OPTIMISM AND PARTICIPATION IN BREAST CANCER SCREENING: EVIDENCE FROM THE UNITED STATES

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Abstract. This study investigates the influence of the personality trait of optimism on participation in breast cancer screening in the US. Breast cancer is the most common cancer among women in the US, accounting for approximately 30% of all new cancer diagnoses annually (American Cancer Society, 2025). Beyond sociodemographic factors, recent literature highlights the significant role of psychological factors, norms, and beliefs in the decision to participate in breast cancer screening. However, the impact of optimistic beliefs on screening uptake has not yet been explored. This study aims to address this gap.
We analyse a sample of approximately 4,500 women aged 50 and older from the US Health and Retirement Study (HRS) spanning 2006 to 2020. A dynamic probit panel data model with random effects is estimated, employing Mundlak's (1978) approach to account for correlated individual effects. Our findings indicate that mammography uptake exhibits strong state dependence. Furthermore, optimism negatively influences mammography uptake among younger women (under 61 years) but positively affects the uptake among women aged 70 and over. These results can be interpreted through the lens of Prospect Theory (Kahneman and Tversky, 1979; Rothman and Salovey, 1997) and Socioemotional Selectivity Theory (Carstensen, 1995). Our findings suggest that policymakers should consider age-specific and psychologically tailored messaging strategies to enhance breast cancer screening adherence across diverse population groups.

1. Introduction

In our study we investigate the influence of the personality trait of optimism on the participation in breast cancer screening programs (through the uptake of mammography) in the US. We investigate this research hypothesis by exploiting data from the US Health and Retirement Study (HRS) in 2006-2020.

Breast cancer is the most common female cancer in the United States (US) accounting for about 30% of all new cancer diagnoses each year and representing the second leading cause of death from cancer in women, behind lung cancer. Mortality rates have been decreasing steadily since 1989, with an overall decline of 44% through 2022, thanks to earlier detection and advancements in treatments. However, in recent years, incidence rates have increased by 1% on an annual basis, due to rising risk factors such as overweight (American Cancer Society, 2025).

Breast cancer screening can help detect breast cancer before there are signs or symptoms of the disease, when it is easier to treat it. Mammography using x-ray is the most common screening test for breast cancer. Magnetic resonance imaging may be used to screen women who have an increased risk of developing cancer (CDC, 2024).

Until April 2024, the U.S. Preventive Services Task Force recommended that women aged 50 to 74 years received a mammography every 2 years. The age target was later expanded to include 40-49-year-olds. In 2023, 79.8% of women aged 50-74 years complied with these recommendations. Despite the screening uptake was lower for low-income (71.3%) and low-educated women (69.9%), the Health People Target 2030 of 80.3% has been almost reached (NCI, 2025). Therefore, the US qualifies as a virtuous country for breast cancer screening, and lessons can be drawn from its experience. In particular, identifying (and addressing) factors that influence women's participation in screening may increase screening uptakes elsewhere.

Apart from sociodemographic characteristics, recent literature has shown that psychological factors, norms and beliefs can play an important role in the choice to take up cancer screening. For instance, the study by Prowse *et al*. (2024) shows that the fear of the unknown regarding a possible diagnosis of cancer or abnormal test results, and a general lack of knowledge around screening programmes are relevant factors that negatively affect the participation in cancer screening (including breast) in high-income countries. Similarly, a systematic review (Tavakoli *et al*., 2024) focussed on breast cancer identifies personal health beliefs, knowledge, perceptions, cultural factors, cues to action, motivation, and self-efficacy, among the factors influencing screening practices in women worldwide.

Among the possible psychological traits, the role played by the Big Five personality traits (i.e., neuroticism, extraversion, openness to experience, agreeableness, conscientiousness) in the choice to participate in cancer prevention programs has been extensively investigated in the literature (Bahat, 2021, Le Clainche *et al.*, 2024, Hajek *et al*., 2020, Niedzwiedz *et al.*, 2019). Previous studies investigating screening practices in countries such as France, Germany, Ireland, Israel, and the UK show clear evidence of a positive association between conscientiousness and extraversion and participation in breast cancer screening, while they report mixed and inconclusive findings about the other three personality traits (i.e., agreeableness, neuroticism, and openness to experience). These findings are confirmed by Aschwanden *et al*. (2019) when exploiting HRS data on older adults in the US. They show that higher conscientiousness and higher extraversion are associated with a higher likelihood of undergoing mammography.

Optimism and pessimism, which are defined as the tendencies to expect positive or negative outcomes in life (Carver *et al.*, 2010), are other psychological traits which have been considered in the health economics literature as determinants of

health behaviours. With regard to the participation in screening programs, the role played by optimistic beliefs have been investigated by few studies. Oster *et al.*, (2013), who consider the genetic testing for Huntington disease, a hereditary disease with limited life expectancy, show that taking the test is rare, and that individuals who express optimistic beliefs about their health are more likely to be untested. Moyer *et al.* (2008), using a sample of pregnant women in Ghana, find that optimism is negatively correlated with HIV knowledge and positively correlated with having never been tested before pregnancy. However, as far as we know, no study has investigated the effects of optimism on the participation in cancer screening programs before. We aim at filling this gap in the literature by investigating the extent to which the personality trait of optimism influences the participation in breast cancer screening (through the uptake of mammography) in the US.

We investigate our research hypothesis by using data from the HRS in 2006-2020. The empirical analysis exploits information about a sample of women living in the US and aged 50 and older. We estimate a dynamic probit panel data model with random effects, using the Mundlak correction to account for correlated individual effects (Mundlak, 1978; Rice and Robone, 2022). We also estimate heterogenous effects by age. When considering the full sample, our estimates suggest a positive, although not statistically significant, effect of optimism on mammography uptakes. However, when we stratify our sample by age groups, we find that for women aged between 50 and 61 *optimism* has a negative and statistically significant influence on the likelihood of undergoing breast cancer screening, while for women aged 70 and above *optimism* has a positive and statistically significant influence. Additionally, our estimates show that participation in breast cancer screening is path-dependent.

Our study provides an original contribution to the literature on the determinants of screening since it is the first investigating the role played by optimism in choosing to undergo cancer screening. We focus in particular on breast cancer screening (i.e., mammography) and exploit longitudinal information from the HRS. The use of a dynamic panel probit model is another original feature of our study.

2. Data and Estimation Strategy

We exploit eight waves of the HRS collected in the years 2006-2020. The HRS is a longitudinal panel survey comprising a large representative sample of ageing adults (older than 50 years) in the US using biennial interviews. The HRS was launched in 1992 by the Institute for Social Research (University of Michigan). In 2004, a new Psychosocial and Lifestyle Questionnaire was introduced, which is also referred to as the “Leave Behind Questionnaire” because it was left for participants

to self-complete after their in-person interview. Since 2006, the "Leave Behind" module has been completed by participants every 4 years, as it has been left to a random 50% of the full sample in each wave (Clarke, 2008).

Our study considers women in couple aged 50 and over and the final sample is made by 4,466 observations. Our dependent variable is *mammography*, a dummy variable equal to 1 if the woman has undergone breast cancer screening (through mammography) in the previous year, and 0 otherwise. Our main independent variable is *optimism*, an index created by averaging the scores obtained using a 6-point Likert scale (from 1 - strongly disagree to 6 - strongly agree) across three different items.[1]

Table 1 - *Descriptive statistics of the main variables.*

Variable	Obs.	Percent	Mean	Std.dev.	Min	Max
Mammography	4466	80%			0	1
Optimism	4466		4.62	1.08	1	6
Religiosity	4466		5.04	1.40	1	6
Locus of control	4466		5.01	1.07	1	6
Age (year)	4466		64.78	10.04	32	93
High_education	4466	57%			0	1
Income (1000 $)	4466		17.77	38.80	0	765
Retired	4466	47%			0	1
Black_other	4466	13%			0	1
Drinking	4466	60%			0	1
Smoking	4466	8%			0	1
No children	4466	4%			0	1
Wealth_total (1000 $)	4466		581.72	1117.76	0	37100
SAH_poor/fair	4466	16%			0	1
SAH_good	4466	32%			0	1
SAH_Vgood_excellent	4466	52%			0	1
No_insurance	4466	28%			0	1
Neuroticism	4466		0.54	0.14	0.25	1
Extraversion	4466		0.81	0.14	0.30	1
Agreeableness	4466		0.91	0.10	0.25	1
Conscientiousness	4466		0.85	0.10	0.35	1
Openness	4466		0.74	0.14	0.25	1

The potential confounders include sociodemographic covariates (i.e., age, education, income, retired, black or other ethnic groups, no children, and log of total wealth), health behaviours (drinking, smoking), self-assessed health ("poor and fair health", "good health" and "very good and excellent health"), having no health insurance, the Big Five personality traits (i.e., neuroticism, extraversion,

[1] Q19g (*I'm always optimistic about my future*), Q19h (*In uncertain times, I usually expect the best*) and Q19i (*Overall, I expect more good things to happen to me than bad*).

agreeableness, conscientiousness, and openness) and beliefs (religiosity and locus of control).

Table 1 shows the descriptive statistics of the main variables included in our econometric model. Women in the sample are on average almost 65 years old, 57% of them declare to have a high education level, 47% are retired, their mean income is about $17,770 and their mean total wealth is about $581,720. About 80% of the women in the sample undergo breast cancer screening, which is in line with US data (NCI, 2025), and their average level of optimism is 4.6 on a scale from 1 to 6. In the sample, 16% declares to be in poor or fair health, 32% in good health, and 52% in good or excellent health; 28% declares to have no health insurance.

Our baseline model is a panel probit model over the period 2006-2020 (corresponding to 8 waves), defined as follows:

$$Y_{it} = \beta\, Optimism_{it} + X'_{it}\gamma + \pi_t + \eta_i + \varepsilon_{it}, \quad (1)$$

where Y_{it} denote a binary outcome for the uptake of mammography for the *i*-th women at time *t* (*i*=1, …, N, and *t*=1, … ,T) . X'_{it} represent women characteristics; π_t is a fixed time effect; η_i is a women-specific random component and ε_{it} is an idiosyncratic time varying error term which is assumed to follow a standard normal distribution. To account for the possibility that the observed regressors are correlated with the unobserved individual effects η_i, we exploit the Mundlak (1978) approach. This approach allows to address this potential correlation by modelling individual-specific effects as a function of the means of the time-varying regressors.[2] Following Wooldridge (2005), the distribution of the individual effects is parameterized as:

$$\eta_i = \theta_0 + \theta_1 Y_{it} + \theta_2 \bar{X}_i + \mu_i, \quad (2)$$

where $\bar{X}_i$ is the average in the sample of the observations on the time-varying women characteristics and μ_i is assumed to be distributed N (0, σ_μ^2), independent of the regressors, the idiosyncratic error term ε_{it} and the initial conditions.

We further estimate a dynamic panel probit over the same time span, by including Y_{it-1} in our specification:

$$Y_{it} = \alpha Y_{it-1} + \rho Y_{i1} + \beta\, Optimism_{it} + X'_{it}\gamma + \pi_t + \eta_i + \varepsilon_{it}, \quad (3)$$

To correct for the initial conditions problem, we adopt the Wooldridge's (2005) approach and include Y_{i1}, the observed values of mammography uptake in the first

[2] The Mundlak (1978) approach is applied by including the within-individual mean of the time-varying regressors.as regressors in our specification.

wave, in the model's specification. Estimating a dynamic panel probit allows us to model *true state dependence*, where past outcomes (e.g., prior uptakes of mammography) directly influence current outcomes, beyond what is explained by observed and unobserved factors.[3] We adopt the Mundlak's (1978) approach even when estimating equation (3).

3. Results

Table 2 displays the baseline results of the estimates of equation (1), investigating the effects of optimism on the uptake of breast cancer screening. The results reveal that, when running our regression model using the entire sample, there is a positive but statistically insignificant relationship between optimism and undergoing a mammography test. However, when the sample is stratified by age groups, the findings vary considerably.[4] For women aged less than 70, the association between optimism and mammography uptake is negative and not statistically significant; however, for women aged 70 and above, the relationship becomes positive and strongly statistically significant (at 1% level).

Table 3 presents the main findings from a dynamic panel probit model based on equation (3). There appears to be a positive and strongly and significant relationship between having undergone a mammography test in the previous wave and the likelihood of undergoing the test in the current wave, particularly for women over 61. Therefore, the uptake of mammography seems to be strongly path-dependent. The results concerning *optimism* align with the baseline findings, although the (negative) coefficient for optimism for women under 61 becomes statistically significant at the 5% level, while the (positive) coefficient for women 70 and above reduces its level of statistical significance at the 5% level. Some covariates, such as *locus of control* and *ethnicity*, also show some positive association with mammography testing.

We also compute the average marginal effects from the fitted model on the probability of undertaking mammography (detailed results are available upon request). For women under 61, a one-point increase on the optimism scale [1, 6] reduces the probability of having the mammography by about 4%, while for women 70 and above it increases such probability by about 3%. These effects are small but not negligible.

[3] A dynamic panel probit models to study cancer screening behaviour has been already adopted, for instance, by Carney et al. (2013).

[4] The three groups are created based on the age variable distribution so that each groups contains approximately one third of the total sample.

Table 2 - *Probit model for mammography uptakes.*

	Full sample b/se	age < 61 b/se	61 <= age <= 69 b/se	age> 69 b/se
Optimism	0.033	-0.067	-0.039	0.155**
	(0.036)	(0.071)	(0.089)	(0.055)
Religiosity	0.049+	0.088+	0.099	-0.043
	(0.027)	(0.047)	(0.068)	(0.046)
Locus of control	0.098**	0.007	0.192+	0.144**
	(0.037)	(0.076)	(0.098)	(0.053)
Age (in 100 years)	-1.781***			
	(0.508)			
High_education	0.148+	0.259	0.254	-0.067
	(0.087)	(0.164)	(0.201)	(0.125)
Income (10k)	-0.013	-0.022	0.022	-0.072
	(0.016)	(0.021)	(0.056)	(0.103)
Retired	-0.044	0.048	-0.439	-0.100
	(0.125)	(0.311)	(0.285)	(0.240)
Black_other	0.272*	0.221	0.733*	0.329
	(0.120)	(0.196)	(0.343)	(0.218)
Drinking	0.272+	0.155	-0.451	0.685**
	(0.150)	(0.319)	(0.400)	(0.257)
Smoking	0.254	-0.442	0.309	0.715
	(0.268)	(0.579)	(0.646)	(0.567)
No children	0.080	0.244	-0.011	-0.082
	(0.200)	(0.335)	(0.493)	(0.340)
Log total wealth	0.130*	0.215+	0.233	0.054
	(0.060)	(0.111)	(0.169)	(0.115)
Sah_good	-0.035	0.280	-0.082	-0.272
	(0.121)	(0.250)	(0.320)	(0.197)
Sah_fair/poor	-0.155	0.691	-0.667	-0.569*
	(0.178)	(0.422)	(0.540)	(0.262)
No_insurance	0.044	0.050	0.208	0.369
	(0.143)	(0.266)	(0.280)	(0.919)
Neuroticism	0.572*	0.173	-0.328	1.102*
	(0.277)	(0.536)	(0.691)	(0.432)
Extraversion	0.387	1.469*	-0.260	-0.214
	(0.354)	(0.661)	(0.861)	(0.549)
Agreeableness	0.106	0.229	0.121	0.535
	(0.431)	(0.786)	-1.072	(0.684)
Conscientiousness	0.080	-0.576	1.536	-0.051
	(0.412)	(0.799)	-1.023	(0.622)
Openness	-0.099	0.042	-0.927	0.051
	(0.342)	(0.656)	(0.837)	(0.506)
constant	-1.088	-1.837+	-2.734+	-2.495**
	(0.670)	-1.114	-1.528	(0.942)
aic	4.081.230	1.653.772	1.014.089	1.529.378
bic	4.273.357	1.813.158	1.160.618	1.683.635
Number of observations	4,466	1,801	1,156	1,509

*Notes: *** p <.001, ** p < .01, * p < .05, + p < .1; standard errors in parentheses. The specification includes as controls also Mean_Income_10k, Mean_Lwealth_total Mean_Retired, Mean_Drinking Mean_Smoking, Mean_SAH_good, Mean_SAH_fair/poor, Mean_No_Insurance.*

Table 3 - *Dynamic probit model for mammography uptakes.*

	Full sample b/se	age < 61 b/se	61 <= age <= 69 b/se	age> 69 b/se
Optimism	0.012	-0.337*	-0.014	0.110*
	(0.043)	(0.168)	(0.079)	(0.053)
Religiosity	-0.024	-0.181+	0.036	-0.012
	(0.031)	(0.100)	(0.057)	(0.040)
Locus of control	0.120**	0.112	0.218*	0.100+
	(0.045)	(0.143)	(0.088)	(0.053)
Age (in 100 years)	-3.631***			
	(0.662)			
High_education	-0.027	-0.022	0.083	-0.123
	(0.087)	(0.253)	(0.154)	(0.108)
Income (10k)	-0.031	-0.063+	0.029	-0.097
	(0.020)	(0.038)	(0.040)	(0.090)
Retired	0.080	0.180	-0.343	0.292
	(0.155)	(0.548)	(0.242)	(0.234)
Black_other	0.347*	0.125	0.488+	0.444+
	(0.149)	(0.322)	(0.268)	(0.231)
Drinking	0.369*	0.237	-0.113	0.544*
	(0.179)	(0.503)	(0.323)	(0.235)
Smoking	0.119	-0.262	0.084	0.681
	(0.336)	(0.949)	(0.520)	(0.531)
No children	-0.417*	-0.610	-0.128	-0.268
	(0.202)	(0.469)	(0.340)	(0.350)
Log total wealth	0.110	0.365	0.095	0.058
	(0.075)	(0.226)	(0.136)	(0.108)
Sah_good	0.034	0.527	-0.068	-0.095
	(0.142)	(0.407)	(0.254)	(0.192)
Sah_fair/poor	-0.069	1.779*	-0.472	-0.334
	(0.208)	(0.832)	(0.416)	(0.254)
No_insurance	-0.079	-0.267	0.215	-0.951
	(0.183)	(0.453)	(0.241)	(0.845)
Neuroticism	0.265	-0.066	-0.064	0.698+
	(0.313)	(0.849)	(0.557)	(0.410)
Extraversion	0.512	0.620	1.225+	0.293
	(0.388)	-1.085	(0.696)	(0.516)
Agreeableness	0.278	0.489	0.325	0.321
	(0.476)	-1.219	(0.853)	(0.640)
Conscientiousness	0.247	0.520	0.244	0.307
	(0.492)	-1.470	(0.856)	(0.628)
Openness	-0.615	0.245	-2.229**	0.081
	(0.378)	-1.039	(0.723)	(0.474)
Mammography (t-1)	0.688***	0.555	0.857***	0.779***
	(0.184)	(0.692)	(0.241)	(0.179)
Mammography (t=1)	0.861***	1.694	0.521*	0.603**
	(0.243)	-1.084	(0.238)	(0.186)
constant	0.178	-0.100	-2.505*	-3.218***
	(0.809)	-1.748	-1.251	(0.959)
aic	1.639.424	346.508	476.820	877.415
bic	1.818.844	475.831	614.686	1.026.358
Number of observations	2,012	479	631	902

*Notes: *** p <.001, ** p < .01, * p < .05, + p < .1; standard errors in parentheses. The specification includes as controls also Mean_Income_10k, Mean_Lwealth_total Mean_Retired, Mean_Drinking Mean_Smoking, Mean_SAH_good, Mean_SAH_fair/poor, Mean_No_Insurance.*

4. Discussion

In our study we investigate the influence of the personality trait of optimism on the choice to participate in breast cancer screening programs and uptake a mammography. We investigate our research hypothesis by considering a sample of about 4,500 women aged 50 and older from the US HRS in 2006-2020.We estimate a dynamic panel probit model, adopting the Mundlak's (1978) approach to account for the possibility that the observed regressors are correlated with the unobserved individual effects. The uptake of mammography seems to be strongly path-dependent. Optimism appears to have negative influence on mammography uptakes for younger women (aged less than 61), while it appears to have a positive influence for older women, aged 70 and above.

There are different possible explanations for the negative influence of optimism on mammography uptake we find for younger women in our sample. First of all, optimistic individuals often exhibit a "positive illusion" or "optimism bias", meaning they believe they are less likely than others to experience negative events (Weinstein, 1980). This leads them to underestimate their personal risk of diseases like breast cancer. Moreover, they are less influenced by fear-based appeals (Aspinwall and Brunhart, 1996). This psychological profile may interact with the way mammography is promoted, which in the US is typically through a negative framing. According to Rothman and Salovey (1997), health behaviours can be divided into two broad categories: prevention behaviours (e.g., using sunscreen, exercising) and detection behaviours (e.g., mammography, HIV testing). On the basis of Prospect Theory (Kahneman and Tversky, 1979), they argue that detection behaviours are more effectively encouraged through loss-framed messages, which emphasize the risks of not performing the behaviour.[5] Optimistic individuals, however, tend to be less responsive to such negatively framed messages, as their general outlook leads them to downplay threatening information. As a result, standard screening campaigns, which often emphasize the potential loss associated with not getting screened, may fail to motivate the group of the optimists effectively.

The negative influence of optimism on mammography uptakes can also be explained in the light of the *information avoidance* mechanism, well-illustrated by Golman *et al.* (2017). The theoretical model of Brunnermeier and Parker (2005) shows that individuals can choose to hold optimistic beliefs, which are a source of anticipatory utility and thus improve immediate well-being, potentially at the risk of intensifying future disappointment. In this context, individuals might indulge in

[5] The predictions of Rothman and Salovey (1997) are confirmed, for example, by a study conducted in Sicily (Italy) by Bertoni *et al*. (2020). They show that loss-framed letters, which emphasize the potential negative consequences of not getting a mammography, stimulate higher attendance to breast cancer screening program.

information avoidance, because acquiring information can interfere with their ability to maintain unwarranted optimism. With regard to health, information avoidance might induce individuals at risk for health conditions to eschew medical tests. Evidence of this behaviour are provided, for instance, by Oster *et al*. (2013) when considering people at risk of Huntington's disease.

With regard to the positive influence of optimism on mammography uptake among women aged 70 and above, one possible explanation lies in age-related shifts in motivational orientation. According to the Socioemotional Selectivity Theory (Carstensen, 1995), older adults increasingly prioritize emotionally meaningful goals and health maintenance. Therefore, optimistic women in this age group may be more motivated to engage in preventive care to preserve their quality of life and autonomy. Moreover, research suggests that optimism enhances health behaviour when individuals perceive a high degree of personal control (Aspinwall and Taylor, 1992). Older women may see mammography as an empowering and manageable step toward maintaining their wellbeing. Finally, this effect may also partly reflect a survivor or selection bias, whereby healthy ageing women with a generally proactive health orientation, besides higher optimism, continue to engage with screening services.

From a policy perspective, we suggest policy makers to promote breast cancer screening initiatives which employ gain-framed, positively oriented messages to effectively reach younger women, who are less responsive to fear-based appeals. Differently, for older women, communications that emphasize empowerment and personal control are more advisable. In general, the adoption of an age and psychologically tailored messaging approach could enhance the screening adherence across diverse population groups.

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