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Russia Versus Breast Cancer: Examination of the "White Rose" Charity Project

Vlada Kosenkova

Master's Thesis

Prague, August 2022

Referees:

Supervisor: Andreas Menzel (CERGE-EI)

Opponent:

Master's Thesis Proposal

CERGE
Charles University

Author's name and surname: Vlada Kosenkova

E-mail: vlada.kosenkova@cerge-ei.cz

Phone: +420605534788

Supervisor's name: Andreas Menzel

Supervisor's email: Andreas.Menzel@cerge-ei.cz

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Proposed Topic:

Russia Versus Breast Cancer: Examination of the Charity Project "White Rose"

Preliminary scope of work:

Research question and motivation

According to the World Cancer Research Fund International (2022), breast cancer is the most common cancer worldwide. Thus, Barchuk et al. (2018) mention that in Russia the breast cancer incidence rates grew up to 47 cases for 100,000 women from 1993 to 2013. Therefore, some countries try to implement healthcare programs to decrease mortality rates associated with this type of cancer. Moreover, a part of these programs aims at decreasing burden on the government budget connected to medical expenses. I propose to investigate the effects of the charity project "White Rose" implemented in Russia to raise awareness about breast cancer among women. This is an entirely new concept of intervention: new medical centers providing free high-quality diagnostics are built in 18 regions of Russia. Such approach helps to improve take-up rates of treatment by eliminating low trust effect that is common in developing countries (Olasehinde et al., 2017). I suggest evaluating the influence of the project on health outcomes, female labor force participation, and female wages using (synthetic) differences-in-differences approach.

I expect to find changes in female labor market structure. I assume that in the short term there would be less women aged 40-44 in the labor market due to cancer diagnosis and related treatment. In contrast, in the long term I anticipate positive effects on the labor force participation among older women (55+). In addition, I suggest that breast cancer survivors on average would receive higher salaries than women without cancer.

Contribution

The program "White Rose" is a new initiative and has not been analyzed before. I aim to quantitatively estimate the effects of this costly program on a set of health and economic outcomes for selected regions: number of women with cancer, female labor force participation, income, and children educational outcomes. I believe that this research might be useful for policy-makers in Russia and could be generalized to other developing countries with similar economic conjuncture.

Methodology

The main strategy approach to estimation of the parameters of interest is difference-in-differences (DID) analysis. It is commonly used to evaluate implemented policies, including those related to the health economics (Wing, Simon, and Bello-Gomez, 2018). Two crucial assumptions of this approach are the parallel pre-treatment trends and common shocks.

The former suggests that the trends of outcome variables of interest in control and treatment groups should be parallel before the policy was implemented. The latter assumption implies that shocks that happen in economy equally affect both control and treatment groups. Therefore, it is important to accurately choose the control group. In case of this paper, however, the level of treatment is the region: those regions, where the medical center was built are considered treated, others – are control group. The regions in Russia are diverse, so it might be hard to find control group that would satisfy the pre-treatment parallel trends assumption. Therefore, to estimate the parameters of interest I will also use synthetic difference-in-differences (SDID), following Arkhangelsky, Athey, Hirshberg, Imbens, and Wager (2021) and Ben-Michael, Feller, and Rothstein (2021). It combines synthetic control that is mostly used in matching problems, and difference-in-differences estimator. Thus, it helps to overcome the possible violation of pre-treatment parallel trends. This estimator re-weights the control units to match the trends of the treated group before intervention as closely as possible. Moreover, Ben-Michael et al. (2021) take into account the staggered nature of the policy implementation, and adjust the estimator to make it robust.

I propose several specifications for regressions. I will constrain the data only to the regions that were treated before 2019, thus, excluding two regions: Tverskaya and Vladimirskaya oblast. The reason to do that is the lack of data to estimate the effects. I will examine the effect of the policy on the following set of outcomes: female labor force participation, number of women with cancer, average income, children educational outcomes, and others.

Outline

1. Introduction and related literature
2. Data description
3. Empirical model and estimation
4. Possible limitations
5. Results and discussion
6. Conclusion

List of academic literature:

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Date: 30.06.2021

Guarantor

Author

Supervisor

Contents

Abstract

According to the World Cancer Research Fund International (2022), breast cancer is the most common cancer worldwide. Therefore, many countries have aimed to implement healthcare programs to decrease mortality rates associated with this type of cancer. Moreover, some part of these programs aims to decrease the burden on government budgets connected to medical expenses. In this thesis, I investigate the effects of the White Rose charity project implemented in Russia to raise awareness about breast cancer among women. I evaluate the influence of the project on health outcomes, including breast cancer mortality rates, the probability to die within a year after the diagnosis, and the share of primary stages of cancer among new diagnoses. I construct a novel dataset using official reports on the oncological situation on the regional level. Using the event study approach, I find intermediate effects that are more pronounced at the longer horizon. In addition, I notice a rise in the number of new breast cancer diagnoses, which might be an indicator of the effectiveness of the program. Because there are no prior studies of this program, the results of my research might be of interest to policymakers in Russia and other developing countries with similar economic structures.

Keywords: Health Economics, Breast Cancer, Differences-in-Differences, Development Economics

Abstrakt

Podle World Cancer Research Fund International (2022) je rakovina prsu celosvětově nejčastější rakovinou. Mnoho zemí se proto zaměřilo na zavedení programů zdravotní péče ke snížení úmrtnosti spojené s tímto typem rakoviny. Některé části těchto programů si navíc kladou za cíl snížit zátěž státních rozpočtů spojenou s léčebnými výdaji. V této práci zkoumám účinky charitativního projektu White Rose realizovaného v Rusku na zvýšení povědomí o rakovině prsu u žen. Hodnotím vliv projektu na zdravotní výsledky, včetně úmrtnosti na rakovinu prsu, pravděpodobnosti úmrtí do jednoho roku po diagnóze a podílu primárních stadií rakoviny mezi novými diagnózami. Konstruuji nový soubor dat s využitím oficiálních zpráv o onkologické situaci na regionální úrovni. Při použití přístupu studie událostí nacházím střední efekty, které jsou výraznější v delším horizontu. Kromě toho zaznamenávám nárůst počtu nových diagnóz rakoviny prsu, což může být ukazatelem účinnosti programu. Protože neexistují žádné předchozí studie tohoto programu, výsledky mého výzkumu by mohly být zajímavé pro tvůrce politik v Rusku a dalších rozvojových zemích s podobnou ekonomickou strukturou.

Keywords: Health Economics, Breast Cancer, Differences-in-Differences, Development Economics

Introduction

Breast cancer is the most common form of cancer among women that leads to death both in developed and developing countries (Rivera-Franco and Leon-Rodriguez, 2018; World Cancer Research Fund International, 2022). Rivera-Franco and Leon-Rodriguez (2018) and Shulman, et al. (2010) state that breast cancer is even more pronounced in the low- and middle-income countries (LMICs). Moreover, according to Rivera-Franco and Leon-Rodriguez (2018), LMICs exhibit the highest mortality rates from this disease, ranging from 40% to 60%. The authors argue that the shortage of early detection programs, treatment facilities, and the bad level of health education may contribute to such results. Barchuk et al. (2018) mention that in Russia the breast cancer incidence rates grew up to 47 cases for 100,000 women from 1993 to 2013. In addition, Saeed et al. (2019) claim that healthcare resources are constrained, thus, understanding of the effects of healthcare interventions is necessary to maximize health and equity levels while minimizing costs. In Russia, breast cancer is a sufficient problem affecting mortality and death rates of women, leading to increase of the years of life lost Barchuk et al. (2018). Besides, Radice and Redaelli (2003) evaluate the cost of cancer treatment on different stages in both high- and low-income countries and find that the expenses increase with the progression of the disease. Therefore, it is crucial to detect cancer earlier to minimize costs associated with the treatment.

In this master thesis, I quantitatively evaluate the effectiveness of the government non-profit project called White Rose that is conducted in Russia. The main purpose of this project is to raise awareness of the importance of women's reproductive health and provide free high-quality medical services, including diagnosis of gynecological disorders and breast cancer. To achieve this goal, eighteen charity centers in fourteen regions of Russia were gradually built from 2011 to 2020.

One region was covered by the program in 2011, three in 2013, two in 2015, five in 2016, one in 2017, one in 2019, and one in 2020. All these regions are highlighted in blue in Figure 1.

Figure 1: The map of Russia with highlighted treated regions (By author).

In addition, the White Rose program provides psychological support for women who were diagnosed with serious disorders to help them with strategizing their next steps. Moreover, on some occasions, it organizes the educational lectures on breast cancer and self-screening. The program is funded by the Foundation for Social and Cultural Initiatives of Russian Federation and receives financial support from private benefactors, independent sponsors, and the government.

According to Glied and Smith (2013), LMICs suffer from the low trust to existing medical institutions due to the low quality of provided services. Medical centers that are built under the White Rose project are advertised as ones with the top-level specialists and highest quality equipment. Thus, if the main problem of non-participation is low trust, this policy should overcome the enrollment issues in all treated regions of Russia. Besides, most of the policies that aim to increase women's participation in screening are mostly educational and encourage them to use services of existing medical institutions (Glied and Smith, 2013). However, Russian White Rose policy focuses mostly on the quality improvement of screening services available to women by building new medical centers, which makes this program one of a kind in LMICs. Thus, this program one of the first to provide a novel approach to increase awareness on breast cancer, while overcoming widespread difficulties.

This paper adds to the literature estimating the efficiency of healthcare interventions in low- and middle-income countries (LMICs) by evaluation of the effects of the policy aimed at the diagnostic of the breast cancer at initial stages on the example of Russia. The staggered implementation makes it possible to conduct a difference-in-differences analysis and to use the natural variation in the data, in contrast to the simulation model approach, like it is done for Egypt in Wahdan (2020), or for India in Okonkwo et al. (2008).

This thesis is organized as following. Firstly, in the Literature Review section, I summarize and analyze literature related to the topic. Secondly, Background section provides an overview of the main statistics related to the breast cancer in the world and describes the White Rose project. In Section 3, I analyze the individual level data and highlight the connections between the breast cancer and socio-economic outcomes. Then, in Section 4, I focus on the region level data, providing an event study. Section 5 contains the main results. Finally, Section 6 provides discussion and concludes.

1 Literature Review

(Cost-)Effective ways to treat cancer

Most of the literature analyzing the effects of various screening programs focus on two main outcomes. The first one is the breast cancer mortality rates, and the second is the cost-efficiency of the program. Thus, Schopper and de Wolf (2009) conduct a meta-study on the effects of the long-term screening programs on the breast cancer mortality rates. They focus on the developed countries, including Australia, Canada, Denmark, Finland, Iceland, Italy, the Netherlands, Spain, Sweden, and the United Kingdom. Schopper and de Wolf (2009), based on the analyzed literature, argue that screening programs results in a significant and large (from 25% to 50%) reduction of the breast cancer mortality rates at least 5 years after the roll-out, depending on the country.

Mühlberger et al. (2021) extend the research of Schopper and de Wolf (2009) by analyzing more than 30 papers on the cost-efficiency of the European screening programs. They conclude that all examined screening programs are indeed cost-efficient. However, they notice that switching from conventional screening to risk-adaptive screening methods may result in even better results. Dibden et al. (2020) confirm the previous findings in another meta-study, including 4 articles examining screening programs in the developing countries outside of Europe.

Okonkwo et al. (2008) study cost-efficiency of screening in the developing setting. They conduct a cost-efficiency analysis of an Indian screening program using model simulations. Results of the analysis confirm that screening is highly cost-efficient according to the benchmark of the WHO. Moreover, Okonkwo et al. (2008) find that screening is almost as efficient as mammography, being almost three times less costly. Additionally, they provide results on the mortality rates reduction, estimating it at 25.8% .

Newman (2022) supports the idea of importance and cost efficiency of the early detection programs. However, she points out that while the cancer burden on LMICs is rising, the financial constraints of these countries suspend them from implying the most effective strategies. Talib et al. (2019) support this idea, analyzing screening programs in Tajikistan, Kenya, and Pakistan.

Thus, screening policies aimed at the early detection of the breast cancer are highly effective both in the developing and developed countries. Høst and Lund (1986) and Adami et al. (1986) notice that the optimal age of detection of breast cancer to decrease mortality is around 40-44 years. Additionally, Newman (2022) suggests that the best strategy for LMICs is to implement less expensive early detection screening programs, due to the financial constraints these countries face, even though they are not as efficient as the methods used by developing countries.

Breast cancer and labor market outcomes

Su et al. (2017) analyze the effects of a breast cancer diagnosis on female labor market outcomes in Malaysia. They interviewed employed women who have been diagnosed with breast cancer not earlier than 3 years before for 12 months during their visits to the oncology outpatient clinics. Su et al. (2017) find that mean income of women significantly decrease (by 21%) within a year after diagnosis. Moreover, they claim that 49% of women diagnosed with breast cancer experienced either significant wage reduction or total wage loss.

Brusletto et al. (2020) conduct a study evaluating the long term effects of surviving cancer on the male and female labor market outcomes in Norway. Women with breast cancer substituted for almost 20% of the sample. Brusletto et al. (2020) find reduction of the workforce participation for both genders in short term, with the results being more pronounced for women. However, they state that around 87% of individuals return to the labor market later on. In addition, they find that women that survived the breast cancer lower their working hours and switching to the part-time employment more that men-survivors. These results contradict to Bradley et al. (2002), who argued that women with breast cancer tend to work more, based on the USA data.

Bradley et al. (2005) examine the short-term effects of the breast cancer diagnosis on women employment in the USA. They find a substantial negative impact of breast cancer on the labor supply six months following the diagnosis. However, Bradley et al. (2002) find that breast-cancer survivors tend to receive higher salaries. Jeon (2017) points that effects of breast cancer on the long-term women's labor market outcomes are mixed, changing from almost no effect on labor force participation in three years after surviving cancer to negative effects (3%-7% reduction in labor force participation).

Spenser et al. (2019) using data from North Carolina find statistically significant negative effects of a breast cancer diagnosis on female employment. However, they prove that the effects are heterogenous: black women and women living in rural areas are facing more prevalent negative effects than urban white women. In addition, Spenser et al. notice that differences in the effects between rural white women, rural black women, and urban black women are not statistically different.

Breast cancer and children outcomes

Effects of being diagnosed with breast cancer on children outcomes are scarce and mixed. Most of the studies focus on the psychological well-being of children. For example, Vannatta et al. (2008) suggests that there is almost no changes in the behavior of children at school. The only risk is for sons of mothers diagnosed with cancer becoming more sensitive and isolated.

On the contrary, Lichtman et al. (1984) notices that the most affected group of children are daughters. They claim that girls becomes hostile to their mothers and tend to isolate more.

Al-Zaben et al. (2015) is one of the very few studied that examine children's school performance. Using data on children from Saudi Arabia aged 5-15 they find decrease in the school performance for 77% of children whose mother was diagnosed with breast cancer. However, they notice that 8% of children improved their performance, and most children (around 90%) improved relationship with their parents, as well.

Breast cancer and self-assessed health, depression, and anxiety

Marroquín et al. (2016) mention that depressive symptoms are common among women diagnosed with breast cancer. They examine ways American women with breast cancer deal with stress induced by the disease, and notice that the feeling of loneliness often correlates and leads to more severe depressive symptoms.

Another paper by Pilevarzadeh et al. (2019) describes a meta-study of the literature estimating depressive symptoms among women with breast cancer around the world. They find that the prevalence of depression in patients with the breast cancer varies from 13% to 46%, depending on the region. Pilevarzadeh et al. (2019) estimate the world prevalence of depression in breast cancer patients as 13.2%.

Tsaras et al. (2018) evaluates the prevalence of depression among women with breast cancer in Greece. They claim that around 38% of women with breast cancer suffer from depression and anxiety. Moreover, they argue that the prevalence of symptoms is more pronounced with the development of the disease. Tsaras et al. (2018) highlight a place of living and religious beliefs as other factors affecting the level of depression and anxiety.

Some research claim that the prevalence of depression in the developing countries is more pronounced. Thus, Alagizy et al. (2020) find that the prevalence of anxiety, depression, and perceived stress among Egyptian women is 73.3%, 68.7%, and 78.2% respectively. They agree with Tsaras et al. (2018) that living in the rural areas increase the prevalence of depressive symptoms among women with breast cancer. However, these results are higher than Hassan et al. (2015) finds for Malaysia: 22% and 31.7% for depression and anxiety, respectively.

2 Background

2.1 Breast cancer today: some facts

According to the WHO Collections (2021) and WCRF International (2022), breast cancer is the most common cancer in the world among all sexes. Breast cancer accounts for almost 26% of the new cancer cases in 2020, with more than 2 million people firstly diagnosed. Figure 2 shows the 5-year distribution of cancer cases by the type of cancer among females. Once again, breast cancer accounts for more than 30% of all cases with more than 7 million of women being diagnosed.

However, although breast cancer is widely spread, WHO Collections (2021) reports that it can be effectively treated if detected timely. Moreover, Rivera-Franco and Leon-Rodriguez (2018) notice that availability of the early detection programs and regular screening leads to improvements in the survival rates. Figure 3 shows the dynamics of the share of the breast cancer deaths in total deaths in Russia for 2000-2019. There was a noticable upward trend until 2012, when the share of the deathts of breast cancer slowly began to decrease, stabilizing around 2.4% for the last 5 years.

Many countries implement different health policies not only to decrease the breast cancer mortality rates. Sun et al. (2018) conduct a comprehensive analysis of the literature and find that the breast cancer treatment costs drastically increase with the progression of the disease. They conclude that treating cancer at Stage III and IV is on average by 95% and 109% more expensive than at Stage I. Thus, identifying cancer at earlier stages substantially reduces budget expenses on the cancer treatment.

Figure 2: Number of breast cancer cases for 2015-2020 (Source: International Agency for Research on Cancer, 2022).

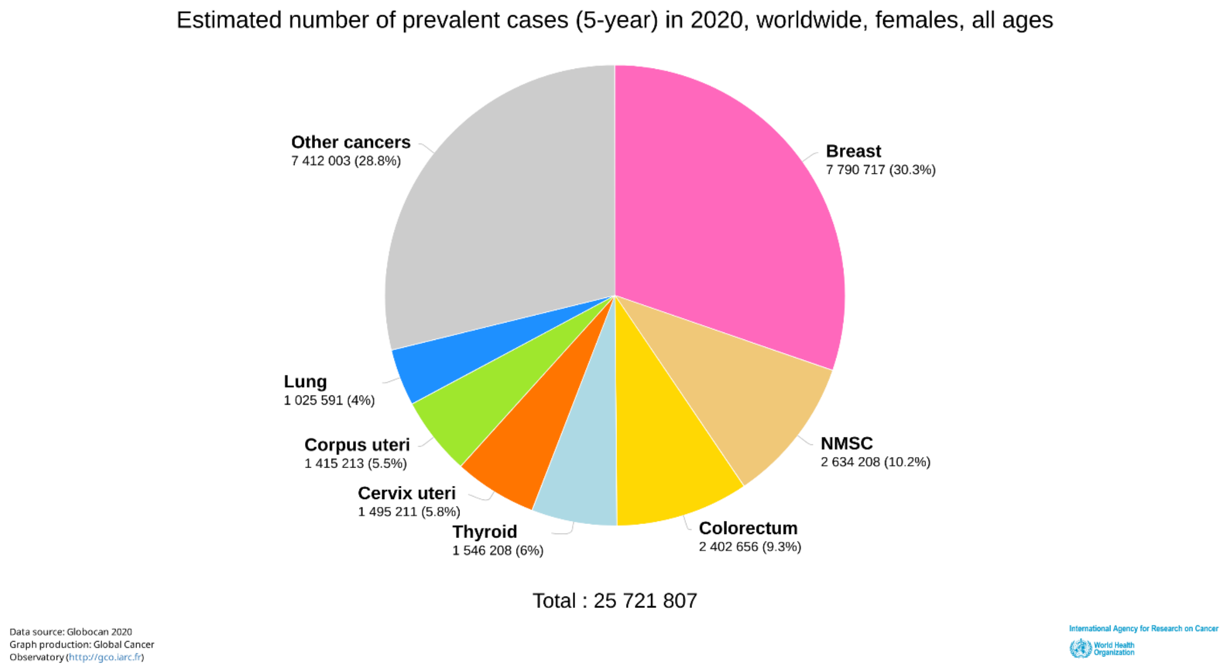
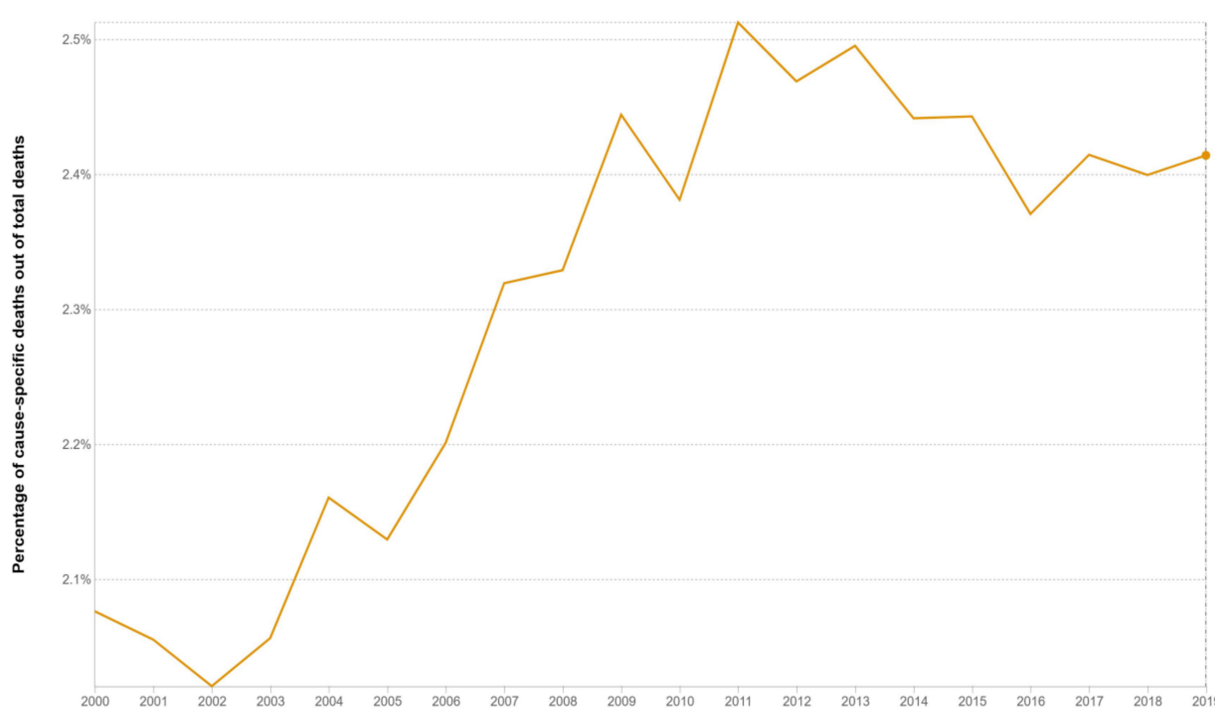


Figure 3: Trends in breast cancer mortality in Russia (Source: WHO, 2022, https://platform.who.int/mortality/themes/theme-details/topics/indicator-groups/indicator-group-details/MDB/breast-cancer)



2.2 The White Rose initiative

The White Rose project is one of the initiatives of the Foundation for Social and Cultural Initiatives of the Russian Federation that was developed under the personal guidance of the Foundation president Svetlana Medvedeva. The project was launched in 2011 and is funded by the government, independent sponsors, and private benefactors. The main idea behind the project is to raise awareness of the breast cancer and women's reproductive health in general by providing free high-quality medical services and informational support to women. To achieve this, 18 new medical centers have been built in 14 regions of Russia since 2011. All the centers are provided with the best equipment and experienced specialists to ensure trusting atmosphere and comfort for the patients. In addition, these centers frequently organize open educational lectures on breast cancer, reproductive health, and importance of regular screening, including correct techniques of self-examination. In some cases, when women are diagnosed with hardly curable diseases, specialists in the White Rose centers provide psychological support and help patients to plan treatment.

While Figure 1 shows the geography of the White Rose medical centers, Table 1 includes the list of all regions that are covered with dates when the centers were open. There are some regions that has several White Rose centers. Most of them, except for Saint Petersburg, are located in different cities within one region.

Although the educational events are open to the general public, only women aged 18 and older with a valid obligatory medical insurance policy (OMS) are eligible for the free medical services. It is worth mentioning that all Russian citizens and people with a permanent residence permit have this OMS policy, which provides them with free medical support.

Table 1: The list of the regions covered by the White Rose project (By author).

Region	Opening date
Saint Petersburg	**December 2011** September 2015
Amur Region	**December 2013** February 2015
Arkhangelsk Region	**November 2013** January 2015
Kemerovo Region	December 2015
Moscow Region	March 2015
Orenburg Region	**December 2015** September 2016
Murmansk Region	September 2016
Primorsky Territory	February 2016
Republic of Bashkortostan	November 2016
Republic of Sakha (Yakutia)	**September 2016** August 2019
Sakhalin Region	January 2016
Ivanovo Region	December 2017
Tver Region	December 2019
Vladimir Region	September 2020

The typical visit to the White Rose center starts with a registration of the patient in the internal system. Firstly, the woman has to fill out a questionnaire and provide identification documents and an OMS policy. Then, the personnel ask her about the procedures she would like to take up, including examinations by a gynecologist and an oncologist-mammologist, ultrasound of the pelvic organs and mammary glands, and several diagnostic tests. The availability of all specialists in one place allows for a fast, convenient, and comprehensive examination compared to the free services provided by the OMS policy.

3 Connection Between Having Cancer and Economic Outcomes: the Case of Russia

3.1 The RLMS panel dataset

For this part of my thesis, I use data from the Russia Longitudinal Monitoring Survey – HSE (RLMS)[1]. The RLMS is a survey conducted among individuals and households from 1994 on an annual basis (except for 1997 and 1999). The data is available in two formats (a cross-section for each wave, and a combined panel) and two languages: Russian and English. This panel is widely used in economic research, especially in the field of health economics (for example, Aistov et al., 2020; Gerry et al., 2004; Gordeev et al., 2013; Kaneva et al., 2018). This survey covers a broad set of topics, including socio-economic, health, and demographic characteristics of individuals, alongside self-assessed indicators of health, well-being, and life satisfaction.

I use the representative panel for individuals from 2000 to 2020, the last available year at the moment of writing this paper. Moreover, I restrict the sample only to women in the workforce that are eligible for the White Rose program (18-72 years old). I describe the variables I use in detail in the next subsection.

3.2 Descriptive statistics

I examine possible relation of the cancer to a set of social and economic outcomes. You can see the full list in Table 2 alongside the correlation coefficients. Although the correlation between the cancer and most of the outcomes is not high, this might be explained by the structure

[1] Is available via https://www.hse.ru/en/rlms/

of the data. The dataset is not balanced: out 87858 observations, only 1862 belong to women who reported that they have cancer, thus, the correlation coefficients may be underestimated. Moreover, correlation will not capture the non-linear dependence, if there is any. Nevertheless, I think that signs of the coefficients might be useful to understand the dynamics in the dataset.

Not surprisingly, the largest correlation is between having cancer and self-assessed health: women with cancer tend to report lower health level. Around 33% of women with cancer answered that their health is 'bad' throughout the years compared to only 8% of women without cancer who did the same.

Other outcomes related to health and psychological well-being are depressive symptoms, loneliness, feeling unsafe and dissatisfied with life. All of them are negatively correlated with the diagnosis: women with cancer tend to feel lonely and unhappy about their lives, have depressive symptoms, and be afraid to walk alone on the empty street. These results find support in the literature, for example, Tsaras et al. (2018), Marroquin et al. (2016), and others write about high prevalence of depression and anxiety among women with breast cancer.

There is no correlation between being diagnosed with cancer and switching to a lower position at work, and between having cancer and being satisfied with the job and working conditions, as well as trusting the executives. Additionally, there is no statistical connection between having cancer and providing trustworthy information according to the opinion of the interviewer. Nevertheless, women with cancer might have appeared more anxious during the interview (correlation is -0.0143).

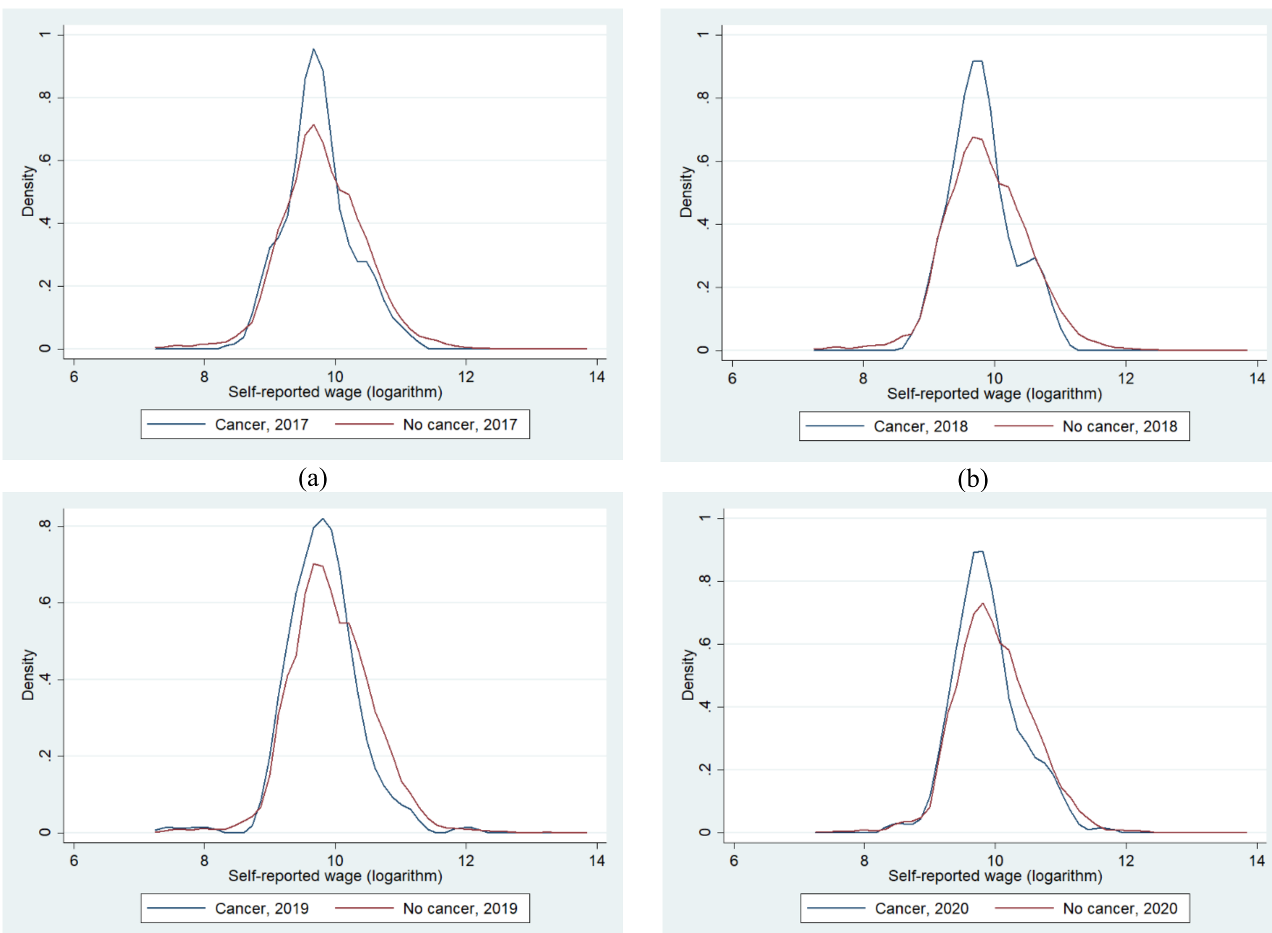
Although the correlation between switching to lower position and reporting a cancer diagnosis is almost 0, it is not exactly true for the promotions. While 4.2% of healthy women were promoted, only 1.7% of women with cancer received the same offer. Additionally, larger share of women with cancer have subordinates compared to healthy women. However, there is a negative correlation between having cancer and the number of subordinates.

Table 2: Correlation coefficients for having cancer and different outcomes.

Name of the variable	**Correlation coefficient**
Monthly salary	-0.0104
Living in the city	-0.0145
Having a job	-0.0741
Being on a paid vacation	0.0727
Satisfaction with the work	0.0033
Satisfaction with working conditions	0.0066
Having subordinates (dummy)	-0.0193
Number of subordinates	-0.0121
Trust to the managers	-0.0070
Trust to the colleagues	-0.0137
Got a promotion	-0.0135
Downshift	0.0002
Having a second job	-0.0130
Satisfaction with life	0.0606
Satisfaction with financial situation	0.0290
Beliefs about inequality	0.0424
Having own business	0.0173
Knowing another language	0.0405
Marital status	-0.0105
Number of children	-0.0112
Being religious	-0.0261
Becoming religious (in adulthood)	0.0202
Feeling of loneliness	-0.0504
Feeling of safety	0.0178
Self-assessed health	**0.1683**
Depression and anxiety	-0.0628
Smoking	0.0111
Number of sigarettes	(data only on women without cancer)
Alcohol consumption	0.0249
Happiness	0.0649
Number of abortions in the last 12 months	(data only on women without cancer)
Number of mini-abortions in the last 12 months	(data only on women without cancer)
Being nervous while answering the questions (opinion of the interviewer)	-0.0143
Providing trustworthy information (opinion of the interviewer)	0.0026

Figure 4 reports the PDFs of the logarithm of self reported wages by years and cancer diagnosis. There is a clear tendency that wages of women with cancer are more concentrated around mean, which is similar or slightly smaller than for women without cancer. This does not hold for other subsamples, for example comparing groups with gynecological diseases (see Appendix 1). The most possible explanation for this tendency is the age distribution for women with cancer. As this diagnosis is usually reported later in life, the women with cancer in the sample are generally older than those without it (see Appendix 2). This, in turn, affects the salary.

Figure 4: PDFs of the logarithm of self-reported wage by years (By author).

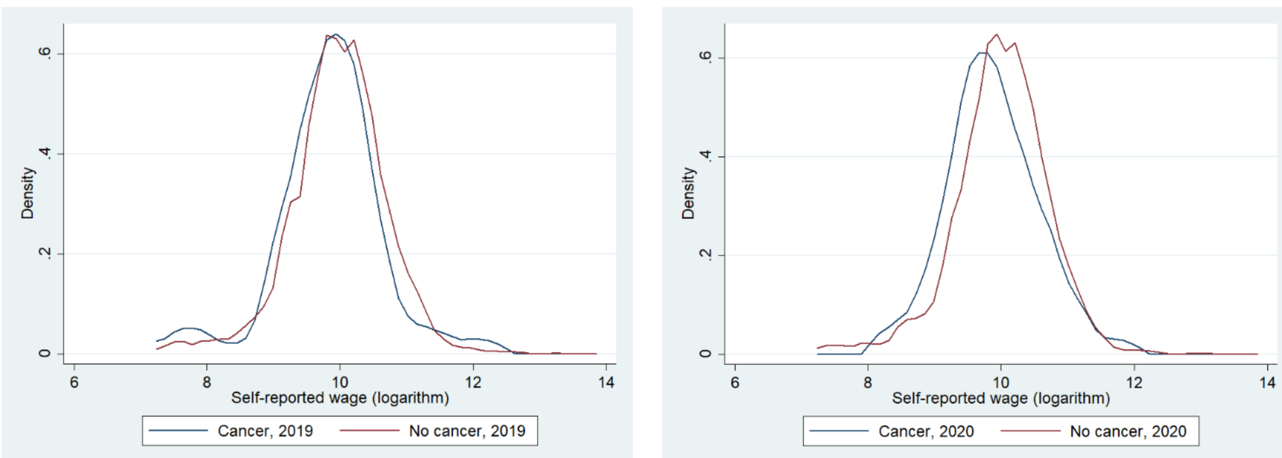


(a) (b) (c) (d)

Figure 5 is similar to Figure 4, as it depicts the density functions of the logarithm of self-reported wage for the last 2 years. However, I use the subsample of women aged 18-55 to plot it.

Trimming the dataset in such a way allows to keep the age distribution similar between two groups: women with and without cancer. Thus. Figure 5 suggests that women with cancer on average receive smaller salary. However, as the sample shrinks, it is less likely to be considered representative, and these results should be considered with caution. Nevertheless, negative impact of cancer diagnosis on labor force participation and wages is well documented in the literature (Su et al., 2018; Brusletto et al, 2020; Spencer et al., 2019).

Figure 5: PDFs of the logarithm of self-reported wage by years (By author).



(a) (b)

4 Estimating the Effects of the White Rose Project on the Health Outcomes

4.1 Structure of the dataset

To estimate the effects of the White Rose project, I constructed a panel dataset for Russian regions. I digitalized annual reports of the National Medical Research Radiological Centre of the Ministry of Health of the Russian Federation[2] that it provides as a part of the Russian national initiative called "Zdorovie (Health)". The initiative was launched in 2009, providing two reports annually. The first report is called "Zlokachestvennye novoobrazovaniia v Rossii (zabolevaemost' i smertnost')" [Malignancy in Russia (morbidity and mortality)][3] provides statistics on cancer morbidity and mortality on the regional level by the type of cancer. The second report – "Sostoianie onkologicheskoi pomoschi naseleniiu Rossii" [Condition of the oncology aid to the population of Russia][4] – focuses mostly on the cancer treatment and, most importantly, provides statistics on the new cancer cases on the regional level by the type and stage of cancer.

I digitalized all the available reports to construct a panel with the data on the new cases of the cancer, the stage cancer was detected on, probability to die in a year after diagnosis, number of deaths of cancer and other variables on a regional level, focusing on cervical and breast cancer. There are two main reason I included data on the cervical cancer. Firstly, although the White Rose project aims to increase the awareness around breast cancer, its clinics provide comprehensive examination for women, including gynecology services. Secondly, cervical cancer is similar to the breast cancer in several aspects: (1) it is easily treatable, especially in the early stages, (2) it is

[2] The website of the institution is available via https://nmicr.ru/en/
[3] Reports are included in the references for each year separately, from 2008 to 2020
[4] Reports are included in the references for each year separately, from 2008 to 2020

widely spread, especially in the LMICs (Allanson and Schmeler, 2021; Vu et al., 2018), (3) screening is one of the most effective methods of prevention for this type of cancer (Chan et al., 2019), and (4) there is enough available data on this type of cancer.

In addition, I included the gross regional product per capita to use as a controlling variable in the dataset. I took it from the Rosstat official website[5].

The last part of the dataset are the dates when the White Rose medical centers were open in the regions. I gathered data from the official webpage of the White Rose project[6] on the Foundation for Social and Cultural Initiatives website and from the news. As the data on the cancer cases is annual, and White Rose medical centers were opened throughout the year, I had to assign the regions a year they were treated. To do that I used the first year the center was operating for more than three months. The news on the official website[7] state that on average one center is supposed to accept up to fifty patients daily, thus, allowing for about 1200 women to take-up medical services monthly.

Thus, I ended up with a panel dataset starting from 2008 to 2020 for all Russian regions. And the balanced panel for all collected indicators from 2011 to 2020. I excluded Saint Petersburg and Leningrad Region regions as the first White Rose center was built in 2011 and, unfortunately, I do not have enough data to confirm the parallel pre-trends assumption. I also excluded the city of Moscow, but left the Moscow Region, where one of the White Rose centers was built. I suppose that Moscow is a very specific region and may serve as a bad control unit, thus, I decided to exclude it.

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[5] It is available via https://eng.gks.ru/
[6] Unfortunately, it is available only in Russian via https://fondsci.ru/projects/social/356/
[7] Unfortunately, it is available only in Russian via https://fondsci.ru/projects/social/356/

Moreover, due to territorial changes, I excluded the Khanty-Mansi Autonomous Area and the Yamalo-Nenets Autonomous District for some of the outcomes, as the data for these two areas is available only starting from 2011.

In addition, I did not include Crimea and Sevastopol Region due to several reasons. Firstly, the data on these regions is available only starting 2014. Secondly, they are not treated and could be only used as the control units. However, they differ from Russian regions. Finally, these regions are not recognized as a part of Russia by most of the world.

4.2 Empirical strategy

Outcomes and mechanisms

I want to estimate treatment effect of the White Rose policy on several outcomes. The first two are the number of women with breast cancer and cervical cancer standardized by the region population. I suggest that there should be more women with these diseases reported (compared to the control group) after the policy implementation. Moreover, I will look at the share of the dynamics of the share of the Stages 1 and 2 of breast cancer cases among all the newly detected cases. I assume the following mechanism: the policy aims at detection of cancer and women's reproductive system disorders at early stages and raising awareness around these issues. It provides safe space with high-quality specialists for diagnostic services, thus, increasing the demand for diagnostic procedures, and, as follows, the number of people with detected cancer at earlier stages. The last thing I would like to look at is mortality. I consider two different outcomes. The first one is the probability to die during the first year after being diagnosed. I suggest that this variable may decline with the time after the program roll-out. If cancer is detected at earlier stages. Than the probability to die will be smaller. The other mortality indicator is the breast cancer death rate, adjusted by the population. I expect this variable to descrease after the implementation of the program.

Methods and possible limitations

The main strategy approach to estimation of the parameters of interest is difference-in-differences (DID) analysis. It is commonly used to evaluate already inplemented policies policies, including those related to the health economics (Wing et al., 2018). The two crucial assumptions of this approach are the parallel pre-treatment trends, and common shocks. The former suggests that the trends of outcome variables of interest in control and treatment groups should be parallel before the policy was implemented. The latter assumption implies that shocks that happen in economy equally affect both control and treatment groups. Therefore, it is important to accurately choose the control group.

In case of this paper, however, the level of treatment is the region: those regions, where the medical center was built (see Figure 1) are considered treated, others – are the control group.

Identifying asssumption

The identifying assumption of the model is that changes in outcomes of interest are driven only by the policy implementation. However, aside from the parallel trends assumption, there are some other possible concerns. Firstly, there might be a risk of spillover, meaning that the outcomes in the untreated unit are affected by the implementation of the policy in the treated region. I suppose that there is no such risk due to high costs. The medical centers are opened in the 'capital' of the treated region, thus, women from other regions should spend a substantial amount of money and time to receive the services. Conversely, there is always a possibility to arrange a meeting with the local gynecologist or mammologist for free, using the public health insurance (the OMS policy). Secondly, the timing of the roll-out of the intervention might be correlated with other factors and is non-random. There is no direct evidence that the policy implementation was non-random, however, I can assume several factors that may influence the timing. First factor is the size of the city, where the center was opened and its level of development, and the quality of medical services for women in the region. On one hand, to provide the new medical center with high-quality specialists, they should be available on the labor market in the area of interest. On the other hand, if medical services in the regions are of high-quality themselves, there might be no need for extra facilities, as women prefer and trust the existing ones more. However, the White Rose medical centers are targeted not only at the specialists in the area, but provide possibilities for relocation, which partially resolve this issue. To control for the development of the region, I include the gross regional product per capita.

Second is the proportion of women relative to men, as women are the main target of the policy. However, Appendix 3 shows that the distribution of the women share in the population is almost uniform among regions, being around 53%. The similar tendency holds for all the prior years.

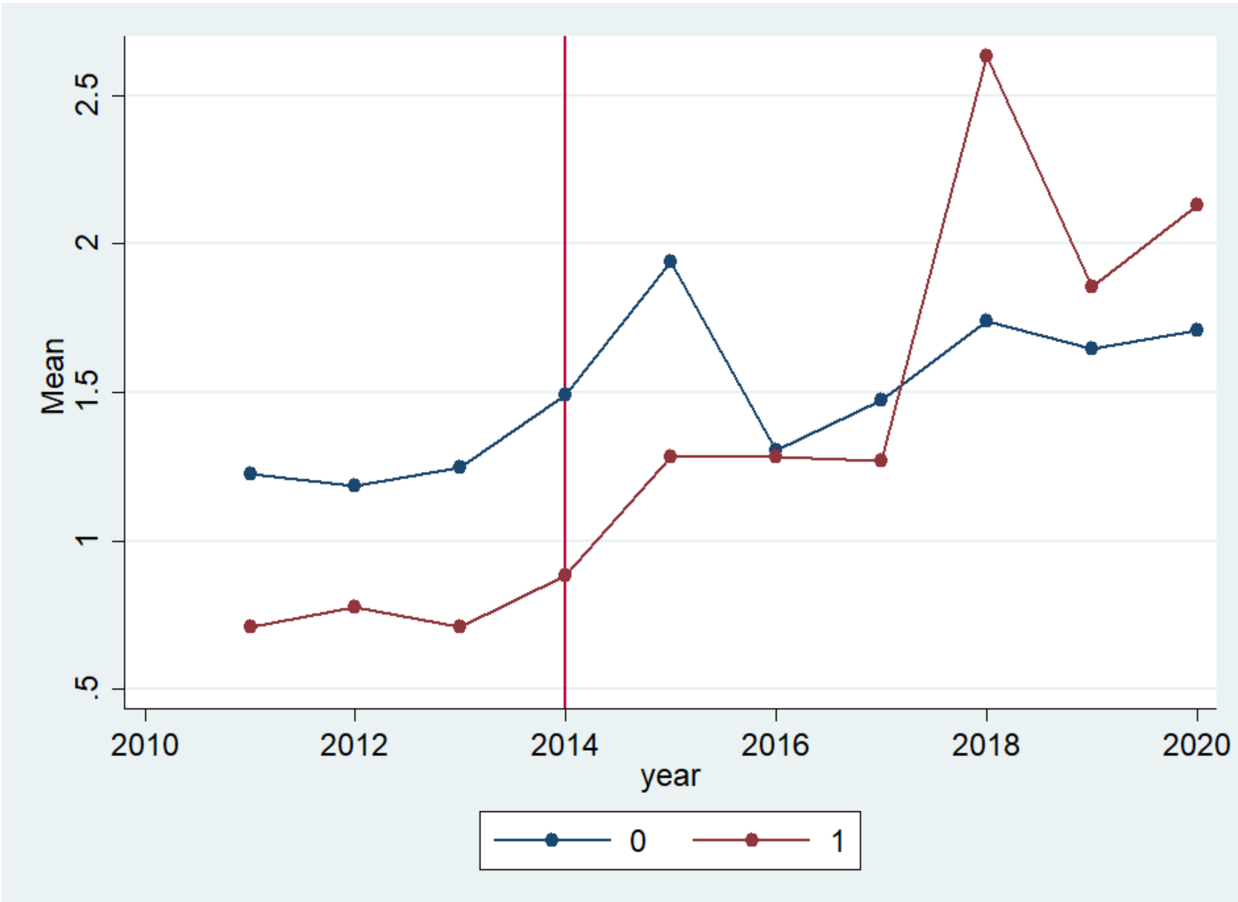
I also assume that there are no trends in changes of outcomes that are correlated with the timing of roll-out: it takes a substantial amount of time and money to implement the policy, and the effects are mostly long-run. Moreover, the White Rose project is going to expand throughout the whole country, according to the information on its oficial webpage.

Parallel trends: are they indeed parallel?

To implement differences-in-differences strategy, I start with checking the pre-treatment trends via graphs. As the White Rose project was launched not in waves, but gradually, I am satisfied with the pre-trends being parallel before the opening of the very first center in 2014.

Unfortunately, the only variable that seemingly has parallel trends is the number of new cases of breast cancer. Figure 6 shows parallel pre-trends, while other graphs are in Appendix 4.

Figure 6: Parallel trends, number of new breast cancer cases. (Treated = 1, Control = 0).



As the White Rose project was rolled-out gradually, I will follow the literature of the new differences-in-differences to estimate the effects. Callaway and Sant'Anna (2018) propose an estimator of the group-time average treatment effect. The classical differences-in-differences framework (Rubin, 2008) can be characterized by only two groups – treatment and control – that are separated by the fixed year the policy was implemented. Callaway and Sant'Anna (2018) suggest to extend this idea by identify group as the year the units were firstly treated. They propose to estimate effects separately, and then to aggregate them into summary parameters. Moreover, their approach allows to estimate effects under conditionally parallel trends, i.e. if it is assumed that the trends are parallel after controlling on covariates.

Table 3: Results of a staggered DiD estimation.

	(1) **New cases of breast cancer**
g2015	
t_2011_2012	0.652**
	(2.68)
t_2014_2016	1.038*
	(2.00)
t_2014_2020	1.240*
	(2.48)
g2016	
t_2015_2018	3.809*
	(1.98)
t_2015_2019	1.420*
	(2.33)
g2018	
t_2014_2015	-0.524***
	(-3.99)
g2020	
t_2011_2012	0.623*
	(2.05)
t_2012_2013	-0.730*
	(-2.10)
Weighted	
w2016_2016	0.0342*
	(2.05)
w2016_2017	0.0342*
	(2.05)
w2016_2018	0.0342*
	(2.05)
w2016_2019	0.0342*
	(2.05)
w2016_2020	0.0342*
	(2.05)

The regression equation that I estimate is the following:

$$Y_{i,t} = \alpha + \beta_1 Treatment_{i,t} + \epsilon_{i,t},$$

where *Treatment* is the variable that equals to 1 if the region *i* was treated at time *t,* and *Y* is the outcome – number of new detected cases of breast cancer in region *i* at time *t.*

The selected results of the estimation are in Table 3. Overall, the results are heterogeneous between groups. There are some significant positive results relating to the period after treatment, suggesting that the number of new cases of breast cancer indeed increased. However, there are significant coefficients for the pre-treatment timing, meaning that the parallel trend assumption may be violated, and the estimates of the effects biased.

To analyze the event in more details, I decided to switch to the event-study method. Moreover, under event study I will be able to analyze other outcomes that do not show parallel pre-trends in control and treatment groups. To do so, I constructed another variable indicating when in time relatively to treatment each region is. All the control regions that were never treated were assigned with 0.

I decided to include a control variable – gross regional product per capita – in the half of the specifications.

5 Main Results

5.1 The effects of the White Rose project on the health outcomes

New cases of breast cancer

I start with the same outcome that I suggested parallel trends for – the standardized number of the bew cases of breast cancer in the region. To conduct a panel event study, I follow Clarke and Tapia-Schythe (2021). I consider openning of a new White Rose medical center in a region as an *event* Thus, variable $Event_s$ records the time period *t* when the White Rose center was opened in the region *s*. Let $Y_{s,t}$ denotes the outcome of interest. Thus, the specification I estimate in this Section can be written as:

$$Y_{s,t} = \alpha + \sum_{j=2..J} \beta_j (Lag\ j)_{s,t} + \sum_{k=1..K} \gamma_k (Lead\ k)_{s,t} + \mu_s + \lambda_t + \epsilon_{s,t}\ (+\delta * grp_{s,t})$$

Mu and lambda are state and time fixed effects, *grp* is the gross regional product per capita that I include in some specifications for control, and $\epsilon_{s,t}$ is the error term.

Lags and Leads of the event may be defined as follows:

$$(Lag\ J)_{s,t} = 1[t \leq Event_s - J]$$

$$(Lag\ j)_{s,t} = 1[t = Event_s - j], for\ j \in \{1, \dots, J-1\}$$

$$(Lead\ k)_{s,t} = 1[t = Event_s \mp k], for\ k \in \{1, \dots, K-1\}$$

$$(Lead\ K)_{s,t} = 1[t \geq Event_s + K]$$

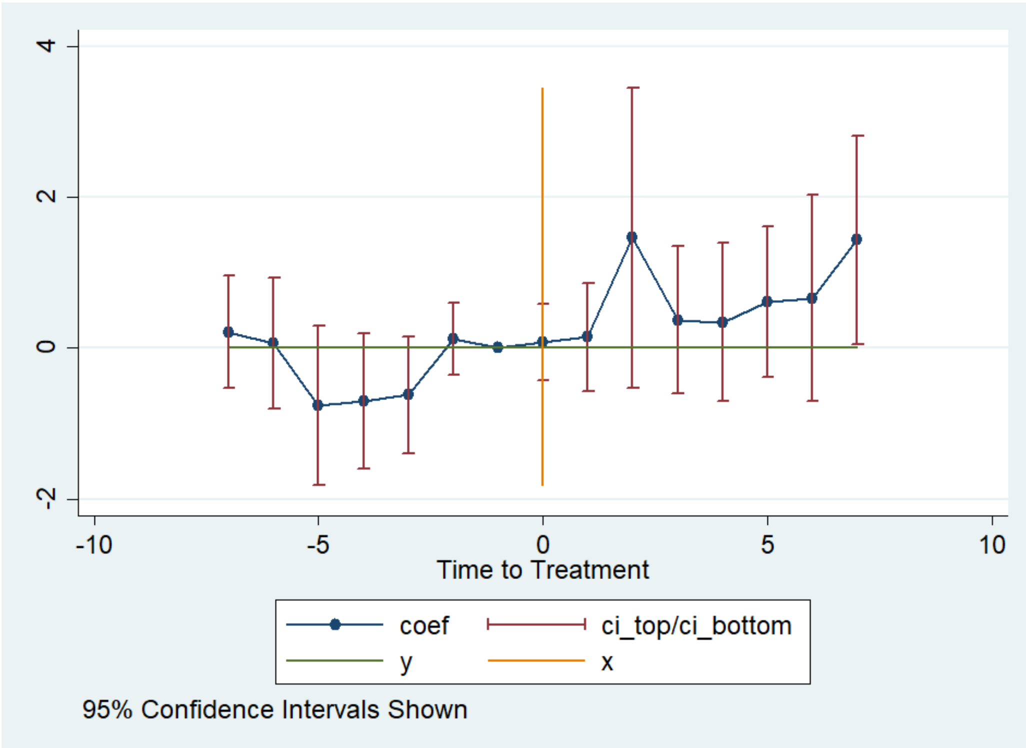
Table 4 contains the results of the estimation, Outcome variable in Columns (1) and (2) is the number of new detected breast cancer cases adgusted by the population of the region. Outcome variable is Columns (3) and (4) is the same variable, but in absolute terms.

Table 4: Results of the event sudy regression (New cases of breast cancer).

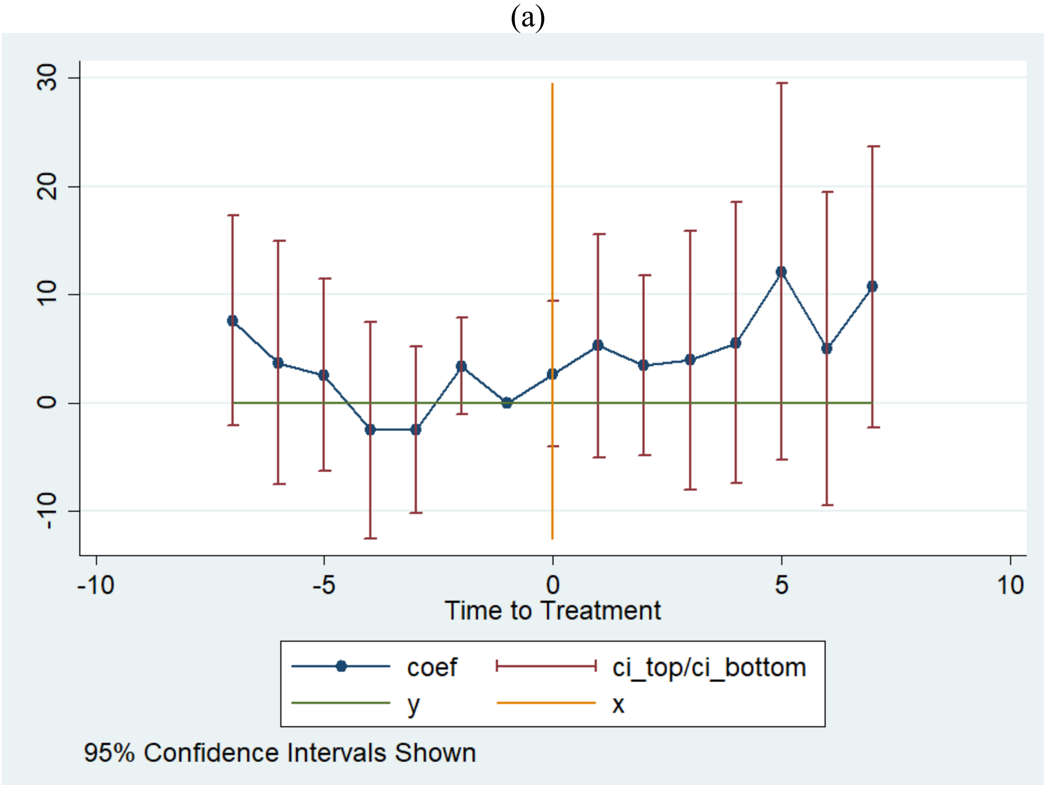
	(1) **New cases, stand.**	(2) **New cases, stand**	(3) **New cases, tot.**	(4) **New cases, tot.**
Before: 6	0.190	0.213	7.511	7.580
	(0.43)	(0.56)	(1.52)	(1.54)
Before: 5	0.0478	0.0620	3.628	3.670
	(0.10)	(0.14)	(0.63)	(0.64)
Before: 4	-0.739	-0.759	2.640	2.580
	(-1.48)	(-1.41)	(0.58)	(0.57)
Before: 3	-0.686	-0.701	-2.459	-2.504
	(-1.60)	(-1.53)	(-0.48)	(-0.49)
Before: 2	-0.605	-0.620	-2.462	-2.504
	(-1.54)	(-1.56)	(-0.62)	(-0.64)
Before: 1	0.127	0.127	3.388	3.387
	(0.52)	(0.52)	(1.49)	(1.49)
After: 1	0.0789	0.0746	2.700	2.687
	(0.30)	(0.29)	(0.79)	(0.79)
After: 2	0.150	0.146	5.284	5.273
	(0.41)	(0.40)	(1.01)	(1.00)
After: 3	1.446	1.463	3.368	3.419
	(1.43)	(1.44)	(0.79)	(0.81)
After: 4	0.354	0.374	3.898	3.960
	(0.74)	(0.75)	(0.64)	(0.65)
After: 5	0.323	0.345	5.492	5.558
	(0.65)	(0.64)	(0.83)	(0.84)
After: 6	0.607	0.612	12.09	12.10
	(1.20)	(1.20)	(1.36)	(1.36)
After: 7	0.663	0.666	5.022	5.030
	(0.96)	(0.95)	(0.68)	(0.68)
After: 8	1.434^{*}	1.433^{*}	10.72	10.72
	(2.05)	(2.03)	(1.62)	(1.62)
Control		-0.000000249		-0.000000743
		(-0.24)		(-0.71)
Constant	1.378^{***}	1.493^{**}	8.523^{*}	8.866^{*}
	(5.62)	(3.05)	(2.52)	(2.60)
N	800	800	800	800

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure 7: Treatment effects by time of the event. (a) Outcome variable - standardized number of new breast cancer cases, (b) outcome variable - absolute number of new cases.



(a)



(b)

Figure 7 graphically depicts the coefficients from Columns (2) and (4). Yellow horizontal line in these graphs is the time when the event happened. Most of the coefficients are insignificant, however, there is a positive effect of the White Rose medical center in 8 years after the event. This may be a sign that new White Rose centers indeed are effective, especially in the long run, and help to correctly and timely diagnose more patients. Additionaly, I conducted a test of joint significance of the lags, to make sure that there is no bias. The F-statistic is 0.0043, and the p-value < 0.5, thus the null hypothesis of joint insignificance holds.

Although most coefficients in Table 4 and Figure 7 are not statistically significant, all of them are positive after the treatment, and following an upward trend starting from 4 years in the program. The most pronounced effect can be seen three years after the treatment period, when the effect of the policy on the standardized number of new breast cancer cases reached the mean of 1.463.

New cases of cervical cancer

Table 5 and Figures 8 and 9 provide results for the new detected cases of cervical cancer. Although the lags are not jointly significant, as for the new cases of breast cancer, all the results are insignificant. In Figure 6 most of the coefficients before treatment are negative, while after the event they become positive. Unfortunately, it is not precisely clear whether this shift is provoked by the activity of the White Rose medical centers or by the natural changes in the population behavior.

It is important to notice that there are several pretreatment periods with statistically significant coefficients, with the 95% confidence interval staying below zero. Althought the test of the joing statistical significance accepted the null hypothesis, this may be an indicator of noisy data with the pretreatment trends.

Figure 8: Treatment effects by time of the event (Outcome variable - standardized number of new cervical cancer cases)

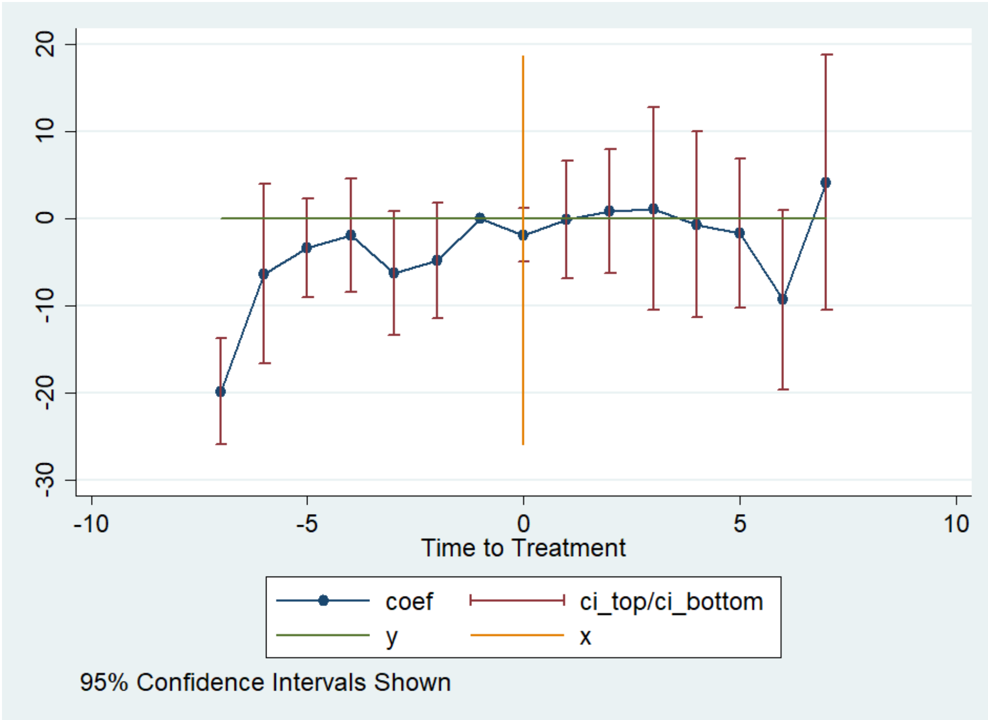


Figure 9: Treatment effects by time of the event (Outcome variable – absolute number of new cervical cancer cases)

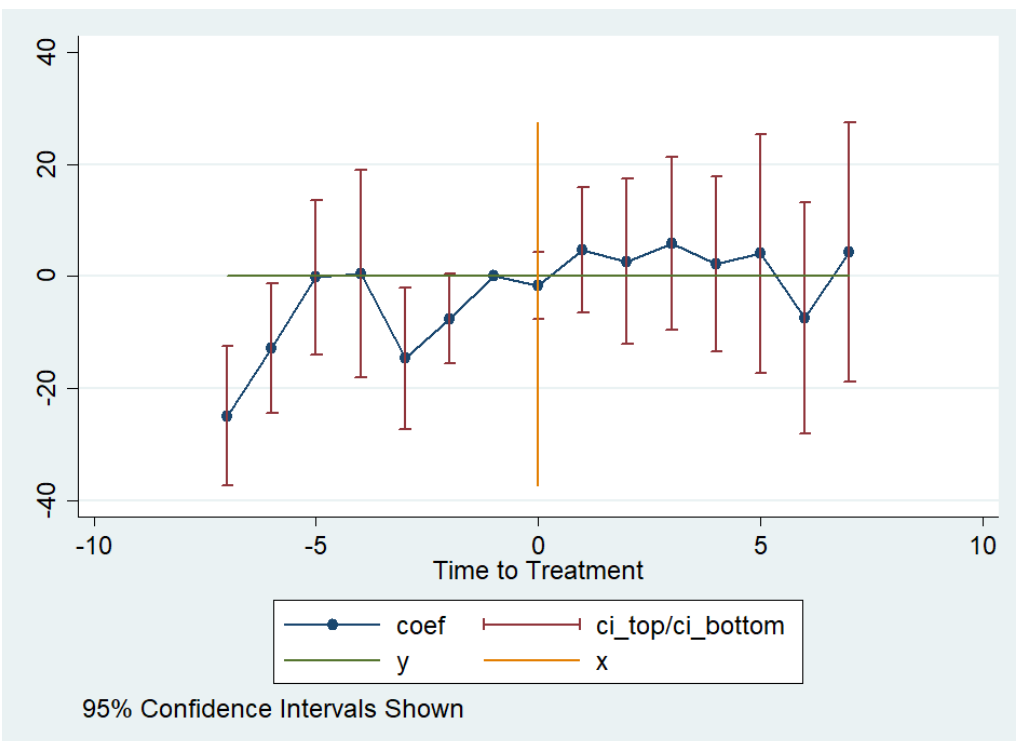


Table 5: Results of the event sudy regression (New cases of cervical cancer).

	(1) New cases, stand.	(2) New cases, stand.	(3) New cases, tot.	(4) New cases, tot.
Before: 7	-19.76***	-19.86***	-25.52***	-24.95***
	(-6.48)	(-6.43)	(-4.04)	(-3.94)
Before: 6	-6.324	-6.385	-13.16*	-12.80*
	(-1.21)	(-1.21)	(-2.22)	(-2.16)
Before: 5	-3.492	-3.405	0.298	-0.205
	(-1.22)	(-1.18)	(0.04)	(-0.03)
Before: 3	-1.990	-1.924	0.840	0.463
	(-0.60)	(-0.58)	(0.09)	(0.05)
Before: 2	-6.336	-6.274	-14.27*	-14.62*
	(-1.75)	(-1.73)	(-2.18)	(-2.27)
Before: 1	-4.880	-4.880	-7.547	-7.551
	(-1.44)	(-1.44)	(-1.85)	(-1.86)
After: 1	-1.949	-1.931	-1.500	-1.607
	(-1.25)	(-1.23)	(-0.49)	(-0.53)
After: 2	-0.0853	-0.0703	4.733	4.646
	(-0.02)	(-0.02)	(0.84)	(0.81)
After: 3	0.947	0.873	2.200	2.628
	(0.26)	(0.24)	(0.29)	(0.35)
After: 4	1.203	1.114	5.348	5.862
	(0.20)	(0.19)	(0.66)	(0.74)
After: 5	-0.592	-0.686	1.670	2.214
	(-0.11)	(-0.13)	(0.21)	(0.28)
After: 6	-1.639	-1.658	3.967	4.079
	(-0.37)	(-0.38)	(0.37)	(0.37)
After: 7	-9.339	-9.349	-7.566	-7.506
	(-1.78)	(-1.77)	(-0.72)	(-0.71)
After: 8	4.114	4.114	4.363	4.360
	(0.55)	(0.55)	(0.37)	(0.37)
Control		0.00000107		-0.00000618
		(0.31)		(-1.68)
Constant	27.70***	27.21***	52.08***	54.94***
	(17.22)	(11.43)	(18.09)	(15.66)
N	800	800	800	800

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

New cases of cancer by Stages

Some other outcomes I would like to consider are the shares of the cancer at different stages in all newly diagnosed cases. I hypothesised that the White Rose programm should increase the share of the Stage 1 and Stage 2 breast cancer in all diagnoses. However, Figure 10 and Table 6 Columns 1 and 2 yields different results. Most of the coefficients after treatment are either negative or slightly above zero. This may happen because the White Rose medical centers still have not got enough attention from younger women. According to the World Healthh Organization (2022), the primary stages of breast cancer are usually detected at the age of 40-45. Thus, if the White Rose centers are more popular among older population, it may be the case that there will be more diseases detected at the later stages.

Figure 12 shows a clear upward trend in the share of Stage 4 cases among all new diagnoses, i tis especially pronounced later in time. Although the coefficients still insignificant, confidence intervals for the last two periods after the treatment looks like they do not cross the x axis and include zero. Thus, I would consider it as a peculiar result: while shares of Stage 1-3 breast cancer diagnoses decreases among new cases, the share of the Stage 4 cancer diagnosis rises substantially. If the White Rose program has an effect on this outcome (which we cannot be entirely sure of) then it looks like it targets older women.

However, the overall number of new diagnoses also has an upward trend, thus, the absolute number of Stage 1 and Stage 2 cancer diagnoses might have increased as well. Unfortunately, the reports do not provide this kind of data, thus, i tis not possible to cjeck it.

Figure 10: Event study, graph. ***Dependend variable:*** *share of people being diagnosed with the Stages 1 or 2 of breast cancer out of total newly diagnosed individuals in the region.*

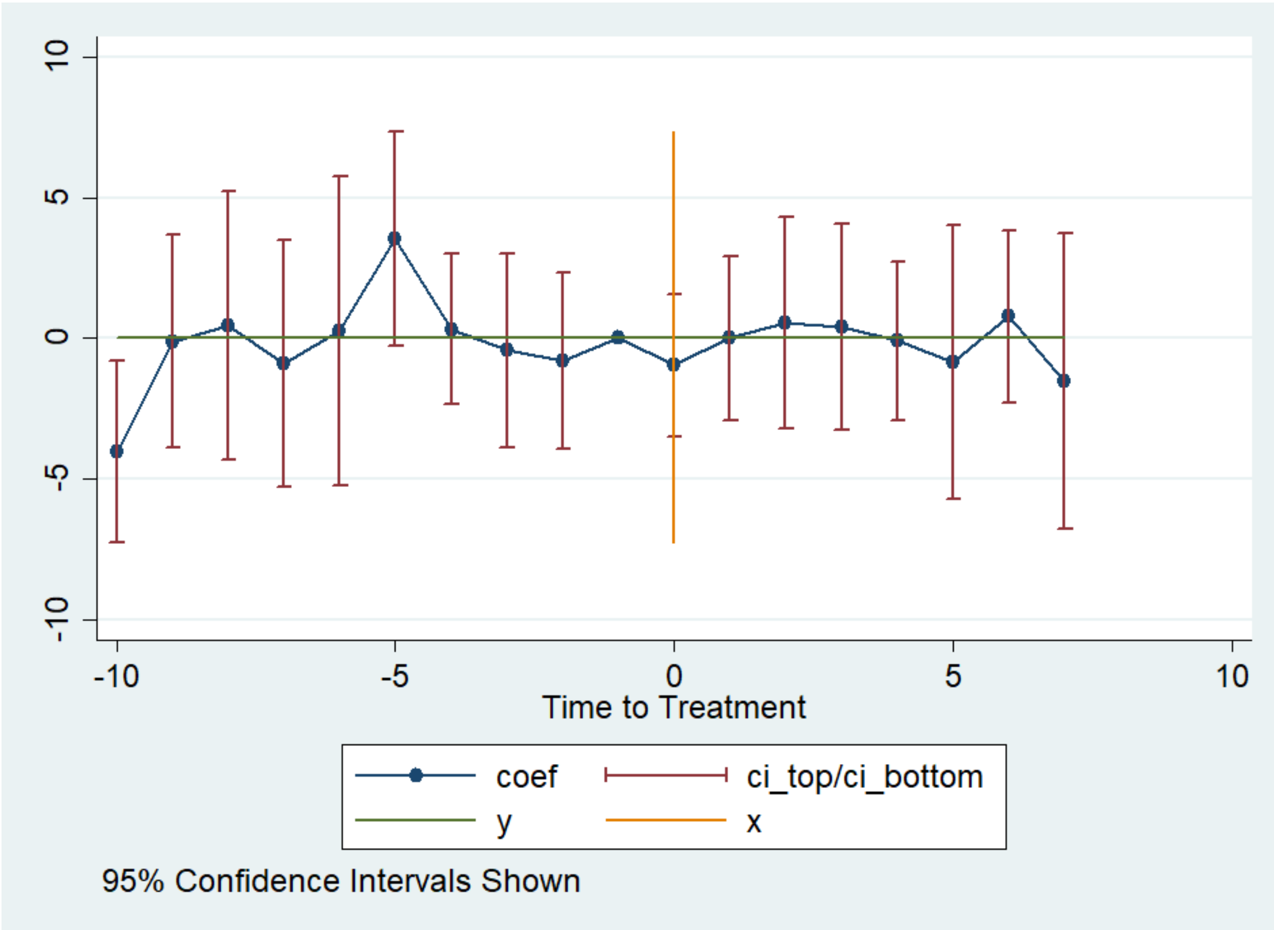


Figure 11: Event study, graph. ***Dependend variable****: share of people being diagnosed with the Stage 3 breast cancer out of total newly diagnosed individuals in the region.*

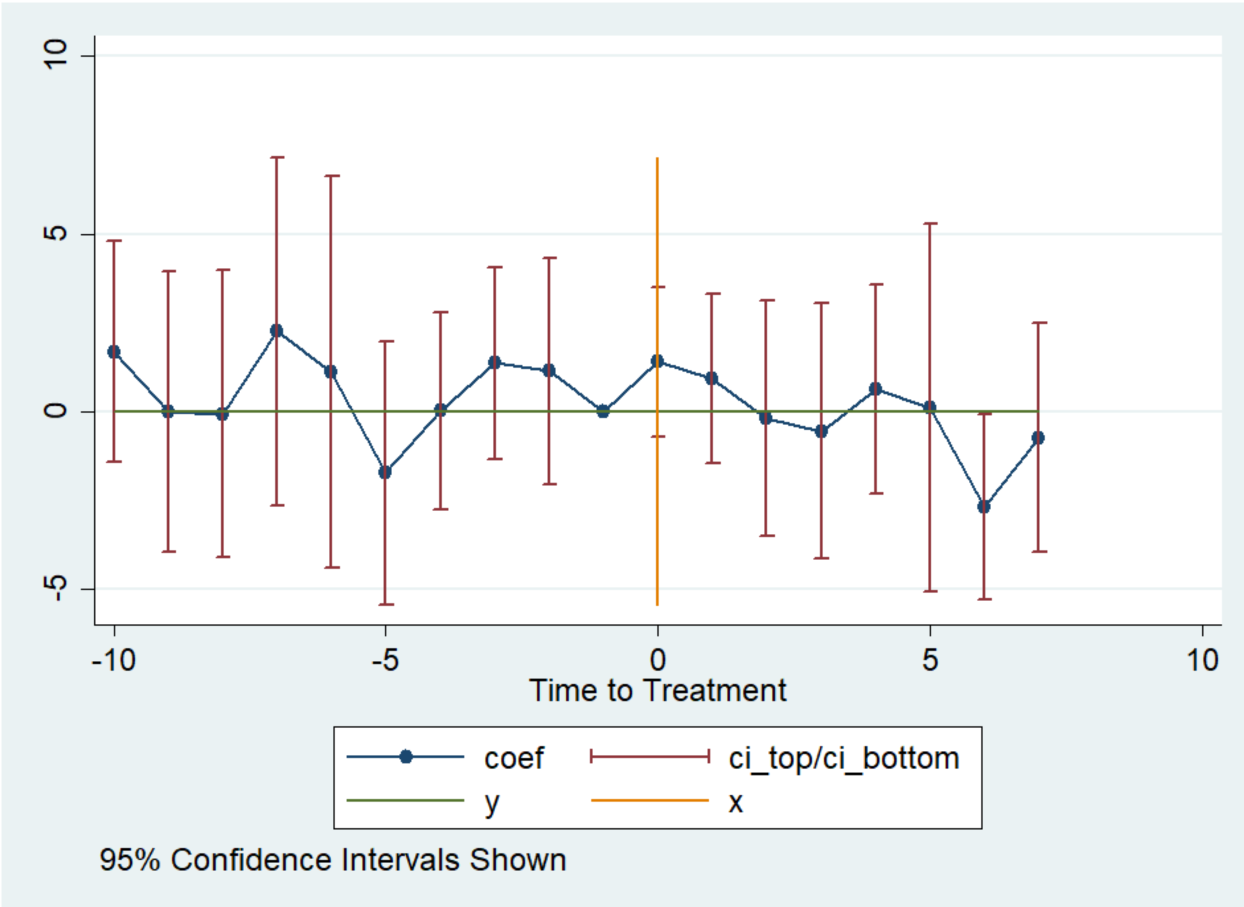


Figure 12: Event study, graph. ***Dependend variable:*** *share of people being diagnosed with the Stage 4 breast cancer out of total newly diagnosed individuals in the region.*

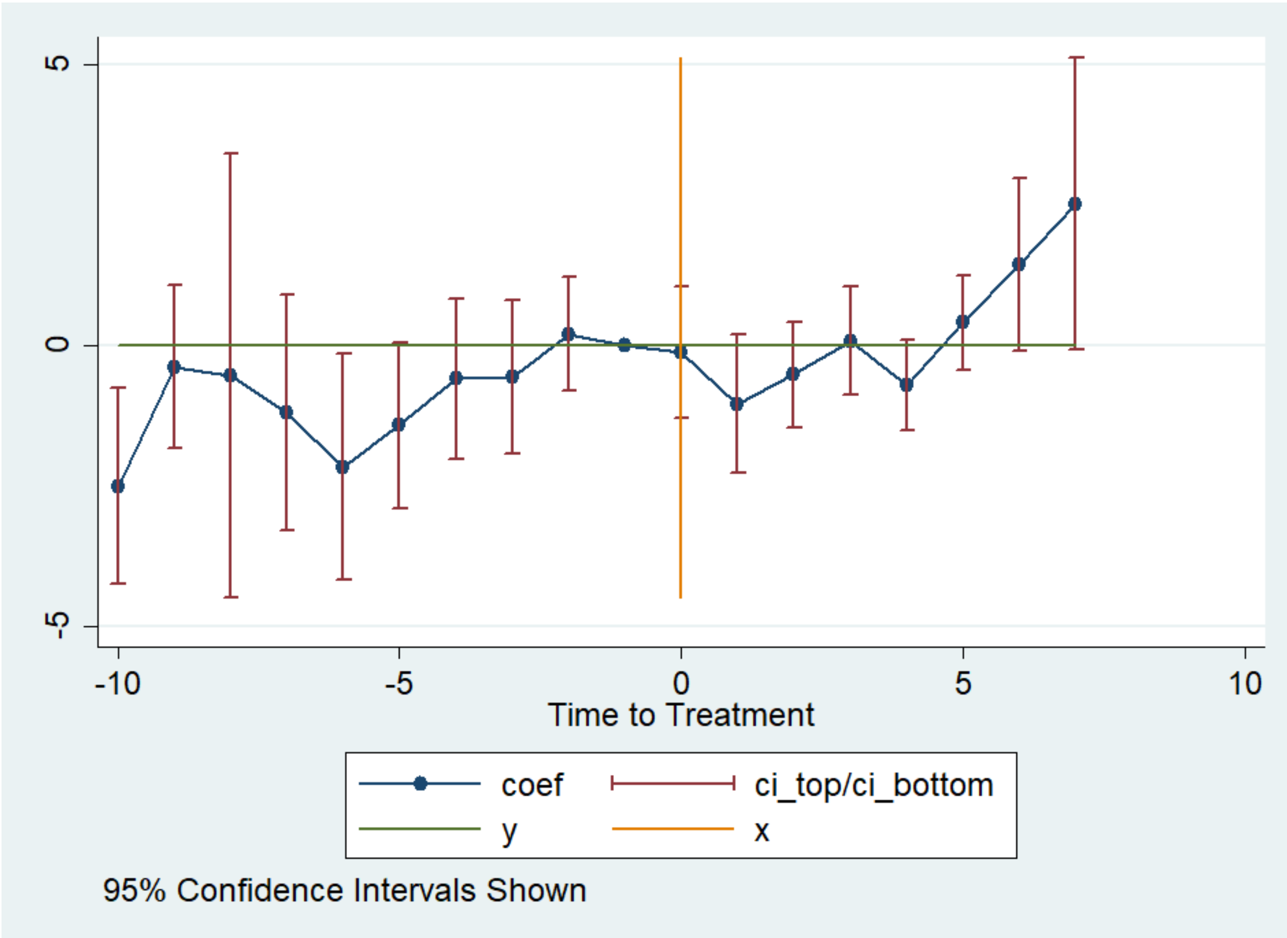


Table 6: Event study, coefficients table. Dependent variable: share of a certain stage of breast cancer out of total new identified cases

	(1) Stages 1-2	(2) Stages 1-2	(3) Stage 3	(4) Stage 3	(5) Stage 4	(6) Stage 4
Before: 9	-4.103*	-4.029*	1.785	1.686	-2.511**	-2.514**
	(-2.47)	(-2.43)	(1.12)	(1.06)	(-2.87)	(-2.83)
Before: 8	-0.170	-0.101	0.0468	0.00383	-0.364	-0.382
	(-0.09)	(-0.05)	(0.02)	(0.00)	(-0.50)	(-0.51)
Before: 7	0.566	0.449	-0.322	-0.0589	-0.507	-0.536
	(0.23)	(0.18)	(-0.16)	(-0.03)	(-0.25)	(-0.27)
Before: 6	-0.844	-0.911	2.061	2.260	-1.178	-1.209
	(-0.38)	(-0.41)	(0.83)	(0.90)	(-1.10)	(-1.13)
Before: 5	0.322	0.258	0.962	1.127	-2.135*	-2.168*
	(0.11)	(0.09)	(0.34)	(0.40)	(-2.11)	(-2.10)
Before: 4	3.576	3.549	-1.781	-1.720	-1.417	-1.427
	(1.84)	(1.83)	(-0.95)	(-0.91)	(-1.89)	(-1.90)
Before: 3	0.347	0.330	-0.0352	0.0304	-0.587	-0.598
	(0.26)	(0.24)	(-0.02)	(0.02)	(-0.81)	(-0.83)
Before: 2	-0.410	-0.434	1.310	1.360	-0.552	-0.563
	(-0.23)	(-0.25)	(0.94)	(0.98)	(-0.79)	(-0.81)
Before: 1	-0.800	-0.801	1.138	1.140	0.203	0.203
	(-0.50)	(-0.50)	(0.70)	(0.70)	(0.39)	(0.39)
After: 1	-0.949	-0.963	1.373	1.397	-0.130	-0.131
	(-0.73)	(-0.75)	(1.28)	(1.30)	(-0.22)	(-0.22)
After: 2	0.0190	0.00777	0.902	0.922	-1.048	-1.048
	(0.01)	(0.01)	(0.75)	(0.76)	(-1.66)	(-1.66)
After: 3	0.499	0.552	-0.0771	-0.177	-0.525	-0.520
	(0.26)	(0.29)	(-0.05)	(-0.10)	(-1.13)	(-1.08)
After: 4	0.346	0.413	-0.414	-0.542	0.0717	0.0790
	(0.19)	(0.22)	(-0.23)	(-0.30)	(0.15)	(0.16)
After: 5	-0.174	-0.100	0.776	0.635	-0.719	-0.710
	(-0.12)	(-0.07)	(0.52)	(0.42)	(-1.84)	(-1.72)
After: 6	-0.867	-0.870	0.123	0.120	0.399	0.402
	(-0.35)	(-0.35)	(0.05)	(0.05)	(0.93)	(0.94)
After: 7	0.803	0.791	-2.686*	-2.677*	1.427	1.431
	(0.52)	(0.51)	(-2.06)	(-2.02)	(1.82)	(1.82)
After: 8	-1.519	-1.540	-0.751	-0.726	2.519	2.523
	(-0.56)	(-0.57)	(-0.45)	(-0.44)	(1.90)	(1.90)
Control		-0.000000775		0.00000144		-7.30e-08
		(-0.67)		(0.81)		(-0.10)
Constant	67.37***	67.68***	22.20***	21.61***	9.237***	9.266***
	(53.49)	(49.97)	(20.57)	(17.19)	(16.43)	(16.11)
N	1035	1030	1035	1030	1035	1030

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Breast cancer mortality rates

Breast cancer mortality dinamics provides interesting results. To begin with, Column 2 in Table 7 is the only specification where the control variable is significantly different from zero. In addition, while the effects of the White Rose program on the absolute value of deaths of breast cancer are mostly negative (coefficients in the periods after the treatment), the standardized value follows the opposite tendency. Most of the coefficients after the treatment are larger than zero.

I suppose that is can be a sign of the effectiveness of the programm, when i tis combined with the previous results on the share of Stage 4 cancer. If White Rose program accidentaly targets older women, it may result in more cases when the first diagnosis of the individual is the fourth stage of cancer. This, in turn, indicates that there will be a higher probability that the person dies of cancer. Thus, if the increase in the number of deaths is caused by the increase in the share of people diagnosed with the Stage 4 breast cancer because they decided to use the White Rose medical centers survices, then it may partially indicate that the programm is effective.

However, in this case it would be more cost-efficient to reevaluate the marketing strategy of the center. If the White Rose clinics attract older audience, the government budget burden increase way more than if they attract younger women with earlier stages of cancer (Schopper and de Wolf, 2009; Holt, 1986).

Figure 13: Deaths of breast cancer, standardized value.

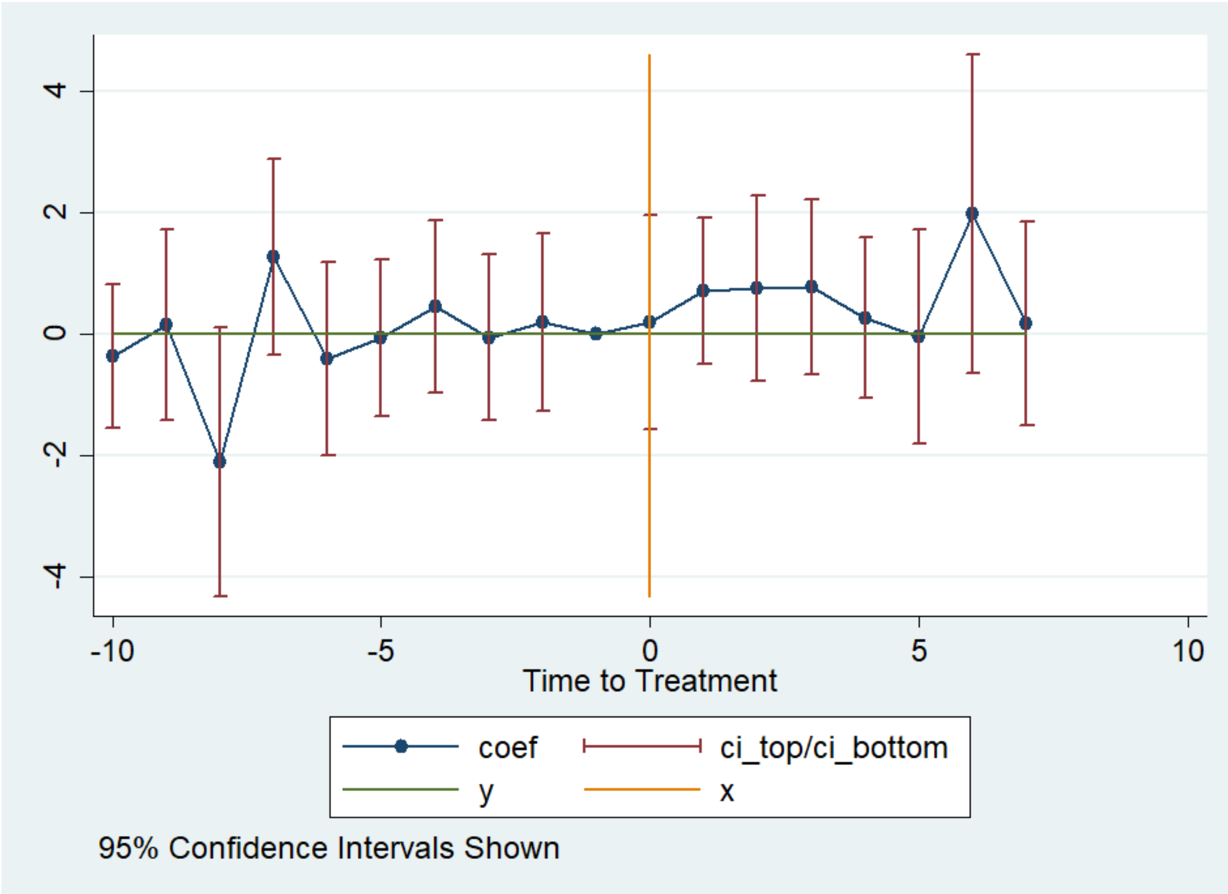


Figure 14: Deaths of breast cancer, absolute value.

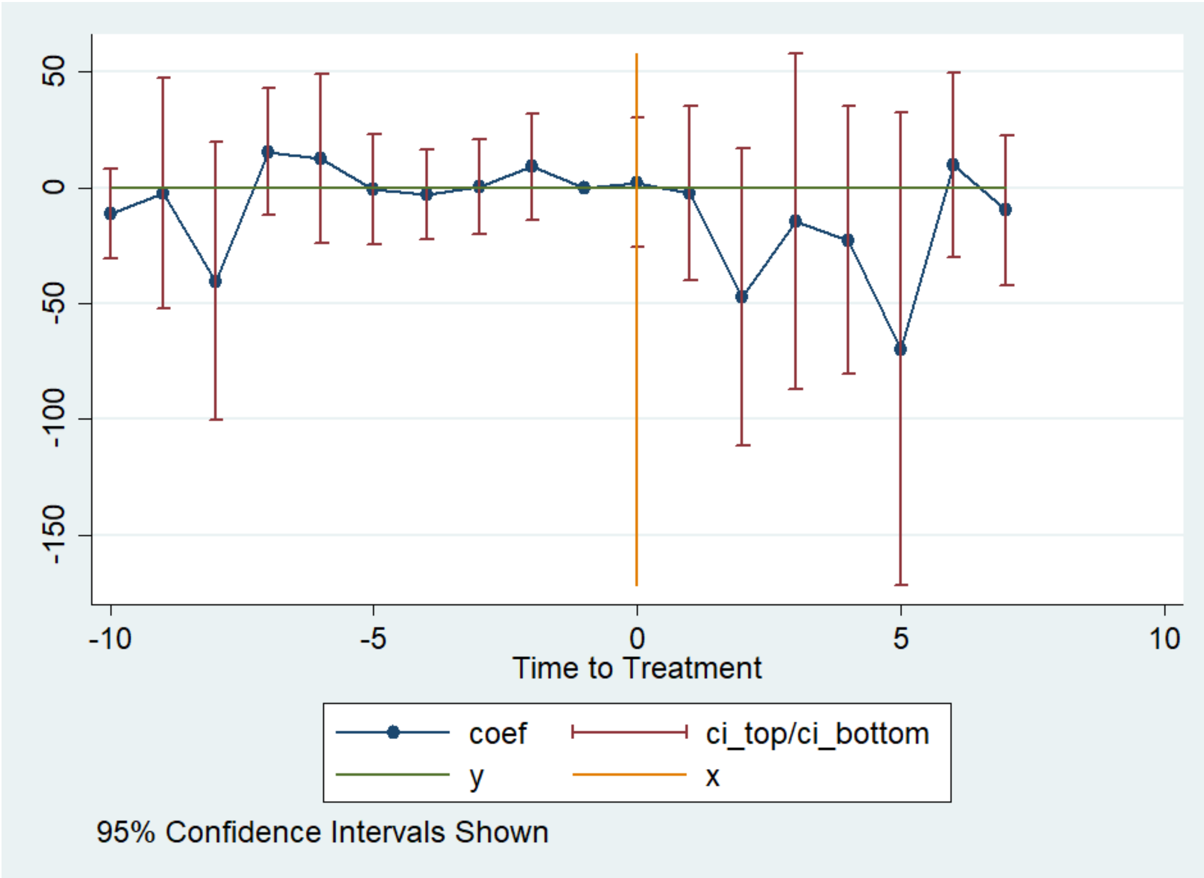


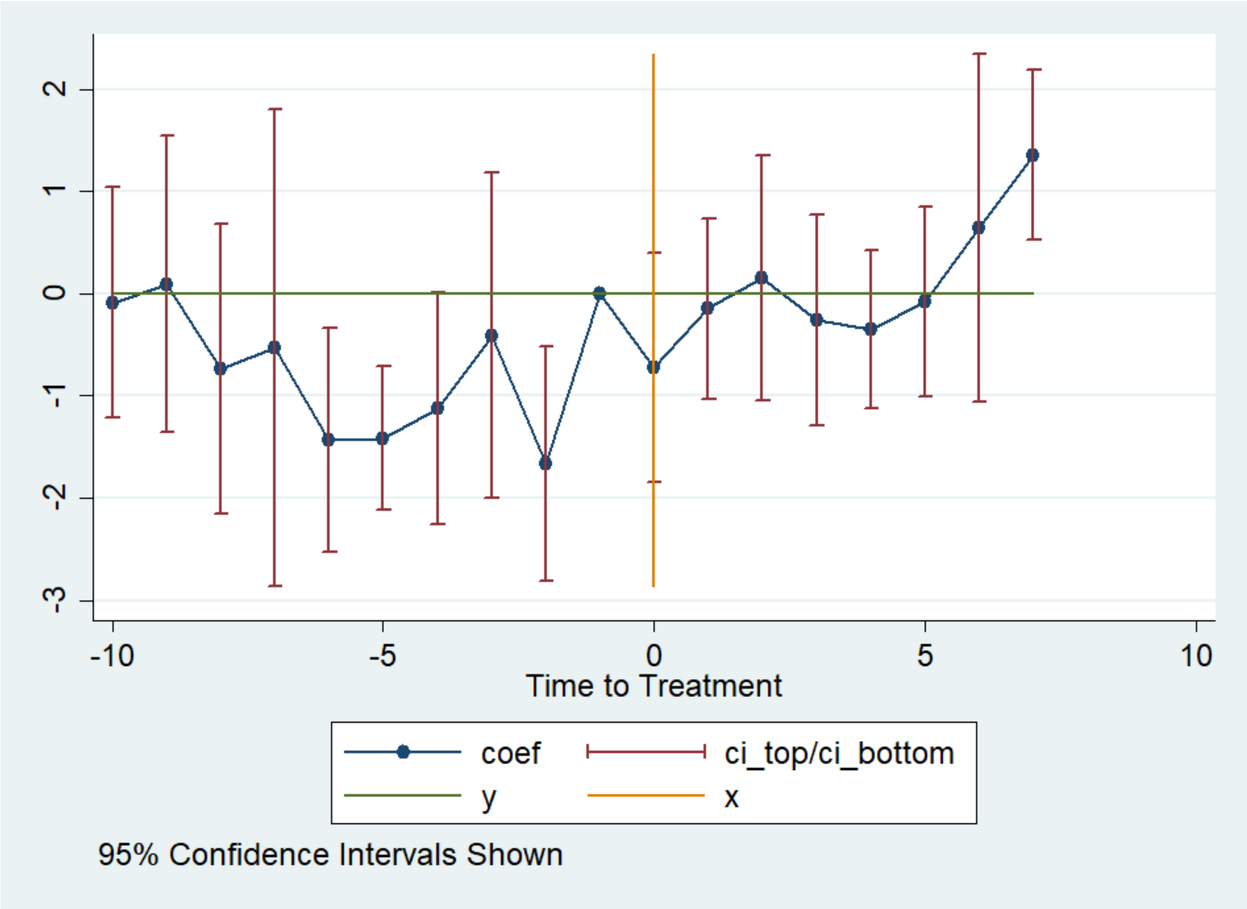
Table 7: Event study, coefficients table. Dependent variables: breast cancer mortality and probability to die in the first year after the diagnosis.(t statistics in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$)

	(1) **Prob. to die in a year**	(2) **Prob. to die in a year**	(3) **Deaths from breast cancer, stand.**
Before: 9	-0.0863	-0.104	-0.396
	(-0.15)	(-0.18)	(-0.64)
Before: 8	0.0921	0.126	0.110
	(0.12)	(0.17)	(0.14)
Before: 7	-0.739	-0.595	-1.994
	(-1.02)	(-0.87)	(-1.83)
Before: 6	-0.532	-0.400	1.333
	(-0.45)	(-0.35)	(1.58)
Before: 5	-1.428*	-1.329*	-0.346
	(-2.55)	(-2.37)	(-0.43)
Before: 4	-1.415***	-1.381***	-0.0475
	(-3.93)	(-3.82)	(-0.07)
Before: 3	-1.125	-1.076	0.464
	(-1.94)	(-1.89)	(0.63)
Before: 2	-0.408	-0.383	-0.0449
	(-0.50)	(-0.47)	(-0.06)
Before: 1	-1.663**	-1.662**	0.192
	(-2.85)	(-2.85)	(0.26)
After: 1	-0.718	-0.708	0.205
	(-1.25)	(-1.23)	(0.23)
After: 2	-0.147	-0.139	0.718
	(-0.33)	(-0.31)	(1.17)
After: 3	0.155	0.111	0.706
	(0.25)	(0.18)	(0.92)
After: 4	-0.256	-0.313	0.718
	(-0.48)	(-0.56)	(0.96)
After: 5	-0.348	-0.412	0.201
	(-0.89)	(-1.09)	(0.30)
After: 6	-0.0799	-0.0867	-0.0410
	(-0.17)	(-0.19)	(-0.05)
After: 7	0.640	0.636	1.973
	(0.74)	(0.72)	(1.50)
After: 8	1.358**	1.361**	0.181
	(3.20)	(3.12)	(0.21)
Control		0.000000628*	
		(2.47)	
Constant	8.061***	7.803***	14.39***
	(15.78)	(15.08)	(17.24)

Table 8: Event study, coefficients table. Dependent variables: breast cancer mortality and probability to die in the first year after the diagnosis.(t statistics in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$)

	(1) **Deaths from breast cancer, stand.**	(2) **Deaths from breast cancer, tot.**	(6) **Deaths from breast cancer, tot.**
Before: 9	-0.367	-14.59	-11.39
	(-0.61)	(-1.42)	(-1.16)
Before: 8	0.137	-6.208	-2.938
	(0.17)	(-0.25)	(-0.12)
Before: 7	-2.108	-44.08	-40.46
	(-1.87)	(-1.46)	(-1.32)
Before: 6	1.262	12.15	15.25
	(1.54)	(0.87)	(1.09)
Before: 5	-0.406	9.845	12.43
	(-0.50)	(0.53)	(0.67)
Before: 4	-0.0761	-2.174	-0.789
	(-0.12)	(-0.18)	(-0.06)
Before: 3	0.445	-4.045	-3.068
	(0.62)	(-0.41)	(-0.31)
Before: 2	-0.0653	-0.322	0.498
	(-0.09)	(-0.03)	(0.05)
Before: 1	0.191	8.977	9.005
	(0.26)	(0.77)	(0.77)
After: 1	0.194	2.169	2.206
	(0.22)	(0.15)	(0.16)
After: 2	0.710	-2.646	-2.637
	(1.16)	(-0.14)	(-0.14)
After: 3	0.747	-47.16	-47.44
	(0.96)	(-1.45)	(-1.45)
After: 4	0.771	-14.22	-14.65
	(1.04)	(-0.39)	(-0.40)
After: 5	0.260	-22.21	-22.73
	(0.38)	(-0.75)	(-0.77)
After: 6	-0.0406	-69.22	-69.67
	(-0.05)	(-1.33)	(-1.34)
After: 7	1.968	10.37	9.765
	(1.47)	(0.51)	(0.48)
After: 8	0.169	-9.278	-9.863
	(0.20)	(-0.56)	(-0.60)
Control	-0.000000608		0.001
	(-0.99)		(0.48)
Constant	14.63^{***}	238.1^{***}	236.4^{***}
	(16.61)	(17.76)	(18.14)

Figure 15: Probability to die within the first year after the diagnosis.



6 Another approach: synthetic differences-in-differences on the White Rose policy

Another way to tackle the violation of the assumtion on the parallel pretreatment trends may be to use synthetic differences in differences. The regions in Russia are diverse (as it can be seen from Figure 1), so it might be hard to find a proper control group. Thus, as an extra method I want to try and estimate the parameters of interest I using synthetic difference in differences following Arkhangelsky et al. (2021) and Ben-Michael et al. (2020). It combines synthetic control that is mostly used in the matching problems, and difference-in-differences estimator. Thus, it should help to overcome the violation of pre-treatment parallel trends. This estimator reweights the control units to match the trends of the treated group before intervention as closely as possible. Moreover, Ben-Michael et al. (2020) take into account the staggered nature of the policy implementation, and adjust the estimator to make it robust. They follow Callaway and Sant'Anna (2018) who suggested an extension of the standard differences-in-differences model, and apply the similar approach to a more comlex synthetic setting

Nevertheless, to construct a good synthetic control, outcomes and their trends should be similar in thecontrol and treated regions. Thus, keeping in mind heterogeneity in the outcomes trends among the regions, I am considering synthetic differences-in-differences approach not as a solution to the violated parallel trends assumption, but as an investigation tool. This approach should construct synthetic control units buy combining regions that were not treated by the White Rose program.

Synthetic differences-in differences extended by Ben-Michael et al. (2020) encorporates the same idea that Callaway and Sant'Anna (2018) describe. Now regions can be divided into groups depending on the time they were treated for the first time. Then, i tis possible to construct a separate synthetic control for each groups of regions. However, the average treatmennt effect is usually aggregated and reported for the whole sample.

Nevertheless, the results obtained using synthethic differences-in-differences approach are still insignificant. Moreover, they should be considered carefully, as the matching did not work successfully, according to the graphs. Table 8 holds the results of the regressions. It is worth mentioning that all the effects are positive and relatively high, comparing to the other results. Thus, this specification suggests that the effect of the White Rose program on the share of the Stage 1 and 2 breast cancer among the newly detected cases is 1.151. However, Table 6 shows the opposite picture – most of the average effects are negative.

Table 9: Treatment effects using synthetic difference-in-difference. T-statistics in the parentheses.

	Treatment effect
New cases of breast cancer, stand.	0.458 (0.64)
New cases of cervical cancer, stand.	1.836 (0.98)
Share of Stage 1 and 2 breast cancer in all new detected cases	1.151 (1.08)
Probability to die in a year after the diagnosis	0.421 (0.77)

7 Discussion

Overall, the results are mixed. The parallel pretrend assumptions are not satidfied for the most of the outcomes of interest. However, the event study approach provides support of the unimportance of lags (they null hypothesis of the joint significance is rejected). Unfortunately, after-treatment periods do not yield any significant results as well.

There are two outcomes of the most interest: the first one is the share of the Stage 4 cancer among the new breast cancer diagnoses. It drastically increase towards the end of the timespan. This tendency is in line with the results for the probability to die within the first year after being diagnosed, which follow the similar trend. Adami et al. (1986) mention that the probability to die increase with the Stage at which the cancer was diagnosed.

Another outcome that stands out is the number of the new cases of breast cancer detected.

In this subsection I would like to discuss possible underlying reasons for the insignificance of the results. Firstly, it may be because of the quality of the data. One reason is that I collected it manually, thus, there may be mistakes due to my inattention, Another reason is the quality of the reports that I was using for constructing the dataset. These reports are arbitrary and are used to control for the hospitals performance, thus some regions may provide not entirely truthful information. Secondly, the effects of the White Rose policy may be too small to detect using this sample. Thus, the results are not significant, even if they exist.

Another reason for insignificance of the results may be low take-up of the policy. However, official news on the White Rose programm argues about its high popularity in Russia. Somewhat connected with it issue – low take up of the advice given in the center. When White Rose specialists suspect cancer in their patients, they have to refer this patient to the public onkology hospital. The specialists cannot control the future actions of the patients, thus, some of them may ignore recomendations or contact a privite oncologist. Then, the public hospitals will not get data about the new cancer case, even though is was detected. This is possible due to low trust in the public healthcare system in low- and middle-income countries, as mentions Glied and Smith (2013).

In addition, it is also possible that the White Rose program has more pronounced long-term effects, which simply cannot be detected at this time.

All these considerations along with the vague results leave a room for the further research. Moreover, as the RLMS dataset does not include respondents from all the regions of Russia, it is hard to get high-quality aggregated information on the economic outcomes. Thus, the research may be developed in this direction, For example, making an agreement with the White Rose project on the anonimous data disclosure, may extend this research to the evaluation of the average individual treatment effects on both health and economic outcomes. This kind of data will make it possible to use variation on the individual level, making the effects easier to detect.

Conclusion

The White Rose project is a policy that aims to raise awareness about breast cancer among Russian women. Eighteen high-quality medical centers providing free diagnostic services of breast cancer were built in fourteen regions of Russia from 2011 to 2020. In this thesis I estimate the effects of this policy on health and economic outcomes.

I use an event study approach, combined with the differences-in-differences and synthetic differences-in-differences methods, following Arkhangelsky et al. (2021), Ben-Michael et al. (2020), and Clarke and Tapia-Schythe (2021) to measure and analyze the average treatment effects on the mortality rates and detection of the breast cancer. I assume that the regions where the White Rose medical centers were opened and have been operating for at least three months are treated, while the others serves as control units. For synthetic differences-in-differences combination of the untreated regions acts as the control unit for different groups of the treated regions. In all approaches I adjust for the staggered construction of the White Rose medical centers along Russia.

To conduct this research, I use two datasets. The first one is the Russia Longitudinal Monitoring Survey. It is a panel collecting data on a various set of economic, demographic, health, and social characteristics on the individual level. I analyze the correlations between the breast cancer diagnosis in women and a wide set of outcomes, supporting this analysis by related literature. The second dataset consists mostly of the digitalized reports of the National Medical Research Radiological Centre of the Ministry of Health of the Russian Federation. These are annually reports with detailed information on most of the oncological diseases on the regional level. This is the main dataset that I use for quantitative estimation of the White Rose project effects.

The results are mostly insignificant. However, these are more pronounced effects at the longer horizon, especially for the variable collecting the number of new cases of the breast cancer. Thus, right now it is hard to detect significant effects of the White Rose medical centers. Overall trends suggests that the program may be efficient. I suppose that the more clear results might be found using other sources of data, maybe, even on the individual level.

I think that this research provides insights on the work and effectiveness of the “White Rose” program. Thus, I believe that the results of this research and its possible future extensions might be useful for policymakers in Russia, as well as to other developing countries with similar economic conjuncture, where such policies could be implemented.

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Appendeces

Apendix 1: Graphs of PDFs of the logarithm of the self-reported wage for women with and without gynecological diseases.

Figure 16: PDFs of the wage logarithm by gynecological disease in 2016 (By author).

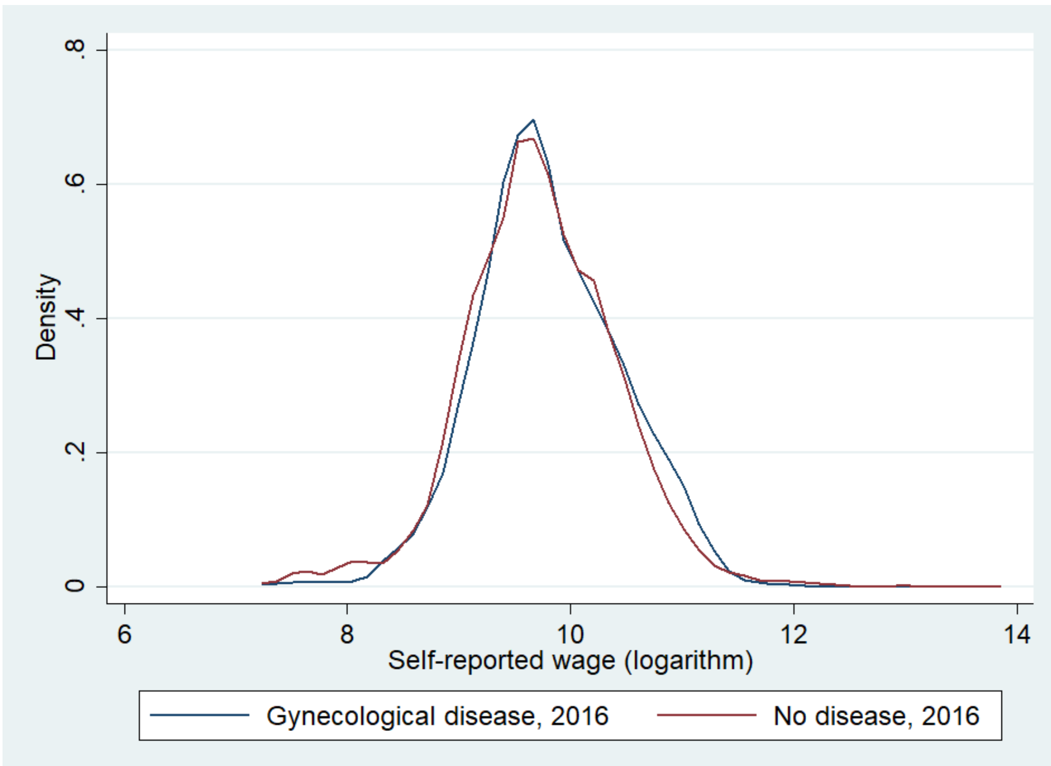


Figure 17: PDFs of the wage logarithm by gynecological disease in 2017 (By author).

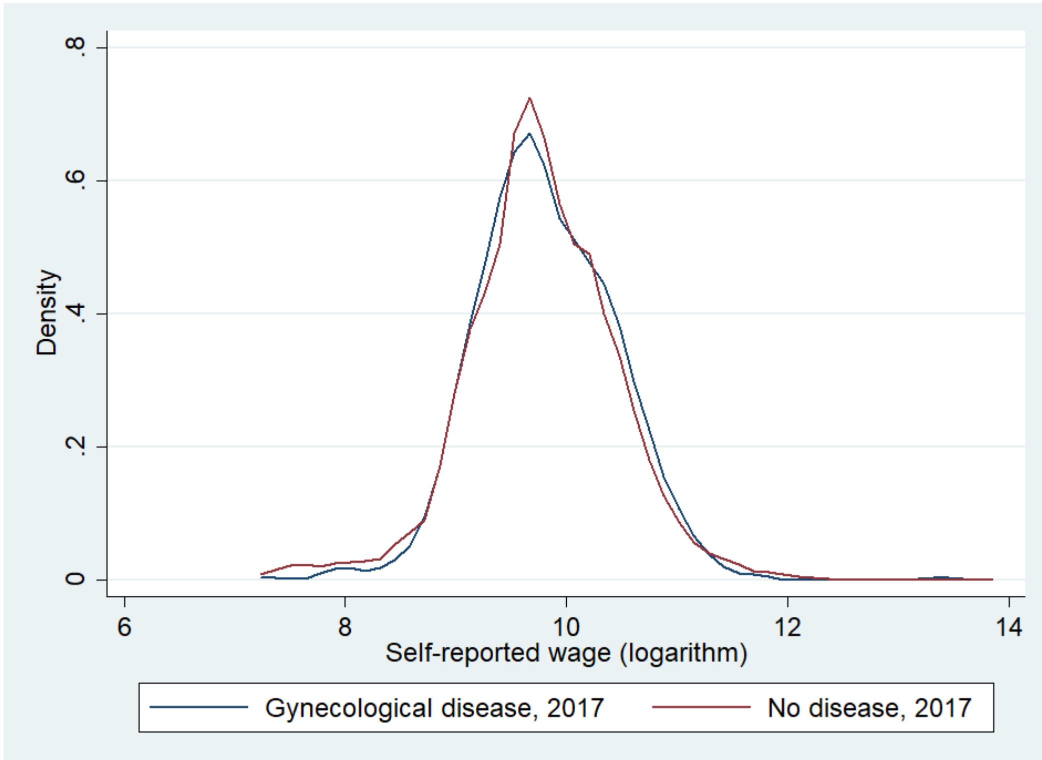


Figure 18: PDFs of the wage logarithm by gynecological disease in 2018 (By author).

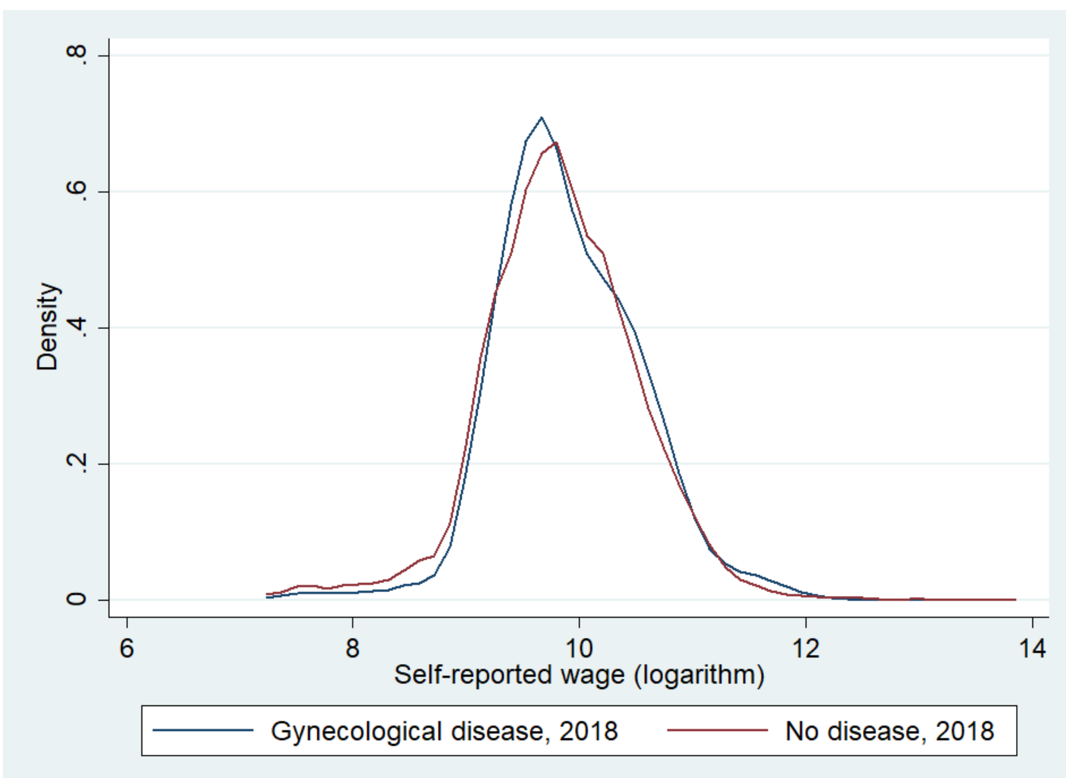


Figure 19: PDFs of the wage logarithm by gynecological disease in 2019 (By author).

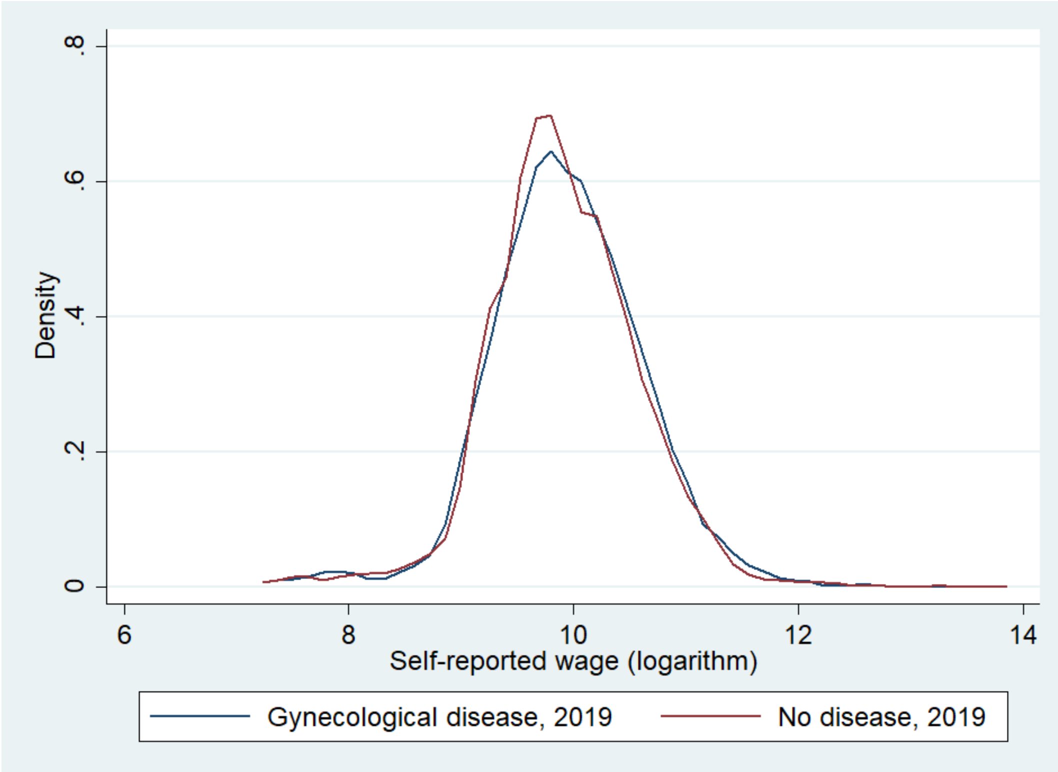
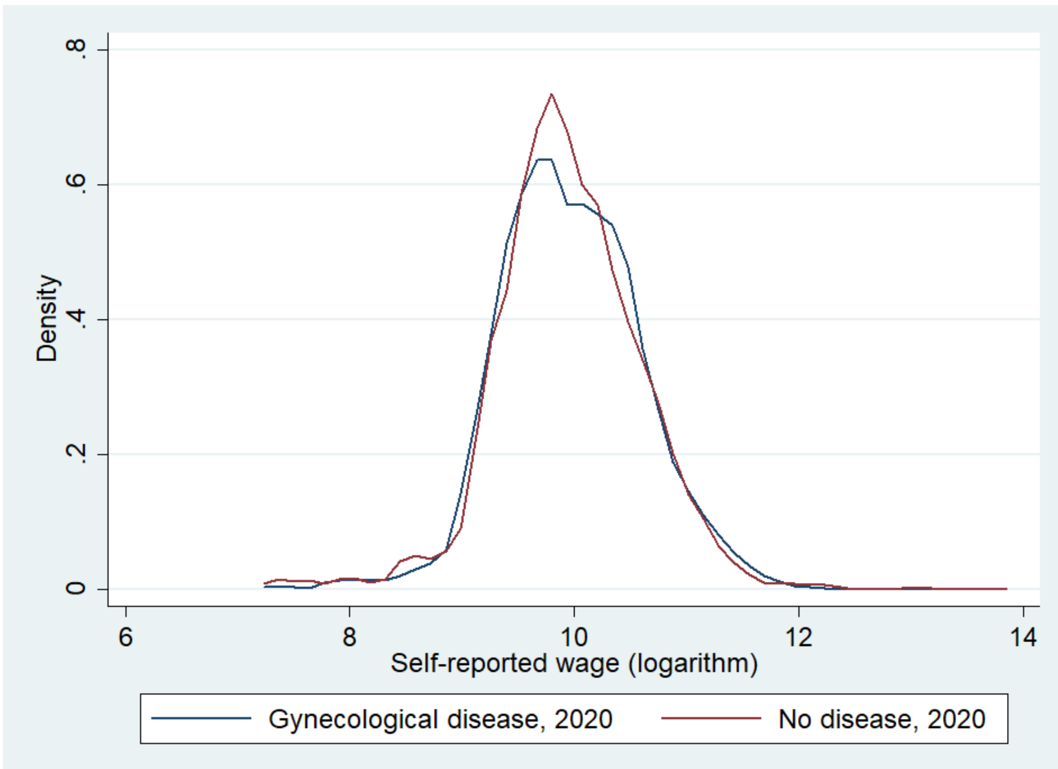


Figure 20: PDFs of the wage logarithm by gynecological disease in 2020 (By author).



Apendix 2: Graphs of PDFs of the age for women with and without cancer.

Figure 21: PDFs of the age by the cancer diagnosis in 2016 (By author).

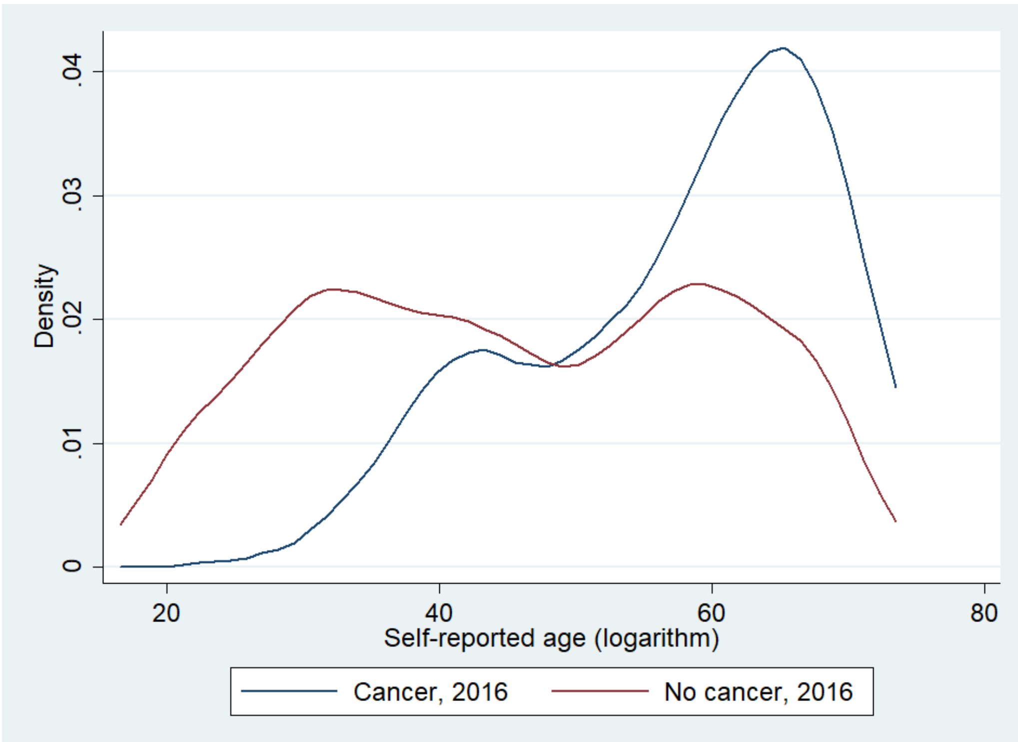


Figure 22: PDFs of the age by the cancer diagnosis in 2017 (By author).

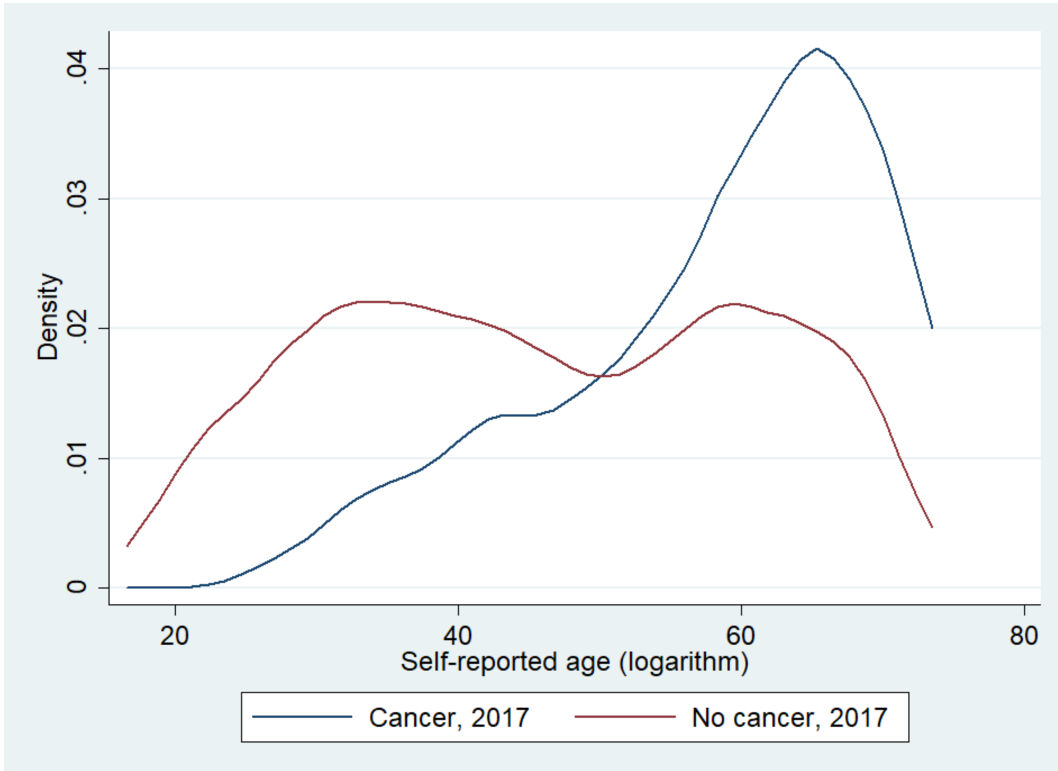


Figure 23: PDFs of the age by the cancer diagnosis in 2018 (By author).

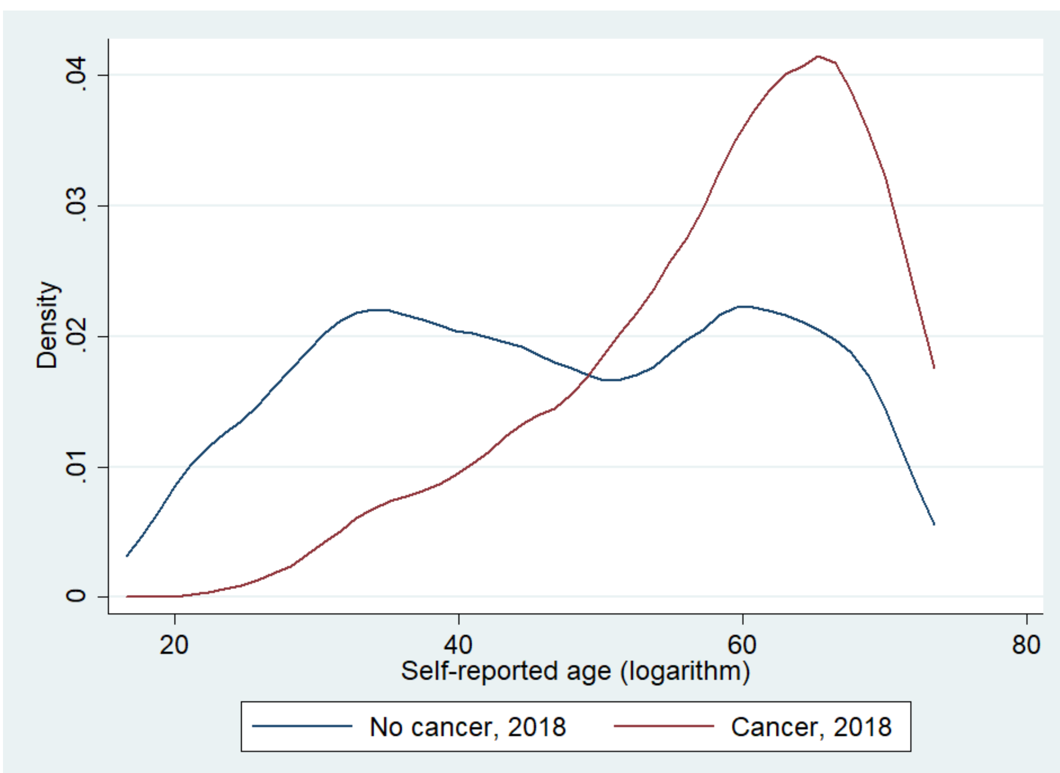


Figure 24: PDFs of the age by the cancer diagnosis in 2019 (By author).

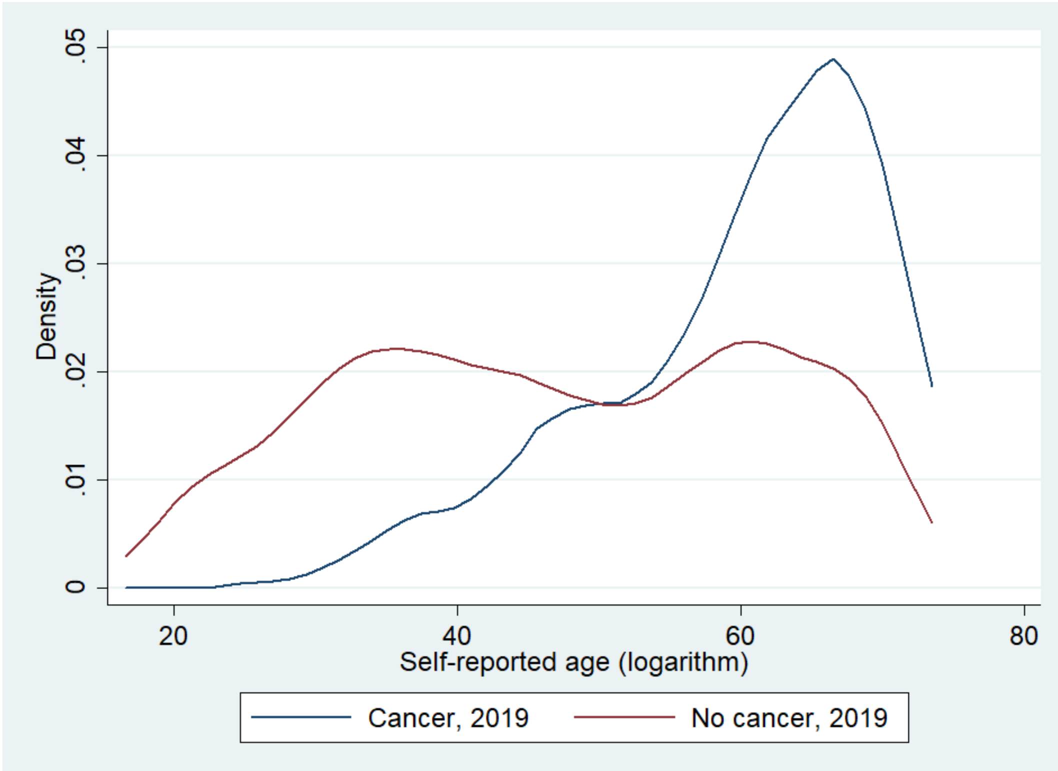
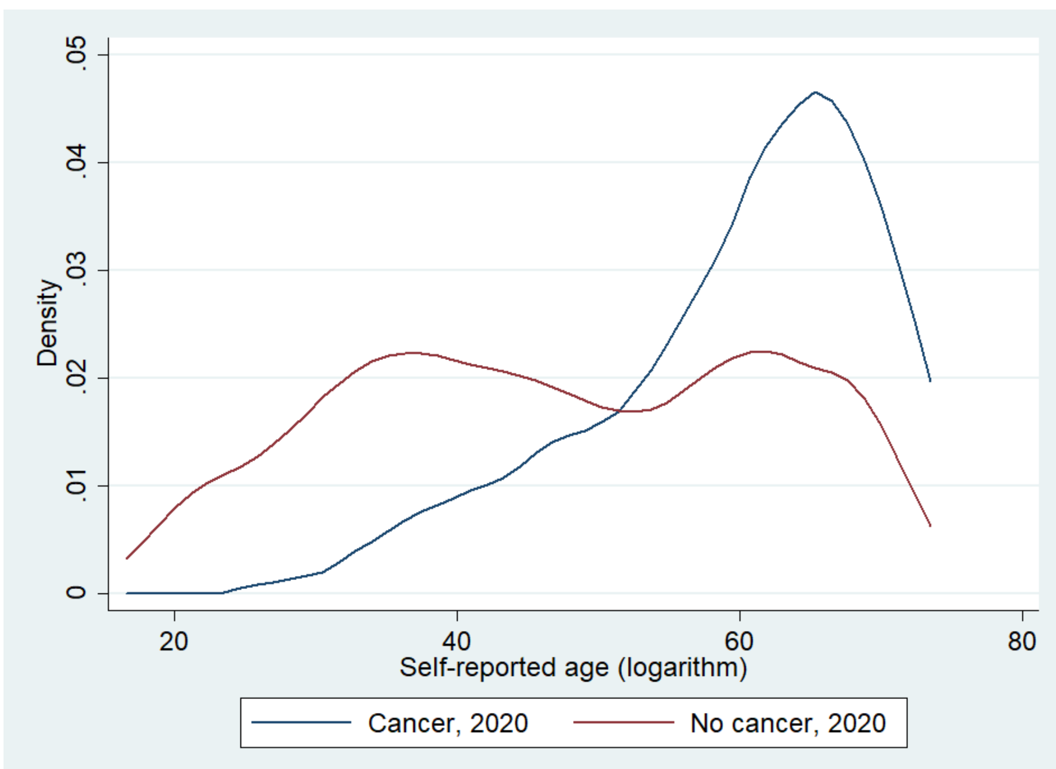
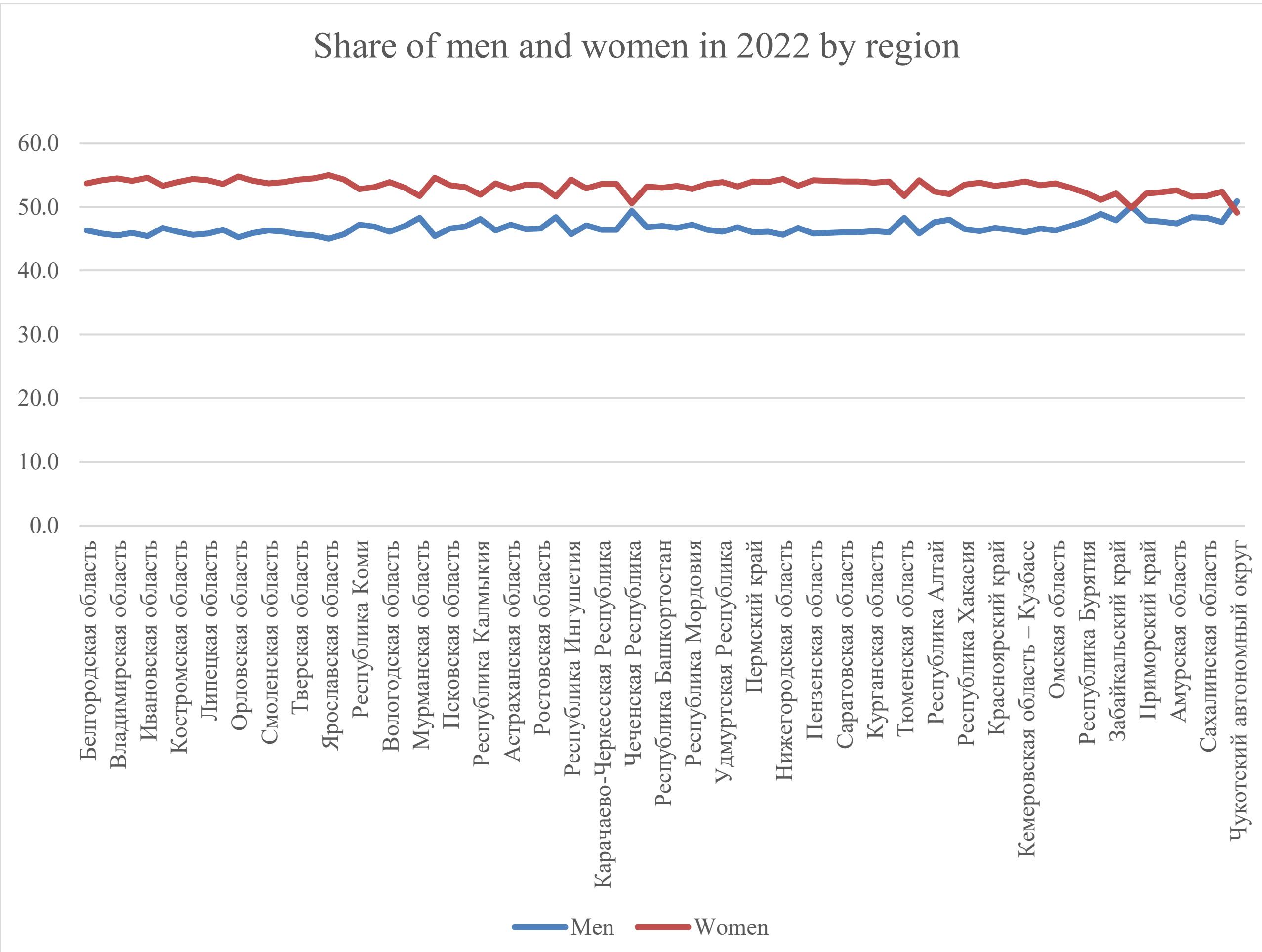


Figure 25: PDFs of the age by the cancer diagnosis in 2020 (By author).



Apendix 3: Share of the male and female population in 2022 by region of the Russian Federation

Figure 26:Population by gender share, 2022



Apendix 4: Parallel trends

Figure 27: Share of people with Stages 1 or 2 breast cancer out of all new cases of breast cancer (Treated = 1, Control = 0).

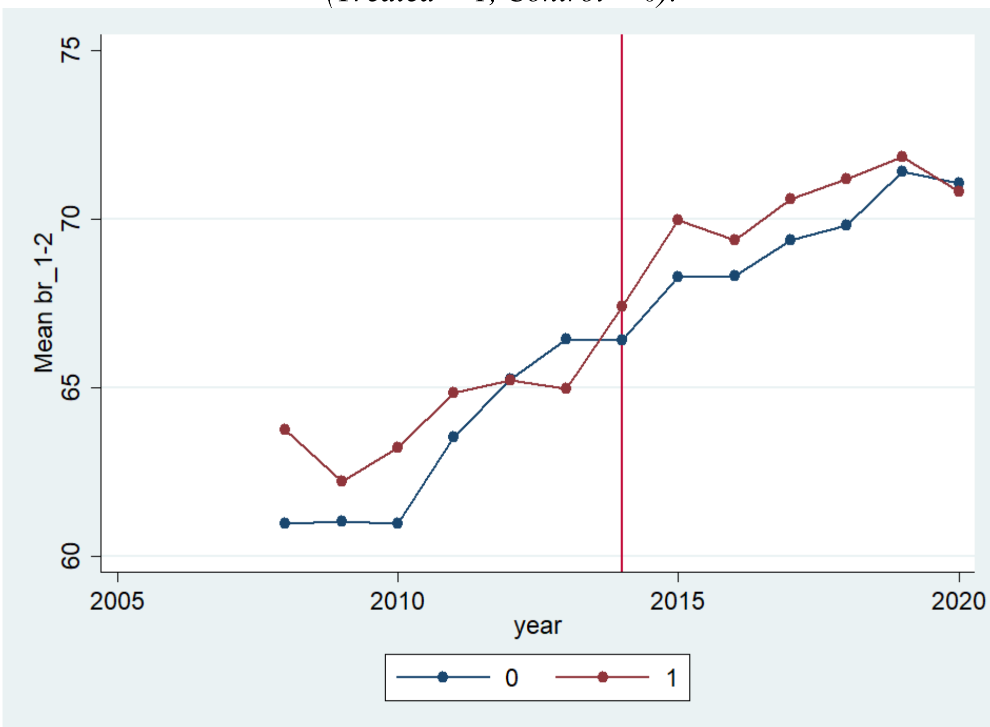


Figure 28: Deaths of breast cancer, standardized by the population (Treated = 1, Control = 0).

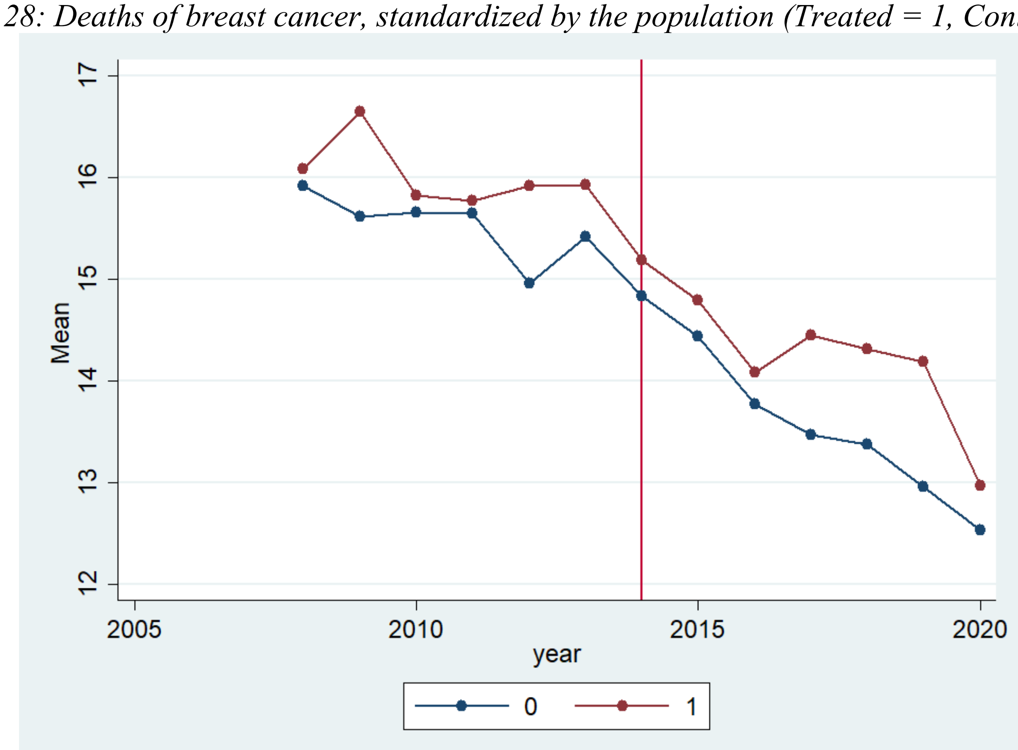


Figure 29: Probability to die of breast cancer in a year after being diagnosed (Treated = 1, Control = 0).

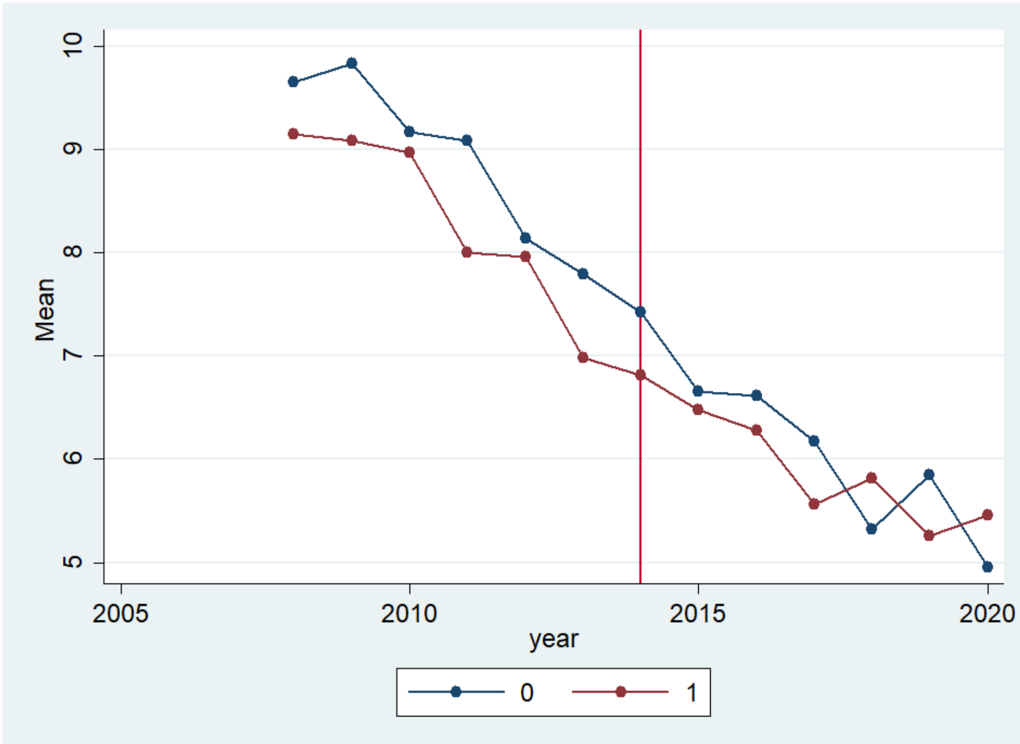


Figure 30: New cases of the cericval cancer, standardized value (Treated = 1, Control = 0).