Breast cancer screening regularity and the coexistence of organized and opportunistic screenings in France

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1 Introduction

The regularity of breast cancer screening is a major public health issue. Screening regularity favors early detection of cancer, and thus higher survival chances leading to a reduction in breast cancer mortality rates. Results of the randomized controlled trials reported by Duffy and Paci (2012) show that screening diminishes breast cancer mortality by 21% in women older than 50 years old. In absolute terms, it means that if 100 000 women are regularly screened over a period of 7 to 11 years, 139 to 310 deaths by breast cancer would be prevented. Screening regularity is not investigated in general population surveys. Instead, surveys usually examine if women have ever been screened or screened in the past 2 years. Beck et al. (2012) observe in 2010 that 87% of women aged between 50 and 74 years old declared that they had a mammography at least once in their life. Furthermore, according to the Haute Autorité de Santé (2011)'s literature review, screening participation rate in the past 2 years ranged from 69% to 80%. However, physicians report a lack of screening regularity i.e. instead of screening every two years, women are screened less frequently.

This chapter aims at understanding how socioeconomic, health characteristics, radiologist supply and the screening system influence screening regularity in France.

The lack of breast cancer screening use (having been screened once in their life or in the past two years) is usually explained by differences in socioeconomic status, health status and health care consumptions (Carrieri and Wübker (2013), Jusot, Or and Sirven (2012) and Sicsic and Franc (2014)). We posit that the screening system may be associated with screening regularity uptake. In several European countries as France, Switzerland, Luxembourg, Austria and Belgium, a dual breast cancer screening system; within which organized (population-based free national screening program) and opportunistic screenings (screening outside the program upon physician's prescription) co-exists. Each screening modality is different in terms of access conditions and content, as shown in the general introduction and the first chapter. Three differences between organized and opportunistic screenings may lead to screening regularity disparities.

Firstly, the population-based screening program is organized at the level of the *département* by management structures which invite all women aged between 50 to 74 years old to be screened every two years. Once she has the invitation letter, she can directly take an appointment with an authorized radiologist. The day of the medical exam, the woman only has to bring the letter to undergo a mammography. Opportunistic screening works differently because a medical prescription from a physician (most probably a gynecologist or a GP) is required to undergo screening. Note that there is no need to have been invited by the management structure to get a prescription from a physician. Once she has a prescription, she can have an appointment with any radiologist to undertake a mammography[1]. The national program invitation system encourages women to directly see a radiologist whereas the opportunistic screening first requires to have a consultation with another physician. Getting a prescription is an additional step, with potential associated time and financial costs, that may constitute a significant barrier to access to screening. Organized screening is less costly in terms of time and finance due to the possibility for a direct appointment with a radiologist. Women may be less willing to be regularly screened if it means facing again financial and time costs due to the physician consultation required to have a prescription.

Secondly, the invitation system sends at least two invitations to screening after the first invitation, a reminder is sent usually 6 or 12 months after the initial invitation. Some management structures even send two reminders. After screening taken part in organized screening, a woman may be more responsive to an invitation she will receive 22 months later. On the contrary, those who chose to be screened on an opportunistic basis may be more likely to disregard invitations received later and don't benefit from such reminders.

Thirdly, organized screening is free of charge (excluding transportation and time costs that are similar for organized and opportunistic screenings) whereas opportunistic screening

[1] All authorized radiologists can perform organized and opportunistic screenings but non-authorized radiologists can't perform mammography. So, there is the same number of radiologists which can perform mammography in or outside the national program.

induces up-front fees. As shown in the first chapter, the agreed Social Security fee for a mammography is 66.42€. National Health Insurance funds it up to 70% (46.5€) of these up-front costs. The 30% of co-payments (20€) and potential balance billing may be covered by private complementary health insurance. Any additional medical exam is invoiced to the patient. The previous chapter shows that a greater number of opportunistic screenings include an echography in addition to the mammography and the clinical examination, when compared to organized screenings. Additionally, if a woman undergoes opportunistic screening, she will have to pay mammography price up-front. There is also a higher chance that this price is increased by extra exams. If a woman experienced screening costs using opportunistic screening, she may have a smaller willingness to pay to screen again than someone who did not experienced any costs or lower ones.

Moreover, researchers in epidemiology and public health examine how the screening modality chosen influences the time length between two screenings. Ouedraogo et al. (2011) find that French women who took part in opportunistic screening are more likely to have a second screening after 26 months or, on the contrary, they screen after a shorter time period (less than 22 months) whereas the recommended time length between two screenings is 24 months. The Haute Autorité de Santé (2011) used the "Échantillon généraliste des bénéficiaires" (EGB) to look at the difference in time interval between two screenings when organized or opportunistic screening is used. In their sample, 46.1% used organized screening and 16.7% used opportunistic screening and 2.9% used both. They examine time intervals between screenings by distinguishing between those who used opportunistic screening only and those who mixed both screening modalities between 2007 and 2010. The same proportion of women (17 and 16.5 respectively) in both groups had a delay superior to 26 months. It seems that when opportunistic screening is used (either in substitution or in addition to organized screening), 17% of women are not screened regularly enough, but the study does not compare these figures with the proportion of those who only used organized screening.

All points raised here suggest that using organized rather than opportunistic screening leads to more regular screenings. In this chapter, we also argue that using organized or opportunistic screening may be associated with different screening trajectories. Screening trajectories correspond to screening modality choices over a period of time: using the same modality or switching between screening modalities.

This empirical work makes use of the data available in the 2006 wave of the Health, Health care and Insurance Survey (ESPS). This database is merged with the Permanent Sample of Population Socially Insured (EPAS) which reports individuals' administrative data based on health care reimbursements by the National Health Insurance between 2006 and 2009. Additionally, we add the Eco-Santé database to characterize radiologist presence in each *département*. Using these databases presents three important advantages. Firstly, we don't rely on declared health behaviors: the EPAS provides us with administrative data for mammography consumption from 2006 to 2009. Using solely administrative data allows us to disentangle mammographies performed in and outside the program, which are classified differently in the Common Classification of Medical Acts (CCAM) with the added advantage of avoiding reliance on declarative data. Secondly, the ESPS survey provides us with a very rich set of sociodemographic and health characteristics. In particular, the questionnaire includes a measure of precariousness, based on questions concerning adverse life events, whose influence on breast cancer screening has never been studied. Thirdly, the supply side factors such as radiologists density and the share of balance billing radiologist per *département* are for the first time included in an analysis of breast cancer screening participation in France.

Our key empirical contribution is to show that organized screening is associated with higher compliance with the two year interval recommended between screenings. Results suggest that using organized screening is positively associated with more regular screening. In line with previous findings, women at the top of the income distribution are more likely to screen regularly than those at the bottom of the distribution. We find that having lived adverse events is strongly and negatively correlated with regular screening. Consulting any physician (general practitioners, gynecologists or any other specialist physician) is positively associated with screening regularity while living in a *département* with a higher share of balance billing radiologists decreases the likelihood to screen regularly. Finally, 65.6% of women are faithful to the same screening modality chosen and only 11.3% switched between modalities between 2006 and 2009. Amongst women who are dissatisfied with organized screening, our results show that disadvantaged women tend not to screen again whereas advantaged ones are more likely to switch to opportunistic screening.

We begin in section 2 by describing the determinants of screening regularity. Section 3 presents the data and the variables of interest and section 4 explains the estimation strategy used. Results are reported in section 5 and discussed in section 6.

2 Literature review

2.1 Socioeconomic determinants of breast cancer screening

To my knowledge, there has never been a study investigating the determinants of screening regularity. Papers usually focus on the determinants of having been screened at least once, or whether a woman screened in the previous two years. In this literature, the absence of breast cancer screening is explained by socioeconomic inequalities characterized by differences in education and income. After controlling for needs, Carrieri and Wübker (2013) find that in many European countries, including France, strong income and education related inequalities exist with respect to breast cancer screening. Jusot, Or and Sirven (2012) report that the chance of getting breast cancer screening in the past two years is on average 1.5 times higher for women in the highest income group, when compared to those in the lowest one. Devaux and Looper (2012) finds income-related inequalities in breast cancer screening in many European countries (Belgium, Canada, Estonia, France, Ireland and Poland), as well as in the US.

Present income and education level are predictors of health behaviors and health status but life trajectories are also linked to them (Bricard (2013) and Cambois and Jusot (2010)). A recent literature has deepened the analysis of social inequalities in health by investigating how life adverse experiences (such a social exclusion) affect individuals' health status. A lifelong adverse experiences (LAE) index was created by Cambois and Jusot (2010) to capture the existence of hardship events. They find that LAE are strongly associated with poor self-assessed health, chronic disease and activity limitations for both men and women, while controlling for other socioeconomic characteristics. We posit that one of the mechanisms behind the LAE effect on health status may be a lack of preventive care use. Therefore, having experienced LAE is expected to be correlated with a lack of mammography use. Related work by Menvielle et al. (2014) focuses on women in great financial difficulty. They construct an index composed of three categories: falling into the 1^{st} income quintile of the distribution, perception to have financial difficulties and under-nutrition. They find that women who fall into 2 of 3 categories tend not to be screened for breast cancer.

2.2 Health status and health care consumption

It has been argued that poor health should be positively associated with cancer screening. For example, those in poorer health are more likely to have higher costs linked to an additional disease (such as treatment and rehabilitation costs) than those in good health. Alternatively, people in poor health may not participate in cancer screening because of functional limitations. People can also choose to prioritize another medical condition, or the chronic disease they actually suffer from. The empirical literature finds that poor health is a barrier to screening. Based on the American Health and Retirement Survey, Wu (2003) demonstrates a negative correlation between cancer screening (mammography use, prostate cancer screening and Pap smear) and several health status measures (self-assessed health and limitations in activities of daily living). Based on ESPS, Sicsic and Franc (2014) report that poor health is negatively linked to having been screened in the past two years. But it is also argued that patients may adapt to their health status and even report higher quality of life than those who don't suffer from a chronic disease (Damschroder, Zikmund-Fisher and Ubel (2005) and Riis et al. (2005)). If individuals with chronic diseases adapt to their health, those who report good health may still have chronic disease. The positive effect of health status is perhaps partly explained by patients with chronic diseases who assessed their health as good.

Poor health is potentially an inherited trait. Women with a 1^{st} degree genetic risks (a mother, sister or daughter had breast cancer) are at high risk for breast cancer. This family history of breast cancer is supposed to have a positive effect on breast cancer screening attendance, especially because they benefit from specific monitoring by gynecologists or oncologists. Some behavioral medicine papers suggest that being at high-risk for breast cancer could discourage screening (Kash et al. (1992) for instance). Information avoidance, in such situation, is usually explained by the anxiety and stress triggered by screening.

As specified in the Medical Convention of 2011 signed by general practitioners (GP), it is part of their responsibilities to advise their patients to be screened for breast cancer. Even though specialist physicians (SP) are not formally asked to advise their patients to screen, gynecologists are very likely to do so. Duport (2012) find that having had either a gynecological examination or a GP consultation in the previous 12 months is positively associated with mammography use. Similarly, Sicsic and Franc (2014) find that consulting a GP less than twice a year and not consulting a SP at all in the previous 12 months predict mammography non-use in the previous two years. More broadly, lower access to the health care system, such as consulting physicians, may prevent individuals from getting screened for breast cancer. It is worth noting that access to SP (as gynecologist) is still highly inequitable compared to access to GP in France. An increasing social gradient (in income quintiles) is observed for SP visits whereas a decreasing social gradient exists for GP visits (Van Doorslaer et al. (2006)). Hence, benefiting from incentives or prescription to screen from a SP or GP can be determined by socioeconomic characteristics and health insurance coverage.

A lack of health insurance coverage is indeed a financial barrier to health care consumption. The better an individual's health insurance coverage, the more likely they are to undergo cancer screening (Hsia et al. (2000) and Trivedi, Rakowski and Ayanian (2008) for example). Health insurance is not supposed to matter for organized screening as it is free. Opportunistic screening generates out-of-pocket expenses and justify that the evaluation of the impact of health insurance coverage in mammography use. Sicsic and Franc (2014) show that women without complementary health insurance or those benefiting from a free complementary health insurance called Complementary Universal Health Coverage (CMU-C) don't screen as often as those who hold a private complementary health insurance. As the CMU-C covers co-payments and forbid physician from applying extra fees, CMU-C beneficiaries should not be exposed to out-of-pocket expenses. In theory, there should be no differentiation between CMU-C beneficiaries and those covered by private complementary health insurance. In practice, Desprès, Guillaume and Couralet (2009) show that there is discrimination against CMU-C beneficiaries which acts as a barrier to access for health care including radiological and gynecological cares. This could somewhat explain Sicsic and Franc (2014)'s results regarding CMU-C beneficiaries.

2.3 Radiologists' accessibility

Breast cancer screening implies the use of radiologists' facilities, whose availability varies between *départements*. The Le Breton-Lerouvillois (2014) showed great territorial disparities in radiologist density as shown in figure 3 in appendix A. A higher density of radiologists can diminish transportation costs as it diminishes the distance from one individual to a radiologist' practice. For instance, Jensen et al. (2013) calculated that the probability of not screening increases with the distance to radiologist's practice, even though it does not increase anymore after a distance longer than 45km. Thus, radiologists density is expected to be positively associated with cancer screening. In fact, Fleisher, Lou and Farrell (2008) remark that density of physicians in Florida is significantly associated with breast cancer survival rate amongst women living, while controlling for individual health and socioeconomic characteristics. Effects of both screening facility availability and treatment efficacy on mortality can not be distinguished. Gorey et al. (2010) specifically observe the positive association between GP and gynecologist density in Ontario (Canada) and breast cancer survival. They find that women with breast cancer are more likely to survive if there are at least 7.25 GPs per 10 000 inhabitants and 6 gynecologists per 100 000 inhabitants. In Germany, Vogt, Siegel and Sundmacher (2014) provide evidence that when there is a mammography center in a district, 1.9% more women undergo breast cancer screening, while controlling for socioeconomic factors. A positive relationship between radiologist density and breast cancer screening uptake can be expected. However, the French national context is different from that of the previously cited countries. In France, higher medical density usually goes with higher share of balance billing physicians. Although "sector 2" physician are allowed to apply balance billing, "sector 1" physicians must charge the regulated fee, upon which reimbursement of the National Health Insurance is based. As described by Dormont and Péron (2014), access to Sector 2 is strongly limited for GPs since 1990 and therefore most of them are in Sector 1 (81% in 2012) whereas 58% of SP (including radiologists) are Sector 1 physician. For radiologists, the correlation coefficients between radiologists density for 100 000 inhabitants and the share of sector 2 per *département* is 0.56 ($P-value < 0.01$) in our data. So, a higher density should induce a higher mammography uptake, but expecting to pay a higher fee in case of opportunistic screening may lead to less mammography uptake. In particular, Paris is very specific regarding physicians installation as it is characterized by a large amount of sector 2 radiologists who generate 72% of the total balance billing amount. Balance billing in Paris reaches an average of 25.60 € compared with 6.1 € in France. As a robustness check of the supply side effects on screening regularity, the analysis is performed excluding Paris, to purge the result from this outlier.

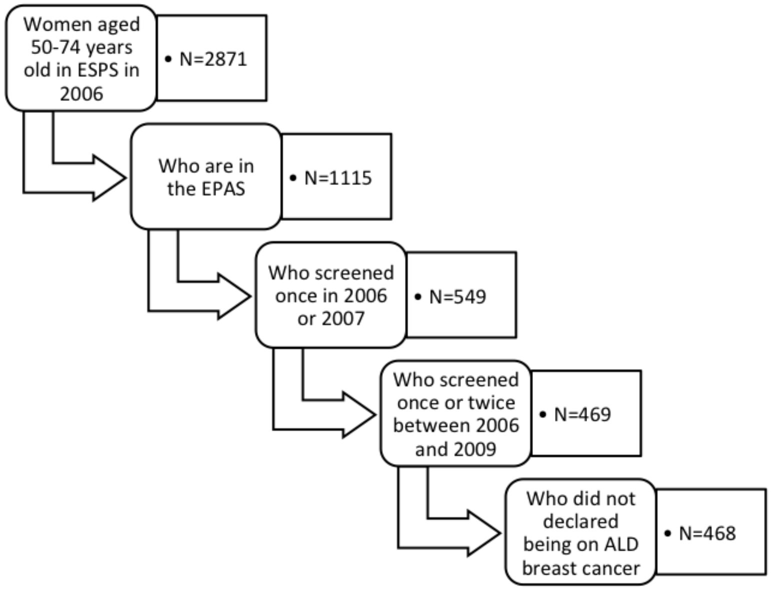
3 Data

3.1 Sample construction

Our work is based on the 2006 wave of the French Health, Health Care and Insurance Survey (ESPS) database merged with the Permanent Sample of Socially Insured (EPAS) and the Eco-Santé database. The ESPS survey is a general population survey conducted by the Institute for Research and Information in Health Economics (IRDES) since 1988 (Allonier, Dourgnon and Rochereau (2008)) using a representative sample of 97% of the population living in metropolitan France. The French commission on data privacy has approved it. The EPAS database is composed of health care consumption of beneficiaries provided by the National Health Insurance for salaried workers, agricultural workers and farmers and for the self-employed. Mammography uptake was made available for each year from 2006 to 2009. Health care consumption, other than mammography, were made available for 2006 and 2008 for a sub-sample of surveyed women. Data from the Eco-Santé database groups administrative data on a range of medical goods and services provided in each *département*. We combined these three databases for women aged between 50 and 74 years old in 2006.

Figure 1 describes the construction stages of the sample. We restrict our sample to women aged 50 to 74 years old who are eligible for the program, who can screen opportunistically, and who were surveyed in ESPS in 2006. Health care consumption reimbursement data was available in the EPAS database for less than half of them. We only include women who were screened in 2006 or 2007 using organized or opportunistic screenings (with bilateral mammography). To avoid including follow-up mammographies in the analysis, we excluded from the sample those women who had screened more than 2 times during the period as their screening choices may have been induced by specific monitoring from their physicians or specific beliefs related to their risk factors. The idea is to make the subsamples of women who use organized and opportunistic screening as comparable as possible, since the code of the CCAM does not allow to directly remove them from the sample. Then, we used whether

Figure 1: Sample construction



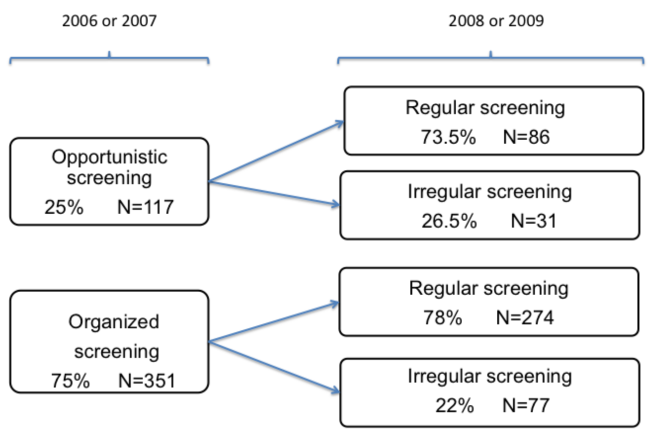
they declared a Long Term Chronic Disease (ALD) and its International Classification of Disease (CIM) code to avoid including someone who declared themselves as a breast cancer patient in 2006. Our final sample is composed of 468 women.

3.2 Screening regularity and screening modality variables

Screening regularity is defined as screening first in 2006 or 2007 and screening a second time in 2008 or 2009. In the sample, 77% of women screened twice between 2006 and 2009 and 23% screened only once in 2006 or 2007. These figures can be compared to the declared regularity of screening found in the third chapter, in which almost 3 out of 4 (74.7%) women stated that they undertake screening regularly.

We can identify the screening modality used because each screening modality is coded differently in the CCAM. There is a code for those who screen opportunistically which excludes any follow-up unilateral mammography but does not exclude follow-up bilateral mammography. There is another code for mammographies performed as part of organized screenings. However, this code also includes mammographies performed on high-risk women who usually

Figure 2: Sample Diagram



have a personal history or a family history of breast cancer, or other gynecological cancers. The sample is constructed in a way that tries to avoid including follow-up mammographies or mammographies for high-risk women (see section 3.1). We also try to control for it using mother's cause of death in the econometric specification.

We are interested in the relationship between the screening modality used in 2006 or 2007 and the choice of complying to the recommended screening time interval. Figure 2 summarizes screening choices according to which screening modality is used.

Concerning screening trajectories described in table I, we observe that women tend to stick to the screening modality previously selected as 65.6% of women in the sample are "faithful". We call faithful those who use the same screening modality the two times. It is worth noticing that 11% switched screening modalities while screening two times in the period. Four percent of women in the sample screened in the program in 2006 or 2007 and used opportunistic screening in 2008 or 2009 and 7% did the opposite. Among those who adhere to the same screening modality, a large majority of them (54.7% of women in the sample) chose organized screening over opportunistic screening.

Table I: Description of screening trajectories

Type	N	%
Switchers	53	11.3 %
Switch from Opp.S to Org. S	35	7 %
Switch from Org. S to Opp.S	18	4 %
Faithful	307	65.6 %
chose Opp S	51	11%
chose Org. S	256	54.7%
Irregular	108	23.1%

3.3 Socioeconomic and health status variables

Among the very rich set of socioeconomic characteristics in the ESPS survey, we chose to characterize individual's socioeconomic status by the age, educational attainment, household income per consumption unit, occupation, LAE index, and health insurance status. The objective is to account for the multi-dimensions of social inequalities. We compare our sample with what is found in the literature to assess our sample's representativeness.

As in Cambois and Jusot (2010), lifelong adverse events (LAE) index is measured using questions on isolation, housing issues and financial difficulties. We consider these experiences regardless of whether they occurred during childhood or adulthood or both [2].

We find that 9.5% of women in our sample experienced at least one event associated with social exclusion. But if we look at the representative sample of women aged between 50 and 74 years old (without restricting the sample to those who screened in 2006 or 2007), we find that 12% experienced an adverse life event. In Cambois and Jusot (2010), 20% of women reported one or more LAE. Our proportion remains under the one found by Cambois and Jusot (2010) for women of any age.

The household income, adjusted by the OECD equivalence scale, is divided in five quintiles and a category corresponding to missing information (23% of the sample) is added. We

[2] The question used are the following: (1) *Have you ever, during your life, experienced difficulties to pay your rent, charges (including electricity, telephone), your financial participation or reimbursement of loans for your housing?*; (2) *Have you, during your life, needed to move in with relatives or friends or to move into sheltered housing as a result of financial difficulties* ; (3) *Have you during your life experienced a long term period of isolation following an event undergone by your or your relatives (move to another area or country, serious conflict, institutionalization or incarceration...)*?

consider four educational levels: tertiary education, *Baccalauréat* level (end of high school), secondary education, primary or no education. Women's occupation at the time of the survey was reported in the following categories: working, retired, unemployed, housewife and disabled or other. Due to our restricted age group, 56.2% of women in the sample are inactive (according to the INSEE definition). This includes retired, unemployed individuals and housewives. We also control for employment type which means whether they are employed or self-employed.

Health insurance coverage is mandatory in France but complementary health insurance is not. Dependent on the level of income, it is possible to benefit from the Universal Health Care coverage (CMU-C). CMU-C beneficiaries are exempted from up-front fees, co-payment is covered and physicians are not allowed to apply balance billing. We separate beneficiaries of private complementary health insurance (93.4%) from the CMU-C beneficiaries (3%), and from those without any complementary coverage (3%) in 2006. If we don't restrict the sample to those who were already screened, we find that 5% have the CMU-C and that 7% don't have any complementary health insurance which is close to the national average.

Health status is measured with two commonly utilized health indicators. The first indicator is a self-assessed health status. It is constructed using the following question *How would you describe your state of health in general?*. Answers ranged from 1: Very good, 2: Good, 3: Fairly good, 4: Poor, 5: Very poor. The variable is dichotomized into two categories: good self-assessed health (responses 1 and 2) and poor self-assessed health (responses 3, 4 and 5). This categorization is used in a number of studies based on the same survey in which self-assessed health predicts mortality and health care demands (Idler and Benyamini (1997), Borg and Kristensen (2000) and Devaux et al. (2008)). In our sample, 54% declared themselves to be in good or very good health, which is 4% higher than if we don't exclude those who did not screened at least once. This difference may be explained by the fact that being in poor health is negatively correlated with screening at least once in one's life. So, women in poor health are under-represented in our sample containing only women who screened at least once.

The second indicator focuses on whether women have a chronic illness for which the National Health Insurance covers 100% of expenses related to this chronic illness. In this Long-term Chronic Disease (ALD) scheme, each chronic illness is classified in the International Classification of Diseases (CIM) and declared by the respondent in ESPS. It allows us to distinguish between cancer patients or those with another chronic illness. The variable is grouped in three categories: having cancer (any cancer except breast cancer as they are excluded from the sample), another chronic illness or none. We find that 79% of our sample report no chronic illness in 2006 while equivalent proportions have either cancer or another chronic illness (9% and 12% respectively). These proportions are almost equal if we don't restrict the sample to those who were screened at least once in 2006 or 2007.

To account for potential genetic transmission of health status, we included a measure of mother's relative longevity. We construct an indicator of their relative longevity using the information available in the ESPS survey of 2006. We use their vital status, year of death, year of birth and cause of death. Concerning the health status of deceased mothers, we use a method based on Trannoy et al. (2010). We compute the relative longevity of each mother using their year of birth and Vallin and Meslé (2001)'s longevity tables. The indicator is calculated as the difference between their age at death minus 15 and their expected longevity at 15 years old. At 15 years old, an individual has survived infantile mortality and will soon be in child-bearing age. The rationale behind this indicator is that individuals with better health status lived longer than other people of their generation, whereby all lived (or survived) long enough to be in age of having children. Each deceased mother is classified according to her relative longevity: she has a high longevity if she is above the median relative longevity, and has a low longevity if she is below the median relative longevity. We refine the measure of health status by using mothers' cause of death declared in an open-question format by their daughters. We only used answers indicating that they died of cancer as some answers did not include which type of cancer was the cause of death.

In the end, a mother's relative longevity is a categorical variable which equals 0 if she is still alive, 1 if she died of cancer, 2 if she died of other causes than cancer but her relative longevity is high, and 3 if she died of other causes but her relative longevity equals the median or is low. In case variables had missing values, we included a missing value dummy.

3.4 Health care consumption and radiologist accessibility

Relevant health care consumptions for the analysis of breast cancer screening are the number of consultations to GP, gynecologists and other SP in 2006 and 2008. We use administrative data of consultations reimbursement from the EPAS database to avoid declaration and recall biases. The number of visits to GP and SP are introduced in the analysis in tertiles to capture the distributional effects of consumption intensity. Since 50.9% of women in the sample did not visit a gynecologist in 2006 and 2008, the first category includes half of the sample. We excluded visits to a radiologist from the amount of visits to a SP, in order not to count for mammography use. Table II displays descriptive statistics of the sample.

We used aggregated indicators to characterize contextual health care supply at the level of the *département* where each woman lives. The density of radiologists is displayed per 100 000 women and only counts radiologists who perform medical imaging (it is only available for 2012). Variability of radiologists' fees is captured by the share of sector 2 radiologists among all radiologists between 2006 and 2009. They are both introduced as continuous variables. Table II and III displays the characteristics of the sample.

4 Estimation strategy

4.1 Determinants of screening regularity

We observe women who were screened once in 2006 or 2007 and the screening modality used. Then, we look at whether they were screened a second time in 2008 or 2009. If a woman was screened a second time in 2008 or 2009, it means that she was screened regularly according

Variable	Categories	Frequency	Percent
Education level	None/Primary edu	166	35.5
	Secondary edu	158	33.7
	A-level	74	15.8
	Tertiary edu	70	15
Monthly income per consumption unit	1st quintile	56	12
	2nd quintile	69	14.8
	3rd quintile	73	15.6
	4th quintile	76	16.2
	5th quintile	89	19
	Refused/Abandon	105	22.4
Occupation	Employed	184	39.3
	Retired	165	35.2
	Unemployed	35	7.5
	Housewife	63	13.5
	Disabled and others	21	4.5
Employment type	Self-employed	14	3
	Employee or other	454	97
	50-54	154	33
Age groups	55-59	108	23
	60-64	92	20
	65-69	57	12
	70-74	57	12
Lifelong Adverse Experience (LAE)	No LAE	421	90
	LAE	47	10
Health insurance coverage in 2006	None	20	4.3
	CMU	11	2.3
	Compl. health insu	437	93.4
Self-assessed health status	Average, Bad, Very bad	136	29.2
	Very Good, Good	254	54.2
	Refused/Abandon	78	16.6
Chronic illness	None	368	79
	Other chronic illness	55	12
	Cancer	45	9
Number of visits to gynecologist in 2006 and 2008	0 visit	238	50.9
	1 visit	67	14.32
	2 to 9 visits	163	34.83
Number of visits to other SP in 2006 and 2008	0 to 4 visits	171	36.54
	5 to 9 visits	145	31
	10 to 55 visits	152	32.46
Number of visits to GP in	0 to 8 visits	172	36.75
	9 to 14 visits	139	29.70
	15 to 65 visits	157	33.55
Mother's relative longevity	Alive	167	36
	Deceased of cancer	66	14
	Deceased of other causes - high longevity	97	21
	Deceased of other causes - low longevity	83	18
	Refused/Abandon	55	12

Table II: Sample's description

Variable	Mean (SD)	Min	Max
Radiologists density for 100 000 inhabitants per département	12.7 (5.38)	5	35
Share of sector 2/sector 1 of radiologists per département	11.52 (16.4)	0	57

Table III: Descriptive statistics of the health care supply

to the recommended time interval. Using a probit model, we investigate whether screening modality and a large set of socioeconomic and health variables are related to screening regularity. Conditionally on having screened at least once in 2006 or 2007, we are able to see whether screening modality influences screening regularity. This estimation strategy has two limitations. The first one is that unobserved factors (as a preference for compliance for example) can explain both the screening modality chosen and screening regularity. Hence, a screening modality may be chosen because the invitation system or getting prescription by gynecologists are believed to induce better compliance with the recommended screening regularity. The screening modality and screening regularity may be a joint simultaneous decision. Our empirical strategy accounts for this potential endogeneity by using a switching probit model.

The second limitation due to the use of a probit model is a potential sample selection problem since we only observe women's screening modality choice and regularity among those who were screened either in 2006 or 2007. We don't observe the chosen screening modality and the screening regularity for women who did not screen in 2006 and 2007. We can't control for potential sample selection problem while looking at the relationship between the screening modality chosen and screening regularity. This is because screening modality is only observable for those who were screened hence it can't be included in the selection equation of a Heckman selection model. The outcome equation would estimate $P(Regularity|Screened = 1, X = screeningmodality)$ and the selection equation would estimate $P(Screened, X = screeningmodality)$, which is impossible because we don't observe the screening modality for $P(Screened) = 0$, i.e. those who were not screened. The only solution would be to remove the screening modality from the selection equation. This would be incorrect, as screening modality is very unlikely to be uncorrelated with having screened at least once. As a result, our estimation strategy only controls for the endogeneity due to self-selection using a switching probit model in addition to the probit model.

4.1.1 Probit model

Denoted by R_i the outcome binary variable for the i_{th} individual of the probit model. Variable R_i equals one if a woman has screened regularly, and zero if she has not.
Denoted by S_i the binary variable of the i_{th} individual. Variable S_i equals one if the individual chose organized screening, and zero if she chose opportunistic screening. $X_{1,i}$ is a vector of socioeconomic determinants, health characteristics, health care consumptions and radiologist's presence at the level of the *départment*.

$$R_i = \alpha_1 S_i + \alpha_2 X_i + u_i \tag{1}$$

The errors are clustered at the level of the *départment* in all estimations as variables describing the health care system are scaled on the *départment* in which an individual lives in. Moreover, the national screening program is organized at the level of the *départment* such that whether the management structure participated in the pilot of the program, specific events organized in the *départementt*, strong engagement of the radiologists in the *départementt* may correlate unobserved heterogeneity across individuals living in the same *départementt*. We therefore allow for intra-départementt correlation.

4.1.2 Switching probit model

One of our variables of interest is the screening modality used in 2006 or 2007, which we expect to be endogenous. Women are able to self-select one modality in order to be screened more regularly. As a complement to the probit model results, our empirical strategy accounts for potential endogeneity by using a switching probit model (Lokshin, Newson et al. (2011)).

In this model, a switching equation sorts individuals over two regimes (screening modalities) and an outcome equation (screening regularity). We could have implemented other estimation procedures such as instrumental variable or recursive bivariate probit estimations. However, the switching probit method has several advantages compared to these other methods. It relaxes the assumption of equality between coefficients of the outcome equation in each screening modality. Hence determinants of screening regularity may differ according to which screening modality was used. According to Lokshin, Newson et al. (2011) and Altonji, Elder and Taber (2005), switching probit models perform better than instrumental variable regressions and bivariate recursive models, unless the proportions of women who were regularly screened and the proportions of women who chose organized screening are quite low. Figure 2 indicates the opposite: a higher proportion chose organized rather than opportunistic screening and a considerable share of women screened twice in the data period.

The switching probit model builds on a first equation for the potentially endogenous binary variable and a second equation determining the outcome of interest. Switching probit models are estimated using a full information maximum likelihood method to simultaneously estimate the binary selection and the binary outcome. As presented in Lokshin, Newson et al. (2011), the switching equation is:

$$\begin{aligned} S_i &= 1 \; if \; \gamma Z_i + \mu_i > 0 \\ S_i &= 0 \; if \; \gamma Z_i + \mu_i \leq 0 \end{aligned} \tag{2}$$

and the outcome equations are:

$$\begin{aligned} R_{1,i} &= \beta X_{1,i} + \epsilon_{1,i} \; if \; S_i = 1 \\ R_{0,i} &= \beta X_{0,i} + \epsilon_{0,i} \; if \; S_i = 0 \end{aligned} \tag{3}$$

$X_{1,i}$ and $X_{0,i}$ are vectors of independent variables, Z_i is a vector of variables determining a switch between organized and opportunistic screenings. μ_i, $\epsilon_{1,i}$ and $\epsilon_{0,i}$ are the error terms and are assumed to be jointly normally distributed with a zero-mean and a correlation matrix as:

$$\Omega = \begin{pmatrix} 1 & \rho_{\mu,0} & \rho_{\mu,1} \\ & 1 & \rho_{0,1} \\ & & 1 \end{pmatrix}$$

where $\rho_{\mu,0}$ is the correlation coefficients between μ_i and $\epsilon_{0,i}$ and $\rho_{\mu,1}$ is the correlation coefficient between $\epsilon_{1,i}$ and μ_i. However, we can not observe $\rho_{0,1}$ because screening regularity is not observed for women who chose organized screening if they had chosen opportunistic screening. The reverse is also true. It means that $R_{1,i}$ and $R_{0,i}$ are never observed simultaneously such as the joint distribution of $\epsilon_{0,i}$ and $\epsilon_{1,i}$ is not identified and $\rho_{1,0}$ cannot be estimated. In this model, it is assumed that $\rho_{1,0} = 1$. Even though this model is supposed to be identified by nonlinearities of its functional form, we use exclusion restriction variables. We assume that there exists a variable that determines the screening modality decision, but does not directly affect the outcome. Thus, Z_i and $X_{j,i}$ with $j = 0, 1$ include a set of regressors which are partly common in both equations.

The log-likelihood function for the simultaneous system of equations is:

$$\begin{aligned} ln\,\mathscr{L} \;=& \sum_{R_i=1,S_i=1} ln\left\{\Phi(X_i\beta_1, Z_i\gamma, \rho_{(\mu 1)})\right\} + \\ & \sum_{R_i=0,S_i=1} ln\left\{\Phi(-X_i\beta_1, Z_i\gamma, -\rho_{(\mu 1)})\right\} + \\ & \sum_{R_i=1,S_i=0} ln\left\{\Phi(X_i\beta_0, -Z_i\gamma, -\rho_{(\mu 0)})\right\} + \\ & \sum_{R_i=0,S_i=0} ln\left\{\Phi(-X_i\beta_0, -Z_i\gamma, \rho_{(\mu 0)})\right\} \end{aligned} \tag{4}$$

where Φ is the cumulative function of a bivariate normal distribution. To ensure that estimated $\rho_{\mu,1}$, $\rho_{\mu,0}$ are bounded between -1 and 1, the maximum likelihood directly estimates: $atanh_{\rho j} = \frac{1}{2} ln(\frac{1+\rho_j}{1-\rho_j})$ for $j = 1, 2$. If it is significant, unobserved determinants generate self-selection into a regime (a screening modality) and influence screening regularity. This may have lead to biased estimates if unobserved heterogeneity is not accounted for. Errors are also cluster at the level of the *département*.

Equation 4 represents the estimated switching probit model. The objective is to compare the marginal effect of the screening modality chosen resulting from the switching probit model with the marginal effect of the screening modality resulting from the probit model.

Identification strategy: The covariates included in the selection and outcome equations were selected using a general-to-specific approach. We started from a general specification including the variables used in the probit model (equation 1) for both equations.

In this general model, we ran exclusion Wald tests for all variables in each equation. Variables that were statistically significant at 10% or more for at least one equation were retained in the specifications for both equations. Through this variable selection process, we chose different variables for inclusion in screening modality and regularity equations: the difference being the exclusion restriction variable. The final specification of the screening regularity equation includes: age groups, mother's relative longevity (for statistical power reasons we do not differentiate deceased mothers by relative longevity), occupation, employment type, household income quintiles, whether experienced adverse life events, insurance coverage (for statistical power reasons, it is simplified to a dummy variable which equals 1 if she has a complementary private health insurance and 0 if she has none or CMU-C), the number of consultations to a GP, specialist and gynecologists, self-assessed health, radiologist's density and the share of sector 2 radiologists in their *départment*. The final specification of the screening modality equation includes the same variables and one exclusion restriction variable.

The restriction exclusion variable is the participation rate in the program per *département* in 2005. If a higher participation rate is observed in a département, someone who lives in this *département* may be more likely to use organized screening in the subsequent years. General engagement of the health care system network and peer effects may encourage the use of organized screening rather than opportunistic screening in 2006 or 2007.

4.2 Determinants of screening trajectories

The second part of the analysis investigates screening trajectories. We distinguish between women who switched from one screening modality to another while screening regularly, women who screen regularly and who are faithful to a screening modality and women who do not screen regularly.

We use multinomial logit to study the determinants of each screening trajectories. Denoted by $P(R_i = j)$ the probability to choose j such that:

$$j \begin{cases} = 0 & \text{if} \quad Not \quad regular \\ = 1 & \text{if} \quad Regular \quad \& \quad Switch \\ = 2 & \text{if} \quad Regular \quad \& \quad No \quad Switch \end{cases} \tag{5}$$

The explanatory variable are the same ones than the ones used in the probit model.

5 Estimation results

5.1 Determinants of screening regularity

5.1.1 Probit model

The first column of table IV shows the probit model estimation results whereas the second column presents the marginal effects. Using the national screening program compared to opportunistic screening increases the probability of regular screening by 7.4%. In line with previous studies, we observe social inequalities in screening regularity due to adverse life events and household income. Women at the top of the income distribution (4th and 5th quintiles) are screened more regularly than those at the bottom of the income distribution.

A direct extension of this result is to measure whether the effect of socioeconomic variables depends on the screening modality used. Indeed, Espinas et al. (2011) assess equity of access to breast and cervical cancer screening when organized and opportunistic screening is used in Catalonia. They find that equity of access to breast cancer increased for the less educated targeted women when organized screening was implemented. Palència et al. (2010) observe socioeconomic inequalities of access to screening in European countries only having opportunistic screening is used but fewer access issues exist where organized screening is in place. To test the hypothesis, we interacted the household income and education variables with the screening modality. None of them was statistically significant. Neither income nor education's effects differ with using organized or opportunistic screenings.

Screening regularity also depends on access to all physicians (GP, gynecologists and other SP). A gradient can be observed for both the number of gynecologist and other SP consultations. Compared with the first tertile, women who consult a gynecologist twice or more in 2006 and 2008 are by 17.3% more likely to undergo regular screening. Visiting a GP quite often (being in the second tertile of the distribution) compared to less frequently, is positively associated with screening regularity.

Being retired compared to being employed, a house wife or disabled increases the likelihood to undergo regular screening. These results are interpretable in the light of the growing literature on the relationship between retirement and health status. Explanations brought forward to explain the positive relationship between retirement and health status includes a reduction in smoking, relief from work-related stress and strain, increased sleep duration and increased physical activity (Eibich (2015) and Insler (2014)). A hypothesis (to be investigated in future work) is the positive effect of retirement on engagement in secondary preventive care such as cancer screening. In addition, self-employed women are less likely to undergo screening than employees (based on their former employment type when they declare being retired in the survey).

Increasing radiologist density for 100 000 inhabitants by 10 radiologists decreases the probability of regular screening by 5% and increasing the share of balance billing radiologists by 10% diminishes the probability to undergo screening by 2.5% [3]. The opposite result was expected concerning the impact of the density of radiologist on screening regularity. As the highest radiologist density is in Paris, we estimated the model without Parisian women (table in the Appendix VIII). Radiologist density is not statistically significant anymore whereas it only reduces the marginal effect of the share of sector 2 radiologists by 0.5%.

Women aged 70 to 74 years old are less likely to undergo regular screening than younger ones. However, this result may be due to the eligibility criteria for the national program. In this study, they are surveyed in 2006 and if they are aged 72 to 74 years old in 2006, they are not eligible for the program anymore in 2008 or 2009. So they have less incentive to undergo a second screening. Note, that excluding women aged 72 to 74 from the estimated model does not change the results apart from increasing the effect of using organized screening (see in table VIII in appendix C). Surprisingly, not being covered by any health insurance is associated with increasing screening regularity. Nonetheless, this result is similar to the findings of Picone, Sloan and Taylor Jr (2004). This can possibly be explained by the fact that in situations where moral hazard prevails, an individual who is covered by a health insurance may increase their exposure to risk by diminishing their demand for preventive health care such as cancer screening (Kenkel (2000)). Both self-assessed health and the ALD status have no statistically significant effect on screening regularity.

There is a remaining uncertainty on the measure of screening modality. The code used in the CCAM for organized screening can also count mammography undertook by women at high-risk. Women with gynecological cancers (uterus and ovarian cancer) and non-gynecological cancers (thyroid, melanoma or kidney cancers) are reported to be at high-risk for breast cancer in the HAS (2012)'s report on breast cancer screening for high-risk individuals. In this case, the mammography performed may be part of a follow-up strategy rather than a screening strategy. The estimation is therefore run without women who declared being

[3]Interaction terms between radiologist density and the share of balance billing sector 2 radiologist is not significant. The correlation coefficient between these variables is 0.56 (P-value$<$0.01) so we introduce them separately in the model. Each one of them remains significant.

cancer patient in 2006 (in table VIII in appendix C) but it does not significantly change the results. As an additional control, we estimated the model including primary preventive care indicators (smoking and BMI) and other secondary preventive care engagements (Pap-Smear and bowel cancer tests). None of them had a statistically significant effect so they were not included in the final specification.

Finally, the fit of the model is evaluated using the size of the area under the Roc curve (in figure4 in appendix B). According to Hosmer Jr and Lemeshow (2004), areas under the Roc curve of 70 to 80% is acceptable. The area under the Roc curve for our model is 78.5%, suggesting that the model has a good fit.

5.1.2 Switching probit model

Table V presents the results of the switching probit model, in which the choice of screening modality is not considered as exogenous. The first column displays the switching equation, where the dependent variable equals 1 if the woman chose organized screening and 0 if she chose opportunistic screening. A clear profile of women who screen opportunistically can be extracted. They are the wealthiest women of the sample, have private complementary health insurance and are more likely to have visited a gynecologist at least once. Conversely, any women whose income falls within the first four quintiles is more likely to choose organized screening compared to those in the top income category. The same choice is observed amongst the CMU-C beneficiaries and those with no complementary health insurance (when pooled) compared to those with a private complementary health insurance. We don't find any significant impact of education in this study whereas Damiani et al. (2012) report that less educated women tend to favor organized screening in Italy.

Concerning the exclusion restriction variable, the participation rate in 2005 is positively associated with choosing organized screening over opportunistic screening in 2006 or 2007.

We now consider results of the screening regularity equation. If screening modality and screening regularity are jointly determined, then $\rho_{(\mu,0)}$ and $\rho_{(\mu,1)}$ should be statistically dif-

Table IV: Estimated coefficients and marginal effects of the probit model

	Screening regularity			
	Coeff.	S.E.	Marg. effect	S.E.
Organized screening	0.301**	0.154	0.074**	0.038
Income (ref: 1st quintile)				
2nd quintile	0.321	0.269	0.096	0.080
3rd quintile	0.484	0.319	0.139	0.091
4th quintile	0.810***	0.300	0.214***	0.082
5th quintile	0.675**	0.327	0.185**	0.089
NA	0.552*	0.300	0.156*	0.085
Had LAE	-0.610***	0.232	-0.151***	0.055
Occupation (ref: retired)				
Employed	-0.575**	0.291	-0.134**	0.064
Unemployed	-0.517	0.321	-0.119	0.075
House wife	-0.423	0.267	-0.094	0.059
Disabled or other	-0.827**	0.415	-0.207**	0.106
Age groups (ref: 50-54 yo)				
55-59 y.o.	-0.147	0.192	-0.034	0.045
60-64 y.o.	0.065	0.247	0.014	0.053
65-69 y.o.	-0.472	0.376	-0.121	0.099
70-74 y.o.	-0.656*	0.390	-0.176*	0.108
Education (ref: none - primary edu)				
Secondary edu	0.286	0.212	0.067	0.051
A-level	-0.352	0.248	-0.099	0.069
Tertiary edu	0.206	0.257	0.050	0.061
Self-employed	-0.742**	0.307	-0.215**	0.095
Compl. Health insu				
No suppl insu	0.942*	0.485	0.167*	0.055
CMU	-0.387	0.379	-0.107	0.114
SAH (ref: poor health)				
Good health	0.039	0.185	0.009	0.045
NA	-0.159	0.280	-0.041	0.073
Chronic illness (ref: no chronic illness)				
Other than cancer	-0.114	0.237	-0.029	0.061
Cancer	-0.201	0.241	-0.052	0.065
Mother's relative longevity (ref: alive)				
Deceased of cancer	0.423*	0.244	0.091*	0.050
Deceased of other reason - High Longevity	-0.169	0.246	-0.044	0.064
Deceased of other reason - Low Longevity	-0.098	0.199	-0.025	0.051
NC	0.000	0.355	0.000	0.088
Nb of visits to gyneco (ref: 0 visit)				
1 visit	0.395*	0.218	0.106*	0.054
2 to 9 visits	0.745***	0.174	0.178***	0.037
Nb of visits to GP (ref: 0 to 8 visits)				
9 to 14 visits	0.296*	0.169	0.072*	0.041
15 to 65 visits	0.092	0.193	0.024	0.049
Nb of visits to SP (ref: 0 to 4 visits)				
5 to 9 visits	0.289*	0.159	0.076*	0.042
10 to 55 visits	0.508**	0.222	0.125**	0.054
Radiologist density	-0.0209*	0.012	-0.005*	0.003
Share of sector 2 radiologist	-0.0102**	0.004	-0.003**	0.001
Constant	0.397	0.398		

ferent from zero. This is not the case as the Wald test statistic is equal to 0.47 with $P - value > 0.1$, leading to a non rejection of the exogeneity of screening modality with respect to screening regularity. There is no residual unobserved heterogeneity inducing self-selection into a screening modality and into undergoing regular screening. This result implies that it is unlikely that screening modality's coefficient is biased. Further analysis may be performed without controlling for the potential endogeneity of the chosen screening modality.

Variables which are statistically significantly associated with screening regularity change slightly according to the screening modality chosen. The most striking difference in the comparison between organized and opportunistic screening use are as follows. Firstly, even if household income is significant for both modalities, the effect is much larger in the case of opportunistic screening. Consulting a GP or a gynecologist only has a statistically significant effect for those who undertook opportunistic screening. This result makes sense to the extent that gynecologists and GPs are the more likely to prescribe opportunistic screenings.

Having experienced life adverse events is strongly and negatively associated with screening regularity, but only in the case of organized screening. Conditional on choosing organized screening, the effect of age seems to be not linear. Women over 65 years old as well as those aged 50 to 54 are less likely to screen regularly than younger ones. Conditional on choosing opportunistic screening, the oldest women of the sample screen more regularly compared to the reference age category. Again, this may be due to the eligibility criteria to the program. For instance, if they were 72 years old in 2006 or 2007 and chose organized screening, they will not be re-invited in 2008 or 2009, which sharply diminishes the likelihood of repeat screening. Therefore, they are more likely to screen regularly if they chose opportunistic screening.

Additionally, we compute the average marginal effect as the difference between the average probability of using organized screening and to screen regularly on the one hand, and on the other hand the average probability of using opportunistic screening and screening regularly. It corresponds to $P(S = 1, R = 1) = 0.789$ and $Pr(S = 0, R = 1) = 0.711$. The mean difference between the two probabilities is statistically significant at the 1% level ($P - value <$

0.01). Holding other variables constant, using organized screening increases, on average, the probability of regular screening by 7.8%. There is a 0.4% difference between the estimation of the effect using a probit model and the estimation made under the switching probit model.

Various diagnostic tests were run to determine the instrument's validity. The Kleibergen-Paap test was calculated on a linearized form using linear instrumental variable regression. We could reject the null hypothesis of under-identification (LM statistic 11.857 with a $P-value < 0.001$). The test proposed by Stock and Yogo (2005) was used to investigate the potential of a weak instrument problem. The hypothesis of weak instrument was rejected with a Cragg-Donald Wald F statistic of 20.081 and critical values of the Stock-Yogo test of 16.38 for 10% size of the Wald test. A last test of the validity of the instrument was conducted by including instruments in the outcome equations. The estimation is not identified through non-linearity. If models are estimated independently, the instrument is insignificant in the screening regularity equation and significant in the screening modality equation.

5.2 Determinants of screening trajectories

The model's base line category is composed of women who screen irregularly and thus not switchers [4]. Estimated results indicate that women who chose to undergo organized rather than opportunistic screening, are more likely to screen regularly while being faithful than screen only once. But women who used organized screening are less likely to screen regularly and being switchers than not screening a second time. The latter result is driven by the 4% of the sample (18 women) who switched from organized to opportunistic screening. For the category of faithful and regular screening, the results are very similar to the results of the probit estimation.

Moreover, women whose mother died of cancer, compared to those whose mother is alive,

[4] The same model was estimated using faithful and regular women as baseline category. Its result are in the appendix D in table IX. Conditional on screening regularly, organized screening leads to being faithful rather than to switch between screening modalities.

Table V: Estimated coefficients of the switching probit model

	Org. screening		Screening regularity: Org. screening		Screening regularity: Opp. screening	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Age groups (ref: 50-54 yo)						
55-59 y.o.	-0.0127	0.173	-0.488*	0.281	0.171	0.39
60-64 y.o.	-0.0954	0.239	-0.376	0.338	0.326	0.488
65-69 y.o.	-0.0639	0.246	-1.116**	0.455	1.547	1.073
70-74 y.o.	-0.0127	0.327	-1.416***	0.442	3.121***	0.628
Income (ref: 1st quintile)						
2nd quintile	-0.0727	-0.356	0.328	-0.286	-0.197	-0.975
3rd quintile	0.0346	-0.35	0.426	-0.305	-0.502	-0.718
4th quintile	-0.183	-0.325	0.735**	-0.353	1.380**	-0.562
5th quintile	-0.630**	-0.3	0.476	-0.497	0.951*	-0.564
NA	-0.321	-0.344	0.524	-0.378	0.72	-0.543
Had LAE	-0.256	0.178	-0.964***	0.277	-0.194	0.594
Self-employed	-0.26	0.387	-0.68	0.419	0.278	0.469
Compl. health insu	-0.647**	0.315	-0.405	0.387	-0.63	0.878
Good health	0.298*	0.168	0.121	0.218	0.391	0.399
Nb of visits to gyneco (ref:0 visit)						
1 visit	-0.444**	0.223	0.461	0.389	0.488	0.631
2 to 9 visits	-0.545***	0.191	0.451	0.342	1.240**	0.488
Nb of visits to GP (ref: 0 to 8 visits)						
9 to 14 visits	0.000	0.198	0.219	0.207	1.029**	0.448
15 to 65 visits	-0.25	0.209	0.007	0.262	0.131	0.401
Nb of visits to SP (ref:0 to 4 visits)						
5 to 9 visits	0.115	0.186	0.327	0.201	0.274	0.418
10 to 55 visits	-0.0344	0.193	0.503*	0.289	0.6	0.392
Radiologist density	-0.00742	0.0119	-0.0284*	0.0164	-0.0406	0.0287
Share of sector 2 radiologist	-0.00005	0.00484	-0.0102**	0.00515	-0.0166	0.0107
Occupation (ref: retired)						
Employed	-0.0172	0.236	-0.693**	0.344	-1.224*	0.647
Unemployed	-0.192	0.308	-0.776**	0.381	-0.443	0.779
House wife	-0.237	0.195	-0.272	0.272	-1.833***	0.623
Disabled or other	0.493	0.444	-0.864*	0.493	-0.933	0.838
Mother's relative longevity (ref: alive)						
Cancer	-0.136	0.252	0.389	0.331	0.674	0.568
Other cause	0.104	0.186	-0.0169	0.227	-0.536	0.443
N.C.	0.293	0.246	-0.0588	0.403	0.335	0.545
Participation rate in 2005	0.0332***	0.00774				
Constant	0.428	0.704	1.487**	0.583	0.615	2.093
$\rho_{\mu,0}$					-0.126	0.816
$\rho_{\mu,1}$			0.549	0.871		
Wald test	0.41 with $Prob > chi2 = 0.81$					

Table VI: Estimated coefficients of the multinomial model

Baseline: irregular screen	Faithful and regular screen		Switcher and regular screen	
	Coeff.	S.E.	Coeff.	S.E.
Organized screening	1.032***	0.259	-1.515***	0.488
Income (ref: 1st quintile)				
2nd quintile	0.693	0.463	-0.467	0.965
3rd quintile	1.026*	0.588	-0.123	0.943
4th quintile	1.308**	0.519	1.498*	0.782
5th quintile	1.100*	0.585	1.436*	0.862
NC	1.097*	0.622	0.707	0.755
Had LAE	-1.453***	0.401	0.0909	0.62
Occupation (ref: retired)				
Employed	-1.107**	0.514	-0.965	0.712
Unemployed	-1.048*	0.603	-0.503	0.724
House wife	-0.675	0.428	-1.522**	0.666
Disabled or other	-1.413*	0.722	-14.79***	0.812
Self-employed	-1.406**	0.557	-1.47	0.94
Age groups (ref: 50 to 54 y.o.)				
55-59 y.o.	-0.346	0.335	-0.247	0.702
60-64 y.o.	-0.122	0.423	0.853	0.638
65-69 y.o.	-0.917	0.705	-0.704	0.922
70-74 y.o.	-1.516**	0.668	0.589	0.845
Education (ref: none or primary)				
Secondary edu	0.545	0.386	0.164	0.454
A-level	-0.558	0.45	-0.706	0.64
Tertiary edu	0.589	0.478	0.0511	0.647
Compl. Health insu				
No suppl insu	1.775*	0.966	1.564	1.094
CMU-C	-0.456	0.67	-13.89***	0.855
Chronic illness				
Other than cancer	-0.163	0.439	-0.46	0.606
Cancer	-0.157	0.461	-1.061	0.744
SAH				
Good health	0.006	0.345	0.155	0.509
NA	-0.285	0.51	-0.345	0.958
Mother's relative longevity (ref:alive)				
Deceased of cancer	0.835*	0.429	0.187	0.824
Deceased of other reason - High Longevity	-0.378	0.433	-0.395	0.658
Deceased of other reason - Low Longevity	-0.181	0.348	-0.0356	0.696
NC	-0.0923	0.721	-0.00512	0.934
Nb of visits to gyneco (ref: 0 visit)				
1 visit	0.722*	0.392	0.492	0.574
2 to 9 visits	1.257***	0.308	1.591***	0.467
Nb of visits to GP (ref:0 to 8 visits)				
9 to 14 visits	0.698**	0.335	-0.112	0.482
15 to 65 visits	0.35	0.313	-0.435	0.568
Nb of visits to SP (ref:0 to 4 visits)				
5 to 9 visits	0.421	0.3	0.532	0.517
10 to 55 visits	0.764*	0.408	1.092*	0.616
Radiologist density	-0.0483**	0.0244	-0.0117	0.0316
Share of sector 2 radiologist	-0.0138	0.00866	-0.0383**	0.0152

are less likely to screen irregularly than to screen regularly and being faithful. Being active (employed, housewife, disabled or unemployed) compared to being retired decreases the likelihood of being faithful to one screening modality and screen regularly. For the category of switchers women who screen regularly, the three main differences concern health insurance, GP consultations and radiologist's density. Beneficiaries of the CMU-C compared to those with private complementary heath insurance are less likely to screen regularly when compared to switchers. Women living in a *département* with a higher share of balance billing radiologists are more likely to screen only once than to switch. This could be explained by the fact that those who experienced monetary costs when screening (because they screened opportunistically and pay for a mammography) are less likely to screen a second time.

To return to the drawbacks of organized screening, we refine the analysis by interacting the screening modality with the household income variable to see if there is a differentiated effect of organized screening by income levels. If the negative effect of using organized screening compared to opportunistic screening is especially strong for poor women, it may be because they can't afford to switch to opportunistic screening and therefore screen only once. If richer women are dissatisfied with the national screening program, they can switch to opportunistic screening.

The income variable is grouped so that it equals 0 if the individual belongs to the 1^{st}, 2^{nd} or 3^{rd} quintile of the income distribution, 1 if the individual belongs to the 4^{th} or 5^{th} income quintile, and 2 if the individual refused to report her income.

Table VII shows that using the national program while being poor decreases the likelihood to switch and screen regularly when compared to not screening again. The interacted term suggests that this effect is diminished when the woman is richer or when she did not report her income level. As a result the negative effect of using organized screening while being poor is much greater (-3.801) than when the woman is richer ($-3.801 + 3.366 = -0.435$). Note that most of the switchers from organized to opportunistic screenings fall into the rich category (13 out of 18 are rich women against only 2 out of 18 are poor). The detrimental effect of using organized screening works through low income women.

Table VII: Multinomial logit with interaction terms

Switchers and regular Baseline: irregular screening		
	Coeff.	S.E.
Organized screening	-3.801***	0.989
Rich	.0401	0.727
N.C.	-.483	0.878
Organized screening X Income		
Rich and organized screening	3.366**	1.067
N.C. and organized screening	2.727*	1.408

To summarize, organized screening still has a positive effect on screening regularity, conditional on women remaining faithful to the screening modality chosen. But using organized screening has a detrimental effect on screening regularity should the woman in question be a switcher. The latter effect seems to be especially strong among poorer women. It is emphasized that women who can afford to use opportunistic screening are more likely to switch, and therefore, more likely to undergo regular screening than the poorer ones.

6 Concluding remarks and discussion

This study sheds some light on the determinants of screening regularity and screening trajectories in France between 2006 and 2009.

We first used a probit and then a switching probit model, to assess screening regularity determinants. Falling into a low income category or having experienced life adverse events decreases the likelihood to screen regularly. Income affects opportunistic screening more strongly than organized screening while LAE's effect is only present in organized screening as shown in the switching probit model's results. These effects reflect both the low adherence to health care programs of individuals in precarious situations and the lower willingness of low income groups to pay for costly screening. Consulting GPs, gynecologists and other SP influence the likelihood of undergoing a second mammography, although consultations to GP and gynecologists only remain significant for opportunistic screening when screening regularity equations are estimated separately. This is perhaps due to the prescription required to undertake screening opportunistically, contrary to organized screening. These results confirm the need to reduce inequalities in access to all physicians, and especially to gynecologists as its effect is much greater than for other physicians. While there is no effect of radiologist density once Paris is excluded, living in a *département* with a higher share of balance billing radiologists decreases the probability to screen regularly.

According to our results, using organized screening is positively associated with screening regularity to the point that it increases by 7.4% the likelihood to undergo screening regularly between 2006 and 2009. Organized screening would favor screening regularity since the expected time and financial costs (related to physician's prescription and out-of-pocket expenses) are lower than for opportunistic screening. We try to distinguish between these two potential channels by which organized screening influence positively regular screening. We interact income and occupation with the screening modality chosen in table X in appendix E. If financial costs is a potential channel, then the effect of income should differ according to which screening modality is used as financial costs is less of a barrier for wealthier individuals. Similarly, there is less time constraint for retired individuals than for active ones, so that the effect of being retired compared to being active should be more important for opportunistic screening users than for organized screening users. While the interaction between income and screening modality is not significant, we find that the effect of being retired compared to being active is greater when opportunistic screening is used.

Finally, organized screening has an invitation system that reminds eligible women to screen and it is more likely to affect receivers that care about the invitation since she used it before. Our data does not allow us to assess if the effect of the screening modality on screening regularity differs because of the existence of the invitation system.

Although we can't distinguish between all channels through which screening modality affects screening regularity, it is likely that time costs and reminders explain our main result.

Regarding screening trajectories, a very large proportion (65.6%) of women are faithful to the screening modality chosen. Among those who switched (11%), 7% of them switched from opportunistic to organized screening. This can be explained by the recent implementation of the program, thus women alter their screening practices to participate in the program. Only 4% of women, who switched between screening modalities, changed from organized to opportunistic screening. Multinomial model's results suggest that using the program may also have a detrimental effect on screening regularity. The effect is driven by women falling into the fourth quintile of the income distribution. This means that only richer women can afford to switch from organized to opportunistic screening whereas poorer women would not screen a second time during the period. Otherwise, organized screening encourages a faithful practice of screening amongst women who screen regularly.

Deriving policy implications on the influence of screening modality on regular screening for today is not possible since screening participation may have evolved since 2009. However, it shows that the coexistence of two screening modalities for breast cancer needs to be taken into account when implementing and evaluating screening programs.

References

Allonier, Caroline, Paul Dourgnon, and Thierry Rochereau. 2008. "The 2006 Health, Health Care and Insurance Survey, a panel for health policies analysis, public health and health economics research." *Irdes, Questions d'économie de la santé*, , (131). 11

Altonji, J., T. Elder, and C. Taber. 2005. "Selection on Observed and Unobserved Variables: Assessing the Effectiveness of Catholic Schools." *Journal of Political Economy*, 1(113): 151?–84. 21

Beck, François, Arnaud Gautier, Agnès Buzyn, and Thanh Le Luong. 2012. *Baromètre cancer 2010.* Inpes. 2

Borg, Vilhelm, and Tage S Kristensen. 2000. "Social class and self-rated health: can the gradient be explained by differences in life style or work environment?" *Social science & medicine*, 51(7): 1019–1030. 15

Bricard, Damien. 2013. "Construction des inégalités des chances en santé à travers les modes de vie." PhD diss. Université Paris Dauphine-Paris IX. 7

Cambois, Emmanuelle, and Florence Jusot. 2010. "Contribution of lifelong adverse experiences to social health inequalities: findings from a population survey in France." *The European Journal of Public Health*, ckq119. 7, 14

Carrieri, Vincenzo, and Ansgar Wübker. 2013. "Assessing inequalities in preventive care use in Europe." *Health policy*, 113(3): 247–257. 2, 6

Damiani, Gianfranco, Bruno Federico, Danila Basso, Alessandra Ronconi, Caterina BNA Bianchi, Gian M Anzellotti, Gabriella Nasi, Franco Sassi, and Walter Ricciardi. 2012. "Socioeconomic disparities in the uptake of breast and cervical cancer screening in Italy: a cross sectional study." *BMC public health*, 12(1): 99. 27

Damschroder, Laura J, Brian J Zikmund-Fisher, and Peter A Ubel. 2005. "The impact of considering adaptation in health state valuation." *Social science & medicine*, 61(2): 267–277. 8

Desprès, Caroline, S Guillaume, and PE Couralet. 2009. "Le refus de soins à l?égard des bénéficiaires de la Couverture maladie universelle complémentaire à Paris." *Fonds de financement de la protection complémentaire de la couverture universelle du risque maladie. La documentation française, Paris.* 9

Devaux, Marion, and Michael Looper. 2012. "Income-Related Inequalities in Health Service Utilisation in 19 OECD Countries, 2008-2009." *OECD Health Working Paper*, 6(58): 649–654. 6

Devaux, Marion, Florence Jusot, Catherine Sermet, and Sandy Tubeuf. 2008. "Hétérogénéité sociale de déclaration de l'état de santé et mesure des inégalités de santé." *Revue française des affaires sociales*, , (1): 29–47. 15

Dormont, Brigitte, and Mathilde Péron. 2014. "Does Health Insurance Encourage the Rise in Medical Prices? A Test on Balance Billing in France." *A Test on Balance Billing in France (December 19, 2014)*. 10

Duffy, S, and E Paci. 2012. "Bénéfices et risques du dépistage du cancer du sein par mammographie." *BEH*, 35: 406–411. 2

Duport, N. 2012. "Characteristics of women using organized or opportunistic breast cancer screening in France. Analysis of the 2006 French Health, Health Care and Insurance Survey." *Revue d'épidémiologie et de santé publique*, 60(6): 421–430. 8

Eibich, Peter. 2015. "Understanding the effect of retirement on health: Mechanisms and Heterogeneity." 25

Espinas, Josep A, Luisa Aliste, Esteve Fernandez, Josep M Argimon, Ricard Tresserras, and Josep M Borras. 2011. "Narrowing the equity gap: the impact of organized versus opportunistic cancer screening in Catalonia (Spain)." *Journal of medical screening*, 18(2): 87–90. 24

Fleisher, Jay M, Jennie Q Lou, and Maria Farrell. 2008. "Relationship between physician supply and breast cancer survival: a geographic approach." *Journal of community health*, 33(4): 179–182. 9

Gorey, Kevin M, Isaac N Luginaah, Karen Y Fung, Emma Bartfay, Caroline Hamm, Frances C Wright, Madhan Balagurusamy, and Eric J Holowaty. 2010. "Physician supply and breast cancer survival." *The Journal of the American Board of Family Medicine*, 23(1): 104–108. 10

HAS. 2012. "Dṕistage du cancer du sein en France : identification des femmes à haut risque et modalitś de dépistage. Volet 1." Haute Autorité de Santé. 26
.

, Haute Autorité de Santé. 2011. "La participation au dépistage du cancer du sein des femmes de 50 à 74 ans en France Situation actuelle et perspectives d'évolution." Haute Autorité de Santé - Barré, Stéphanie and Hirtzlin, Isabelle. 2, 4

Hosmer Jr, David W, and Stanley Lemeshow. 2004. *Applied logistic regression.* John Wiley & Sons. 27

Hsia, Judith, Elizabeth Kemper, Catarina Kiefe, Jane Zapka, Shoshanna Sofaer, Mary Pettinger, Deborah Bowen, Marian Limacher, Linda Lillington, and Ellen Mason. 2000. "The importance of health insurance as a determinant of cancer screening: evidence from the Women's Health Initiative." *Preventive medicine*, 31(3): 261–270. 9

Idler, Ellen L, and Yael Benyamini. 1997. "Self-rated health and mortality: a review of twenty-seven community studies." *Journal of health and social behavior*, 21–37. 15

Insler, Michael. 2014. "The health consequences of retirement." *Journal of Human Resources*, 49(1): 195–233. 25

Jensen, LF, AF Pedersen, B Andersen, M Fenger-Grøn, and P Vedsted. 2013. "Distance to screening site and non-participation in screening for breast cancer: a population-based study." *Journal of Public Health*, fdt068. 9

Jusot, Florence, Zeynep Or, and Nicolas Sirven. 2012. "Variations in preventive care utilisation in Europe." *European Journal of Ageing*, 9(1): 15–25. 2, 6

Kash, Kathryn M, Jimmie C Holland, Marilyn S Halper, and Daniel G Miller. 1992. "Psychological distress and surveillance behaviors of women with a family history of breast cancer." *Journal of the National Cancer Institute*, 84(1): 24–30. 8

Kenkel, Donald S. 2000. *Prevention.In Culyer A. J. and J. P. Newhouse (eds.), Ch. 31. Handbook of health economics.* Elsevier. 26

Le Breton-Lerouvillois, G. 2014. "Conseil national de l?ordre des médecins." *Atlas de La Démographie Médicale En France-Situation Au 1er Janvier*, 2014. 9

Lokshin, Michael, Roger B Newson, et al. 2011. "Impact of interventions on discrete outcomes: Maximum likelihood estimation of the binary choice models with binary endogenous regressors." *Stata Journal*, 11(3): 368–385. 20, 21

Menvielle, Gwenn, Jean-Baptiste Richard, Virginie Ringa, Rosemary Dray-Spira, and François Beck. 2014. "To what extent is women?s economic situation associated with cancer screening uptake when nationwide screening exists? A study of breast and cervical cancer screening in France in 2010." *Cancer Causes & Control*, 1–7. 7

Ouedraogo, Samiratou, Tienhan S Dabakuyo, Julie Gentil, Marie-Laure Poillot, Vincent Dancourt, and Patrick Arveux. 2011. “Population-based study of breast cancer screening in Cote d’Or (France): clinical implications and factors affecting screening round adequacy.” *European Journal of Cancer Prevention*, 20(6): 462–474. 4

Palència, Laia, Albert Espelt, Maica Rodríguez-Sanz, Rosa Puigpinós, Mariona Pons-Vigués, M Isabel Pasarín, Teresa Spadea, Anton E Kunst, and Carme Borrell. 2010. “Socio-economic inequalities in breast and cervical cancer screening practices in Europe: influence of the type of screening program.” *International Journal of Epidemiology*, dyq003. 25

Picone, Gabriel, Frank Sloan, and Donald Taylor Jr. 2004. “Effects of risk and time preference and expected longevity on demand for medical tests.” *Journal of Risk and Uncertainty*, 28(1): 39–53. 26

Riis, Jason, George Loewenstein, Jonathan Baron, Christopher Jepson, Angela Fagerlin, and Peter A Ubel. 2005. “Ignorance of hedonic adaptation to hemodialysis: a study using ecological momentary assessment.” *Journal of Experimental Psychology: General*, 134(1): 3. 8

Sicsic, Jonathan, and Carine Franc. 2014. “Obstacles to the uptake of breast, cervical, and colorectal cancer screenings: what remains to be achieved by French national programmes?” *BMC health services research*, 14(1): 465. 2, 7, 8, 9

Stock, James H, and Motohiro Yogo. 2005. “Testing for weak instruments in linear IV regression.” *Identification and inference for econometric models: Essays in honor of Thomas Rothenberg.* 30

Trannoy, Alain, Sandy Tubeuf, Florence Jusot, and Marion Devaux. 2010. “Inequality of opportunities in health in France: a first pass.” *Health economics*, 19(8): 921–938. 16

Trivedi, Amal N, William Rakowski, and John Z Ayanian. 2008. “Effect of cost sharing on screening mammography in Medicare health plans.” *New England Journal of Medicine*, 358(4): 375–383. 9

Vallin, Jacques, and France Meslé. 2001. *Tables de mortalité françaises pour les XIXe et XXe siècles et projections pour le XXIe siècle.* Éditions de l’Institut national d’études démographiques. 16

Van Doorslaer, Eddy, Cristina Masseria, Xander Koolman, et al. 2006. “Inequalities in access to medical care by income in developed countries.” *Canadian medical association journal*, 174(2): 177–183. 8

Vogt, Verena, Martin Siegel, and Leonie Sundmacher. 2014. “Examining regional variation in the use of cancer screening in Germany.” *Social Science & Medicine*, 110: 74–80. 10

Wu, Stephen. 2003. "Sickness and preventive medical behavior." *Journal of health economics*, 22(4): 675–689. 7

*Appendices

Appendix A Medical density

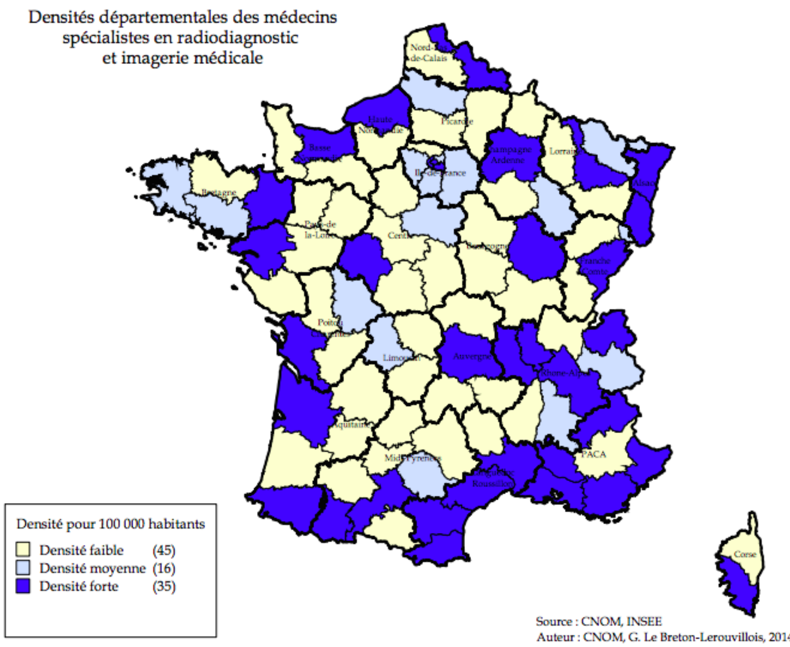
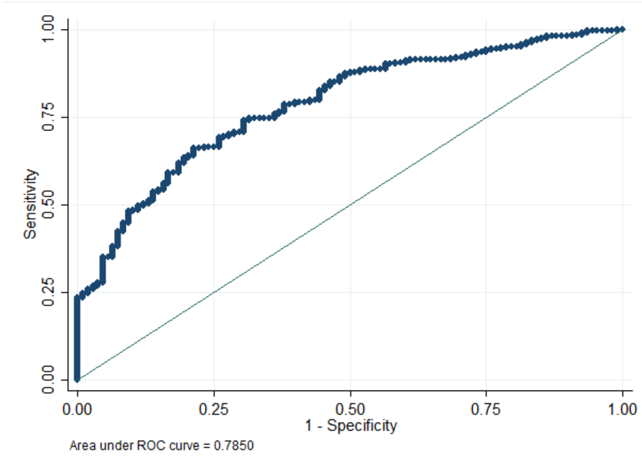


Figure 3: Density distribution of radiologists

Appendix B Area under roc curve

Figure 4: Area under roc curve for the probit model



Appendix C Robustness checks

Table VIII: Probit model estimated results

	Screening regularity					
	w/o Parisian		w/o women aged 72-74 yo.		w/o women with cancer	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Organized screening	0.337**	0.160	0.375**	0.157	0.304*	0.167
Mother's relative longevity (ref: alive)						
Deceased of cancer	0.541**	0.249	0.465*	0.25	0.460*	0.267
Other reason - High Longevity	-0.123	0.246	-0.0259	0.249	-0.121	0.253
Other reason - Low Longevity	-0.00134	0.197	-0.0739	0.203	-0.15	0.225
NC	0.0345	0.361	0.00384	0.358	0.208	0.378
Occupation (ref: retired)						
Employed	-0.472	0.305	-0.631**	0.294	-0.699**	0.286
Unemployed	-0.561*	0.334	-0.544*	0.323	-0.436	0.376
House wife	-0.339	0.270	-0.491*	0.285	-0.556**	0.254
Disabled or other	-0.747*	0.436	-0.896**	0.422	-1.110***	0.347
Age groups (ref: 50 to 54 years old)						
55-59 y.o.	-0.206	0.197	-0.194	0.189	-0.136	0.206
60-64 y.o.	0.0211	0.268	0.0159	0.24	0.22	0.271
65-69 y.o.	-0.549	0.402	-0.6	0.384	-0.595*	0.359
70-74 y.o.	-0.709*	0.402	-0.103	0.474	-1.080***	0.365
Had LAE	-0.680***	0.237	-0.688***	0.24	-0.998***	0.222
Education (ref: non or primary)						
Secondary edu	0.227	0.216	0.394**	0.199	0.378*	0.216
A-level	-0.448*	0.245	-0.246	0.257	-0.287	0.266
Tertiary edu	0.188	0.281	0.275	0.273	0.193	0.299
Income (1st quintile)						
2nd quintile	0.256	0.274	0.478*	0.277	0.612**	0.301
3rd quintile	0.441	0.324	0.504	0.318	0.674**	0.328
4th quintile	0.765**	0.318	0.827***	0.29	1.021***	0.3
5th quintile	0.647*	0.354	0.741**	0.327	0.843***	0.321
NA	0.532*	0.313	0.622**	0.298	0.822**	0.324
Self-employed	-0.771**	0.315	-0.865***	0.29	-0.781**	0.345
Compl. Health insu 2006						
No suppl insu	0.789	0.480	0.987**	0.494	1.575***	0.463
CMU	-0.387	0.401	-0.378	0.399	-0.312	0.467
Self assessed health						
Good health	-0.0136	0.186	0.0143	0.183	0.112	0.208
NA	-0.164	0.283	-0.132	0.278	-0.332	0.279
Chronic illness						
Other than cancer	-0.237	0.226	-0.0463	0.26	-0.0389	0.247
Cancer	-0.13	0.249	-0.297	0.235		
Nb of visits to gyneco (ref: 0 visit)						
1 visit	0.358	0.227	0.371	0.232	0.422*	0.256
2 to 9 visits	0.671***	0.161	0.764***	0.176	0.846***	0.198
Nb of visits to GP (ref: 0 to 8 visits)						
9 to 14 visits	0.285	0.177	0.313*	0.175	0.327*	0.186
15 to 65 visits	0.0244	0.193	0.116	0.194	0.028	0.226
Nb of visits to SP (ref: 0 to 4 visits)						
5 to 9 visits	0.352**	0.159	0.258	0.168	0.454**	0.192
10 to 55 visits	0.543**	0.228	0.484**	0.217	0.612**	0.253
Radiologist density	-0.00878	0.023	-0.0204	0.013	-0.0191	0.0125
Share of sector 2 radiologist	-0.00845*	0.005	-0.0109**	0.00457	-0.0128***	0.00463
Constant	0.298	0.478	0.296	0.396	0.182	0.424

Appendix D Multinomial model

Table IX: Determinants of screening trajectories

Baseline: faithful and regular	Irregular screening		Switching and regular	
	Coeff.	S.E.	Coeff.	S.E.
Organized screening	-1.032***	-0.259	-2.547***	-0.461
Mother's relative longevity (ref: alive)				
Deceased of cancer	-0.835*	-0.429	-0.648	-0.709
Deceased of other reason - High Longevity	0.378	-0.433	-0.0172	-0.607
Deceased of other reason - Low Longevity	0.181	-0.348	0.146	-0.62
NC	0.0923	-0.721	0.0872	-0.925
Self-employed	1.406**	-0.557	-0.0646	-0.925
Occupation (ref: retired)				
Employed	1.107**	-0.514	0.141	-0.525
Unemployed	1.048*	-0.603	0.546	-0.65
House wife	0.675	-0.428	-0.847	-0.573
Disabled or other	1.413*	-0.722	-13.38***	-0.682
Age groups (ref: 50 to 54 y.o.)	0.346	-0.335	0.0986	-0.598
55-59 y.o.	0.346	-0.335	0.0986	-0.598
60-64 y.o.	0.122	-0.423	0.975*	-0.537
65-69 y.o.	0.917	-0.705	0.212	-0.867
70-74 y.o.	1.516**	-0.668	2.105***	-0.603
Had LAE	1.453***	-0.401	1.544**	-0.61
Education (ref: none or primary)				
Secondary edu	-0.545	-0.386	-0.381	-0.366
A-level	0.558	-0.45	-0.149	-0.586
Tertiray edu	-0.589	-0.478	-0.538	-0.525
Income (ref: 1st quintile)				
2nd quintile	-0.693	-0.463	-1.16	-0.89
3rd quintile	-1.026*	-0.588	-1.149	-0.884
4th quintile	-1.308**	-0.519	0.19	-0.666
5th quintile	-1.100*	-0.585	0.336	-0.792
Nc	-1.097*	-0.622	-0.39	-0.883
Compl. Health insu 2006				
No suppl insu	-1.775*	-0.966	-0.211	-0.816
CMU	0.456	-0.67	-13.44***	-0.791
Chronic illness				
Other than cancer	-0.006	-0.345	0.149	-0.47
Cancer	0.285	-0.51	-0.0595	-0.878
SAH				
Good health	0.163	-0.439	-0.297	-0.509
NA	0.157	-0.461	-0.905	-0.726
Nb of visits to gyneco (ref: 0 visit)				
1 visit	-0.722*	-0.392	-0.23	-0.502
2 to 9 visits	-1.257***	-0.308	0.334	-0.382
Nb of visits to GP (ref: 0 to 8 visits)				
9 to 14 visits	-0.698**	-0.335	-0.811*	-0.437
15 to 65 visits	-0.35	-0.313	-0.785*	-0.465
Nb of visits to SP (ref:0 to 4 visits)				
5 to 9 visits	-0.421	-0.3	0.11	-0.51
10 to 55 visits	-0.764*	-0.408	0.328	-0.587
Radiologist density	0.0483**	-0.0244	0.0367	-0.0279
Share of sector 2 radiologist	0.0138	-0.00866	-0.0245*	-0.0143

Appendix E Interaction terms

Table X: Interaction terms of organized screening and occupations

	Coeff.	S.E.
Organized screening	-0.9052**	0.4114408
Occupation (fef: retired)		
Active	-1.891***	0.508
Unemployed	-1.4501*	0.767
House wife	-1.8412**	0.668
Disabled or other	-1.8482	0.7902
Organized screening X Occupation (ref: retired)		
Active and Organized screening	1.6285***	0.436
Unemployed and Organized screening	1.128	0.758
House wife and Organized screening	1.823*	0.671
Disabled or other and Organized screening	1.214	0.8113
Organized screening	.1664	0.5596
Income (ref: 1st quintile) 2nd quintile	0.3348	0.6991
3rd quintile	0.8644678	0.776
4th quintile	0.6174	0.7096
5th quintile	0.4608	0.582
N.C	0.293	0.573
Organized screening X Income		
Organized screening and 2nd quintile	-0.0081	.741795
Organized screening and 3rd quintile	-0.445	0.778
Organized screening and 4th quintile	0.234	0.7557
Organized screening and 5th quintile	0.279	0.54086
Organized screening and NC	0.3221	0.6105