Effects of Prostate Cancer Screening Mandates on Prostate Cancer Mortality

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MMSS Honors Thesis
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Abstract

Health insurance mandates are playing a bigger role in today’s society as state representatives see increased benefits of certain health products. After being introduced to the general public, the PSA test has been shown to increase the finding of prostate cancer incidence and preventatively reduce prostate cancer mortality. Today, there are 33 states that have enacted legislation to require either the PSA test and/or the DRE physical exam to screen for prostate cancer. Extensive research has not been done on the effects of prostate cancer screening mandates on prostate cancer mortality rates. We perform a state fixed effects regression that controls for time fixed effects as well as time since the mandate was enacted, which should mimic the results of a difference-in-difference regression. We also control for the stringency, parity pricing, and whether both DRE & PSA tests are required. From our results, we have found that the mandate has had a statistically significant effect on prostate cancer mortality on the African American population. In addition, the African American population is very sensitive to the pricing of the insurance policy. We also found that prostate cancer screening mandates were inconsequential for the Hispanic and white population. However, the white population showed sensitivity to the stringency of the mandate. As the oldest prostate cancer screening legislation was enacted in 1992, we may not be seeing the full effects of the mandate as prostate cancer causes the highest rates of mortality in men over the age of 75.
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1. Introduction

Over the past two decades, prostate cancer mortality has been increasing for the black and white population. From 1973 to 1991, age adjusted mortality rate has increased from 20.3 to 24.7 per 100,000 white men in the United States. Black men in the United States have also seen a rise in age adjusted mortality rate from 39.5 to 56.2 per 100,000 from 1973 to 1993.

However, since the approval of the prostate-specific antigen (PSA) test by the Food and Drug Administration in 1986, PSA exams have had a beneficial impact in exposing prostate cancer incidence. From 1986 to 1992, whites had a 108% increase in age adjusted incidence rates from 86 to 176 incidences per 100,000 men per year. From 1986 to 1993, Blacks had a similar increase of 102% in age adjusted incidence rates from 124 to 250 per 100,000 men per year. (Stanford JL, Stephenson RA et al. 1999)

Prior research has shown that screening for prostate cancer reduces mortality rates. (Wagner 1997) Nine years since the introduction of the PSA exams by the FDA, prostate cancer mortality rates and the actual number of men dying of prostate cancer has declined, further supporting the benefits of preventative prostate cancer screening. (Stanford JL, Stephenson RA et al. 1999)

From prior studies, it has been found that people may not take advantage of cancer screening tests despite its benefits to their health. (N Lurie 1987 ) People may not take advantage of cancer screening tests if there is a higher cost to access it. Also, screening for prostate cancer may not become apparent in mortality rates if the costs of post-screening treatments and post-operative complications are too high.

In response to the perceived benefits for prostate cancer screening and the need for elected representatives to incorporate any type of perceived benefit into legislation, the number
of state mandates have been steadily growing. There were only a couple state mandates for health care insurance during the 1960s. Overtime, state mandates have played a prominent role in health care insurance with 1,961 mandates existing today. (Bunce 2008)

There are currently 33 state mandates for prostate cancer screening with variable levels of comprehensiveness. States such as New Jersey and New York require parity pricing in their insurance coverage. Parity coverage means that co-pays, co-insurance, and deductibles will be equivalent between prostate cancer screening and the other services that the particular insurance covers. Other states have different stringencies in terms of age, race, and risk requirements necessary to exercise the insurance policy for prostate cancer screening. Finally, states differ in terms of requiring both the PSA and DRE tests or just the PSA test.

Exploration into the efficacy of prostate cancer screening mandates on prostate cancer mortality rates have not been explored in depth. We attempt to find the correlation between prostate cancer mandates and mortality rates differentially across Blacks, Hispanics, and whites. In addition, we will control for the stringency, parity pricing, and whether both the PSA and DRE tests are offered.
2. Literature Review

**Effect of State Mandate on Cost of Insurance**

The effect of state mandates on the price of health care insurance has been well documented. Health insurance mandates allow for more benefits to people who are covered by health insurance, but they do come at a cost. It has been estimated that mandated benefits increase the cost of basic health care from 20 to 50 percent. This varies across states and the particular mandate. Prostate cancer screening mandates are estimated to increase total cost of providing insurance by less than 1 percent. (Bunce 2008) This is significant as more than half the decline in coverage rates in the 1990s has been due to the increase in insurance premiums. According to a study in large metropolitan statistical areas (MSAs), a 1 percent increase in premium has caused 164,000 people to become uninsured. (Chernew 2005). Additional studies on employment based coverage have found that a 1 percent increase in premium will result in 300,000 employees becoming uninsured. (GAO 1998, 1999) Prior research has also shown that when insurance premiums do not accurately reflect a particular person’s risk level because of state regulations, healthy people on the margin will choose to be uninsured. (Glied 2008)

**Effect of Parity Legislation on Consumption of Insurance**

Prior research has also emphasized the importance of parity legislation. As part of the Mental Health Parity act (MHPA) of 1996, large employers were mandated to provide coverage for mental illness equivalent to the “lifetime and annual caps set for physical illnesses.” It has been found that states which require parity pricing for mental health insurance policies see an increase in total treatment admissions, as compared to states do not require or offer parity pricing. Thus, Dave and Mukerjee have found that reducing out-of-pocket expenses and
improving access to healthcare treatments will result in an increased consumption of health care. This may be of significance when controlling for parity pricing for prostate cancer screening. About 11 states thus far have explicitly stated parity requirements for prostate cancer screening. For example: Vermont has stated that parity coverage for prostate cancer screening is subject to the same dollar limits, deductibles, and coinsurance factors. (Dave and Mukerjee 2008)

*Does Prostate Screening Actually Decrease Mortality?*

Previously, the benefits of prostate-specific antigen testing, digital rectal examination, and other types of screening have been ambiguous. However, recent studies have shed light on the efficacy of prostate cancer screening. A recent study was done on 76,693 men at 10 U.S. study centers. About half the subjects were given an annual screening while the other half remained the control group. After a seven year follow-up, 116 prostate cancer incidences per 10,000 men was found for the screening group and 95 prostate cancer incidences per 10,000 men was found for the control group. Thus, the incidence of prostate cancer was found to increase with the use of various screening methods. The mortality rate was found to be 2.0 deaths per 10,000 men in the screening group and 1.7 deaths per 10,000 men in the control group. Thus, the mortality rate in the screening group was surprisingly higher. This difference, however, was not significant. (Andriole 2009) Another recent study was done on 180,000 men in 7 European countries within the 50 to 74 year old age bracket to analyze the efficacy of prostate cancer screening. In this study, prostate-cancer screening decreased prostate-cancer deaths by 7.1 deaths per 10,000 men after an average follow-up time of 8.8 years (Schroder 2009). From these two large scale studies, the effect of prostate cancer screening on mortality rates is still ambiguous.
Factors Contributing to Prostate Cancer Mortality

Many factors contribute to prostate cancer mortality. A 1 percent increase in per capita number of family physicians reduces the prostate cancer mortality rate by 0.5 percent. Family physicians are the first line of contact for people with prostate cancer. The proper diagnosis of prostate cancer in a timely fashion increases the chances of survival. In addition, a 1 percent increase in real per capita total health spending reduces the prostate cancer mortality rate by 0.7 percent. The higher propensity to pay for insurance co-pays, co-insurance, and deductibles by someone with prostate cancer will make it more likely the prostate cancer will be detected at an early stage. Subsequently, the prostate cancer mortality rate should decline. Finally, rising income has a negative effect on mortality at higher income levels. Higher income levels will allow people with prostate cancer to exercise their insurance more often and obtain higher levels of care after initially being diagnosed with prostate cancer. Interestingly, there is a positive relationship between income and mortality at lower income levels. While initially sounding counterintuitive, this could be due to dietary and life-style choices made by lower income people. Lower income people may consume more unhealthy food that can cause prostate cancer as their income rises. (Matteo and Matteo 2005)

Relationship Between Age and Prostate Cancer Mortality

From previous studies by the National Cancer Institute, it has been found that the United States prostate cancer mortality rates increases with age. White males observe an increase in prostate cancer mortality rate as the age bracket increases. At age less than 65, white males have a prostate cancer mortality rate that is insignificant. White males that 65-74 years old have a
prostate cancer mortality rate around 100 per 100,000 people. White males that are 75+ years old have a prostate cancer mortality rate hovering around 350 per 100,000 people. It is interesting to compare this to the Black population. Black males also observe an increase in prostate cancer mortality rate as the age bracket increases. However, Black males observe a higher level of prostate cancer mortality in all age brackets than White males. At age less than 65, black males have a prostate cancer mortality rate that is insignificant as well. Black males that are 65-74 years old have a prostate cancer mortality rate around 250 per 100,000 people. Black males that are 75+ years old have a prostate cancer mortality rate that was around 550 per 100,000 people in 1973, but has increased drastically to 800 per 100,000 people in 1994.

(Stanford JL, Stephenson RA et al. 1999)

**Racial Disparities Between Access to Healthcare**

Many studies have been completed to elucidate the stark differences in access to healthcare for different racial groups. Most studies conclude that the insured minority groups (i.e. Hispanics and Blacks), are more likely to have access problems to primary care than Whites. The difference in access to primary care between the uninsured minority and Whites becomes even more pronounced for the uninsured minority groups. (Hargraves 2003)

Latinos are the most likely out of all the ethnic groups to not have access to healthcare. 26 percent of Latino adults indicated that they do not have a usual source of healthcare. 13 percent of Latinas and 25 percent of Latinos that were in fair or poor health did not receive any healthcare treatment in the past year. 24 percent of uninsured Latinas and 40% of uninsured Latinos in fair or poor health conditions did not see a physician for more than a year. Poverty is biggest determinant of whether Latinos will have insurance. Latinos are the poorest out of all of
the ethnic groups. 59 percent of Latinos were below 200 percent of the poverty level. Studies have shown that basic necessities such as housing, transportation, food, and clothing are the largest drains on income. Healthcare insurance is seen as a luxury that is one of the first things sacrificed by Latinos. Thus, 43-47 percent of Latinos that were 200 percent below poverty were uninsured. Latinos have lowest insurance coverage at any educational level.

In addition to poverty, lack of citizenship also contributes to the higher levels uninsured in the Latino population. Noncitizens account of 58% of Latinos that are uninsured. When lacking citizenship, access to job-based coverage and Medicaid decreases. Also, non-citizens are at an educational disadvantage and are less likely to be offered a job that offers employment health benefits. 1996 welfare reform legislation terminated access to Medicare for Latinos for anyone who entered the United States after 1996. Studies have found that many Latinos fear enrolling for Medicare even though they are eligible and have entered the United States before 1996. Legal immigrants fear that exposing their status in the US through Medicare enrollment will affect their future ability to become US citizens. Many legal immigrants also fear that they may have to repay any benefits they received through Medicare in the future. (Perry MJ, Stark E, et al. 1998)

African Americans have seen a rise in uninsured rates from 21 to 23 percent. This has been a consequence of African American Medicaid coverage dropped from 1994 to 1997 from 23 to 19 percent. Job based insurance increased from 50 to 53 percent. However, African Americans are still less likely to receive job based insurance than their white counterpart at the same company. A strong reason for the high uninsured rates for African Americans is because 27 percent of African Americans are below poverty level. African Americans are at an educational disadvantage; thus, their lifetime earnings are less than their white counterparts,
which results in decreased access to healthcare. More African Americans, about 35 percent, live in single parent families. Married couples have more opportunities to receive job based insurance and they have higher earnings to pay for health care insurance. Less health insurance coverage has resulted translated into 19 percent of African American women and 26 percent of African American men having gone without seeing a physician for more than a year. (E. Richard Brown, Victoria D. Ojeda, et al. 2000)

Minority groups also face barriers to healthcare in terms of the number of providers available in a given area, the amount of time it takes to travel to the provider, and the number providers in an area that understand the language and culture of the minority group. Even after diagnosing their disease, minority groups are less likely to undergo treatment for their disease. For example: African Americans and Latinos have a higher mortality and morbidity for cardiovascular disease. (Hall WD, Ferrario CM, et al. 1997) However, these two groups are less likely to seek out more advanced cardiac treatments such as: cardiac catheterization and coronary revascularization. (Mitchell JB and K. RK 1995) Further research has even shown that African American women have a higher likelihood of being diagnosed with late stage breast cancer than whites due to the cost barriers to seeking out diagnostic services and treatment. (Mitchell JB and K. RK 1995)

The consequence of ethnic disparities between access to healthcare delayed diagnosis, management, and treatment of prostate cancer. The minorities’ inability to access healthcare prevents them from receiving adequate screening, health education and counseling, and decreased willingness to treat the disease. (E. Richard Brown, Victoria D. Ojeda, et al. 2000)
Available Post-screening Treatments and Post-operative Side Effects

Dietary and lifestyle choices can play a key role in the potency of various cancers, including prostate cancer. The lack of key vitamins and minerals in the body from healthy foods can lead to more aggressive tumor growth. The increased consumption of key vitamins and minerals can severely slow the progress of prostate cancer. In addition, exercising for at least 30 minutes a day at least 3 days a week has been linked to decreased advancement of prostate cancer.

A wide array of surgical procedures is also available to treat prostate cancer. Radial prostatectomy is the most direct approach. Surgeons attempt to isolate the tumor growth in the prostate and cut it out through an incision through the abdomen and from behind the pubic bone. A less invasive approach is laparoscopic surgery, which requires smaller incisions on the abdomen and the introduction of tiny cameras and surgical tools to remove the prostate cancer. Surgical treatment is highly dependent on the surgeons’ natural talent and experience. Another form of treatment is radiation therapy. High doses of x-ray are exposed to the prostate area in order to kill tumor cells. (Peter R. Carroll, Michael A. Carducci, et al. 2005)

Negative Sides Effects of Prostate Cancer Treatments

Urinary dysfunction is a common side effect of prostatectomy and radiation treatments. Post-operative prostate cancer patients have cited inability to control urine flow, increased urination, pain upon urination and blood with urine. Spontaneous bleeding in the urine can happen years after radiation treatment. In this case, a urologist must be seen in order to close off bleeding points.

Bowel dysfunction has been common in radiotherapy. Bowel dysfunction includes
frequent diarrhea, uncontrolled bowel movements, and bleeding into the rectum. Radiation therapy significantly damages the rectal walls. Bleeding has shown to increase from 5 percent immediately after radiation therapy to 25 percent in two years. (Peter R. Carroll, Michael A. Carducci, et al. 2005)

**Genetic Factors for Prostate Cancer Incidence and Morbidity**

African Americans have been found to have a 12.3 percent frequency of being diagnosed with advanced stage prostate cancer and Hispanics have been found to have a 10.5 percent frequency of being diagnosed with advanced stage prostate cancer. In contrast, whites have been found to have a 6.3 percent of frequency of being diagnosed with prostate cancer. In this study, demographic, socioeconomic, clinical, and pathologic factors were held constant. (Hoffman, R. M., F. D. Gilliland, et al. 2001). Furthermore, recent studies have found five single-nucleotide polymorphisms (SNPs) in our DNA that is present with higher frequency in patients with prostate cancer. The study found that the higher frequency of the five SNPs in our DNA is correlated with a statistically significant difference between time to prostate cancer diagnosis. African Americans were found to have more genetic risk factors than high-risk white men. African Americans that had 4-5 risk factors within their DNA had on average an earlier time to prostate cancer diagnosis. (Nelson, R. 2008)
3. Data

3.1 Dependent and Independent Variable Source

The prostate cancer mortality data that has been used in this analysis comes from the National Program of Cancer Registries (NPCR). Crude and age-adjusted mortality rates for each of the 50 states and Washington D.C. were provided for the years from 1999 to 2005. Mortality rates were available for the overall, African American, White, and Hispanic populations. The crude and age-adjusted mortality rates are given as the total number of prostate cancer deaths during a specific year in the population category of interest, divided by the at risk population for that category and multiplied by 100,000. ²

The state mandate data from Section 2 comes from the State Cancer Legislative Database Program (SCLD) developed by the National Cancer Institute (NCI). The SCLD data base provides the legislative date, effective date, types of insurers (groups, individual insurers, PPO, HMO), types of tests (DRE or PSA), required characteristics to exercise prostate cancer screening coverage (lower limit of age and risk rate), and financial requirements (parity coverage, non-parity coverage).

Healthcare expenditure data is found in the Center for Medicare & Medicaid Services (CMS) database. Personal health care expenditures per capita was provided for each of the 50 states and the District of Columbia. Annual personal income data is found in the Bureau of Economic Analysis (BEA) database.
3.2 Independent Variables

Table 1: State Mandates on Prostate Cancer

<table>
<thead>
<tr>
<th>State</th>
<th>Year Effective</th>
<th>Parity Coverage</th>
<th>Stringency</th>
<th>PSA &amp; DRE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>1996</td>
<td>No</td>
<td>3</td>
<td>PSA</td>
</tr>
<tr>
<td>California</td>
<td>1999</td>
<td>No</td>
<td>1</td>
<td>Both</td>
</tr>
<tr>
<td>Colorado</td>
<td>1996</td>
<td>No</td>
<td>3</td>
<td>Both</td>
</tr>
<tr>
<td>Connecticut</td>
<td>2000</td>
<td>No</td>
<td>3</td>
<td>PSA</td>
</tr>
<tr>
<td>Delaware</td>
<td>1992</td>
<td>No</td>
<td>4</td>
<td>PSA</td>
</tr>
<tr>
<td>D.C.</td>
<td>2002</td>
<td>Yes</td>
<td>4</td>
<td>Both</td>
</tr>
<tr>
<td>Georgia</td>
<td>1992</td>
<td>No</td>
<td>3</td>
<td>PSA</td>
</tr>
<tr>
<td>Illinois</td>
<td>1997</td>
<td>No</td>
<td>4</td>
<td>Both</td>
</tr>
<tr>
<td>Indiana</td>
<td>1999</td>
<td>Yes</td>
<td>4</td>
<td>PSA</td>
</tr>
<tr>
<td>Kansas</td>
<td>1998</td>
<td>Yes</td>
<td>3</td>
<td>Both</td>
</tr>
<tr>
<td>Louisiana</td>
<td>1998</td>
<td>No</td>
<td>3</td>
<td>Both</td>
</tr>
<tr>
<td>Maine</td>
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<td>6</td>
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<tr>
<td>Maryland</td>
<td>1997</td>
<td>Yes</td>
<td>2</td>
<td>Both</td>
</tr>
<tr>
<td>Minnesota</td>
<td>1996</td>
<td>Yes</td>
<td>3</td>
<td>Both</td>
</tr>
<tr>
<td>Missouri</td>
<td>1999</td>
<td>Yes</td>
<td>4</td>
<td>Both</td>
</tr>
<tr>
<td>Nevada</td>
<td>2007</td>
<td>No</td>
<td>4</td>
<td>Both</td>
</tr>
<tr>
<td>New Jersey</td>
<td>1996</td>
<td>Yes</td>
<td>3</td>
<td>Both</td>
</tr>
<tr>
<td>New York</td>
<td>2001</td>
<td>Yes</td>
<td>4</td>
<td>Both</td>
</tr>
<tr>
<td>North Carolina</td>
<td>1994</td>
<td>Yes</td>
<td>3</td>
<td>PSA</td>
</tr>
<tr>
<td>North Dakota</td>
<td>1997</td>
<td>No</td>
<td>3</td>
<td>Both</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>1999</td>
<td>No</td>
<td>4</td>
<td>Both</td>
</tr>
<tr>
<td>Oregon</td>
<td>2005</td>
<td>No</td>
<td>4</td>
<td>Both</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>2000</td>
<td>No</td>
<td>4</td>
<td>Both</td>
</tr>
<tr>
<td>South Carolina</td>
<td>1998</td>
<td>Yes</td>
<td>4</td>
<td>Both</td>
</tr>
<tr>
<td>South Dakota</td>
<td>2001</td>
<td>No</td>
<td>3</td>
<td>Both</td>
</tr>
<tr>
<td>Tennessee</td>
<td>1997</td>
<td>No</td>
<td>6</td>
<td>PSA</td>
</tr>
<tr>
<td>Texas</td>
<td>1998</td>
<td>No</td>
<td>3</td>
<td>Both</td>
</tr>
<tr>
<td>Vermont</td>
<td>2007</td>
<td>Yes</td>
<td>4</td>
<td>PSA</td>
</tr>
<tr>
<td>Virginia</td>
<td>1998</td>
<td>No</td>
<td>4</td>
<td>Both</td>
</tr>
<tr>
<td>Washington</td>
<td>2006</td>
<td>No</td>
<td>3</td>
<td>PSA</td>
</tr>
<tr>
<td>West Virginia</td>
<td>1991</td>
<td>No</td>
<td>6</td>
<td>PSA</td>
</tr>
<tr>
<td>Wyoming</td>
<td>2001</td>
<td>No</td>
<td>3</td>
<td>Both</td>
</tr>
</tbody>
</table>

Mandate

Up until 2007, there have been 32 state mandates passed that require specified group insurers and HMOs to provide prostate screening. Year effective describes the particular year that the mandate impacts insurance companies. The variables in Table 1 have been included to describe the comprehensiveness of the state prostate cancer legislation. Mandate describes whether a state in a given time period has implemented a prostate cancer screening mandate. Mandate was coded as a dummy variable where mandate was 1 if a state’s prostate cancer screening mandate became effective in that particular year or 0 if no mandate existed in that particular year.
Mandate = \begin{cases} 
1 = \text{yes} \\
0 = \text{no} 
\end{cases}

Stringency of Mandate

Stringency describes the amount of requirements that the insurance policy holder must meet in order to obtain prostate cancer screening through their insurance. The stringency score is on a scale from 1 to 6 with 1 being the least stringent and 6 being the most stringent. Stringency score is -1 in order to mark the years when the state did not have a mandate in place.

\begin{equation}
\text{Stringency Score} = \begin{cases} 
-1 = \text{nomand} \\
1 = \text{least} \\
2 \\
3 \\
4 = \text{baseline} \\
5 \\
6 = \text{most} 
\end{cases}
\end{equation}

The baseline level of stringency is defined by the American Cancer Society (ACS) prostate screening mandate guidelines.

Baseline level of stringency:

Examinations include prostate-specific antigen (PSA) blood test and digital rectal exam (DRE)

Yearly examination to all men beginning at age 50

Yearly examination to high risk men beginning at age 45
The high risk category includes African American men and men with a family history of prostate cancer.

Scoring is based on three main categories:

The first category is Age of All Men. If the prostate cancer screening mandate specifies a lower age limit than 50 years old for all men or does not specify any age limit for all men, the insurance policy will capture a larger demographic of insurance policy holders that can potentially undergo prostate cancer screening. In this instance, a score of -1 was given in the Age of All Men category because the mandate is less stringent.

The second category is Age for High Risk Men. If the prostate cancer screening mandate specifies a lower age limit than 45 years old for high risk men or does not specify any age limit for high risk men, the insurance policy will also capture a larger demographic of insurance policy holders that can potentially undergo prostate cancer screening. In this instance, a score of -1 was given in the Age for High Risk Men category.

The third category is High Risk Standards. If the prostate cancer screening mandate does not give more opportunities to African American men or men with a family history of prostate cancer, insurance policy holders in certain demographics will find it harder to obtain testing. African American men and men with a family history of prostate cancer are at a much higher risk of getting prostate cancer. In this instance, a score of +1 was given in the High Risk Standards category. Many prostate cancer screening mandates also specified that physician recommendation is required in order to verify the degree of prostate cancer risk in a patient. Needing physician recommendation is another layer of stringency that adds to the difficulty in obtaining prostate cancer screening. In this case, a score of +1 was given in the High Risk Standards category.
The baseline stringency score is set at 4. The positive or negative change in the three scoring categories were summed and added to the baseline stringency score to obtain the final stringency score.

$$\text{Stringency Score}_i = \text{Age for All Men}_i + \text{Age for High Risk}_i + \text{High Risk Standards}_i$$

where $i$ = state

Example of scoring procedure:

Alaska specifies in their prostate screening mandate that 40 year old Black men or men with a family history of prostate cancer should be provided with PSA tests. In this case, a score of –1 was given in the Age for High Risk category and a score of 0 was given in the High Risk Standards category. Alaska also specifies that all men over the age of 50 should receive PSA tests. A score of 0 was given for the Age of All Men category.

Table 2: Stringency Score Calculation for Each State

<table>
<thead>
<tr>
<th>Mandated Areas</th>
<th>Age for All Men</th>
<th>Age for High Risk</th>
<th>High Risk Standards</th>
<th>Stringency Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL</td>
<td>0</td>
<td>-1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CA</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>1</td>
</tr>
<tr>
<td>CO</td>
<td>0</td>
<td>-1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT</td>
<td>0</td>
<td>-1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>DE</td>
<td>0</td>
<td>+1</td>
<td>-1</td>
<td>4</td>
</tr>
<tr>
<td>DC</td>
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<td>0</td>
<td>4</td>
</tr>
<tr>
<td>GA</td>
<td>-1</td>
<td>-1</td>
<td>+1</td>
<td>3</td>
</tr>
<tr>
<td>IL</td>
<td>0</td>
<td>-1</td>
<td>+1</td>
<td>4</td>
</tr>
<tr>
<td>IN</td>
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<td>4</td>
</tr>
<tr>
<td>KS</td>
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Parity Coverage

Parity coverage is an important metric in our model as it assesses whether the legislation allows for differential dollar limits for prostate cancer screening. The states that do have parity coverage for prostate cancer screening specify that the insurance policy may not be subject to dollar limits, deductibles, copayments, or coinsurance provisions that are less favorable than the same provisions applying to physical illness generally in some varied form.

The extra costs that the insurance companies incur from providing prostate cancer screening can be passed onto insurance policy holders through higher copayments. However, providing parity coverage on prostate cancer screening provides a greater financial incentive for the insured to get checked for prostate cancer. Reducing this financial barrier to entry with parity coverage may allow more people to screen themselves for prostate cancer, which may impact prostate cancer mortality rates.

The parity independent variable was coded as a dummy variable with a value of 1 given to a state prostate cancer screening mandate that specifies parity coverage to some degree or 0 if a state has no clause in their legislation regarding parity coverage. The parity score is -1 in order to demark the years when the state did not have a mandate in place.
Parity = \begin{cases} 
-1 = \text{nomand} \\
1 = \text{yes} \\
0 = \text{no}
\end{cases}

**PSA and DRE**

The test independent variable is another metric to assess the comprehensiveness of the prostate cancer screening mandate. Two types of tests are mainly used in order to detect and diagnose prostate cancer:

The digital rectal exam (DRE) is an exam where a doctor or nurse checks for cancerous lumps around the prostate area by inserting a lubricated, gloved finger into the rectal area. The prostate-specific antigen (PSA) test is a blood test where the physician checks for abnormal levels of prostate-specific antigen protein. The concentration of prostate-specific antigen increases when a tumor forms on the prostate. An important note about the PSA tests is that they can give false positives because PSA levels may increase in the bloodstream due to non-cancerous reasons such as: inflammation of the prostate or enlargement of the prostate. Both of these non-cancerous conditions also occur as men age.

When a particular prostate cancer screening mandate requires insurance policies to provide both the DRE and PSA screening tests, physicians are able to form a more comprehensive diagnosis for the patient. Providing both exams or only the PSA exam may have an impact on the timely treatment of the prostate cancer and subsequently impact the mortality rate due to prostate cancer.

The test independent variable was coded as a dummy variable with a value of 1 given to a state prostate cancer screening mandate that requires both the DRE and PSA screening tests or 0
if a state only requires insurance policies to provide PSA screening tests. The test score is -1 in
order demark the years when the state did not have a mandate in place.

\[
\text{Test} = \begin{cases} 
-1 & = \text{nomand} \\
1 & = \text{both} \\
0 & = \text{PSA}
\end{cases}
\]
4. Model Specification

I have estimated the following state fixed effects model for each race with dummies for
time and time since mandate was enacted in order to produce a "difference-in-difference"-type
result:

\[
C_{mort_it} = B_0 + B_1mand + B_2mand \cdot string + B_3mand \cdot parity + B_4mand \cdot test
+ B_5income_{it} + B_6health expend_{it} + B_7T_i + \epsilon_{it}
\]

Where  \( C_{mort_it} = \) crude prostate cancer mortality rates

\( B_0 = \) constant
\( Mand = \) Dummy variable indicating whether a state has a prostate mandate in place
\( Mand \cdot string = \) Controls for stringency of the prostate cancer mandate
\( Mand \cdot parity = \) Controls for mandate with parity pricing for prostate cancer screening
\( Mand \cdot test = \) Controls whether PSA & DRE tests are both offered in mandate for screening
\( Income_{it} = \) State level income per capita
\( Health expend_{it} = \) State level health expenditure per capita
\( N_i = \) Years since mandate became effective dummies from 2 to 15 years
\( T_i = \) Vector of time fixed effects dummies from years 2000 to 2004

As shown in Tables 1, 2, and 3, Eight regressions with different combinations of the
stringency-mandate, parity-mandate, and test-mandate interaction variables were run for each
racial group in order to see the incremental effect of the control variables on the mandate
coefficient.

(Baseline) This is the bare bones model which does not control for either Stringency, PSA and
DRE tests, or parity pricing in mandates.
(1) Controlling for Stringency of mandate only
(2) Controlling for PSA and DRE tests required by mandate only
(3) Controlling for parity pricing of mandate only
(4) Controlling for parity pricing of mandate only
(5) Controlling for Stringency and PSA and DRE tests in mandates only
(6) Controlling for PSA and DRE tests and parity pricing in mandates only
(7) Controlling for Stringency, PSA and DRE tests, and parity pricing in mandates

*State Fixed Effects Regression*

The fixed effects estimator allows us to remove the unobserved effect, \( v_i \), before we estimate the parameters. Time constant effects that affect crude prostate cancer mortality rates will be washed out. Some important state fixed effects that we would like to remove to prevent bias in our coefficients: age distribution within states and cost barrier factors. We assume that over a five year time span that the age distribution within states stays fixed over time. Age distribution should be removed before estimating parameters because prostate cancer is a disease of old age. We would expect a population with their age distribution shifted toward the older spectrum to have higher prostate cancer mortality rates. The distribution of doctors within a certain state is expected to be stable over the five year study. One of the barriers to health care coverage for minority groups is the distance to the provider. A longer distance to the provider is an added cost which brings the total cost of health care above the minority group’s reservation price for health care, which may have an effect on prostate cancer mortality rates.

*Income per Capita*

Prior research has found income per capita to be a significant factor in affecting mortality rates. Income per capita was found to have a negative correlation with mortality rates at high income levels and a positive correlation with mortality rates at low income levels. Income per capita data was found at the state level for the entire aggregate population from 2000 to 2004. A limitation in this model is that income per capita was not found for each minority group.
**Health Expenditure per Capita**

Prior research has found health expenditure to be a significant factor in affecting mortality rates. Health care expenditure was found to have a negative correlation with mortality. Health expenditure per capita was found at the state level for the entire aggregate population from 2000 to 2004. Again, another limitation in this model is that health expenditure per capita was not found for each minority group.

**Years Since Mandate Became Effective**

The $N_t$ vector contains time lag dummies which control for the amount of years that have passed since the mandate became effective in a particular state. There were 14 time lag dummies that were controlled for in each regression. Mandates may have larger effects over time as the younger demographic begins to test for prostate cancer. The effects of the early screening of the prostate cancer will only be evident in the prostate cancer mortality rates after many years. Once again, we are controlling for the fact that prostate cancer is a disease of old age.

**Time Fixed Effects**

The $T_t$ vector contains five year dummies from the year 2000 to the year 2004, which controls for time fixed effects in each year. These time dummies capture general trends over time such as increases in healthcare technology that would affect prostate cancer mortality rates in all fifty states and the District of Columbia. For example: laparoscopic surgery is considered to be a global technological improvement over radial prostatectomy as it is minimally invasive and requires the usage of robotic arms with mini cameras and tools to remove the prostate
cancer. Laparoscopic surgery decreases some of the side effects caused by the more invasive radial prostatectomy, which may have implications for prostate cancer mortality.
5. Results

During any interpretations of coefficients, it should be noted that every regression controls for years since mandate was effective, year fixed effects, health care expenditure per capita of each state, and income per capita of each state.

General Effects of Mandate

One result that pervades throughout the Black, White, and Hispanic results is the insignificance of the test-mandate interaction variable. Mandating insurance companies to provide both PSA & DRE or only one of the two tests does not have a significant impact on prostate cancer mortality rates. Test-mandate’s uniform insignificance in all racial groups leads us to believe that controlling for this variable is unnecessary.

In general, race plays an integral role in the efficacy of having prostate cancer screening mandates. We have found starkly contrasting mortality results between Blacks, Whites, and Hispanics when controlling for various aspects of the mandate. As shown in table 3, having a prostate cancer screening mandate appears to have a significant negative correlation with prostate cancer mortality for Blacks. Interestingly, Table 4 shows that the coefficient on mandate is negative, but insignificant for Whites. In contrast, Table 5 displays prostate cancer screening mandates to have both positive and negative correlations with mortality for Hispanics depending on the controls.

Effects of Mandate on Blacks

Equation 4 in table 3 highlights the statistical significance of the mandate and parity-mandate interaction variables for Blacks. Both the mandate and parity-mandate interaction
variable is significant at the 1 percent level. The 95% confidence interval for mandate and the parity-mandate interaction variable was [-4.421022, -1.994986] and [-5.488195, -.7817149], respectively. Offering parity pricing for prostate cancer screening seems to play a significant role in decreasing mortality rates for Blacks. The change in prostate cancer mortality with respect to the change in mandate status is approximated by

\[
\frac{\Delta \text{cmort}}{\Delta \text{mand}} = B_1 + B_3 \text{string}_{n=4} + B_3 \text{parity}.
\]

When stringency of the mandate is held at its baseline level of n = 4 and parity pricing is required for prostate cancer screening, having a mandate decreases the prostate cancer mortality rate by 3.1319506 Black persons per 100,000 Black people. While the stringency-mandate interaction variable for Blacks was insignificant, it is illuminating to note that the coefficient was positive. Thus, increasing the stringency of the mandate increases the mortality rate, ceteris paribus.

When holding the test-mandate, parity-mandate, and stringency-mandate interaction variables constant for Blacks as shown in Equation 7 of Table 3, mandate only became significant at the 13% level. However, the parity-mandate interaction variable remains significant at the 5% level with all controls. Both the stringency-mandate and test-mandate interaction variables were insignificant. The change in prostate cancer mortality with respect to the change in mandate status is approximated by

\[
\frac{\Delta \text{cmort}}{\Delta \text{mand}} = B_1 + B_3 \text{string}_{n=4} + B_3 \text{parity} + B_4 \text{test}
\]

When stringency of the mandate is held constant at its baseline level of n=4, parity pricing is required for prostate cancer screening, and both the PSA and DRE tests are offered in the insurance package, having a mandate decreases the prostate cancer mortality rate by
Effects of Mandate on Whites

The stringency of the mandate plays an important role in lowering the prostate cancer mortality rate, which contrasts with the positive stringency-mandate coefficients found in the Black results. Equations 1, 4, 5, and 7 in Table 4 indicate that the stringency-mandate interaction variable is statistically significant for Whites. The change in prostate cancer mortality with respect to the change in stringency of the mandate is given by

$$ \frac{\Delta \text{mortality}}{\Delta \text{stringency}} = B_{2, \text{mand}}. $$

When holding parity-mandate constant, an increase in stringency of the mandate by 1 unit decreases the mortality rate by 1.455144 White persons per 100,000 White people. The stringency-mandate variable is statistically significant at the 1% level and has a 95% confidence interval of [-2.109985, -.8003028]. Similarly, when holding test-mandate and parity-mandate constant, an increase in stringency of the mandate by 1 unit decreases the mortality rate by 1.431238 White persons per 100,000 White people. The stringency-mandate variable in this case is also statistically significant at the 1% level and has a 95% confidence interval of [-2.193559, -.6689165].

While the test-mandate and parity-mandate variables do not show statistical significance in any of the equations, the directionality of the coefficients should be noted. Requiring insurance policies to offer parity pricing for prostate cancer screening has a negative effect on mortality rates for Whites. In addition, requiring insurance policies to offer both the DRE and PSA tests has a negative effect on mortality rates for Whites.
Effects of Mandate on Hispanics

As shown by Table 5, a common, but important theme running throughout the Hispanic data is that mandate, stringency-mandate, test-mandate, and parity-mandate were insignificant in every regression that was run.

In addition to the insignificant results, the directionality of mandate appears to arbitrarily change depending on the controls used in each equation. For example: When controlling for stringency and parity pricing of the mandate, the coefficient on mandate is positive in equation 4. However, when controlling for stringency, parity pricing, and tests offered by the mandate, the coefficient on mandate is negative in equation 7. Directionality changes can also be seen in parity-mandate from equations 3, 4, 6, and 7 in Table 5.

The directionality of mandate stringency appears to be positive in every equation for the Hispanic data. Thus, an increase in mandate stringency increases Hispanic mortality rates.
6. Discussion

General Concept Behind Prostate Cancer Screening Mandates

The general concept behind mandating insurance policies to include prostate cancer screening is to allow easier access to diagnostic treatments so that at risk patients can take a more preventative approach to prostate cancer. Before the mandate, there are at risk patients with health insurance who do not get screened for prostate cancer because it is not covered at all or inappropriate priced. After the mandate, at risk patients would hypothetically have easier access to prostate cancer diagnosis, and subsequently explore treatment options to remove the prostate cancer before metastasis. In concept, mandated legislation for prostate cancer screening is to decrease prostate cancer mortality.

Prostate Cancer Screening Mandates Effect on Blacks

We found that prostate cancer screening mandates have a statistically significant negative effect on prostate cancer mortality. The mandates impact on mortality can possibly be attributed to four trends.

The first trend is that relatively affluent Blacks that are employed and receive job based health insurance are affected at the margin to consume more prostate cancer screening. After being diagnosed through screening, more affluent Blacks may be able to pay the deductible necessary to receive the more costly prostate cancer treatments and follow ups for post-operative complications in the years following initial diagnosis. This would cause a reduction in prostate cancer mortality.

The first trend is supported by our results. We were able to observe that having parity pricing in prostate cancer screening mandates has a statistically significant and negative effect on
prostate cancer mortality for Blacks. At any educational attainment, Blacks on average make less than their white counterpart. Thus, reducing the costs to prostate cancer screening may be imperative in motivating cost-conscious Blacks with insurance to undertake diagnostic treatment and explore higher cost surgical procedures. Additionally, we found that the directionality on income was negative. As higher income is generated, prostate cancer mortality decreases.

The second trend is that less affluent Blacks that are employed and receive job based health insurance are still affected at the margin to consume more prostate cancer after screening. However, after diagnosis, less affluent Blacks may opt for much less costly treatments such as a change in diet with a higher vitamin and mineral intake or exercise in order to slow the growth of the tumor to a manageable rate. This subgroup also does not have to deal with the costs of post-operative complications such as spontaneous internal bleeding.

The third trend is that Blacks are not being screened for prostate cancer which may actually benefit their health in the long run. There are several reasons why it is reasonable to assume that a high proportion of Blacks are not being screened for prostate cancer. It has been well documented that mandates increase the cost of insurance premiums. Prostate cancer mandates are reported to have an increase of less than 1 percent on insurance costs. Thus, many Blacks on the margin, especially the 27 percent of Blacks who are below poverty, may not buy health insurance due to prostate cancer mandates and may be unaffected by the mandate. Also, previous demographic studies have found that the uninsured rate in the Black population has risen to 23 percent. Finally, there are severe cost barriers to medical coverage as 19 percent of Black women and 26 percent of Black men have not seen a physician in more than a year. Previous studies have shown that at lower levels of income, minority groups value spending on subsistence goods such as: housing, transportation, food, and clothing. Even after being
diagnosed for prostate cancer, lower income Blacks may not be able to afford the high deductible costs of prostate cancer surgery. Surprisingly, we argue that this may be a benefit for lower income Blacks that may not be able to fund post-diagnostic treatment and post-treatment complications. Most patients who undergo invasive procedures to clear prostate cancer from their bodies have bowel, erectile, and urinary problems. Some of the most serious cases for concern are spontaneous internal bleeding. Blacks are thus shielding themselves from prostate cancer related problems that may affect mortality.

More metrics within our regression analysis support the third trend. We found that as the stringency of the mandate goes up, prostate cancer mortality goes down. We had the expectation that as stringency on the mandate goes up, prostate cancer mortality should go down. It is intuitive to believe that less preventative treatments given to a person will result in a higher likelihood of getting advanced stage prostate cancer, which would increase mortality. However, we do not see this as there may be a clear benefit for lower income Blacks from avoiding the entire prostate cancer screening process. Additionally, health expenditure has negative directionality. As health expenditure increases, prostate cancer mortality increases. While this control was not significant, the negative impact of spending on prostate cancer screening and treatment may not be completely beneficial for Blacks.

A fourth trend that should be considered is the biological component of prostate cancer for Blacks. Prior studies have shown that Blacks have a higher disposition, morbidity and mortality for prostate cancer. Thus, a higher population in this demographic in the appropriate income bracket have the potential to benefit from the prostate cancer screening mandate.

A combination of one or more of these trends affects the prostate cancer mortality rate for Blacks. There is great potential in future research to tease out which one of these four trends
play the most significant factor in lowering prostate cancer mortality rates for Blacks.

_Prostate Cancer Screening Effects on Whites_

We found that prostate cancer mandates have a statistically insignificant impact on prostate cancer mortality rates for non-Latino whites. The lack of significance can be attributed to whites not having as many pre-mandate cost barriers to coverage than other minority groups.

One barrier to coverage is the high financial costs of the insurance premium, diagnostic testing, and subsequent surgical treatment of prostate cancer. Financial barriers are not as large for the white population. Only 9 percent of whites have family incomes below poverty level and 23 percent of whites are below 200 percent of poverty. With more whites having a higher income than minority groups, whites may already have a higher ability to get checked for prostate cancer screening and internalize the treatment and post-operative costs. Further evidence that whites have a higher propensity to receive preventative care screening and treatment procedures for illnesses is underscored by a few illuminating statistics. Only 15 percent of whites say that they don’t have a usual source of care. Also, only 6 percent of women and 14 percent of men in fair to poor health conditions have not paid a visit to the doctor in the past year. Thus, a mandate that makes prostate-cancer screening even easier to obtain for higher income whites may not as large of an impact as it did on Blacks.

While having a mandate in a state was not significant, the level of stringency of the mandate did seem to have a statistically significant negative effect on prostate cancer mortality for Whites. As the stringency on a mandate increases, the prostate cancer mortality decreases. For the 23 percent of whites that are 200 percent of poverty, stringency of the mandate may have a larger impact. Like blacks who have limited income for healthcare expenditure, whites may
not be able to fund post-diagnostic treatment and post-treatment complications. Thus, lower income whites may be benefiting from shielding themselves from post-surgical prostate cancer complications.

Prostate Cancer Screening Mandates Effect on Hispanics

We found that prostate cancer screening mandates did not have a significant impact on prostate cancer mortality rates. None of the mandate interaction variables proved to be significant as well. Hispanics face huge cost barriers to healthcare. Prior studies have shown Latinos to be the poorest out of all the ethnic groups. A startling 59 percent of the Latino population was recorded to be below 200 percent of the poverty level. The Latino populations financial disadvantage translates into 37 percent of the non elderly Latino population being uninsured. Also, Latinos are less willing to get treated for a disease or illness as illuminated by the statistic that 24 percent of uninsured Latinas and 40 percent of uninsured Latinos in fair or poor health conditions did not see a physician for more than a year. Thus, it is a reasonable assumption that the state mandate would have the least impact on the Hispanic population. For the Latino population that is insured, they may not be unable to afford deductibles for treatment and post-operative complications.
7. Conclusion

We have found that prostate cancer screening mandates have a differentiated impact between races. Mandate was found to have a significant negative impact on African American prostate cancer mortality rates. Also, African Americans tended to be very sensitive to the pricing scheme of the insurance policy. With parity pricing, the mandate was found to decrease African American prostate cancer mortality rates even further. From our analysis, we found that lower income African Americans may face larger benefits than costs when deciding not to get screened for prostate cancer. Mandate was found to have an insignificant impact on white prostate cancer mortality rates. However, whites were sensitive to the stringency of the insurance policy. We have concluded that whites face much smaller costs and barriers to healthcare than minority groups. Thus, with a higher propensity to already get screened for prostate cancer, white people are not drastically affected by a new mandate that makes it even easier to obtain prostate cancer screening. Finally, mandate seemed to be inconsequential for Hispanics. Hispanics have the highest amount of people at or below poverty level. Thus, many Hispanics do not have healthcare coverage and would be unaffected by a mandate that would benefit people with healthcare coverage.

Future directions for this paper would be to collect several years before 1999 and several years after 2004. Some of the results may have been insignificant due to large standard errors, which may be due to the small sample size. Furthermore, prostate cancer is a disease of the old age. The risks of dying from prostate cancer rise rapidly as age increases. Thus, the benefits of early prostate cancer screening in young adults may not be seen until thirty or forty years later when prostate cancer may affect mortality data. This paper’s findings can be further expanded upon by applying the state fixed effects model controlling for time fixed effects and mandate
time lags in the future. While our model was intended to mimic a “difference-in-difference” approach, the actual DD regression can also be tested in a future paper.
## Table 3: Black Data

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* Significant at the 10% level  
** Significant at the 5% level  
*** Significant at the 1% level  

Baseline  
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(2) Controlling for PSA and DRE tests required by mandate only  
(3) Controlling for parity pricing of mandate only  
(4) Controlling for Stringency and parity pricing of mandate only  
(5) Controlling for Stringency and PSA and DRE tests in mandates only  
(6) Controlling for PSA and DRE tests and parity pricing in mandates only  
(7) Controlling for Stringency, PSA and DRE tests, and parity pricing in mandates
Table 4: White Data

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<td>-.0538</td>
<td>(.3372)</td>
<td>-.619002</td>
<td>(9.549386)</td>
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<td>(2.690)</td>
<td>-2.902</td>
<td>(2.611)</td>
<td>-3.785</td>
<td>(2.616)</td>
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<td>Hexpend</td>
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<td>.005766</td>
<td>(.002520)</td>
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<td>(.002458)</td>
<td>.005767</td>
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<tr>
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<td>.0003069</td>
<td>(2.438e4)</td>
<td>.000259</td>
<td>(2.048e4)</td>
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<td>(2.81e4)</td>
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<td>R²</td>
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<td>0.2511</td>
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Table 5: Hispanic Data

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<th>Variable</th>
<th>Baseline</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
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<td>.02405</td>
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<td>(.05998)</td>
<td>.01660</td>
<td>(.04855)</td>
<td>.04118</td>
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<td>(.05357)</td>
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<td>-.0413</td>
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<td>-.04796</td>
<td>(.05198)</td>
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<td>-.0003008</td>
<td>(.08921)</td>
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<td>(1.889e4)</td>
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<td>(1.887e4)</td>
<td>9.28e5</td>
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</table>

\[\text{R}^2\]

40
9. References


GAO. “Private Health Insurance: Impact of Premium Increases on the Number of Covered Individuals is Uncertain.” 1998 GAO/HEHS-98-203R.


