



# When public health intervention is not successful: Cost sharing, crowd-out, and selection in Korea's National Cancer Screening Program<sup>☆</sup>

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## ARTICLE INFO

### Article history:

Received 5 April 2016

Received in revised form 26 February 2017

Accepted 27 February 2017

Available online 6 March 2017

### JEL classification:

I10

H40

### Keywords:

Public health intervention

Cost sharing

Crowd-out

Selection

Cancer screening

## ABSTRACT

This study investigates the impact of and behavioral responses to cost sharing in Korea's National Cancer Screening Program, which provides free stomach and breast cancer screenings to those with an income below a certain cutoff. Free cancer screening substantially increases the screening take up rate, yielding more cancer detections. However, the increase in cancer detection is quickly crowded out by cancer detection through other channels such as diagnostic testing and private cancer screening. Further, compliers are much less likely to have cancer than never takers. Crowd-out and selection help explain why the program has been unable to reduce cancer mortality.

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## 1. Introduction

Cancers are the major cause of death in developed countries. In response to the huge disease burden, many developed countries implement public cancer screening programs. For example, Korea spends around \$34.4 million on public cancer screening (Ministry of Health and Welfare, 2016), and most European countries including the United Kingdom, Germany, and France also have

<sup>☆</sup> The authors gratefully acknowledge the helpful comments from the editor and two anonymous referees, Douglas Almond, Woojin Chung, Booyuel Kim, Wojciech Kopczuk, Wilfredo Lim, Sangsoo Park, Cristian Pop-Eleches, Leigh Linden, Miguel Urquiola, Eric Verhoogen, Tal Gross, and Till von Wachter as well as the seminar participants at Columbia University, Cornell University, Indiana University, UC Santa Cruz, McGill University, University of Connecticut, RAND Corporation, Sydney University, Yonsei University, Seoul National University, Korea University, and the National Cancer Center of Korea. This research is a part of the project "Impact Analysis of the National Cancer Screening Program (NCSP)" initiated by the National Health Insurance System (NHIS). The views expressed herein are ours and do not reflect the views of the NHIS. All errors are our own.

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such programs. Even the United States spends \$194 million on a public cancer screening program, the National Breast and Cervical Cancer Early Detection Program (NBCCEDP), which provides free cancer screenings to those with an income below 250% of the federal poverty level.<sup>1</sup>

Public cancer screening became popular based on the results of the clinical randomized controlled trials (RCTs).<sup>2</sup> However, evidence on population-based cancer screening is still rare, even though the effects of such screening might differ from those provided by clinical RCTs because of behavioral responses. For example, the take-up rate in RCTs is close to 100%, which is

<sup>1</sup> Information is available at <https://www.cdc.gov/cancer/nbccedp/> (accessed on September 2016).

<sup>2</sup> Mammography for breast cancer (Shapiro, 1977; Moss et al., 2006) and the fecal occult blood test (FOBT) for colorectal cancer (Mandel et al., 1993; Hardcastle et al., 1996) were the only screenings with evidence from RCTs before 2008. Recently, RCTs on the PSA test for prostate cancer (Andriole et al., 2009; Schröder et al., 2009), low dose computed tomography (CT) (Gross, 2011) and chest X-ray (Oken et al., 2011) for lung cancer, and sigmoidoscopy (Atkin et al., 2010) and colonoscopy (Zauber et al., 2012) for colorectal cancer have been published in medical journals.

far higher than that in the population-based setting.<sup>3</sup> Therefore, if population-based cancer screening unintentionally encourages specific groups of people to take up screening, the effects of the screening on these groups might differ from those in a clinical experimental setting.<sup>4</sup> Furthermore, because cancer screening is more popular than it was in the early days of RCTs, the availability of substitutes such as private screening and diagnostic testing has increased. Therefore, understanding these behavioral responses is important for examining the impact of public cancer screening programs.<sup>5</sup>

This study analyzes the impacts of and behavioral responses to cost sharing in Korea's National Cancer Screening Program (NCSP), one of the largest population-based cancer screening programs in the world. The NCSP provides subsidized stomach and breast cancer screenings for individuals aged 40 and above once every two years. Cancer screening is free to those below a designated insurance contribution cutoff, while a 50% copayment is charged to those above the cutoff.<sup>6</sup>

We use a regression discontinuity (RD) design that takes advantage of this contribution cutoff in the NCSP. This design allows us to compare people with similar characteristics, but sharply different cost sharing, and thus different public cancer screening take-up rates. Therefore, we measure the causal effect of one time free public cancer screening eligibility. Moreover, we carefully demonstrate behavioral responses to the program such as crowd-out and selection to screening. We first investigate the dynamic aspect of cancer detection through various channels by using data on all cancer detections regardless of the detection channel over five years after screening. Furthermore, we explore the characteristics and cancer mortality of those induced to take up cancer screening by the program (compliers) and compare them with other sub-populations such as those who take up screening regardless of the availability of free cancer screening (always takers) and those who do not undergo screening, even when it is free (never takers).

The analysis allows us to draw three main conclusions. First, we find that the take-up rate of public cancer screening increases by around 10 percentage points – more than doubling – when the price of public cancer screening decreases from a 50% copayment to zero. The estimated arc elasticities of demand for public cancer screening are approximately  $-0.47$ . In addition, cost sharing reduces demand for public cancer screening without increasing the efficiency of cancer detection. In other words, cost sharing does not encourage the screening of people who are more likely to have cancer.

Second, we find that an increase in the cancer screening take-up rates results in a significantly increase in cancer detections in the short-term; however this detection hike quickly erodes over time because of a decrease in cancer detections through other channels such as private cancer screening and diagnostic testing.<sup>7</sup> Specifically, the initial increase in cancer detections through public cancer screening is crowded out within a year by a decrease in detections through private screening and diagnostic testing. This finding

implies that public cancer screening is provided to those who would have nevertheless been tested within a year through other cancer detection channels. Conceptually, the increase in cancer detections through public cancer screening should erode completely over time if cancer is eventually detected sometime before death (e.g., through diagnostic testing) and screening per se does not cause cancer. Therefore, time to crowd-out could be critical to the benefit of the individual if the early detection of cancer can decrease cancer mortality.

Third, we find that never takers are significantly less healthy than compliers and always takers in terms of cancer mortality. This policy-relevant finding suggests that the provision of population-based public cancer screening did not reach people more in need of screening during the study period. These behavioral responses to public cancer screening explain, at least partially, why subsidizing cancer screening is unable to make early detections of cancer or reduce cancer mortality.

Hence, the present study makes two novel contributions. The first contribution is to show that behavioral responses to public health intervention programs, such as crowd-out and selection, could be crucial to their success. The second contribution is to improve the understanding of cost sharing in the provision of preventive health services.

The remainder of this paper is organized as follows. Section 2 discusses the existing body of knowledge on the subject. Section 3 explains the background to the study. Section 4 describes the data and presents the descriptive statistics. Section 5 shows the estimation strategy. Section 6 presents the results, and Section 7 conducts an additional robustness check. Finally, Section 8 concludes the study.

## 2. Review of the literature

We first study whether an increase in cancer detections through public cancer screening is crowded out (over time) by the decrease in cancer detections through other channels including diagnostic testing and private cancer screening.<sup>8</sup> Therefore, this study is related to the attenuation of public intervention program when alternatives are available. For example, Heckman et al. (2000) show that the impacts of job training program weakens when the control group receives substitute training and/or the compliance in the treatment group is low.

We also investigate selection to public cancer screening programs by exploring the characteristics of compliers, always takers, and never takers to address the following question: when expanding a public health program, which parts of the population in terms of health and socioeconomic status does the program reach. Only a few studies have explored compliers' characteristics in relation to health intervention programs. For example, Almond and Doyle (2011) and Anderson et al. (2012) investigate compliers' characteristics in the context of postpartum hospital stays and health insurance, respectively, but neither studies find significant differences between compliers, always takers, and never takers. Thus, ours is one of the few studies to identify that the characteristics of compliers have real policy relevance.

This study is also related to cost sharing in preventive health services. The benefits of cost sharing for healthcare service provision are unclear based on the findings of previous studies. Charging a non-zero price for health services could improve their effectiveness of these services by curbing unnecessary demand. However, it may

<sup>3</sup> RCT study participants are not randomly chosen from the population; rather, they are those who agree to participate in the study.

<sup>4</sup> The take-up rates in a population-based breast cancer screening program were found to be 55.2%, 67.0%, and 76.4% in Korea, the United States, and the United Kingdom, respectively (Ministry of Health and Welfare, 2016; NCI, 2007; Health and Social Care Information Centre, 2014).

<sup>5</sup> Crowd-out and selection could also explain why the effects noted in experimental settings differ from those in population-based cancer screening. The compliance rate is close to 100% in the experimental setting and the crowd-out effect could be timing- and setting-specific.

<sup>6</sup> The insurance contribution is a fixed percentage of the basic salary of those with employee insurance. It was 3.62% and 3.94% in 2002 and 2003, respectively.

<sup>7</sup> The cancer screening process tests for cancer in the absence of symptoms in contrast to diagnostic tests, which people undergo to detect cancer in the presence of relevant symptoms, based on a doctor's recommendation.

<sup>8</sup> It worth noting that the concept of crowd-out in our study is different from that in previous crowd-out literature which shows the manner in which a public intervention program erodes private provision. For example, Gruber and Simon (2008) provide an excellent literature review on the crowd-out in health insurance.

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