer was slightly smaller. Women with breast cancer were 18 percentage points less likely to be employed relative to women without cancer.[17]

Table 4 looks at the probability of employment 6 months following a cancer diagnosis/MIS 5, conditional on initial employment. The results are very similar to those in Table 3. Column (1) shows that relative to women without breast cancer, women with cancer were 18 percentage points ($p < 0.01$) less likely to work 6 months following diagnosis. In column (2), women with local cancer were 18 percentage points ($p < 0.01$) less likely to work, and women with regional and distant cancers were 34 percentage points ($p < 0.01$) less likely to work 6 months following diagnosis relative to CPS respondents. Women with in situ cancers and women with unreported cancer stage were not statistically significantly different from the controls in their probability of continuing to work. Turning to column (3), when

[17] Table 3, column (3) does not contain separate variables for cancer stage. Because the results were qualitatively similar to column (1), we did not attempt to estimate separate propensity scores for each stage.

Table 4
Probability of employment, conditional on prior employment, $n = 747$

Independent variables	(1) Base model	(2) Stage included	(3) Propensity score
Propensity score	N/A	N/A	−0.22 (0.26)
Breast cancer yes/no	−0.18 (0.03)***	N/A	−0.17 (0.03)***
In situ	N/A	−0.02 (0.06)	N/A
Local	N/A	−0.18 (0.05)***	N/A
Regional/distant	N/A	−0.34 (0.06)***	N/A
Unknown cancer stage	N/A	−0.16 (0.15)	N/A
African-American	−0.13 (0.05)***	−0.12 (0.05)***	−0.12 (0.04)***
Age	−0.001 (0.003)	−0.001 (0.003)	0.004 (0.01)
Never married	0.04 (0.06)	0.06 (0.05)	0.04 (0.06)
Separated, widowed, divorced	0.01 (0.04)	0.001 (0.04)	−0.00 (0.04)
High school	−0.03 (0.08)	−0.03 (0.08)	−0.04 (0.08)
Some college	0.04 (0.07)	0.04 (0.07)	0.06 (0.08)
College graduate	0.04 (0.07)	0.02 (0.08)	0.04 (0.08)
Number of children ≤18	−0.02 (0.02)	−0.02 (0.02)	−0.02 (0.02)
Household income ≥ US $75,000	0.03 (0.04)	0.04 (0.04)	0.03 (0.04)
Household income ≤ US $20,000	−0.06 (0.07)	−0.07 (0.07)	−0.08 (0.06)

Note: See notes to Table 3.
*** Significant at $p < 0.01$. Missing data for income reduced the sample size ($n = 66$).

the propensity score is added in the regression model the effect of cancer is robust. Women with cancer were 17 percentage points less likely to remain working 6 months following diagnosis relative to women without cancer.

In terms of the control variables, none have statistically significant effects on the probability of employment except race. African-American race was negatively associated with being employed in the second period (−0.12, $p < 0.01$). This finding led to further investigations to determine if the racial difference in employment reflects a stronger negative effect of breast cancer for African-American women. We estimated separate probit regressions that mirror Table 4 for African-American and white women. White women with breast cancer were 14 percentage points ($p < 0.01$) less likely to be employed 6 months following diagnosis relative to white women in the CPS control group. African-American women with breast cancer experienced a much stronger non-employment effect 6 months following diagnosis. These women were 35 percentage points less likely to be employed relative to African-American women in the CPS control group (results not shown).

5.3. *Weekly hours worked*

Table 5 shows the change in weekly hours worked, conditional on being employed at period 1 and period 2, by cancer status and cancer stage, relative to being cancer free. In columns (1), (3), (4), and (6), the coefficient on cancer is negative and statistically significant ($p < 0.01$). Working women with breast cancer reduced their weekly hours worked by nearly 7 h or 18% 6 months following diagnosis. Women with more advanced stages reduced weekly hours worked by more, relative to women in the control group (column (2)). Average weekly hours reductions by stage were: 3.70 (in situ), 6.94 (local), and 10.18 (regional/distant). In terms of the percentage changes in weekly hours (column (5)), women

Table 5
Changes in weekly hours worked, conditional on second period employment, $n = 540$

Independent variables	(1) Raw change	(2) Raw change	(3) Raw change, propensity score	(4) Percent change	(5) Percent change	(6) Percent change, propensity score
Propensity score	N/A	N/A	2.67 (6.96)	N/A	N/A	−0.05 (0.23)
Breast cancer (yes/no)	−6.68 (0.87)***	N/A	−6.97 (0.85)***	−0.18 (0.03)***	N/A	−0.19 (0.03)***
In situ	N/A	−3.70 (1.15)***	N/A	N/A	−0.12 (0.04)***	N/A
Local	N/A	−6.94 (1.04)***	N/A	N/A	−0.18 (0.03)***	N/A
Regional/distant	N/A	−10.18 (1.27)***	N/A	N/A	−0.28 (0.04)***	N/A
Unknown stage	N/A	−6.22 (3.12)**	N/A	N/A	−0.16 (0.10)	N/A
African-American	−0.62 (1.07)	−0.57 (1.05)	−0.71(1.15)	−0.03 (0.04)	−0.03 (0.03)	−0.04 (0.04)
Age	0.18 (0.06)***	0.18 (0.06)***	0.12 (0.16)	0.004 (0.002)*	0.001 (0.001)*	0.01 (0.01)
Never married	−0.99 (1.44)	−0.33 (1.43)	−1.23 (1.50)	−0.04 (0.05)	−0.02 (0.05)	−0.04 (0.05)
Separated, widowed, divorced	−0.51 (1.07)	−0.54 (1.05)	−0.99 (1.07)	−0.02 (0.04)	−0.02 (0.03)	−0.03 (0.04)
High school	−2.17 (1.98)	−2.24 (1.95)	−2.24 (2.03)	−0.06 (0.07)	−0.06 (0.06)	−0.06 (0.07)
Some college	−2.19 (1.95)	−2.15 (1.92)	−2.66 (2.03)	−0.06 (0.06)	−0.05 (0.06)	−0.06 (0.07)
College graduate	−1.82 (1.99)	−2.02 (1.96)	−2.04 (1.99)	−0.07 (0.07)	−0.08 (0.07)	−0.07 (0.07)
Number of children ≤18	1.10 (0.51)**	1.19 (0.50)**	1.02 (0.51)**	0.03 (0.02)	0.03 (0.02)*	0.02 (0.02)
Household income ≥ US $75,000	−1.88 (0.98)*	−1.82 (0.96)*	−1.91 (0.97)**	−0.05 (0.03)	−0.05 (0.03)	−0.05 (0.03)
Household income ≤ US $20,000	−0.05 (1.62)	−0.47 (1.60)	0.23 (1.69)	0.01 (0.05)	0.00 (0.05)	0.01 (0.06)

Note: See notes to Table 3.
* Significant at $p < 0.10$.
** Significant at $p < 0.05$.
*** Significant at $p < 0.01$.

with in situ, local, and regional/distant cancer reduced their hours by 12, 18, and 28%, respectively. Columns (3) and (6), which include propensity scores in the estimations, show very similar effects of cancer on weekly hours worked.

Table 6 shows findings from analyses that do not condition on employment 6 months following diagnosis/MIS 5. Coefficients for cancer and cancer stage were negative and statistically significant. These coefficients are larger than those observed in Table 5 because they reflect the employment effect of cancer as well.

5.4. Understanding the employment to non-employment transition

Table 7 shows the employment transitions made from baseline/MIS 4 to 6 months following diagnosis/MIS 5 for the cancer and CPS sample. Because most of the breast cancer sample was employed at the time of diagnosis, we focus our discussion on the employment to non-employment transition. Fourteen percent of the women with breast cancer who were working prior to diagnosis were not working 6 months following diagnosis but reported having a job, which suggests that these women had taken either a leave of absence or extended sick leave from their jobs. The corresponding number for the CPS women was 5%.

One could speculate that the effect of breast cancer for the women who have jobs but are not working is temporary, and that these women are more likely return to their jobs relative to those reporting that they retired or are unable to work, and that by including these women in the "non-employed" category, we overestimate the negative longer-term labor supply effects of breast cancer. To address this point, we expanded our definition of employed to include women who reported having a job but not working, and estimated probit equations analogous to those in Table 4 (results not shown). The effect of breast cancer was smaller, but still negative and statistically significant (−0.08, $p < 0.01$). Future data collection will determine if these women who report having a job do indeed return to working status at 12 or 18 months following diagnosis. Nevertheless, during the interim when these women are absent from their jobs, it is likely that they and their families experience adverse economic consequences such as lost wages, and delayed promotions or career advancements.

We explored a number of reasons that could explain why some women do not return to work 6 months following a breast cancer diagnosis. Within the cancer sample, we tested the following hypotheses: (1) women employed in physically demanding jobs were less likely to return to work; (2) women working for smaller firms (e.g., fewer than 25 employees[18]) are less likely to return to work because their employers may have been unable or unwilling to hold jobs for the women while they underwent treatment; and (3) women employed in organizations with more generous sick leave that allowed a longer recovery period were less likely to return to work. To test these hypotheses, we used data collected from the cancer sample; comparable data were not available for the CPS control group. Subjects were asked questions regarding job activities (time spent sitting, standing, walking, and climbing stairs) prior to cancer diagnosis, the number of people who worked for their employer (fewer than 25, 25–49, 50–99, or 100 or more), and the presence and duration of paid sick leave. In

[18] The Americans with Disabilities Act applies to employers with 25 or more employees and the Family Medical Leave Act applies to employers with 50 or more employees.

Table 6
Changes in weekly hours worked, conditional on first period employment, $n = 716$

Independent variables	(1) Raw change	(2) Raw change	(3) Raw change, propensity score	(4) Percent change	(5) Percent change	(6) Percent change, propensity score
Propensity score	N/A	N/A	−15.92 (10.82)	N/A	N/A	−0.18 (0.29)
Breast cancer (yes/no)	−11.28 (1.49)***	N/A	−11.22 (1.44)***	−0.30 (0.04)***	N/A	−0.30 (0.04)***
In situ	N/A	−3.88 (2.04)*	N/A	N/A	−0.10 (0.06)*	N/A
Local	N/A	−10.94 (1.76)***	N/A	N/A	−0.28 (0.05)***	N/A
Regional/distant	N/A	−17.49 (1.91)***	N/A	N/A	−0.47 (0.05)***	N/A
Unknown stage	N/A	−10.39 (5.02)**	N/A	N/A	−0.24 (0.14)*	N/A
African-American	−6.73 (1.70)***	−6.07 (1.66)***	−6.33 (1.69)***	−0.14 (0.05)***	−0.12 (0.04)***	−0.14 (0.05)***
Age	0.15 (0.10)	0.13 (0.10)	0.47 (0.24)*	0.00 (0.00)	0.00 (0.00)	0.01 (0.01)
Never married	−1.32 (2.45)	−0.52 (2.40)	−1.49 (2.45)	−0.00 (0.07)	0.02 (0.06)	−0.00 (0.07)
Separated, widowed, divorced	−1.95 (1.79)	−2.28 (1.75)	−2.21 (1.77)	−0.02 (0.05)	−0.03 (0.05)	−0.04 (0.05)
High school	−1.79 (3.20)	−2.04 (3.13)	−2.51 (3.21)	−0.05 (0.09)	−0.05 (0.08)	−0.06 (0.09)
Some college	0.19 (3.18)	0.15 (3.11)	2.26 (3.40)	0.02 (0.09)	0.02 (0.08)	0.04 (0.09)
College graduate	−0.41 (3.29)	−1.46 (3.22)	0.44 (3.30)	0.00 (0.09)	−0.03 (0.09)	0.01 (0.09)
Number of children ≤18	1.05 (0.87)	1.22 (0.85)	0.77 (0.88)	0.01 (0.02)	0.01 (0.02)	0.01 (0.02)
Household income ≥ US $75,000	−1.18 (1.68)	−0.98 (1.64)	−1.03 (1.66)	−0.02 (0.05)	−0.01 (0.04)	−0.02 (0.04)
Household income ≤ US $20,000	−0.12 (2.61)	−0.43 (2.56)	−1.27 (2.72)	−0.05 (0.07)	−0.06 (0.07)	−0.07 (0.07)

Note: See notes to Table 3.
* Significant at $p < 0.10$.
** Significant at $p < 0.05$.
*** Significant at $p < 0.01$.

Table 7
Employment transitions from baseline/MIS 4 to 6 months following diagnosis/MIS 5

	N	(1) Employed	(2) Non-employed; has job	(3) Non-employed; without job	(4) Non-employed; retired	(5) Disabled or unable to work
Breast cancer sample baseline ($n = 479$)						
Employed	443	305 (69%)	60 (14%)	25 (5%)	8 (2%)	45 (10%)
Non-employed; has job	3	0 (0%)	2 (67%)	1 (33%)	0 (0%)	0 (0%)
Non-employed; without a job	33	1 (3%)	0 (0%)	32 (97%)	0 (0%)	0 (0%)
CPS sample MIS 4 ($n = 576$)						
Employed	370	313 (85%)	19 (5%)	36 (10%)	0 (0%)	2 (.5%)
Employed; has job	29	24 (83%)	1 (3%)	5 (17%)	0 (0%)	0 (0%)
Non-employed; without a job	177	27 (15%)	0 (0%)	122 (69%)	20 (11%)	8 (4%)

Note: Columns (2) through (5) show the employment transitions made from baseline to 6 months following diagnosis/MIS 5. Numbers of observations do not match Table 2 because of missing employment data for the cancer sample ($n = 3$) and CPS sample ($n = 2$) and because of non-employed individuals reporting their status as retired ($n = 14$ for the cancer sample and $n = 28$ for the CPS sample) or disabled/unable to work ($n = 7$ for the cancer sample and $n = 8$ for the CPS sample) in the first period. The employment status did not change for the vast majority of these individuals.

separate probit regressions predicting the transition from employment to non-employment, we added the independent variables described above. The coefficients for the newly added independent variables were all statistically insignificant (results not shown).

We also directly asked subjects who were not working 6 months following diagnosis if cancer and/or its treatment were the reason their labor supply changed. The reasons listed for not working 6 months following diagnosis were illness (74%), “other” (19%), on lay-off (6%), and family or personal obligation (1%). These results tend to confirm that our estimations have detected negative causal effects of breast cancer on women’s labor supply.

6. Conclusions

The results show a substantial negative impact of breast cancer on labor supply 6 months following diagnosis. Women with breast cancer were about 17 percentage points less likely to be employed 6 months following diagnosis relative to women in the CPS control group at MIS 5. The effects were stronger for those with more advanced stage cancers, while there was no employment effect on women with in situ cancers. Among women employed prior to diagnosis, at least 12% appeared to move out of the labor force altogether by retiring or becoming disabled, suggesting that for some women the transition to non-employment may be permanent. Fourteen percent of previously working women diagnosed with breast cancer reported that they were not employed, but had a job. Perhaps these women will return to work at a later time.

The non-employment effect of breast cancer appears to be about twice as strong for African-American women. Reasons why breast cancer has a stronger effect on African-American women are unclear and warrant further investigation. Possible explanations include those that are job-related (e.g., physical demands) and/or treatment related (e.g., more aggressive and/or toxic regimens).

Upon diagnosis with invasive breast cancer, women and their families must be prepared for some level of economic loss. Future studies are needed to explore in greater depth reasons why many women do not work 6 months following diagnosis and to develop interventions that minimize non-employment. For example, since many women with cancer reported that their reason for not working was because of symptoms related to treatment, perhaps interventions that reduce these symptoms will, in turn, minimize the impact on patients’ abilities to work. Cancer patients may also be unaware that employers, through provisions of the Americans with Disabilities Act (ADA), are required to make reasonable accommodations to their illness (which may include time off for treatment, rest breaks, and possible job restructuring).

The Nation’s health priorities focus on early detection and turning once life-threatening conditions into chronic conditions (U.S. Department of Health and Human Services, 2000). If we estimate that 50% of the American Cancer Society’s 140,000 predicted cases of breast cancer are working women, approximately 70,000 women will experience labor market consequences attributable to cancer each year. Our study demonstrates that breast cancer will lead to substantial short-term and in some cases perhaps permanent reductions in labor supply. With the exception of a small reduction in hours worked, the negative labor supply effects were not observed for women with in situ cancers—lending additional support to arguments for early detection and treatment. Later stage cancers, on the other hand, accounted for breast cancer's negative labor supply effects.

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