

Do Medical Treatments Work for Work? Evidence from Breast Cancer Patients

Online Appendix

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A1 Additional Sources of Income Insurance Against Health Shocks

Unemployment Insurance In Denmark, employers have the right to terminate the employment of workers who have been on sick leave for extended periods of time, typically a total of 120 days during a period of 12 months. Unlike other forms of social security, unemployment insurance is not automatic. Instead, individuals must apply to become members of an unemployment fund (A-kasse). During our study period around 78% of individuals were members of an A-kasse.

Members of an A-kasse are entitled to unemployment benefits if they are employed for at least 52 weeks during the previous 3 years. During our study period, members could receive benefits for a maximum period of 7 years (until 1993) or 5 years (after 1994). Benefit amounts were calculated as 90% of the earnings in the year before the job loss with a maximum weekly amount of DKK 2,615 (559 USD) in 1996.

Social Assistance Benefits provided by the social assistance program are means-tested and also depend on age and marital status. During our study period, social assistance benefits typically amounted to 60 to 80% of the maximum level of unemployment benefits (Pedersen and Larsen, 2008). In contrast to unemployment benefits, individuals could receive social assistance benefits for an unlimited period of time.

Early Retirement Individuals who are members of an unemployment insurance fund and have been so for a sufficiently long period of time are eligible for early retirement before the full retirement age. The full retirement age for individuals born before July 1, 1939 is 67. Individuals born after that date are eligible for retirement at age 65. Both groups are eligible for early retirement at age 60. Individuals transition into the old-age pension program at the full-retirement age. The early retirement pension was reformed several times during the course of our study. The benefit levels typically equaled 80-100% of the maximum unemployment insurance benefit level, depending on the age of entry into early retirement (Bingley, Gupta and Pedersen, 2012).

A2 Control Function Approach to Heckman Selection Model with Endogenous Covariates

The structural equation of interest is Equation (1):

$$Y_{it}^a = \alpha_1 + RT_{it}\beta_1 + \mathbf{X}_{it}\gamma_1 + u_{1t} + \epsilon_{1it}. \quad (1)$$

There are two fundamental problems with estimating Equation (1) via OLS. The first is what we focus on in the main text, which is that RT_{it} is potentially correlated with the error term ϵ_{1it} . The second is that the actual values of Y_{it}^a are only observed for those that live until period t . The first problem is handled as before with the first-stage Equation (2):

$$RT_{it} = \alpha_2 + T95_i Post95_t \beta_2 + \mathbf{X}_{it}\gamma_2 + u_{2t} + \epsilon_{2it}. \quad (2)$$

The second problem is characterized by a third equation that identifies selection into the sample in period t . Let s_{it}^* be an index that identifies the propensity for a person to survive until period a and the person will survive if $s_{it}^* > 0$. The observed economic outcome is therefore $Y_{it}^a | s_{it}^* > 0$. The survival index is driven by the underlying equation:

$$s_{it}^* = \alpha_4 + RT_{it}\beta_4 + \mathbf{Z}_{it}\theta_4 + \mathbf{X}_{it}\gamma_4 + \epsilon_{4it}, \quad (A2.1)$$

where the vector $\mathbf{Z}_{it}$ contains factors that impact survivability but not labor supply (ϵ_{1it}). Let $s_{it} = 1$ which only occurs if $s_{it}^* > 0$. When the error terms are jointly normally distributed, this is a Heckman (1974)

selection model with endogenous covariates in the outcome equation of interest. [Schwiebert \(2015\)](#) outlines a control-function approach to estimation. Equation (2) is first estimated by OLS and the residuals from that regression are then added to Equation (1) and, assuming the errors terms ϵ_{1it} and ϵ_{4it} are bivariate normally distributed, Equation (1) and Equation (A2.1) are estimated via FIML. The model requires that we include one or more excluded instruments in the selection equation (A2.1), i.e., variables that plausibly affect survivability but have no direct effect on labor market outcomes. The excluded instruments are triple interactions between the T95 indicator, an indicator for being diagnosed after 1995, and (i) an indicator for having a tumor larger than 5cm, or (ii) indicators for the type of surgery (i.e., breast conserving or mastectomy). These variables strongly predict mortality but should not necessarily be predictive of labor supply. We make one further change to our specification to reduce the computational burden: we reduce the dimensionality of the covariates in Equations (1), (2) and (A2.1) by replacing the full set of interactions between the indicators for clinical characteristics determining RT eligibility with the T95 indicator, and the set of year-of-diagnosis fixed effects with an indicator for diagnosis in or after 1995. Column 3 in Appendix Table A9 below shows that this change leaves our baseline results (reported in Column 1) virtually unchanged.

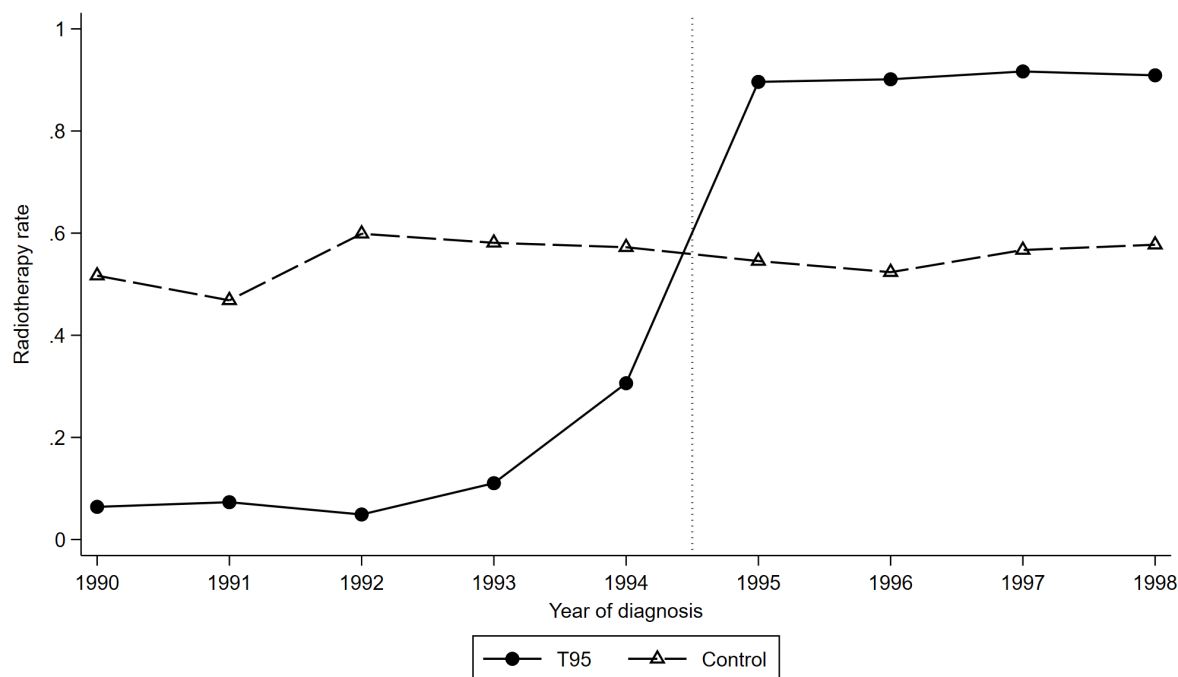
References

- Bingley, Paul, Nabanita Datta Gupta, and Peder J. Pedersen.** 2012. “Disability Programs, Health, and Retirement in Denmark since 1960.” In *Social Security Programs and Retirement around the World: Historical Trends in Mortality and Health, Employment, and Disability Insurance Participation and Reforms.*, ed. David A. Wise, 217–249. University of Chicago Press. chapter 5.
- Heckman, James.** 1974. “Shadow Prices, Market Wages, and Labor Supply.” *Econometrica*, 42(4): 679–694.
- Pedersen, Peder J., and Mona Larsen.** 2008. “Pathways to Early Retirement in Denmark, 1984-2000.” *International Journal of Manpower*, 29(5): 384–409.
- Schwiebert, Jörg.** 2015. “Estimation and Interpretation of a Heckman Selection Model with Endogenous Covariates.” *Empirical Economics*, 49(2): 675–703.

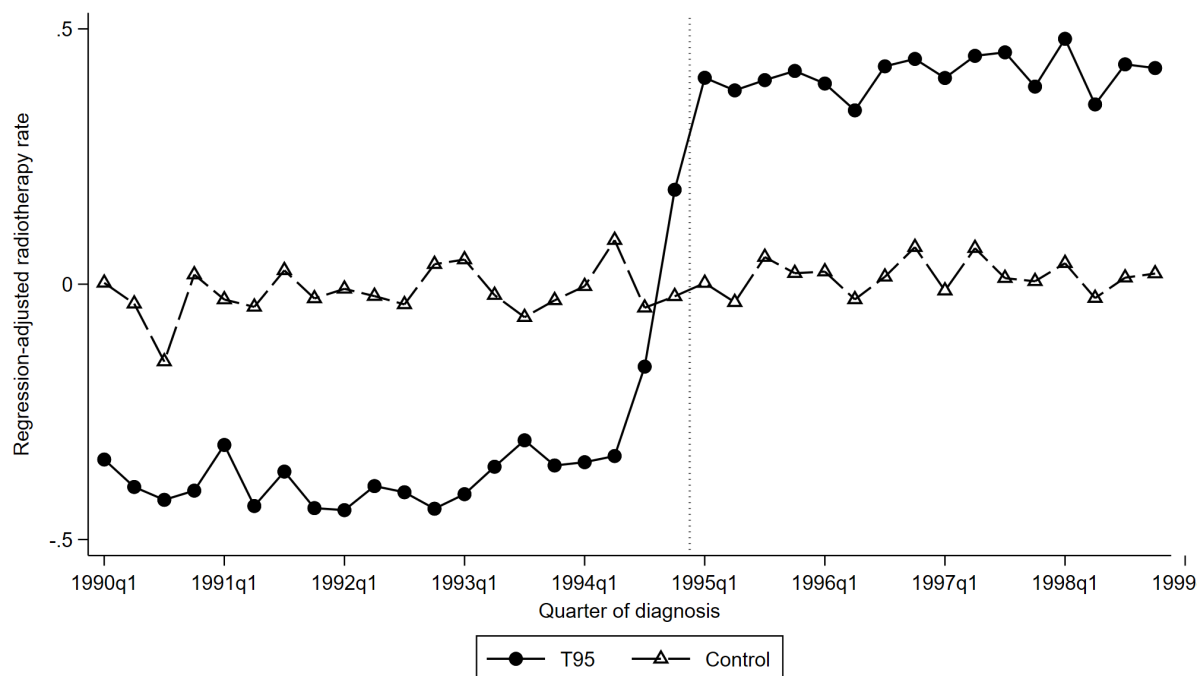
Definitions	Trial arm	Adjuvant treatment	Start	End
Age eligibility: < 75 years <u>Low risk:</u> Tumor $\leq$ 5cm and positive nodes and grade I (if premenopausal) <u>High risk:</u> Tumor > 5 cm or Positive nodes or (Premenopausal and ductal grade II-III) <u>Radiation therapy:</u> • Lumpectomy • Carcinoma not removed microradically • Additional eligibility criteria: – Age $\leq$ 45 years and $\geq$ 4 positive nodes (until Jan. 95) – Premenopausal, positive nodes or tumor > 5 cm (from Jan. 95)	Low risk A High risk: • Receptor status positive, 70-74 years	None		
	B High risk: • Premenopausal, receptor status positive, positive nodes	1 CMF	Jan. 90	Jun. 98
		2 OA	Jan. 90	Jun. 98
	C High risk: • Postmenopausal, receptor status positive/unknown	1 Tamoxifen 1 year	Jan. 90	Jan. 97
		2 Tamoxifen 2 years	Jan. 90	Jan. 97
		3 Tamoxifen $\frac{1}{2}$ year + Megace $\frac{1}{2}$ year	Jan. 90	Jan. 95
		Tamoxifen 5 years	Jan. 97	
		1 CMF	Dec. 89	Jun. 98
	D High risk: • Premenopausal, positive nodes or receptor status positive/unknown • Postmenopausal, receptor status positive, < 70 years	2 CEF	Dec. 89	Jun. 98
		3 CMF + pamidronate	Jul. 90	Jan. 96
		4 CEF + pamidronate	Jul. 90	Jan. 96

Notes: Summary of the DBCG89 randomized control trial protocol, based on [the official protocol](#) provided by the Danish Breast Cancer Cooperative Group, last accessed on December 20, 2024. “Positive nodes” indicates that the cancer spread to at least one lymph node. “Receptor status” refers to the presence of hormone receptors. “CMF” stands for the cyclophosphamide, methotrexate, and fluorouracil treatment regimen, while the “CEF” regiment substitutes epirubicin for methotrexate. Finally, OA indicates ovarian ablation (the removal of ovaries).

Appendix Figure A1: DBCG89 Randomized Control Trial Protocol

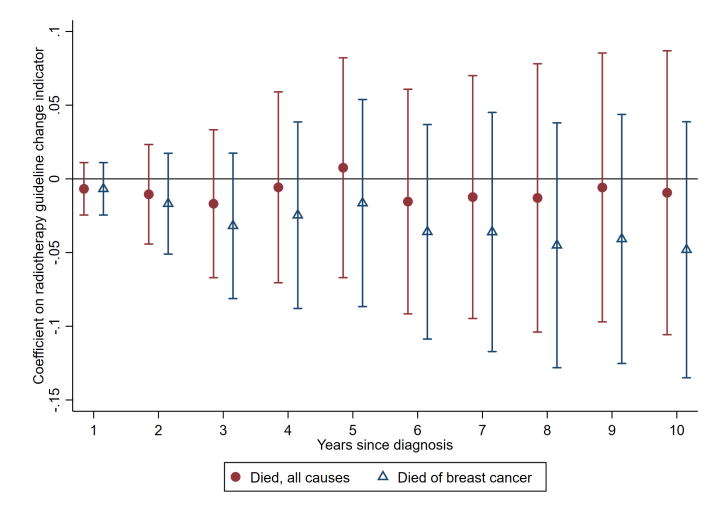


(a) Yearly Raw Data

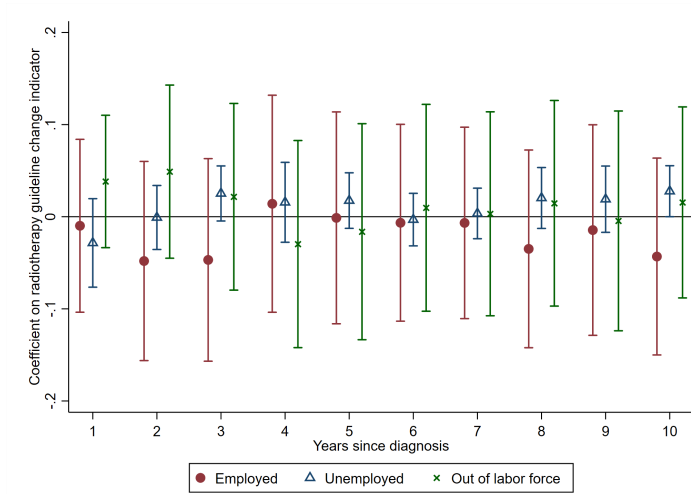


(b) Quarterly Regression-Adjusted Data

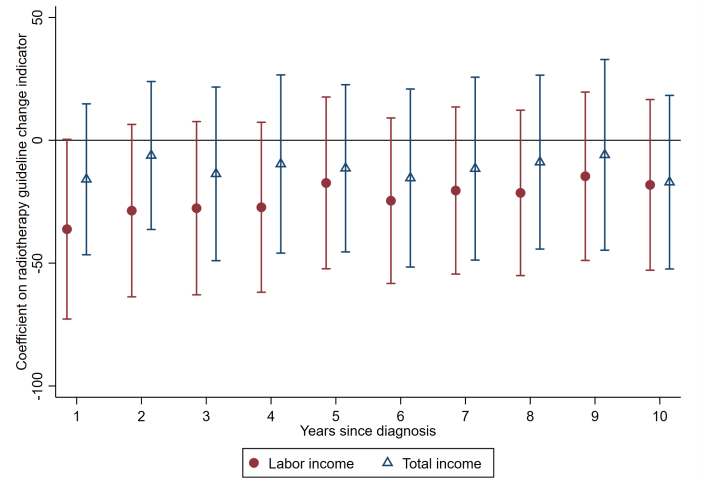
Notes: Panel (a) plots the fraction of breast cancer patients receiving radiotherapy by year of diagnosis, separately for *T95* and the comparison group. Panel (b) presents the regression-adjusted probability of receiving radiation therapy by year and quarter of diagnosis. The regression-adjusted probability of receiving radiation therapy is the residual from a regression of the indicator for receipt of radiation therapy on indicators for age at diagnosis in full years, tumor size in cm, the number of positive nodes (0, 1–3, 4+), having the tumor removed micro-radically, the type of surgery (lumpectomy, mastectomy, or lumpectomy followed by mastectomy), and the type of chemotherapy received (DBCG89 clinical trial arm). The regressions are estimated separately for *T95* and the comparison group. Each dot in Panel (b) represents the average of the residuals from these regressions for women diagnosed in the year and quarter indicated on the horizontal axis.



(a) Mortality



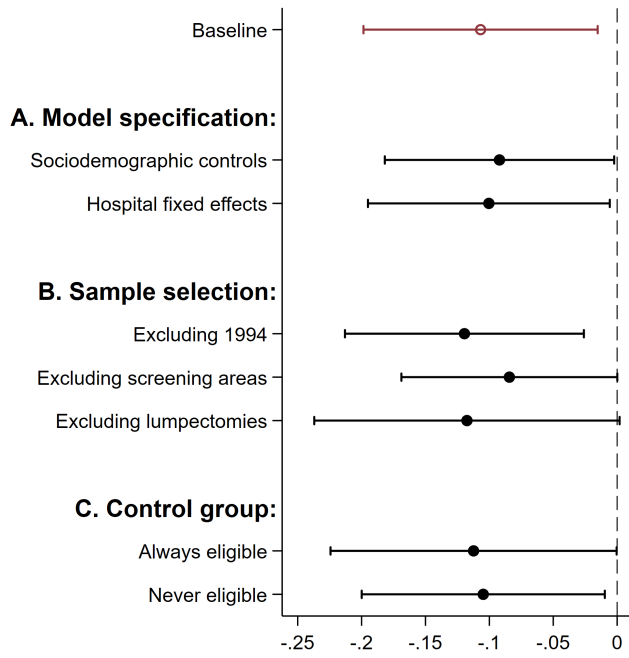
(b) Employment Status



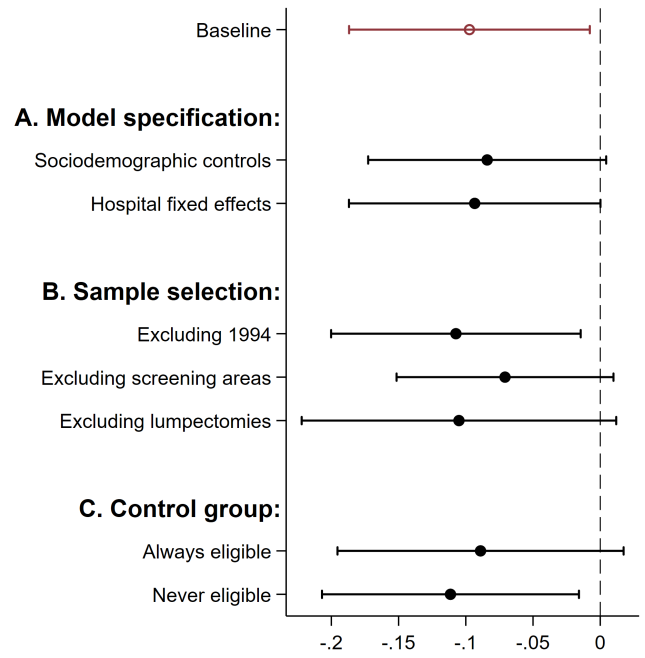
(c) Income

Notes: Each point and vertical segment represents the 2SLS estimate of Equation (1) using the full set of control variables described in the notes to Appendix Table A4 and its corresponding 95% confidence interval for the coefficient of the radiotherapy indicator. We estimate separate 2SLS regressions for each outcome measured at the time shown on the horizontal axis.

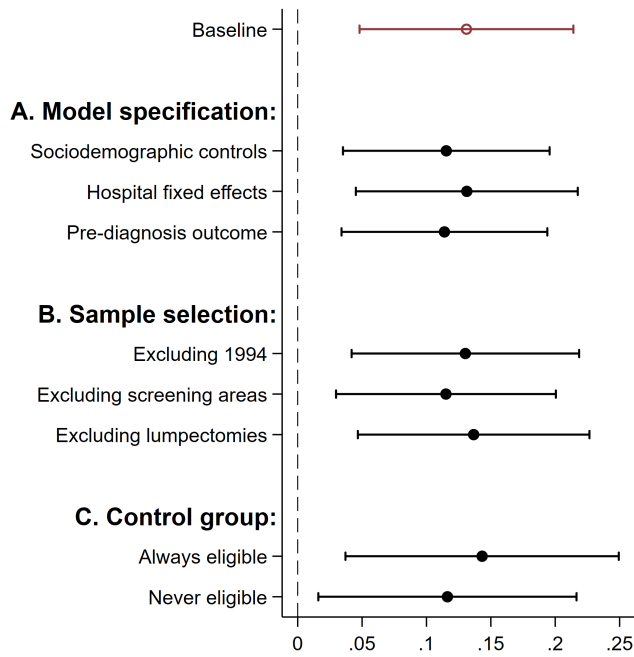
Appendix Figure A3: Placebo Effects of Radiation Therapy Guideline Change Among the Control Group



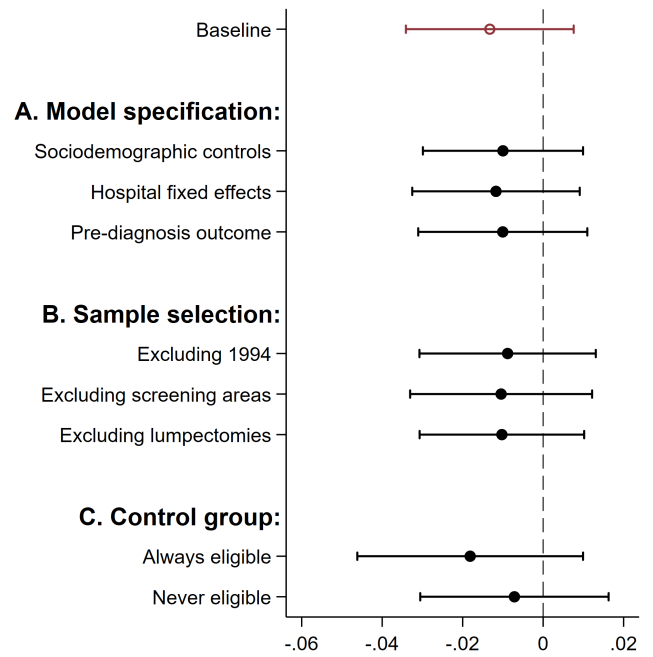
(a) Died of any cause



(b) Died of breast cancer

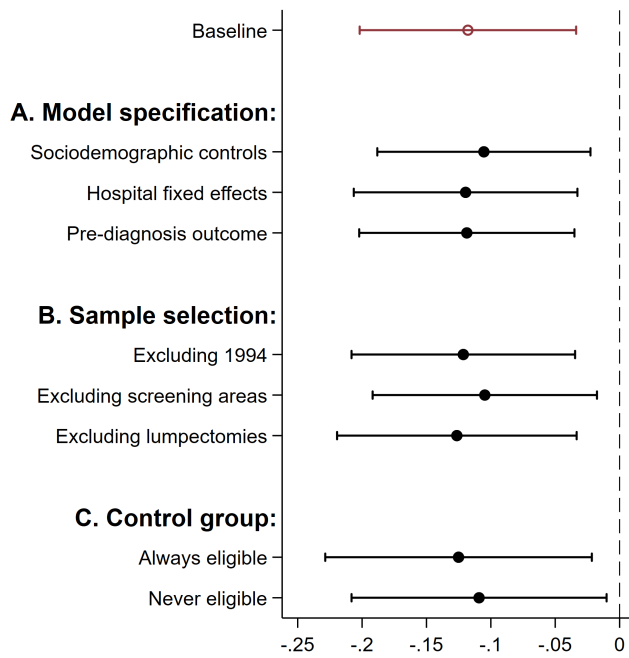


(c) Employed

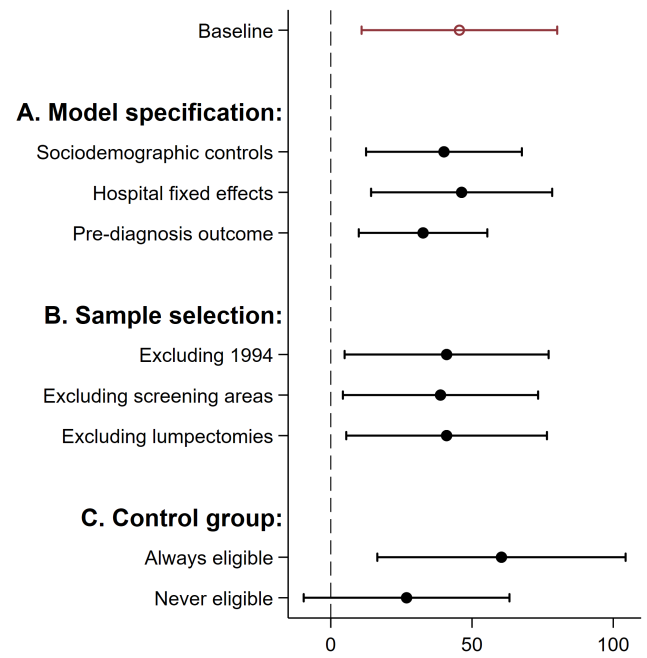


(d) Unemployed

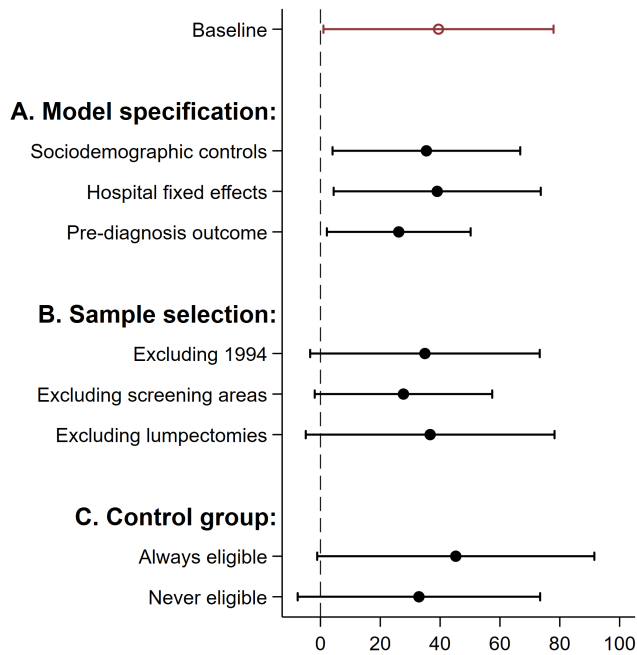
Appendix Figure A4: Robustness of Results, Average Outcomes 1–5 Years After Diagnosis



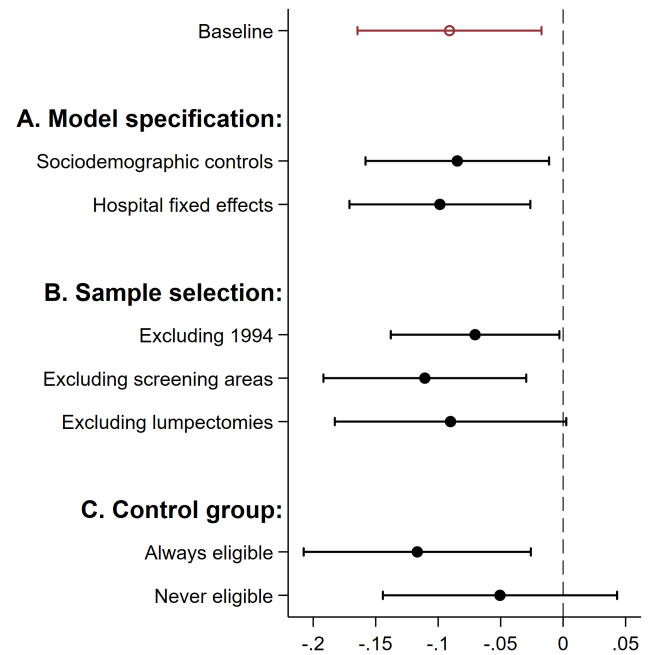
(e) Out of the labor force



(f) Labor income

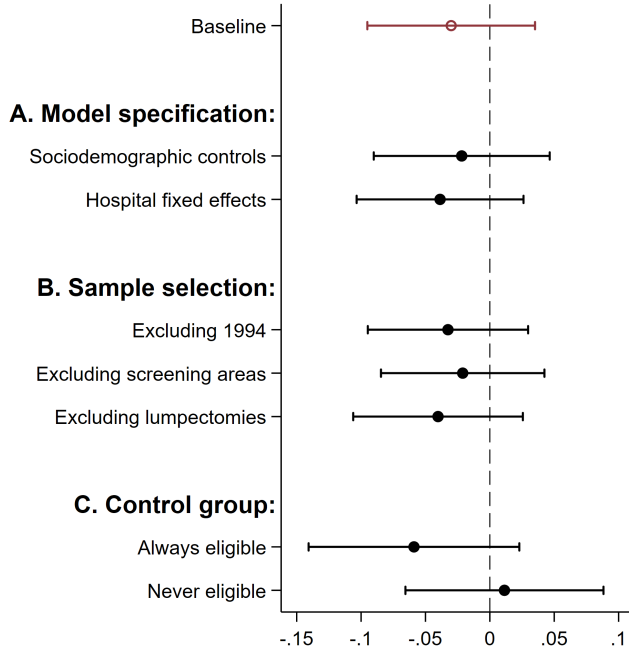


(g) Total income

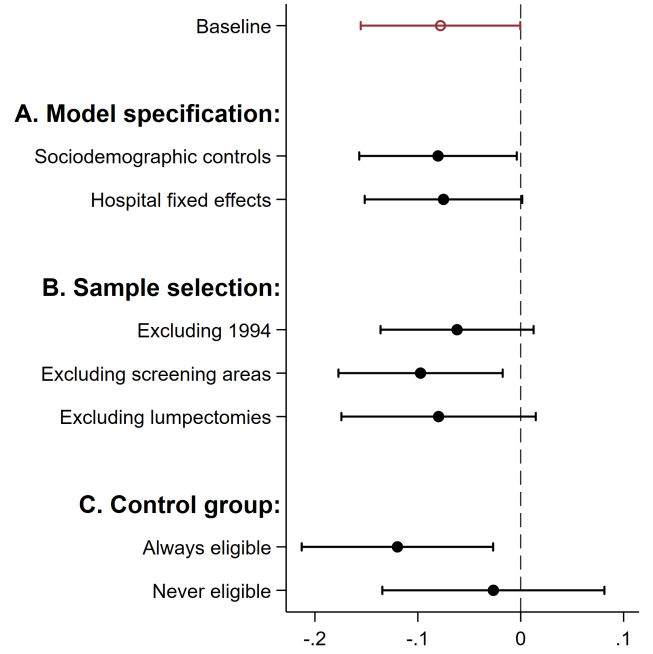


(h) Any welfare

Appendix Figure A4 (cont.): Robustness of Results, Average Outcomes 1–5 Years After Diagnosis



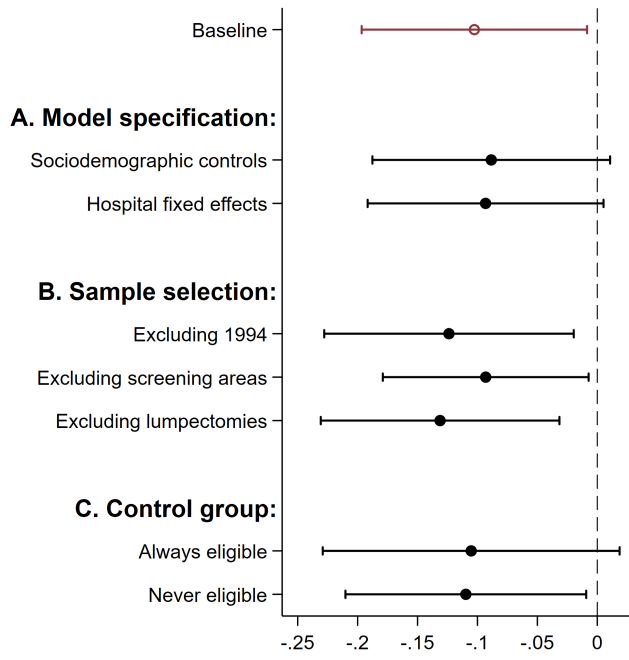
(i) Disability benefits



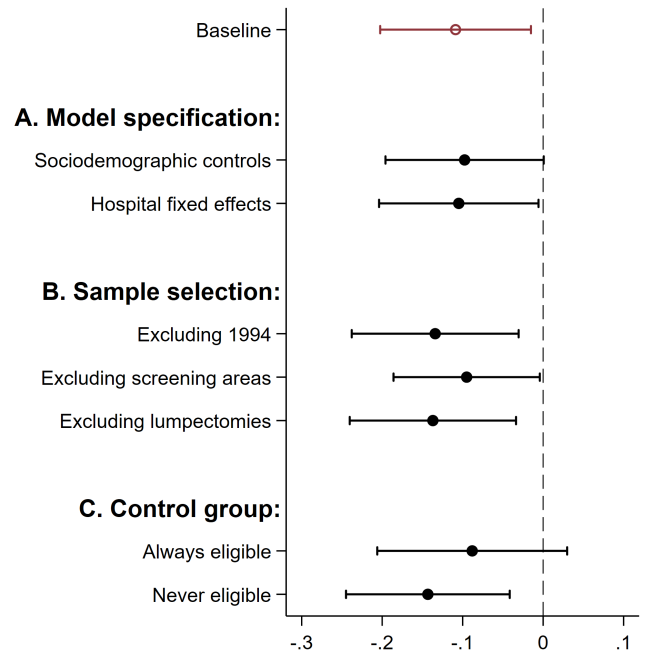
(j) Sickness benefits

Notes: Each point and line segment represent the 2SLS estimate of Equation (1) using the full set of control variables described in the notes to Appendix Table A4 and its corresponding 95% confidence interval for the coefficient of the radiotherapy indicator. We estimate separate 2SLS regressions for each outcome, averaged over the period 1–5 years after diagnosis (labor market outcomes) or cumulatively 5 years after diagnosis (mortality, use of government transfers). “Baseline” represents our baseline specification, Equation (1). “Sociodemographic controls,” “Hospital fixed effects,” and “Pre-diagnosis outcomes” indicate specifications that add to Equation (1) the demographic characteristics listed in Table 2, fixed effects for the treatment hospital, or the average of the corresponding outcome over the period 2–4 years before diagnosis, respectively. “Excluding 1994,” “Excluding screening areas” and “Excluding lumpectomies” indicate that the estimation sample does not include women diagnosed in 1994, women residing in areas with pilot universal screening programs, or women undergoing breast-conserving surgeries, respectively. Finally, “always eligible” and “never eligible” indicate that the control group only includes women who were eligible or not eligible for radiotherapy regardless of the year of diagnosis, respectively.

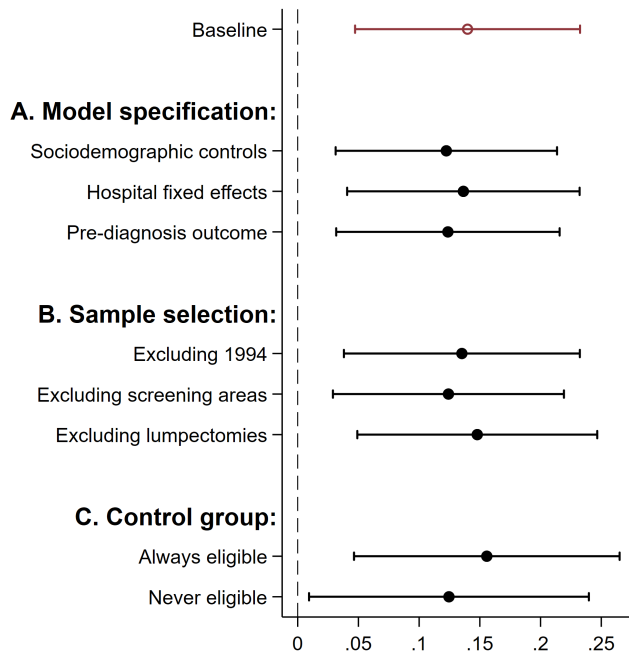
Appendix Figure A4 (cont.): Robustness of Results, Average Outcomes 1–5 Years After Diagnosis



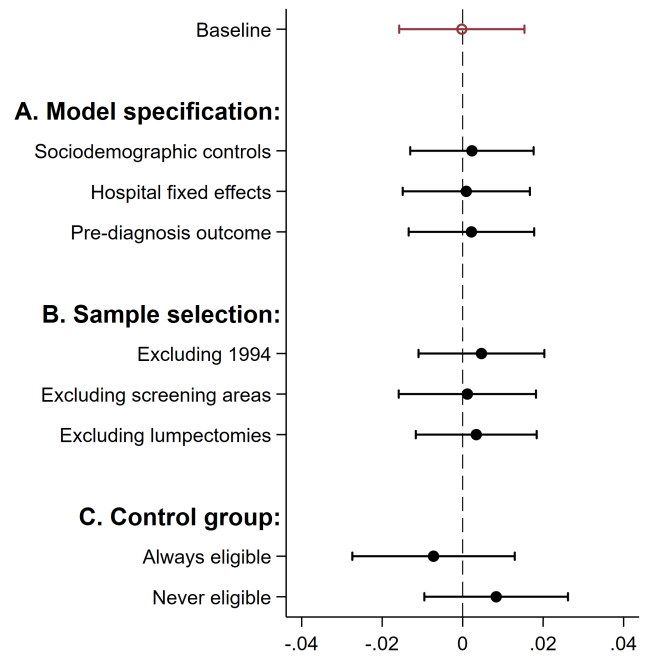
(a) Died of any cause



(b) Died of breast cancer

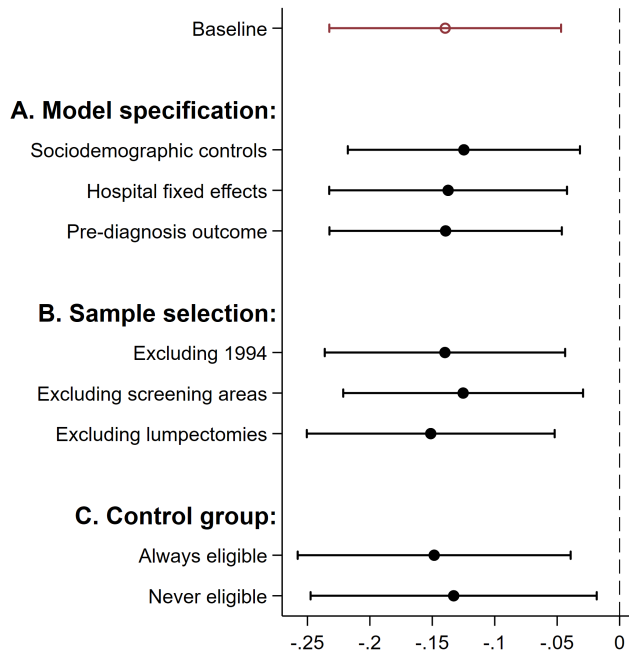


(c) Employed

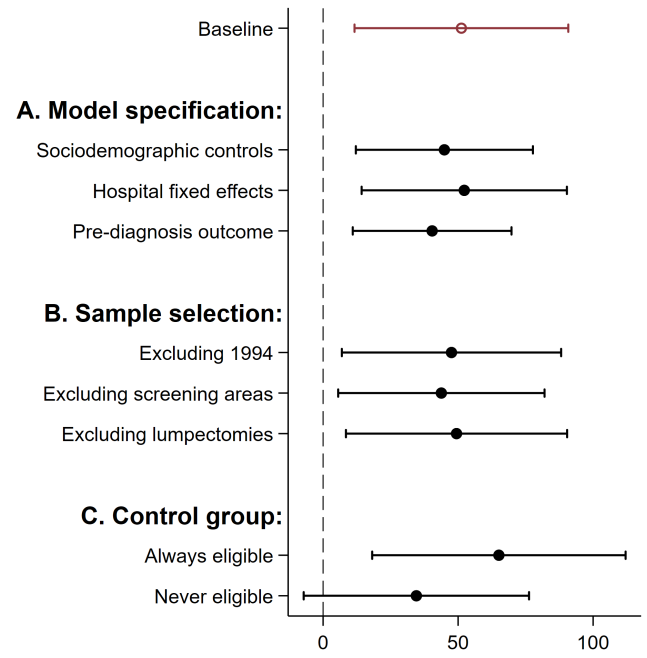


(d) Unemployed

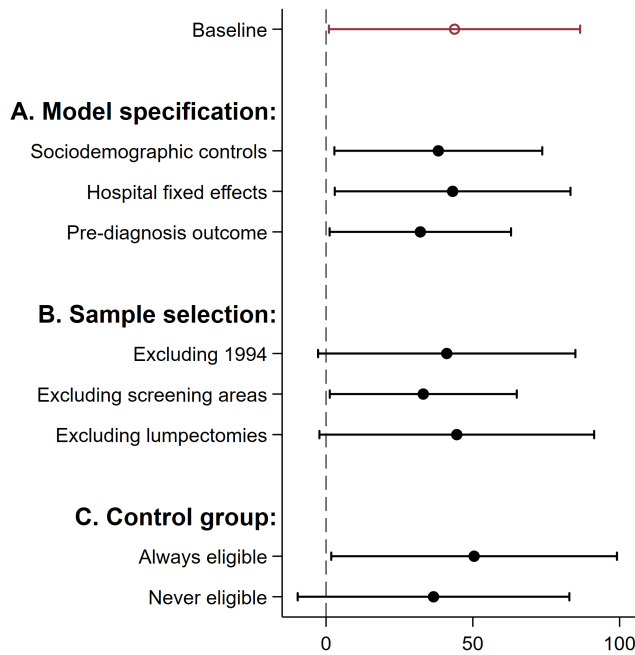
Appendix Figure A5: Robustness of Results, Average Outcomes 6–10 Years After Diagnosis



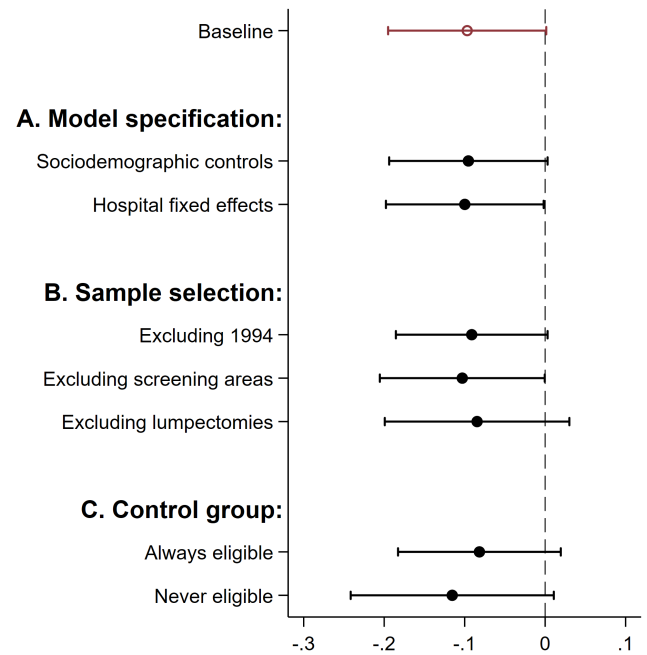
(e) Out of the labor force



(f) Labor income

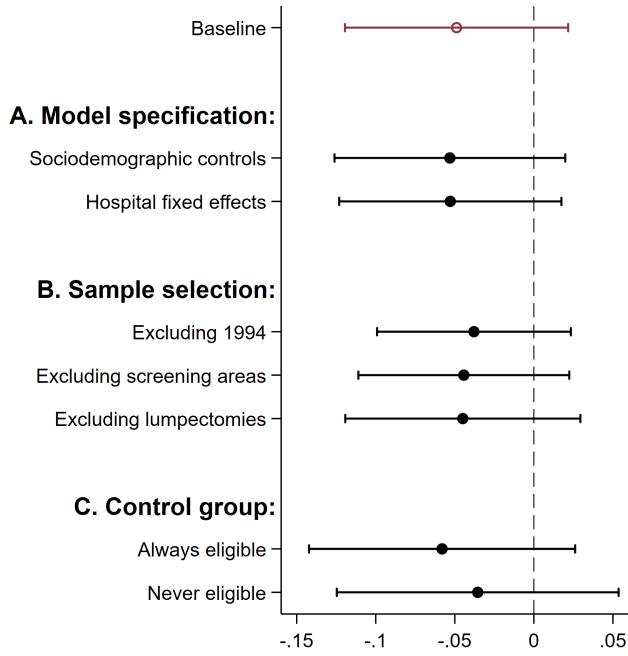


(g) Total income

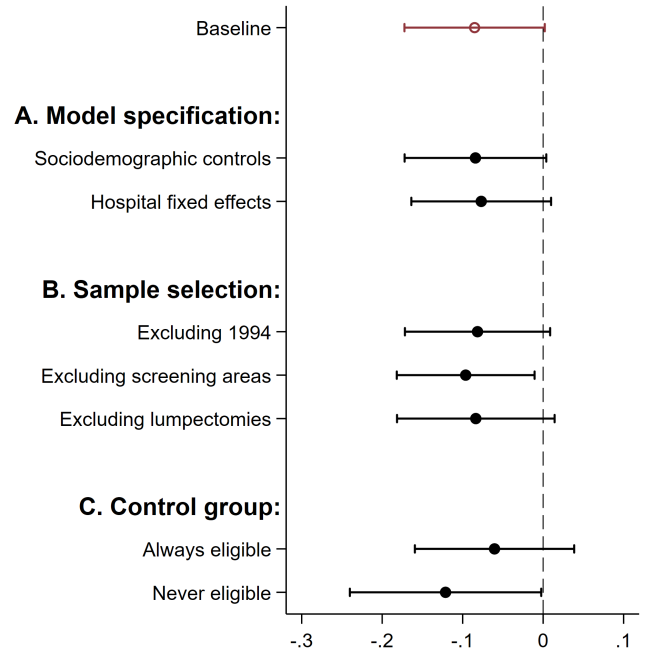


(h) Any welfare

Appendix Figure A5 (cont.): Robustness of Results, Average Outcomes 6–10 Years After Diagnosis



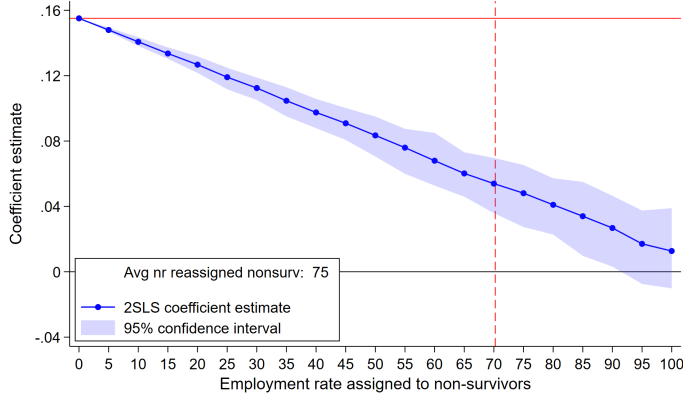
(i) Disability benefits



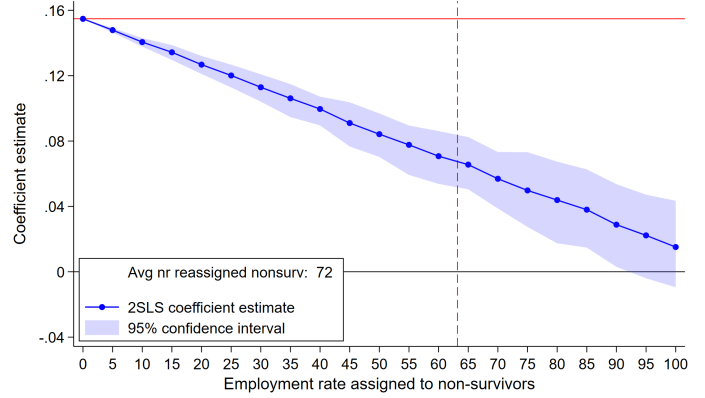
(j) Sickness benefits

Notes: Each point and line segment represent the 2SLS estimate of Equation (1) using the full set of control variables described in the notes to Appendix Table A4 and its corresponding 95% confidence interval for the coefficient of the radiotherapy indicator. We estimate separate 2SLS regressions for each outcome, averaged over the period 6–10 years after diagnosis (labor market outcomes) or cumulatively 5 years after diagnosis (mortality, use of government transfers). “Baseline” represents our baseline specification, Equation (1). “Sociodemographic controls,” “Hospital fixed effects,” and “Pre-diagnosis outcomes” indicate specifications that add to Equation (1) the demographic characteristics listed in Table 2, fixed effects for the treatment hospital, or the average of the corresponding outcome over the period 2–4 years before diagnosis, respectively. “Excluding 1994,” “Excluding screening areas” and “Excluding lumpectomies” indicate that the estimation sample does not include women diagnosed in 1994, women residing in areas with pilot universal screening programs, or women undergoing breast-conserving surgeries, respectively. Finally, “always eligible” and “never eligible” indicate that the control group only includes women who were eligible or not eligible for radiotherapy regardless of the year of diagnosis, respectively.

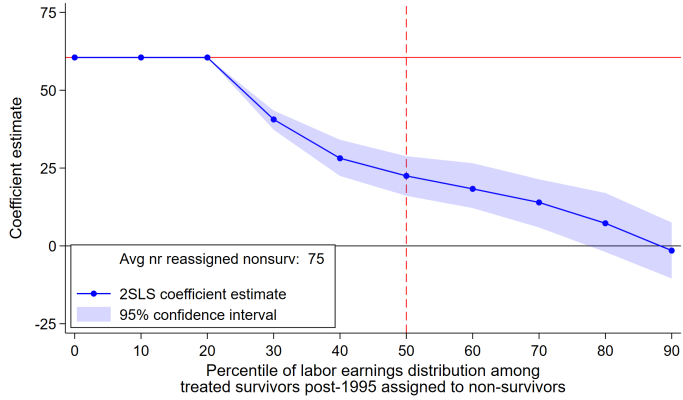
Appendix Figure A5 (cont.): Robustness of Results, Average Outcomes 6–10 Years After Diagnosis



(a) Employed 5 Years After Diagnosis



(b) Employed 10 Years After Diagnosis



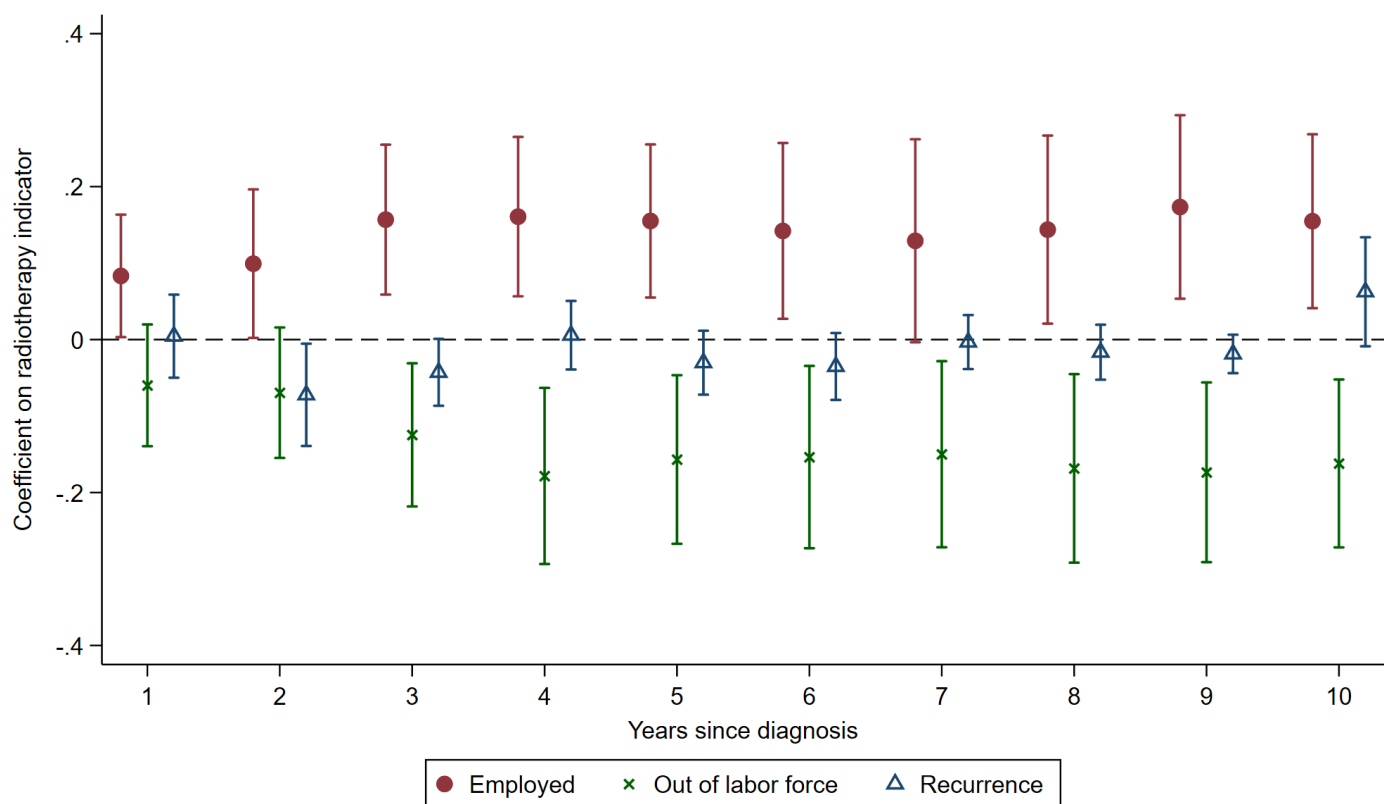
(c) Labor Earnings 5 Years After Diagnosis



(d) Labor Earnings 10 Years After Diagnosis

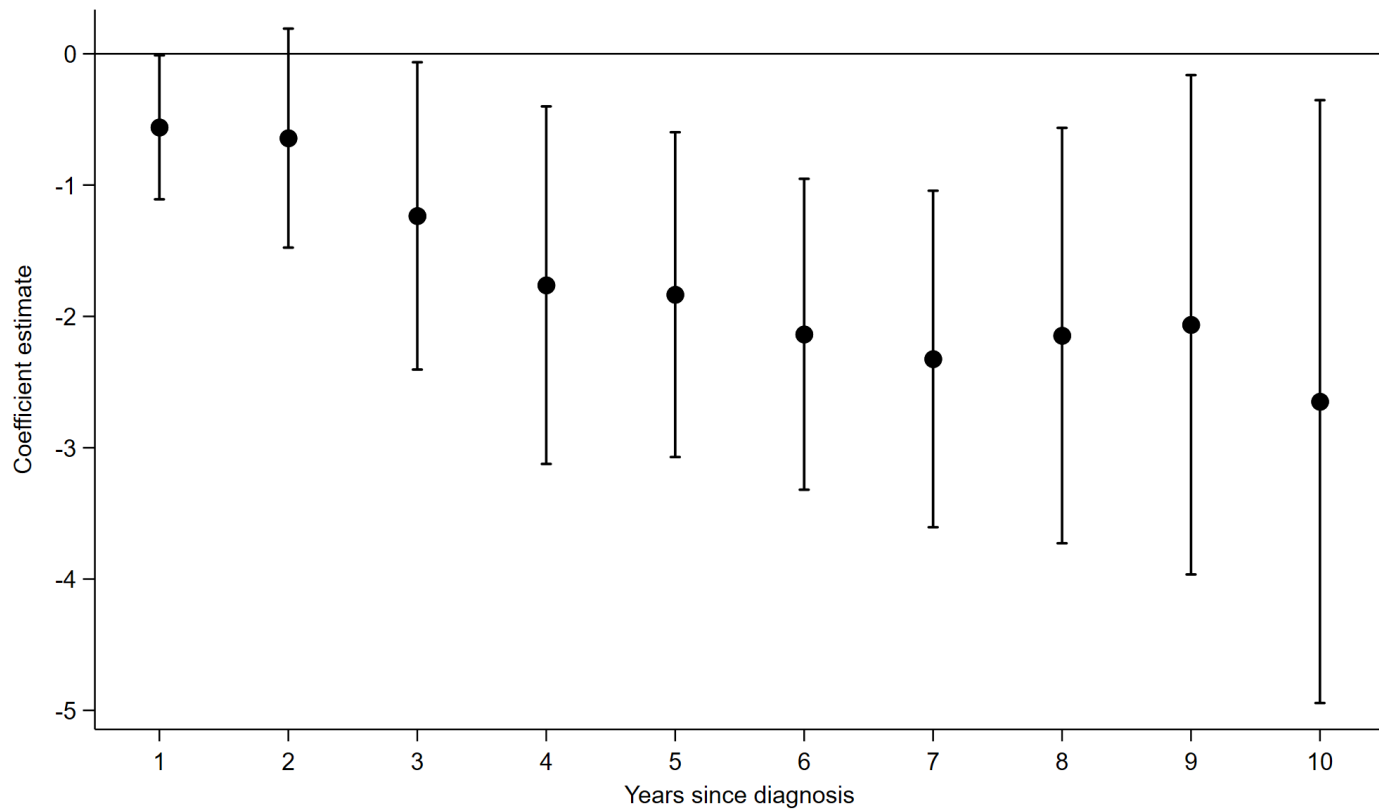
Notes: Each point represents the average of the 2SLS estimate and the corresponding empirical 95% confidence interval for the coefficient of the radiotherapy indicator from 100 replications of the baseline model, using the full set of control variables described in the notes to Appendix Table A4, after replacing the outcomes of a random sample of non-survivors among T95 in the pre-1995 period with the employment rate indicated in the horizontal axis (panels a and b) or with the percentile of labor earnings among survivors in T95 in the post-1995 period indicated in the horizontal axis (panels c and d). The number of selected non-survivors corresponds to the estimated mortality gain at that time after diagnosis. The vertical dotted line indicates the average employment rate (panels a and b) the median labor earnings (panels c and d) among survivors in T95 in the post-1995 period. The horizontal solid red line indicates the baseline 2SLS estimate.

Appendix Figure A6: The Role of Mortality in Driving the Results, Employment and Labor Earnings



Notes: Each point and vertical segment represent the 2SLS estimate of Equation (1) using the full set of control variables described in the notes to Appendix Table A4 and its corresponding 95% confidence interval for the coefficient of the radiotherapy indicator. We estimate separate 2SLS regressions for each outcome measured at the time shown on the horizontal axis.

Appendix Figure A7: Effect of Radiation Therapy on Employment, Exit from Labor Force, and Yearly Recurrence



Notes: Each point and vertical segment represent the 2SLS estimate of Equation (1) using the full set of control variables described in the notes to Appendix Table A4 and its corresponding 95% confidence interval for the coefficient of the radiotherapy indicator. We estimate separate 2SLS regressions for for the cumulative number of inpatient and outpatient hospital contacts from diagnosis until each time shown on the horizontal axis.

Appendix Figure A8: Effects of Radiation Therapy on Hospitalizations

Appendix Table A1: Descriptive Statistics for Women Diagnosed Before and After the RT Guideline Change

	Treated with RT		Not treated with RT	
	Before 1995 (1)	After 1995 (2)	Before 1995 (3)	After 1995 (4)
A. Demographic Characteristics				
Age at diagnosis	41.60 (5.86)	43.63 (5.81)	44.38 (5.14)	43.67 (5.52)
Years of education	12.89 (3.06)	13.12 (2.77)	12.52 (3.11)	13.17 (2.99)
Married?	0.68	0.66	0.73	0.72
Immigrant?	0.05	0.03	0.03	0.07
Characteristics 2-4 years pre-diagnosis				
Employed?	0.85	0.83	0.84	0.82
Unemployed?	0.07	0.05	0.06	0.06
Out of the labor force?	0.08	0.12	0.09	0.12
Labor earnings (thousands)	217.63 (136.01)	228.98 (151.23)	211.27 (132.57)	226.71 (145.60)
Gross personal income (thousands)	269.77 (113.59)	294.53 (131.47)	263.03 (116.21)	290.65 (122.73)
B. Disease Pathology				
Tumor size in mm	29.94	26.34	25.38	21.66
≤ 20mm?	0.41	0.48	0.51	0.56
21–50mm?	0.46	0.44	0.43	0.41
≥ 51mm?	0.12	0.08	0.06	0.03
Number of positive nodes	4.10	3.39	1.93	0.41
Zero?	0.40	0.24	0.36	0.86
1–3?	0.10	0.43	0.49	0.09
4+?	0.50	0.33	0.15	0.05
Carcinoma not removed micro-radically?	0.11	0.04	0.01	0.00
Had mastectomy?	0.60	0.73	0.97	0.93
Had lumpectomy?	0.39	0.23	0.01	0.02
Had lumpectomy followed by mastectomy?	0.02	0.03	0.02	0.05
C. Health Outcomes				
Died:				
5 years after diagnosis?	0.25	0.20	0.20	0.14
10 years after diagnosis?	0.39	0.32	0.33	0.22
Died of breast cancer:				
5 years after diagnosis?	0.25	0.19	0.19	0.14
10 years after diagnosis?	0.38	0.30	0.30	0.20

Notes: Means and standard deviation (in parentheses) of the characteristics indicated in the row in the sample indicated in the column. Variable names ending in a question mark are dummy variables with one being yes and zero being no, while variables with monetary values are expressed in thousands of 2015 DKK. Demographic characteristics are measured in the year of diagnosis or averaged over the period 2–4 years before diagnosis, as indicated.

Appendix Table A1 (cont.): Descriptive Statistics for Women Diagnosed Before and After the RT Guideline Change

	Treated with RT		Not treated with RT	
	Before 1995 (1)	After 1995 (2)	Before 1995 (3)	After 1995 (4)
D. Labor Market Outcomes				
Employed:				
5 years after diagnosis?	0.51	0.57	0.54	0.65
10 years after diagnosis?	0.41	0.44	0.39	0.50
Unemployed:				
5 years after diagnosis?	0.02	0.03	0.03	0.01
10 years after diagnosis?	0.02	0.01	0.03	0.01
Out of the labor force:				
5 years after diagnosis?	0.47	0.40	0.43	0.34
10 years after diagnosis?	0.57	0.55	0.58	0.49
Labor earnings:				
5 years after diagnosis?	157.34 (172.24)	190.60 (180.25)	155.56 (164.69)	203.81 (179.53)
10 years after diagnosis?	141.19 (180.49)	157.64 (192.69)	129.58 (168.72)	180.13 (192.77)
Gross personal income:				
5 years after diagnosis?	211.27 (164.72)	248.46 (184.50)	218.15 (159.21)	266.01 (168.24)
10 years after diagnosis?	182.77 (191.89)	210.26 (188.00)	188.07 (173.60)	246.71 (188.97)
Any government transfer:				
1–5 years after diagnosis?	0.26	0.30	0.29	0.29
6–10 years after diagnosis?	0.18	0.23	0.25	0.25
Sickness benefits:				
1–5 years after diagnosis?	0.10	0.16	0.14	0.17
6–10 years after diagnosis?	0.07	0.09	0.10	0.11
Disability benefits:				
1–5 years after diagnosis?	0.14	0.14	0.12	0.12
6–10 years after diagnosis?	0.10	0.14	0.14	0.14
Number of Observations	524	935	983	381

Notes: Means and standard deviation (in parentheses) of the characteristics indicated in the row in the sample indicated in the column. Variable names ending in a question mark are dummy variables with one being yes and zero being no, while variables with monetary values are expressed in thousands of 2015 DKK. Demographic characteristics are measured in the year of diagnosis or averaged over the period 2–4 years before diagnosis, as indicated.

Appendix Table A2: Effects of Adjuvant Radiation Therapy on Mortality and Labor Market Outcomes, OLS Estimates

	Years since diagnosis									
	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 (7)	8 (8)	9 (9)	10 (10)
Died?	0.009 (0.008)	0.007 (0.014)	-0.018 (0.017)	-0.028 (0.022)	-0.056** (0.024)	-0.057** (0.024)	-0.061** (0.024)	-0.066*** (0.022)	-0.071*** (0.023)	-0.068*** (0.022)
Mean outcome	0.005	0.037	0.091	0.142	0.182	0.210	0.235	0.262	0.278	0.298
Died of breast cancer?	0.009 (0.008)	0.009 (0.014)	-0.011 (0.017)	-0.022 (0.022)	-0.049** (0.024)	-0.049* (0.025)	-0.055** (0.025)	-0.062*** (0.023)	-0.068*** (0.023)	-0.069*** (0.023)
Mean outcome	0.005	0.033	0.084	0.132	0.172	0.196	0.220	0.243	0.258	0.276
Employed?	0.004 (0.027)	0.015 (0.029)	0.051* (0.028)	0.050 (0.031)	0.033 (0.026)	0.029 (0.031)	0.025 (0.032)	0.047 (0.028)	0.052* (0.028)	0.046 (0.029)
Mean outcome	0.729	0.683	0.625	0.590	0.569	0.540	0.521	0.496	0.456	0.424
Unemployed?	0.008 (0.012)	-0.010 (0.012)	-0.002 (0.012)	0.015 (0.010)	0.009 (0.008)	0.020** (0.009)	0.025** (0.012)	0.014 (0.009)	-0.001 (0.006)	0.010 (0.007)
Mean outcome	0.054	0.047	0.040	0.032	0.025	0.028	0.017	0.022	0.025	0.022
Out of labor force?	-0.031 (0.020)	-0.005 (0.026)	-0.049* (0.027)	-0.065** (0.031)	-0.042* (0.025)	-0.049* (0.029)	-0.051* (0.029)	-0.060** (0.027)	-0.051* (0.027)	-0.056** (0.027)
Mean outcome	0.152	0.271	0.336	0.378	0.406	0.433	0.463	0.482	0.519	0.554
Annual labor income	9.961 (9.617)	3.717 (9.983)	11.060 (11.045)	16.142 (9.914)	15.272 (10.659)	13.485 (11.034)	13.581 (11.935)	11.997 (11.961)	16.878 (10.981)	19.892* (10.973)
Mean outcome	207.445	199.525	188.281	176.824	168.533	162.338	158.934	154.349	150.507	143.179
Annual gross income	6.488 (8.632)	6.502 (9.306)	8.990 (10.029)	19.274* (10.951)	18.227 (11.069)	19.770 (11.956)	17.100 (12.226)	16.422 (11.314)	15.396 (12.685)	17.900 (11.806)
Mean outcome	275.107	263.301	252.104	237.931	230.073	220.608	217.998	212.011	211.982	203.078

Notes: OLS estimates based on Equation (1), estimated in the full analysis sample ($N = 2,823$). Each cell presents the estimate of the coefficient on the indicator for radiotherapy from a separate regression for the outcome indicated in the row measured at the time indicated in the column. All specifications include all possible interactions among the following indicators: having mastectomy, being younger than 45 years of age at diagnosis, the number of positive nodes (0, 1-3, 4+), having a tumor larger than 50mm, and having the tumor removed micro-radically; separate indicators for age at diagnosis in full years, tumor size in cm, the number of positive nodes (0, 1-3, 4+), having the tumor removed micro-radically, the type of surgery (lumpectomy, mastectomy, or lumpectomy followed by mastectomy), and the type of chemotherapy received (DBCG89 clinical trial arm); and year-of-diagnosis fixed effects. Variable names ending in a question mark are dummy variables with one being yes and zero being no, while variables with monetary values are expressed in thousands of 2015 DKK. The reported mean of the outcome is calculated among women who do not receive radiotherapy. Standard errors are clustered at the hospital level. Significance levels: * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$.

Appendix Table A3: Effects of Adjuvant Radiation Therapy on Government Transfers, OLS Estimates

	Years since diagnosis	
	1–5 (1)	6–10 (2)
Any government transfer?	−0.032 (0.023)	−0.031 (0.026)
Mean outcome	0.411	0.328
Sickness benefits?	−0.031 (0.026)	−0.046* (0.025)
Mean outcome	0.285	0.230
Disability pension?	−0.007 (0.016)	−0.001 (0.020)
Mean outcome	0.125	0.128
Number of weeks with any government transfer	0.191 (3.495)	1.135 (4.383)
Mean outcome	28.181	31.187
Number of weeks on sickness benefits	2.553 (3.666)	4.558 (5.244)
Mean outcome	21.961	31.596
Number of weeks on disability pension	−0.031 (0.026)	−0.046* (0.025)
Mean outcome	0.285	0.230

Notes: OLS estimates based on Equation (1), estimated in the full analysis sample ($N = 2,823$). Each cell presents the estimate of the coefficient on the indicator for radiotherapy from a separate regression for the outcome indicated in the row measured at the time indicated in the column. All specifications include all possible interactions among the following indicators: having mastectomy, being younger than 45 years of age at diagnosis, the number of positive nodes (0, 1–3, 4+), having a tumor larger than 50mm, and having the tumor removed micro-radically; separate indicators for age at diagnosis in full years, tumor size in cm, the number of positive nodes (0, 1–3, 4+), having the tumor removed micro-radically, the type of surgery (lumpectomy, mastectomy, or lumpectomy followed by mastectomy), and the type of chemotherapy received (DBCG89 clinical trial arm); and year-of-diagnosis fixed effects. Variable names ending in a question mark are dummy variables with one being yes and zero being no, while variables with monetary values are expressed in thousands of 2015 DKK. The reported mean of the outcome is calculated among women who do not receive radiotherapy. Standard errors are clustered at the hospital level. Significance levels: * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$.

Appendix Table A4: Effects of Adjuvant Radiation Therapy on Mortality and Labor Market Outcomes, 2SLS Estimates

	Years since diagnosis									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	1	2	3	4	5	6	7	8	9	10
Died?	0.002 (0.011)	0.001 (0.020)	-0.046 (0.035)	-0.054 (0.042)	-0.107** (0.046)	-0.097** (0.048)	-0.098** (0.049)	-0.108** (0.046)	-0.102** (0.050)	-0.103** (0.047)
Mean outcome	0.005	0.037	0.091	0.142	0.182	0.210	0.235	0.262	0.278	0.298
Died of breast cancer?	0.002 (0.011)	-0.002 (0.019)	-0.039 (0.035)	-0.049 (0.041)	-0.097** (0.045)	-0.087* (0.047)	-0.095** (0.048)	-0.109** (0.044)	-0.104** (0.049)	-0.109** (0.047)
Mean outcome	0.005	0.033	0.084	0.132	0.172	0.196	0.220	0.243	0.258	0.276
Employed?	0.086** (0.039)	0.099** (0.049)	0.157*** (0.049)	0.161*** (0.052)	0.155*** (0.050)	0.142** (0.058)	0.129* (0.067)	0.144** (0.062)	0.173*** (0.060)	0.155*** (0.057)
Mean outcome	0.796	0.683	0.625	0.590	0.569	0.540	0.521	0.496	0.456	0.424
Unemployed?	-0.018 (0.022)	-0.030 (0.019)	-0.032** (0.016)	0.018 (0.015)	0.002 (0.017)	0.012 (0.014)	0.021* (0.012)	0.025* (0.013)	0.000 (0.011)	0.007 (0.013)
Mean outcome	0.052	0.047	0.040	0.032	0.025	0.028	0.017	0.022	0.025	0.022
Out of labor force?	-0.068* (0.037)	-0.069 (0.043)	-0.125*** (0.047)	-0.178*** (0.058)	-0.157*** (0.055)	-0.154** (0.060)	-0.150** (0.061)	-0.168*** (0.062)	-0.174*** (0.059)	-0.162*** (0.055)
Mean outcome	0.152	0.271	0.336	0.378	0.406	0.433	0.463	0.482	0.519	0.554
Annual labor income	32.328* (18.103)	25.864 (16.875)	50.832*** (18.949)	53.255*** (18.662)	61.506** (23.274)	54.875** (22.859)	57.395** (23.368)	52.117** (25.008)	54.663** (25.263)	65.107** (24.749)
Mean outcome	207.445	199.525	188.281	176.824	168.533	162.338	158.934	154.349	150.507	143.179
Annual gross income	23.458 (19.667)	18.745 (18.696)	37.963* (20.996)	51.629** (22.192)	62.744** (24.981)	59.074** (27.445)	41.302 (26.050)	51.139** (24.718)	39.289 (29.628)	46.874* (27.154)
Mean outcome	275.107	263.301	252.104	237.931	230.073	220.608	217.998	212.011	211.982	203.078

Notes: 2SLS estimates based on Equation (1), estimated in the full analysis sample ($N = 2,823$). Each cell presents the estimate of the coefficient on the indicator for radiotherapy from a separate regression for the outcome indicated in the row measured at the time indicated in the column. All specifications include all possible interactions among the following indicators: having mastectomy, being younger than 45 years of age at diagnosis, the number of positive nodes (0, 1–3, 4+), having a tumor larger than 50mm, and having the tumor removed micro-radically; separate indicators for age at diagnosis in full years, tumor size in cm, the number of positive nodes (0, 1–3, 4+), having the tumor removed micro-radically, the type of surgery (lumpectomy, mastectomy, or lumpectomy followed by mastectomy), and the type of chemotherapy received (DBCG89 clinical trial arm); and year-of-diagnosis fixed effects. The instrument is the interaction between an indicator for the woman belonging to the T95 group and an indicator for being diagnosed in or after 1995. Variable names ending in a question mark are dummy variables with one being yes and zero being no, while variables with monetary values are expressed in thousands of 2015 DKK. The reported mean of the outcome is calculated among women who do not receive radiotherapy. Standard errors are clustered at the hospital level. Significance levels: * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$.

Appendix Table A5: Effects of the 1995 Guideline Change on Mortality and Labor Market Outcomes, Reduced-Form Estimates

	Years since diagnosis									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	1	2	3	4	5	6	7	8	9	10
Died?	0.002 (0.008)	0.000 (0.015)	-0.034 (0.027)	-0.041 (0.031)	-0.080** (0.035)	-0.073** (0.037)	-0.074** (0.037)	-0.081** (0.035)	-0.077** (0.038)	-0.077** (0.036)
Mean outcome	0.005	0.037	0.091	0.142	0.182	0.210	0.235	0.262	0.278	0.298
Died of breast cancer?	0.002 (0.008)	-0.001 (0.015)	-0.029 (0.027)	-0.037 (0.031)	-0.073** (0.034)	-0.065* (0.036)	-0.072** (0.036)	-0.082** (0.034)	-0.078** (0.038)	-0.082** (0.036)
Mean outcome	0.005	0.033	0.084	0.132	0.172	0.196	0.220	0.243	0.258	0.276
Employed?	0.063** (0.030)	0.075** (0.037)	0.118*** (0.037)	0.121*** (0.039)	0.117*** (0.038)	0.107** (0.043)	0.097* (0.050)	0.108** (0.046)	0.131*** (0.046)	0.117*** (0.043)
Mean outcome	0.729	0.683	0.625	0.590	0.569	0.540	0.521	0.496	0.456	0.424
Unemployed?	-0.018 (0.016)	-0.022 (0.015)	-0.024** (0.012)	0.013 (0.012)	0.001 (0.013)	0.009 (0.010)	0.016* (0.009)	0.019** (0.009)	0.000 (0.008)	0.005 (0.010)
Mean outcome	0.054	0.047	0.040	0.032	0.025	0.028	0.017	0.022	0.025	0.022
Out of labor force?	-0.045 (0.030)	-0.052 (0.032)	-0.094*** (0.035)	-0.134*** (0.043)	-0.118*** (0.042)	-0.116** (0.045)	-0.113** (0.046)	-0.127*** (0.046)	-0.131*** (0.044)	-0.122*** (0.041)
Mean outcome	0.152	0.271	0.336	0.378	0.406	0.433	0.463	0.482	0.519	0.554
Annual labor income	24.334* (13.603)	19.469 (12.681)	38.263*** (14.260)	40.086*** (13.986)	46.298*** (17.515)	41.306** (17.262)	43.203** (17.646)	39.230** (18.861)	41.146** (19.037)	49.008*** (18.729)
Mean outcome	207.445	199.525	188.281	176.824	168.533	162.338	158.934	154.349	150.507	143.179
Annual gross income	17.657 (14.768)	14.110 (14.074)	28.576* (15.820)	38.863** (16.763)	47.230** (18.889)	44.467** (20.782)	31.090 (19.730)	38.494** (18.718)	29.574 (22.419)	35.284* (20.536)
Mean outcome	275.107	263.301	252.104	237.931	230.073	220.608	217.998	212.011	211.982	203.078

Notes: OLS estimates of the reduced-form in Equation (3), estimated in the full analysis sample ($N = 2,823$). Each cell presents the estimate of the coefficient on the instrument ($T95_{it}Post95_t$) from a separate regression for the outcome indicated in the row measured at the time indicated in the column. All specifications include all possible interactions among the following indicators: having mastectomy, being younger than 45 years of age at diagnosis, the number of positive nodes (0, 1-3, 4+), having a tumor larger than 50mm, and having the tumor removed micro-radically; separate indicators for age at diagnosis in full years, tumor size in cm, the number of positive nodes (0, 1-3, 4+), having the tumor removed micro-radically, the type of surgery (lumpectomy, mastectomy, or lumpectomy followed by mastectomy), and the type of chemotherapy received (DBCG89 clinical trial arm); and year-of-diagnosis fixed effects. The instrument is the interaction between an indicator for the woman belonging to the T95 group and an indicator for being diagnosed in or after 1995. Variable names ending in a question mark are dummy variables with one being yes and zero being no, while variables with monetary values are expressed in thousands of 2015 DKK. The reported mean of the outcome is calculated among the control group (always and never eligible women) diagnosed in the period 1990-1994, before the change in guidelines. Standard errors are clustered at the hospital level. Significance levels: * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$.

Appendix Table A6: Effects of the 1995 Guideline Change on Government Transfers, Reduced-Form Estimates

	Years since diagnosis	
	1–5 (1)	6–10 (2)
Any government transfer?	−0.068** (0.028)	−0.073** (0.037)
Mean outcome	0.411	0.328
Sickness benefits?	−0.059** (0.029)	−0.064* (0.033)
Mean outcome	0.285	0.230
Disability pension?	−0.023 (0.025)	−0.037 (0.026)
Mean outcome	0.125	0.128
Number of weeks with any government transfer	−3.641 (4.810)	−6.944 (5.938)
Mean outcome	28.181	31.187
Number of weeks on sickness benefits	−2.607 (1.901)	−2.596* (1.525)
Mean outcome	8.443	9.558
Number of weeks on disability pension	−2.131 (4.653)	−4.181 (6.044)
Mean outcome	21.961	31.596

Notes: OLS estimates of the reduced-form in Equation (3), estimated in the full analysis sample ($N = 2,823$). Each cell presents the estimate of the coefficient on the instrument ($T95_i Post95_t$) from a separate regression for the outcome indicated in the row measured at the time indicated in the column. All specifications include all possible interactions among the following indicators: having mastectomy, being younger than 45 years of age at diagnosis, the number of positive nodes (0, 1–3, 4+), having a tumor larger than 50mm, and having the tumor removed micro-radically; separate indicators for age at diagnosis in full years, tumor size in cm, the number of positive nodes (0, 1–3, 4+), having the tumor removed micro-radically, the type of surgery (lumpectomy, mastectomy, or lumpectomy followed by mastectomy), and the type of chemotherapy received (DBCG89 clinical trial arm); and year-of-diagnosis fixed effects. The instrument is the interaction between an indicator for the woman belonging to the T95 group and an indicator for being diagnosed in or after 1995. Variable names ending in a question mark are dummy variables with one being yes and zero being no, while variables with monetary values are expressed in thousands of 2015 DKK. The reported mean of the outcome is calculated among the control group (always and never eligible women) diagnosed in the period 1990–1994, before the change in guidelines. Standard errors are clustered at the hospital level. Significance levels: * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$.

Appendix Table A7: Descriptive Statistics, T95 versus Comparison Patients Diagnosed During 1990–1994

	T95 (1)	Control group (2)	<i>p</i> -value (3)
A. Disease Pathology			
Tumor size in mm	28.86 (19.35)	25.30 (16.62)	0.000
$\leq 20\text{mm?}$	0.45	0.50	0.034
21–50mm?	0.45	0.44	0.810
$\geq 51\text{mm?}$	0.11	0.06	0.001
Number of positive nodes	2.94 (3.22)	2.46 (4.12)	0.010
Zero?	0.02	0.67	0.000
1–3?	0.76	0.00	0.000
4+?	0.22	0.33	0.000
Carcinoma not removed micro-radically?	0.00	0.09	0.000
Had mastectomy?	0.98	0.72	0.000
Had lumpectomy?	0.00	0.26	0.000
Had lumpectomy followed by mastectomy?	0.02	0.02	0.587
B. Demographic Characteristics			
Age at diagnosis	45.04 (5.24)	41.99 (5.44)	0.000
Years of education	12.49 (3.15)	12.79 (3.04)	0.062
Married?	0.71	0.71	0.910
Immigrant?	0.03	0.04	0.422
Characteristics 2–4 years pre-diagnosis			
Employed?	0.83	0.86	0.063
Unemployed?	0.07	0.05	0.046
Out of the labor force?	0.10	0.08	0.375
Labor earnings	208.92 (133.18)	217.47 (134.24)	0.216
Gross personal income	262.15 (115.98)	268.20 (114.72)	0.311
Number of Observations	703	804	

Notes: Columns 1 and 2 present the mean and standard deviation (in parentheses) of the characteristic indicated in the row in the sample indicated in the column among women diagnosed between 1990–1994. Variable names ending in a question mark are dummy variables with one being yes and zero being no, while variables with monetary values are expressed in thousands of 2015 DKK. Demographic characteristics are measured in the year of diagnosis or averaged over the period 2–4 years before diagnosis, as indicated. Column 3 presents *p*-values for the test of equality of the means in Columns 1 and 2.

Appendix Table A8: Effects of Radiation Therapy on Predetermined Patient Characteristics

	(1)
Years of education	0.167 (0.286)
Mean outcome	12.698
Married?	−0.049 (0.044)
Mean outcome	0.729
Immigrant?	−0.010 (0.023)
Mean outcome	0.038
Observations	2,823

Notes: 2SLS estimates based on Equation (1), estimated in the full analysis sample ($N = 2,823$). Each cell presents the estimate of the coefficient on the indicator for radiotherapy from a separate regression for the outcome indicated in the row measured in the year of diagnosis. All specifications include all possible interactions among the following indicators: having mastectomy, being younger than 45 years of age at diagnosis, the number of positive nodes (0, 1–3, 4+), having a tumor larger than 50mm, and having the tumor removed micro-radically; separate indicators for age at diagnosis in full years, tumor size in cm, the number of positive nodes (0, 1–3, 4+), having the tumor removed micro-radically, the type of surgery (lumpectomy, mastectomy, or lumpectomy followed by mastectomy), and the type of chemotherapy received (DBCG89 clinical trial arm); and year-of-diagnosis fixed effects. The instrument is the interaction between an indicator for the woman belonging to the $T95$ group and an indicator for being diagnosed in or after 1995. Variable names ending in a question mark are dummy variables with one being yes and zero being no, while variables with monetary values are expressed in thousands of 2015 DKK. The reported mean of the outcome is calculated among women who do not receive radiotherapy. Standard errors are clustered at the hospital level. Significance levels: * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$.

Appendix Table A9: Sensitivity of Effects of Radiation Therapy to Selective Survival

	Baseline (1)	Only survivors (2)	Baseline with T95 and Post95 indicators (3)	Heckman selection model (4)
A. Employed?				
5 years after diagnosis	0.155*** (0.049)	0.120** (0.051)	0.153*** (0.049)	0.110** (0.054)
Observations	2,823	2,256	2,823	2,823
Mean outcome	0.560	0.701	0.560	0.560
F-statistic	1,375	1,154	1,142	
10 years after diagnosis	0.155*** (0.048)	0.159*** (0.057)	0.156*** (0.048)	0.153*** (0.059)
Observations	2,823	1,912	2,823	2,823
Mean outcome	0.427	0.631	0.428	0.427
F-statistic	1,375	905	1,142	
B. Labor earnings				
5 years after diagnosis	60.518*** (17.282)	52.336*** (18.925)	59.999*** (17.287)	50.017** (22.818)
Observations	2,823	2,256	2,823	2,823
Mean outcome	174.115	216.910	174.171	174.008
F-statistic	1,375	1,154	1,142	
10 years after diagnosis	63.973*** (17.969)	76.797*** (22.397)	64.102*** (17.983)	71.605*** (23.192)
Observations	2,823	1,912	2,823	2,823
Mean outcome	147.908	217.793	147.966	147.851
F-statistic	1,375	905	1,142	

Notes: Columns 1–3 present 2SLS estimates based on Equation (1), estimated in the full analysis sample (Columns 1 and 3) or in the sample of survivors only (Column 2). Column 4 shows the estimates from a Heckman selection model with endogenous covariates, estimated in the full analysis sample (see Section A2 for details). Each cell presents the estimate of the coefficient on the indicator for radiotherapy from a separate regression for the outcome indicated in the panel measured at the time indicated in the row. All the specifications include indicators for age at diagnosis in full years, tumor size in cm, the number of positive nodes (0, 1–3, 4+), having the tumor removed micro-radically, the type of surgery (lumpectomy, mastectomy, or lumpectomy followed by mastectomy), and the type of chemotherapy received (DBCG89 clinical trial arm). In addition, the specifications in Columns 1 and 2 include all possible interactions among the following indicators: having mastectomy, being younger than 45 years of age at diagnosis, the number of positive nodes (0, 1–3, 4+), having a tumor larger than 50mm, and having the tumor removed micro-radically, as well as year-of-diagnosis fixed effects; while the specifications in Columns 3 and 4 include indicators for the T95 group and for diagnosis in or after 1995. The instrument for the radiotherapy indicator is the interaction between an indicator for the woman belonging to the T95 group and an indicator for being diagnosed after 1995. The excluded instruments in the selection equation in Column 4 are triple interactions between the T95 indicator, an indicator for being diagnosed after 1995, and (i) an indicator for having a tumor larger than 5cm, or (ii) indicators for the type of surgery (i.e., breast conserving or mastectomy). “Employed?” is a dummy variable with one being yes and zero being no. “Labor earnings” are expressed in thousands of 2015 DKK. The reported mean of the outcome is calculated among women who do not receive radiotherapy. F-statistic is the robust first-stage F statistic for the test of significance of the instrument. Standard errors are clustered at the hospital level. Significance levels: * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$.