Essays on Public Economics

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Chapter 1

Labor Market Dynamics and Disability Insurance

1.1 Introduction

How do workers flow across the unemployment, employment, and non-participation over the life-cycle? Any policy which effects the margin of one state effects flows into a different state. For example, unemployment benefits will affect workers labor market supply decision as well at the employment choices. In this paper, I develop an equilibrium search and matching model over the life-cycle to characterize labor market flows. I model two major social insurance programs: unemployment insurance (UI) and Social Security Disability Insurance (DI) to account for their interaction on worker labor supply decision. My model incorporates incomplete markets, aggregate productivity shocks, and idiosyncratic heterogeneity. I put special attention to modeling DI and its effect on labor force participation.

In the United States, Social Security Disability Insurance (DI) applications soared during the Great Recession concomitantly with an increase in unemployment rate. The decline in the award rate this period suggests that the applicants during downturns are fundamentally different than those who apply in other times. However, comparisons of the health status of workers show no evidence that the health of DI applicants during the Great Recession are systematically worse than previous periods. An alternative explanation for the increase in applicants is the interaction between DI and unemployment benefits (UB) jointly determining labor market flows across states. Search frictions, wages, and the overall labor market conditions mechanically entice workers to apply to the program and leave the labor market. Governments implement UB and DI programs because workers are unable to fully insurance against temporary or permanent shocks to their labor productivity. While the annual outlays for DI ($143 billion) outstrip unemployment benefits (UB) ($29 billion), there have been relatively few studies on the interaction of the two programs despite their similarities.

To understand how labor market flows are jointly determined, consider a simple case of an aggregate productivity shock. The returns to employment relative to unemployment decrease, increasing the unemployment rate. The opportunity cost of non-participation also decreases, raising the relative value of non-participation for the marginal worker. Depending on the parametrization, UB and DI may be complements or substitutes to each other. For workers where DI is a complement to UB, extensions to unemployment benefits will have no effect on the application decision. For workers where DI is a substitute to UB, extensions to unemployment benefits permit these workers to continue to search for work as in Mueller, Rothstein, and Von Wachter, 2016.

My life-cycle model characterizes gross worker flows over the business cycle. This specification allows for policy analysis of age-specific programs such as disability insurance. It is also an expansion of literature of life-cycle and directed search to include both UB and DI programs and multiple states. I model these flows using a directed search model. This framework is well-suited for analyzing UB and DI because it can account for the joint interaction of search frictions, labor market opportunities, and aggregate shocks on workers' decisions. Directed search permits for a block recursive equilibrium which is relatively tractable to solve given the enormous amounts of heterogeneity. Moreover, unlike previous papers, I account for sixteen potential transitions over the life-cycle.

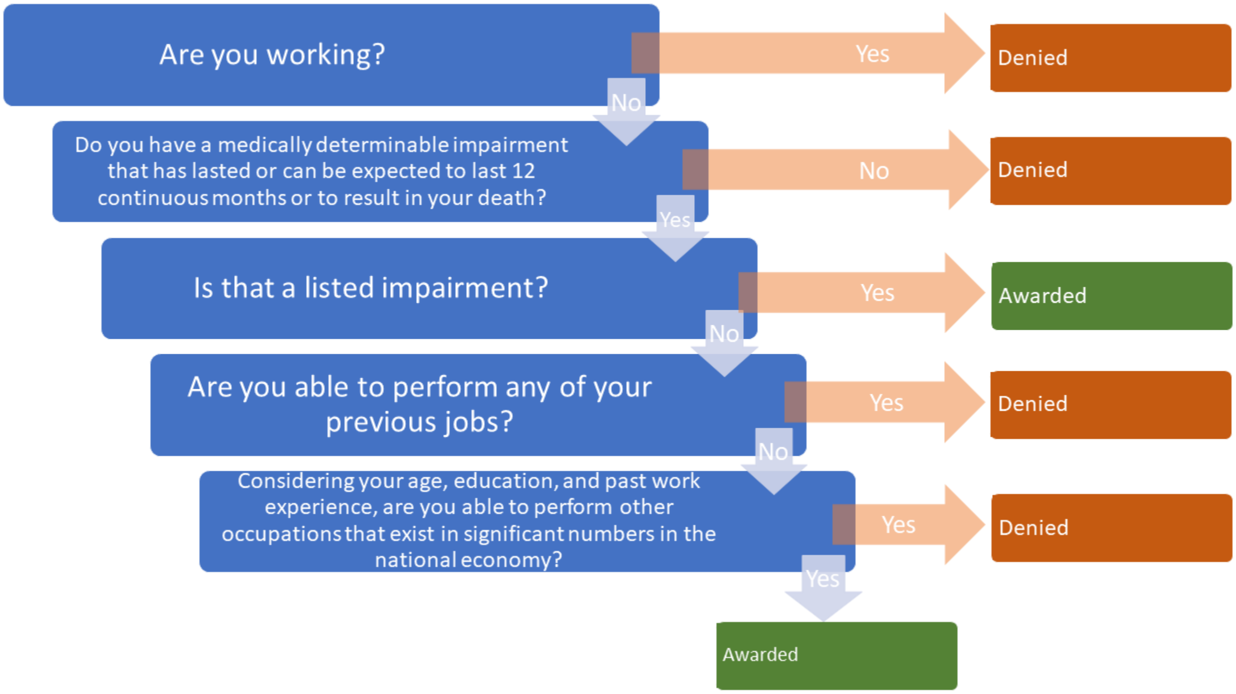
This paper is organized as follows: Section 2 is an overview of the disability insurance program with emphasis on salient properties that our model will replicate. Section 3 summarizes the relevant literature. Section 4 discusses our data and empirical trends of DI applicants. Section 5 and Section 6 introduces our model and calibration. Section Section 7 shows the result of our calibration and Section 8 concludes.

1.2 Overview of Disability Insurance

1.2.1 History and Design of the DI Program

DI is designed to protect workers from permanent income shocks occurring through a long-term, career-ending disability. The Social Security Administration (SSA) adopted the disability program in 1956 in response to the market failure of private disability insurance. This market was replete with moral hazard and adverse selection and prior to

Figure 1.1: Disability Determination Process



Source: **Low and Pistaferri, 2015**

the establishment of DI, private firms were suffering considerable losses in the industry. Subsequent reforms of the DI extended the number of eligible for the program to include those under the age of 50 and widow(er)s as well as allowing recipients to be eligible for Medicare after being on the program for two years. Growing enrollment and concerns of the fiscal sustainability of the program led to the first major reforms of the program in 1984 which reassessed its eligibility criteria and introduced a medical review standard for continued recipients. These reforms led to a short-lived reduction in expenses in the program, but soon thereafter enrollment and expenditures in the program returned to its increasing rate.

At the core of DI's screening process is the "substantial gainful activity" (SGA) eligibility requirement. Applicants who cannot meet a threshold amount ($1,170 monthly for non-blind individuals Social Security Administration and Policy, 2018) regardless of hours worked may be considered eligible. While a person may be working or not working and meet the SGA criteria, it effectively makes unemployment a de facto necessary state before applying to the DI program.

There is a five-step evaluation process to consider whether an applicant is working and earning above the SGA (See **Figure 1.1**). In the first stage, disability benefits cannot commence until after five months have elapsed since the onset of the disability. The five-month duration from the beginning of the disability is to ensure that the applicant has a permanent injury. At this stage, an individual applies for disability at the Social Security office where the application is reviewed to ensure that the individual meets various non-medical requirements (age, work credits, SGA, etc) for eligibility. If met, the application is then sent to the state's Disability Determination Services (DDS) office which decides if an individual is disabled. The DDS reviews an applicant's medical records which also hold information about the person's ability to work. At this stage, the DDS first can affirm whether a person is disabled. To do so, the DDS uses a list of ailments 14 major body systems such as musculoskeletal, digestive, endocrine, and so forth. If the impairment is on the SSA's impairment list, they are automatically considered impaired.

If the applicant's impairment does not fall under the above list, she proceeds to step four. At this stage, the applicant's specific condition is assessed as to whether it affects the ability for the applicant to work in her previous occupation. For instance, a work limitation from arthritis on one's fingers may not affect a construction worker, but the same affliction on a seamstress may allow the worker to qualify for DI. The DDS determines whether the impairment interferes with a person's capacity to do her past work. If it determines it does, then the process moves to step five where DDS assess whether she can do other work giving considerations to the person's medical condition, age, work experience and skills. If a person is denied at this stage, they can appeal repeatedly at different levels. The first screening of the appeal occurs at the state's DDS, then an administrative law judge, then an Appeals Council, and, finally, at a federal court level. French and Song, 2014 summarizes these stages.

1.3 Literature Review

This paper is connected with the literature on optimal disability insurance and labor supply. The growing numbers of awardees and applicants to DI has garnered substantial research on the optimal design of the program. Autor and Duggan, 2003, 2006, 2007; David and Duggan, 2006 focused on how policy reforms such as reduced screening stringency and higher replacement rates of disability insurance since the 1980s have led to the gradual increase in the disability applicants and recipients. These policy changes also coincided with the greater structural change of the economy of a decline in demand for unskilled-labor. Other policy reforms granted in-kind benefits and services (i.e. Medicare eligibility) which deters recipients from returning to the workforce and may be a means of early retirement for many beneficiaries. The combination of these concomitant forces led to a increase in disability rolls and increase strain on its finances. Other research on DI focus on optimal screening policy to ensure recipients are legitimately unable to work to reduce inefficiencies Golosov and Tsyvinski, 2006 suggest introducing an asset test to reduce false acceptances to the program. Low and Pistaferri, 2015 develop a life-cycle model to estimate different parameters of risk (work limitation, idiosyncratic productivity, labor market frictions, etc.) to assess optimal disability insurance. After matching targeted moments, they evaluate policy changes to the disability program and document that the program is characterized by several false rejections instead of false acceptances. Their model suggests that relaxing screening stringency is welfare improving and that greater generosity in other welfare programs such as food stamps reduces DI application rates among non-disabled workers. Michaud, Nelson, and Wiczer, 2018 document and disentangle vocational demographics related to DI awards. Michaud and Wiczer, 2018b develop a model where correlated productivity and health shocks affect the rise of DI. A worker's demographic characteristics determines how vulnerable they may be to economic shocks. In their model, heterogeneous agents are exposed to macroeconomic risks differently because each occupation bundles tasks differently. In separate paper Michaud and Wiczer, 2018a build a general equilibrium model where DI improves welfare through risk-sharing and occupational reallocation.

This paper is also connected to the literature on optimal unemployment insurance and its interaction with disability insurance. Lindner and Nichols, 2014; Rutledge, 2011 look at how unemployment benefits may substitute for DI. This result is buttressed by Mueller, Rothstein, and Von Wachter, 2016 who examine the relationship between unemployment insurance duration and disability insurance. They use SSA administrative data to show that there is limited labor force attachment of DI applicants prior to receiving benefits. While my paper is in the same spirit of theirs, they only consider the partial equilibrium response of disability insurance. Kitao, 2014 develops a neoclassical general equilibrium model with stochastic ageing to assess the interaction between DI and UI as well as medicare. She finds that a reduction in medicare services could reduce the overall participation in DI. Cheron, Hairault, and Langot, 2013; Hairault et al., 2012 develop life-cycle models on unemployment insurance that is a modification of the classical Diamond-Mortensen-Pissarides model and, thus, intractable to extend it with heterogeneity to assess DI in our case. My model builds upon Menzio, Telyukova, and Visschers, 2016 who develop a directed search to look at UE, EU, and EE flows over the life-cycle. The direct search framework allows for the introduction of more idiosyncratic and aggregate heterogeneity. While Menzio, Telyukova, and Visschers, 2016 serves as a baseline, my model allows for endogeneous retirement and labor force participation.

1.4 Empirical Evidence

1.4.1 Data Overview

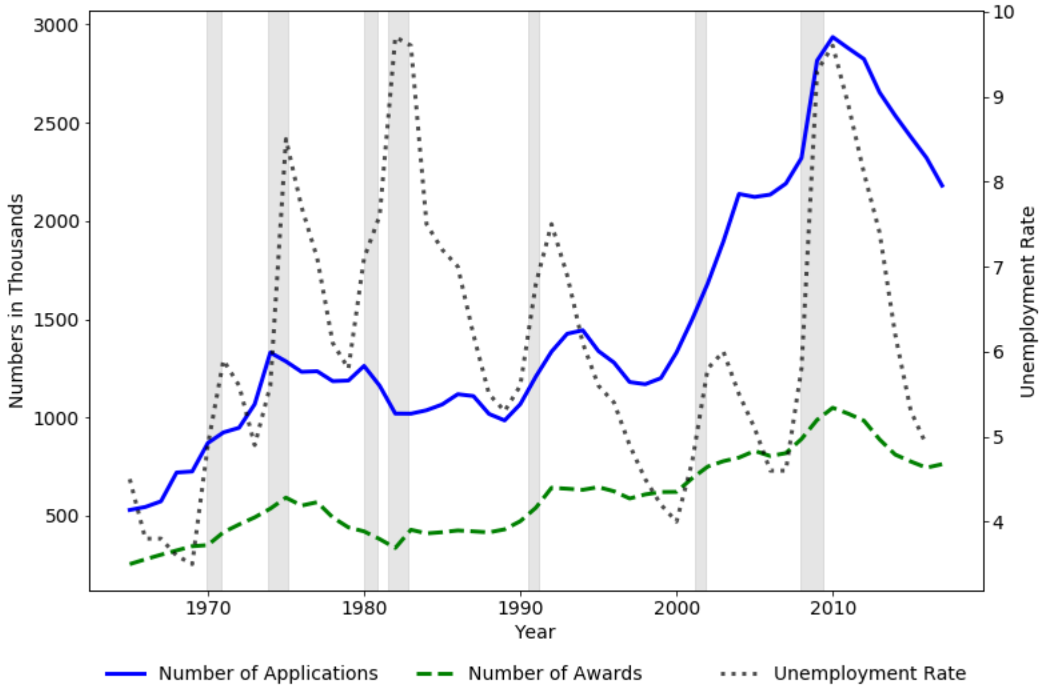
To model a multi-state model with disability, I use aggregate data to describe trends in the disability insurance program. I use two sources of data to calibrate my model: the Social Security Administration's (SSA) Annual Statistical Report and the Census Bureau's Survey of Income and Program Participation (SIPP). The SSA releases aggregate annual data on disability applications, recipients, and expenditures by state and nationally in its annual report on the Social Security Disability Insurance Program. The SSA also releases monthly data of applications at Social Security Field Offices and awards of disability benefits from 1992. SIPP is a panel collection of various economic and demographic data of workers in a series of waves from surveys in 2001, 2004, and 2008.

Aggregate Data

This section summarizes the relationship of joint labor market flows. Historically, there was a weak overall relationship between unemployment and disability applications since 1965 (**Figure** 1.2). However, after reform in the United States welfare system in 1996, the relationship between unemployment and disability becomes much stronger. The correlation between the two from 1965-1996 is 0.58 while it rises from 1996-2017 to 0.78. This supports the hypothesis of Autor and Duggan, 2003 of substitution away from welfare to disability insurance for during labor market downturns. In more recent monthly data from January 1990 to January 2019, Figure 1.3 shows a a positive trend between disability applications at the Social Security Field Offices and the unemployment rate. Typically, the increase in the unemployment rate precedes the the increase in applications. The award rate (number of awards per application) declines with the unemployment rate[1], suggesting that applicants during downturns are healthier than the average applicant. This mechanically make sense because the appeal of disability insurance increases during downturns for the marginal applicant. Figure **??** charts the 24-month lag award rate to unemployment rate. After the 1996, we see that there is a strong negative correlation between the the award rate and the unemployment rate. Especially in the recessions around 2000 and 2007, we see an

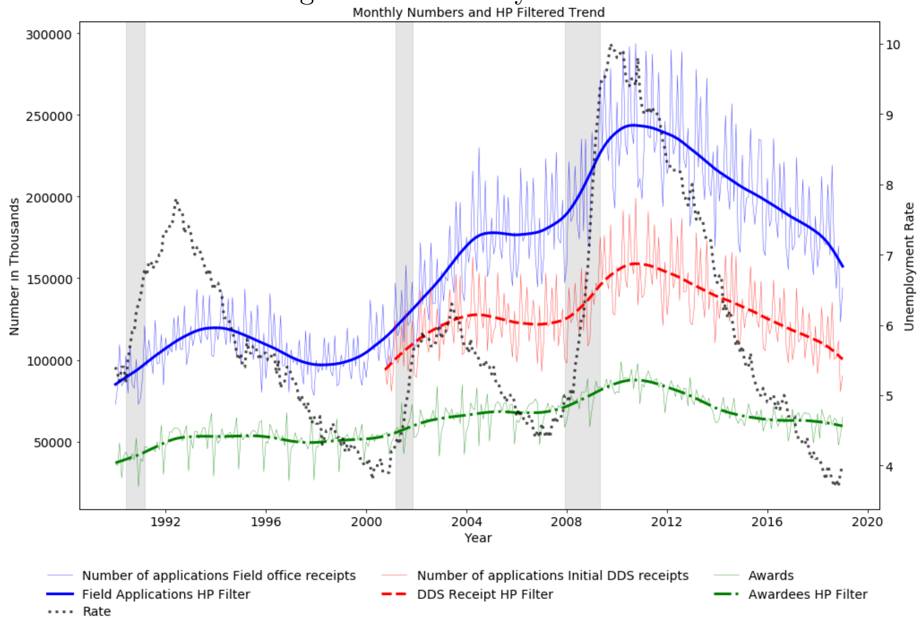
[1] This statement refers to the ratio of awards over applicants from the same time period. However, decision typically take 6-18 months from the initial application before award. Taking the lagged award to application ratio from 24, 18, 12, and 6 months obtains a correlation of -0.60, -0.55, -0.44, -0.41, respectively.

Figure 1.2: Annual Disability Application and Unemployment Rate



Social Security data from Social Security Trust Fund, Unemployment Data from the Bureau of Labor Statistics. The left vertical axis is the number in thousands of applications and awards while the right vertical axis corresponds to the dotted unemployment rate.

Figure 1.3: Monthly Numbers



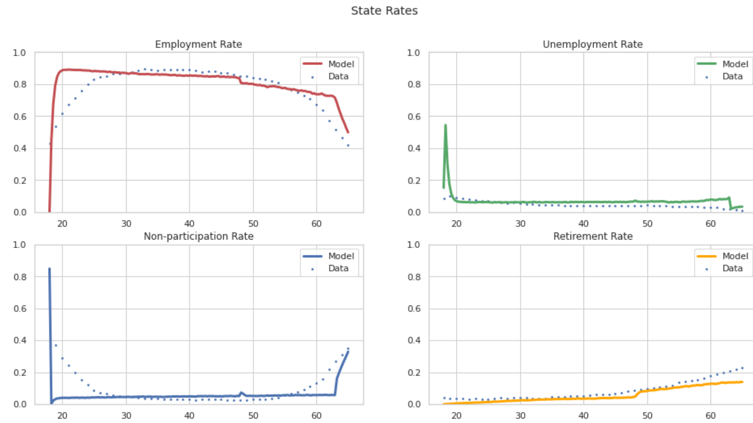
Source: Social Security data from Social Security Trust Fund. Smooth lines are HP filtered trend data with a smoothing parameter of 1600. In 2000 and 2008, the uptakes in unemployment correspond to the decrease in the 24-month lagged award rate suggesting workers who apply in downturns are healthier than those who apply during expansions.

immediate spike. Figure **??** shows the change in awards over the consideration level during this period. There's a marked shift at the consideration level in which workers are awarded disability insurance. This reflects the hypothesis that DI is being used as a de facto wefare program for out of work individuals who may be otherwise healthy.

1.4.2 Labor Market Flows and Transitions

This section summarizes the empirical evidence of labor market flows across employment, active unemployment, inactive unemployment, and disability. I use SIPP from 2001-2012 to account for labor market transitions. The labor market status is aggregated into four different states depending on the empstat variable as summarized in **Table ??**. The data is limited to high-school educated males aged 22-62 years old in order to avoid other factors which may contribute to non-participation (school, childbirth, etc.) over the life-cycle. Classification into flows into disability may underestimate the number of workers entering disability if using the empstat variable classification of NILF, unable to work. In particular, many workers who are receiving disability may self-identify themselves as "retired." To resolve this, I aggregate disabled and retires as a single group. While I limit my observations

Figure 1.4: Life-cycle Rate Simulation vs Data



Source: **SIPP** Quarterly labor market rates across employment, unemployment, non-participation, and disabled for men ages 18-65 between 2001-2012.

Table 1.1: Labor Market Transitions, all ages

Data	E	U	N	D
E	94.97	1.63	2.00	1.40
U	30.52	50.56	15.32	3.60
N	16.21	7.03	73.16	3.60
D	7.34	1.04	2.95	88.67

Quarterly labor market transitions across employment (E), unemployment (U), non-participating (N), and disabled (D) for men ages 22-62 between 1992-2017. Rows are period t state's transition to column variable state in period $t+1$.

to males before the age 65, I focus attention on workers under the age of 62 to avoid workers who may retire under Social Security's Early Entitlement Age. The model is calibrated to match the US labor market from 2001-2012 and transitions to and from employment, unemployment, non-participation, and disability from SIPP. I choose to focus on men to avoid patterns of not participation of women typically due to childbirth. I aggregate disabled and retired as a single variable because many disability recipients may self-describe themselves as retired.

Table 1.1 summarizes transitions of the quarterly data for all age groups. Transitions from the monthly SIPP is aggregated to a quarterly frequency using the mode from the three month period. Transitions are determined using a Markov-switching model. Table **??** shows a sub-sample aggregate transitions across to the states over the life-cycle. I also use the SIPP to determine the transition across health states. I allow workers to be "healthy" or "disabled" over the life-cycle beginning at age 18. The classification is based on the self-reported health status where a respondent has a limitation that prevents working. I determine transitions across these states as a Markov process for each age.

1.5 Model

In this section, I develop a model that extends the life-cycle directed search models of Wee, 2013, Menzio, Telyukova, and Visschers, 2016, Guo, 2018 to include multiple states of Krusell et al., 2011. My model features incomplete asset markets, expiring unemployment benefits, active and inactive unemployment, disability insurance, human capital depreciation, idiosyncratic productivity and aggregate productivity shocks. On one side of the market, firms create vacancies defined by requirements across age, idiosyncratic productivity, assets, and wages. On the other side of the market, workers direct their search to markets which vacancies are demarcated by the ages, idiosyncratic productivity, assets, and wages. Search frictions prevent the market from clearing so workers and firms may end a period without having matched. Because the search process is directed, the solution admits to a block recursive equilibrium where the worker's policy functions will not depend on the distribution of unemployed and employed workers.

1.5.1 Economic Environment

Time is discrete and continues forever. Workers are born at age $t_0 = 0$ and live for T years resulting at T overlapping generations in any given period. For notation clarity, I drop the generation identifier from my value functions and will refer to t for both the age and period. Each worker is endowed with an indivisible unit of labor and discounts the next period by $\beta \in (0,1)$. At age $\tilde{T}$, all workers must retire and receive $b_R > 0$ until their death at age T. Workers aged $t < \tilde{T}$ may be of four possible states: employed, actively unemployed, inactively unemployed, or disabled. Employed and actively unemployed workers are classified as participating in the labor market and can be treated as being on a separate "island" which workers choose to move to. Inactively unemployed and disabled workers are classified as non-participating and are on a separate island. On the "production"" island, there is a continuum of firms who create vacancies at a cost of $k > 0$ or be matched with a worker. Matched firms operate a constant returns to scale production function dependent on the worker experience (x), worker productivity (h), and aggregate labor productivity (y) to produce $g(x, y)$ units of output.

Participating workers direct their search within a submarket characterized by a fixed-wage (w), age (t), idiosyncratic characteristics (s), and aggregate state (ψ). Because search is directed, this allows for a tractable block recursive competitive equilibrium

(BRCE) which will allow for analyses of our programs outside of steady state. The idiosyncratic state $s = (a, x, h)$ where a is assets, x is experience, and h is labor productivity. In my calibration, labor productivity h is viewed as a proxy for health status. The labor productivity takes on discrete values $h \in H$={Unhealthy,Healthy}={0,1} that follows an age dependent Markov process described in the previous section. Both active and inactive unemployed workers are also eligible for unemployment benefits of $b_U > 0$ that may stochastically expire at rate $\epsilon \in [0, 1]$ to $\underline{b} > 0$. New workers are all born unemployed receiving $\underline{b}$, health status $h_0 = h_0$, $x_0 = 0$, $a_0 = 0$.

Aggregate labor productivity and idiosyncratic labor productivity follow an $AR(1)$ process:

$$ln(y_t) = \rho_y ln(y_{t-1}) + \sigma_y \epsilon_{yt}$$

where $0 < \rho_y, \sigma_y$ and ϵ_{yt} is identically independently distributed. The production function $g : \mathbb{N} \times \mathbb{H} \times \mathbb{R} \to \mathbb{R}_+$ is concave, continuous, increasing in all arguments. The firm offers a wage w and may experience negative profit as long as its present-discount value is greater than zero. The distribution of employed workers $\forall t, s, w, y$ is characterized by $e = e(t, s, w, y)$. As an abuse of notation, the distribution of unemployed workers $\forall t, s, b, y$ is characterized by $u = u(t, s, b, y)$ while the distribution of non-participating workers is characterized by $n = (t, s, b, y)$. The distribution of disabled workers $\forall t, s, b, y$ is characterized by $d = (t, s, b, y)$. Finally, the returns to savings is $r = (1 + r)$. The aggregate state is summarized as $\psi = (r, e, u, n, d, y)$.

1.5.2 Timing and Labor Market Flows

A period is separated into five stages: entry-and-exit, separation, search and matching, production, and realization. In the first stage of period t, the t generation of workers of age $t_0 = 0$ enters the economy and the workers from generation $t - T$, age T exit, and age $\tilde{T}$ retire.

In the separation stage, employed workers of age t, idiosyncratic state s, receiving wage w decide to end their matches with probability $d(t, s, w, y) \in [\delta, 1]$ where $\delta \in [0, 1]$ is the exogenous probability of separation. Workers who are separated at this stage are actively unemployed at rate $\rho \in [0, 1]$ or inactively unemployed (i.e. non-participating) at rate $(1 - \rho)$. This feature is to ensure that transitions from employment match the labor market data. Workers decided whether they are actively search for work in sub-markets or are inactive and waiting to be awarded disability. Actively unemployed workers receiving benefits lose their benefits at a rate $\epsilon \in [0,1]$. Stochastic unemployment benefits is a common modeling technique which allows for examining the effects of unemployment extensions without increasing the number of state variables (See Mitman and Rabinovich, 2015). If a worker chooses to be inactive they give up their unemployment benefits and receive $\underline{b}$ and wait to receive disability benefits awarded at a rate $\alpha_t(s,\psi)$. Disabled workers lose their disability at an exogenous rate of $\eta \in [0,1]$.

In the search and matching stage, both unemployed and employed workers search a submarket. Each submarket $\theta_t(s,w,\psi)$ is characterized by the age, idiosyncratic state, and aggregate productivity. The arrival rate of searching while employed (λ_E) is normalized to one and searching while unemployed is (λ_U). Workers choose which submarket to visit based on their own age, idiosyncratic state, aggregate productivity, unemployment benefits level, and the wage they are interested in. Thus, a worker searching in a submarket (t,s,w,ψ) faces a market tightness $\theta_t(s,w,\psi)$ and has a probability of $p(\theta_t(s,w,\psi))$ that they will meet a vacancy. The matching function $p:\mathbb{R}_+ \to [0,1]$ is a twice-differentiable, strictly increasing, and strictly concave function such that $p(0)=0$ and $lim_{\theta\to\infty}p(\theta)=1$. On there other side of the market, firms create vacancies in the submarket for type (t,s,w,ψ) and meet workers with the probability $q(\theta_t(s,w,\psi))$ where $q:\mathbb{R}_+ \to[0,1]$ is a twice-differentiable, strictly decreasing function such that $q(0)=1$ and $lim_{\theta\to\infty}q(\theta)=0$.

At the production stage, employed workers produce $g(s,y)$ units of output and receive wage w. Employed workers who have separated from their jobs into active unemployment receive benefits b_U or inactive unemployment receive $\underline{b}$. Unemployed workers receive benefits b_U or $\underline{b}$ depending whether their benefits have expired. Disabled workers receive $d_0 > 0$. Finally, all workers make their savings decisions for tomorrow $\hat{a} \geq 0$. At the end of the period, all workers experience (x) and the health status (h) transition. The aggregate state y evolves for the next period.

1.5.3 Equilibrium Definition

Worker Value Function

For all workers ages $t \geq \tilde{T}$, workers must retire and choose a consumption and savings bundle $\{c,\hat{a}\}$ to solve

$$R_t(s,\psi) = \underset{\{c,\hat{a}\}}{max}\; u(c) + \beta \mathbb{E}_{\hat{s'},\hat{\psi}|s,\psi} R_{t+1}(\hat{s},\hat{\psi})$$

$$s.t.$$

$$c + \hat{a} \leq d_0 + (1+r)a$$

$$c, \hat{a} \geq 0$$

until their death in period T where $d_0 > 0$ and the carat ($\hat{}$) above the variable represents next period's values. Note, workers may save, but they cannot borrow from the future at any point in the model. A disabled worker solves a same problem almost identical to above but for any t where she becomes eligible and a chance to be forced back into the labor market ($\eta \geq 0$)

$$D_t(s,\psi) = \underset{\{c,\hat{a}\}}{max}\; u(c) + \beta \mathbb{E}_{\hat{s},\hat{\psi}|s,\psi}((1-\eta) D_{t+1}(\hat{s},\hat{\psi}) + \eta V_{t+1}(\hat{s},\hat{\psi}))$$

$$s.t.$$

$$c + \hat{a} \leq d_0 + (1+r)a$$

$$c, \hat{a} \geq 0$$

Let the idiosyncratic states s be defined by $s_U = (s, b)$ for all $b \in b_U, \underline{b}$ when unemployed and $s_E = (s, w)$ when employed. For an unemployed worker, she may choose to actively search or inactively apply for disability benefits. Given idiosyncratic state s_U aggregate state ψ, an unemployed worker of age t receives:

$$V_t(s,\psi) = max\{U_t(s_U,\psi), N_t(s_U,\psi)\}$$

where inactive unemployment (non-participating) is expressed as

$$N_t(s_U,\psi) = \max_{\{c,\hat{a}\}} u(c) + \mathbb{E}_{\hat{s},\hat{\psi}|s,\psi}[\alpha_t(\hat{s},\hat{\psi})V_{t+1}(\hat{s}_U,\hat{\psi}) + (1-\alpha_t(\hat{s},\hat{\psi}))D_{t+1}(\hat{s},\hat{\psi})]$$

$$s.t.$$

$$c + \hat{a} \leq b + (1+r)a$$

$$c, \hat{a} \geq 0$$

and active unemployment is expressed as

$$U_t(s_U,\psi) = \max_{\{c,\hat{a}\}} u(c) + \mathbb{E}_{\hat{s},\hat{\psi}|s,\psi}[V_{t+1}(\hat{s}_U,\hat{\psi}) + S_{t+1}(\hat{s}_U,\hat{\psi})]$$

$$s.t.$$

$$c + \hat{a} \leq b + (1+r)a$$

$$c, \hat{a} \geq 0$$

where

$$S_{t+1}(\hat{s}_U,\hat{\psi}) = \max_{\{\hat{w}\}} p(\theta_t(\hat{s},\hat{w},\hat{\psi}))(W_{t+1}(\hat{s}_E,\hat{\psi}) - V_{t+1}(\hat{s}_U,\hat{\psi}))$$

In the current period, the worker of age t produces and consumes $b \in \{b_U, \underline{b}\}$ where $b_U > \underline{b}$ units of output. An active worker's unemployment benefits b_U may expire with a probability ϵ and following the rule $\Gamma_b(b'|b)$ such that $Pr(\underline{b}|\underline{b}) = 1$ and $Pr(b|b_U) = \epsilon$. At the same time, worker experience may depreciate for unemployed workers at a rate$Pr(\underline{x}|\underline{x}) = 1$ and $Pr(\underline{(x)}|x) = \rho_U$. If the worker chooses to be active, at the beginning of the next period, the worker gets an opportunity to choose a submarket to search for employment and receive continuation utility $V_{t+1}(\hat{s}_U,\hat{\psi}) + S_{t+1}(\hat{s}_U,\hat{\psi})$. The value $S_{t+1}(\hat{s}_U,\hat{\psi})$ is the maximum with respect to wage $\hat{w}$ of the probability that the worker finds a job $p(\theta_{t+1}(\hat{s},\hat{w},\hat{\psi}))$ times the value to the worker of employment in an match $W_{t+1}(\hat{s_E},\hat{\psi}) - V_{t+1}(\hat{s_U},\hat{\psi})$. If a worker does not meet a firm, then they continue in unemployment receiving $V_{t+1}(\hat{s_U},\hat{\psi})$.

Given the idiosyncratic state $s_E = (s, w)$ and aggregate state ψ, an employed worker of age t solves:

$$W_t(s_E, \psi) = w + \beta \mathbb{E}_{\hat{s}, \hat{\psi} | s, \psi} [\max_{d \in \{\delta, 1\}} d\tilde{V}_{t+1}(\hat{s}_U, \hat{\psi})$$

$$+ (1 - d)(W_{t+1}(\hat{s}_E, \hat{\psi}) + S_{t+1}(\hat{s}_E, \hat{\psi})]$$

$$s.t.$$

$$c + \hat{a} \leq w + (1 + r)a$$

$$c, \hat{a} \geq 0$$

where

$$\tilde{V}_{t+1}(\hat{s}_U, \hat{\psi}) = \eta U_{t+1}(\hat{s}_U, \hat{\psi}) + (1 - \eta) N_{t+1}(\hat{s}_U, \hat{\psi})$$

and

$$S_{t+1}(\hat{s}_E, \hat{\psi}) = \max_{\{\tilde{w}\}} p(\theta_{t+1}(\hat{s}, \tilde{w}, \hat{\psi}))((W_{t+1}(\tilde{s}_E, \hat{\psi}) - W_{t+1}(\hat{s}_E, \hat{\psi}))$$

where $\hat{s}_E = (\hat{s}, \hat{w})$ and $\tilde{s}_E = (\hat{s}, \tilde{w})$.

In the current period t, the worker receives wage w. At the separation stage next period, the worker chooses to become unemployed with probability d and receives either $U_{t+1}(\hat{s_U}, \hat{\psi})$ or $N_{t+1}(\hat{s_U}, \hat{\psi})$. When a worker separates from her job for whatever reason and enters active unemployment, she receives the unemployment benefits b_U. If the worker chooses not to separate, she receives continuation utility $W_{t+1}(\hat{s}_E, \hat{\psi}) + S_{t+1}(\hat{s}_E, \hat{\psi})$ where $S_{t+1}(\hat{s}_E, \hat{\psi})$ is the maximum utility of a new job with respect to the wage $\hat{w}$.

Firm Value Function

For a firm, given it is matched with a worker of productivity s, aggregate state ψ, the worker's quit $\hat{d} = d_{t+1}(\hat{s}_E, \hat{\psi})$ and search $\hat{p} = p(\theta_{t+1}(\hat{s}, \hat{w}, \hat{\psi}))$ decisions, it solves:

$$J_t(s_E, \psi) = g(s, y) - w + \beta \mathbb{E}_{\hat{s}, \hat{\psi} | s, \psi} [(1 - \hat{d})$$

$$\times (1 - \hat{p}) max\{J_{t+1}(\hat{s}_E, \hat{\psi}), 0\}$$

The market tightness of a submarket is such that

$$V = -k + q(\theta_t(s_E, \psi))J_t(s_E, \psi)$$

and $\theta_t(s, \psi) \geq 0$.

1.5.4 Definition

A **Block Recursive Equilibrium** (BRE) consists of a market tightness function, θ_t, value functions for the unemployed worker, policy functions for the unemployed worker, value functions of a matched worker, and a policy function for each worker-firm match for each generation t=0,1,...,T such that

1. The worker value functions are independent of aggregate state ψ.
2. Market tightness satisfies $V = -k + q(\theta_t(s_E, \psi))J_t(s_E, \psi)$ for all (s_E, ψ).
3. The value function and policy function satisfy for all types of workers s, s_U, s_E and all ages t.

The above definition allows to solve for (2) and (3) independent of (1) and, therefore, it is relatively tractable when faced with substantial heterogeneity. Moreover, as discussed in Menzio, Telyukova, and Visschers, 2016, the above recursive equilibrium is unique and socially efficient.

1.6 Calibration

I follow the search and matching literature to target aggregate flows discussed in my empirical section. I calibrate the steady-state by holding all other parameters fixed and estimate to match the fraction of unemployed households and disability applicants from 1990-2018. A period is one quarter and workers lives for 200 quarters where the first 160 are for working and the final 40 they are retired. This is equivalent to working for 40 years between the ages of 22-62 and being retired for 10 years. I use a quarterly discount factor of $\beta = .99$ which is equivalent to a one year interest rate of approximately 4%. The utility function is a standard constant relative risk aversion (CRRA) standard within the search literature:

$$u(c) = \frac{c^{1-\sigma} - 1}{1 - \sigma}$$

with $\sigma = 2.0$. The production function assumes the following form dependent on whether the worker is $h = \{0, 1\}$ ={Unhealthy, Healthy}, $x = \{0, 1\}$ ={Inexperience, Experienced}, and the aggregate productivity state y. Its parameters are used to target the employment and unemployment rates over the life-cycle.

$$g(x,h,y) = \begin{cases} 0 & \text{if } h=0, x=0 \\ 0.5y & \text{if } h=0, x=1 \\ 0.7y & \text{if } h=1, x=0 \\ y & \text{if } h=1, x=1 \end{cases}$$

For my matching function, I use an urn-ball function per Haan, Ramey, and Watson, 2000 with $\gamma = 1.7$.

$$p(\theta) = \theta(1+\theta^{\gamma})^{-1/\gamma} \qquad q(\theta) = p(\theta)/\theta = (1+\theta^{\gamma})^{-1/\gamma}$$

This functional form ensures that the matching probability will always be strictly between 0 and 1. For acceptance into disability, the function is depends on an inexperienced worker being unhealthy.

$$\alpha_t(s,\psi) = \alpha_t(h) = \alpha_t(\text{unhealthy}) = \begin{cases} .125 & \text{if t} < \frac{5}{8}\tilde{T} \\ 0.25 & \text{if } \frac{5}{8}\tilde{T} \leq t < \frac{7}{8}\tilde{T} \\ 0.5 & \text{if } \frac{7}{8}\tilde{T} \leq t < T \\ 0 & \text{otherwise} \end{cases}$$

The above function is designed so that workers under the age of 44 take an average of 8 quarters to receive disability. Moreover, inexperience is taken as a necessary step before a worker can qualify for the program. So experienced workers who have a prolonged duration of unemployment must first lose their experience before they are able to qualify for the program. Aggregate productivity follows an AR(1) process:

$$ln(y_t) = \rho_y ln(y_{t-1}) + \sigma_y \epsilon_{yt}$$

Table 1.2: Estimated Parameters

Parameter	Value	Description
T	160	Lifespan
β	0.99	Quarterly discount rate
δ	0.50	Exogenous job destruction
ρ_y	0.71	Auto-correlation of aggregate productivity y
σ_y	0.008	Standard deviation of aggregate productivity y
$\underline{b}$	0.2	Home production
b_U	0.4	Home production + unemployment benefits
$\bar{d}$	0.62	Home production + disability benefits
ϵ	0.125	Unemployment expiration rate
κ	0.8	Vacancy posting cost
γ	1.7	Matching function parameter
ρ	0.2	Random placement into non-participation
η	0.1	Lose Retirement/Disability

where $\rho_y = .71$, $\sigma_y = 0.08$ and $\epsilon_{yt} \sim N(0, \sigma^2)$ and the process is discretized to a 7-point grid using Rouwenhurst's method. The calibration data aggregate productivity comes from the Bureau of Labor Department's annual labor productivity and has been de-trended using an HP-filter with a smoothing parameter of 1600 for quarterly data based on Ravn and Uhlig, 2002. The unemployment benefits are at 0.40 to match the average nation-wide replacement rate Mitman and Rabinovich, 2015. Disability benefits are set to 0.64 to match the average nation-wide replacement rate Gruber, 2005. Unemployment extensions $\epsilon = 0.125$ to match the 2 years of extensions during the Great Recession. I set the exogenous separation rate to be a constant $\delta = 0.05$ per quarter. The labor vacancy and posting cost κ is chosen to target a mean steady state unemployment rate of 5.0%.

1.7 Results

I simulate my model for 360 periods and burn the first 160 for 50 simulations. Each generation has 1000 agents. To evaluate the validity of my model at the aggregate level my model to compute various flows as discussed in the empirical section. Table **??** shows flows of my model compared to that of the data while **??** separates the disabled from non-participation. The three-state version of my model can generally capture worker employment rate and its overall trend. My model can account for movements later on in the life-cycle, especially workers who transition into disability. It is also able to capture the non-participation of workers later on in their life-cycle. Once I disentangle the disabled from the non-participants, the model does a better job at modeling the program participation of

Table 1.3: Labor Market Transitions, all ages

Model	E	U	N	Data	E	U	N
E	84.60	6.41	8.99	**E**	94.97	1.63	3.40
U	35.61	40.60	23.79	**U**	30.52	50.56	18.92
N	18.70	19.80	61.49	**N**	11.78	4.04	84.19

Quarterly labor market flows across employment (E), unemployment (U), and non-participating (N)for men ages 22-62 between 2001-2008. Rows are period t state's transition to column variable state in period $t+1$.

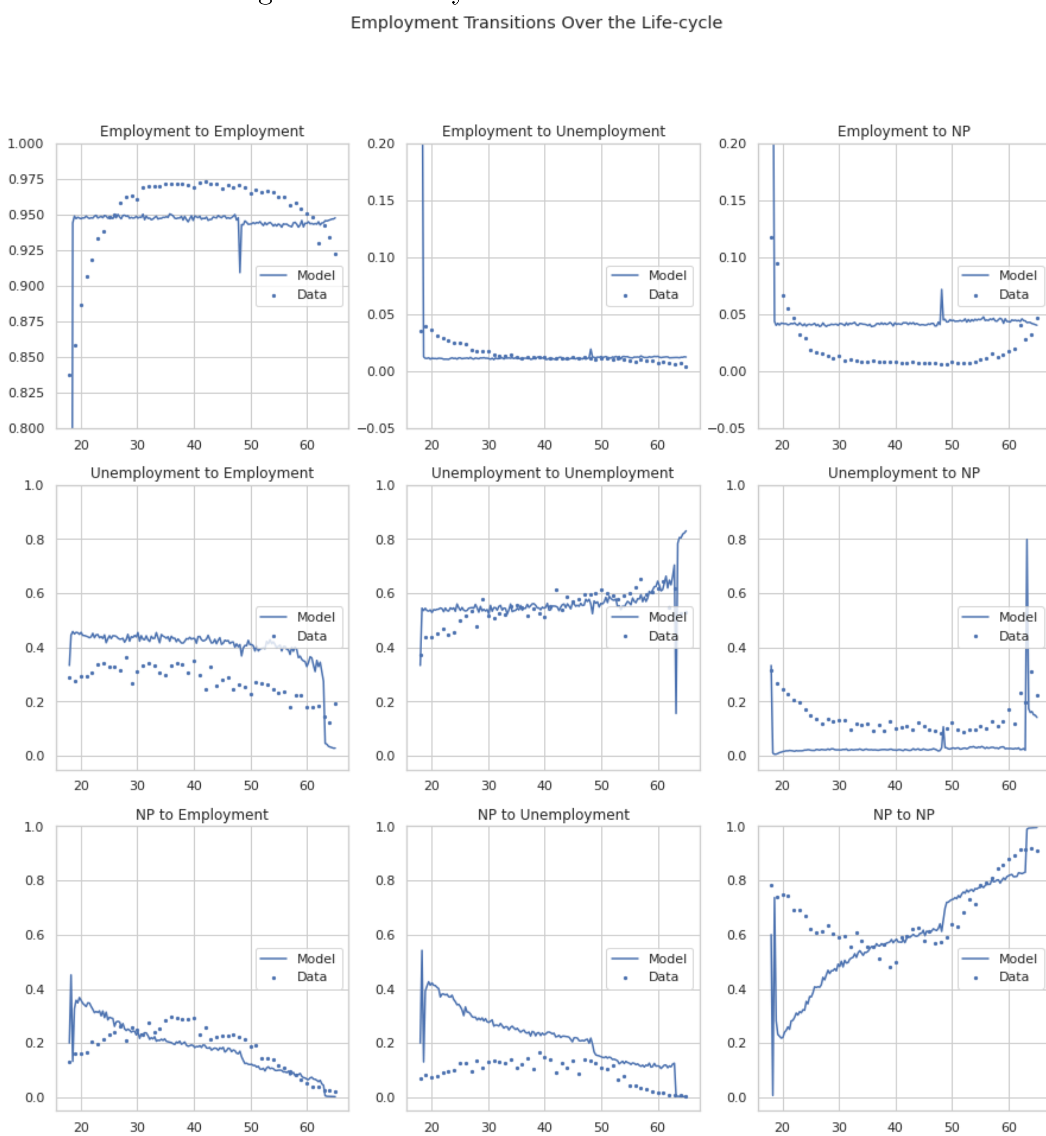
disability. On the other hand, my model does not capture the rates earlier in the life-cycle. I am not directly aiming to model these ages on the life-cycle where there may be rapid learning by doing. My model only allows for two states of experience and no learning of the match quality on behalf of the worker. Neglecting these features will likely lead to poorer modeling earlier in the life-cycle because the worker "shopping" will happen earlier in the life-cycle.

Table 1.3 shows the overall fit of flows across three states. The relative magnitudes are similar but it underestimates the employment-to-employment flow and overestimates the non-participation-to-unemployment flow. As discussed before, my model does only accounts for worker experience and does not account for match quality which would effect the employment-to-employment flow. The costless choice from transitioning away from non-participation also allows for greater movement in my model compared to the data. Figure 1.5 shows these transition rates over the life-cycle from the various combinations of employment, unemployment, and non-participation. My model captures the average transitions across the states, but once we look closer to the data, it does not capture employment transitions over the life-cycle. However, it does a relatively good job at the non-participation rate, suggesting that the disability program is relatively important in determining worker movements later in the life-cycle.

1.8 Conclusion

In this paper, I describe the labor market flows across four states employment, unemployment, non-participation, and disability. My framework incorporates aggregate productivity shocks and can be used to assess the interaction between two large social insurance programs unemployment and disability insurance. It extends the literature in two fronts: first by incorporating disability insurance in a general equilibrium framework. By doing so, we can tell how workers and firms respond to labor market frictions when applying to disability insurance. Secondly, it extends the literature of life-cycle search by

Figure 1.5: Life-cycle Rate Simulation vs Data



Source: SIPP Quarterly flows across employment, unemployment, and non-participation for men ages 18-65 between 2001-2012.

modeling transitions across multiple states over the business cycle. Two main extensions would be to include the impulse response function or other policy programs. First, it can fully incorporate the worker's impulse response functions in the wake up an aggregate productivity shock to determine the optimal disability insurance relative to unemployment insurance. This model also can be extended to include other salient programs which effect the labor market such as Medicaid.

Chapter 2

Long Shadow of Racial Discrimination: Evidence from Housing Covenants of Minneapolis

2.1 Introduction

Does historical housing discrimination have a persistent effect on cities today? Given the key role agglomeration forces play in city structures, initial neighborhood characteristics set by nature, historic accident, or other factors matter considerably for present-day outcomes. What if racially discriminatory housing policies set these initial conditions when cities are first developing? What are the long-term effects of historic racial discriminatory policies on socioeconomic outcomes within cities today? This paper studies these questions by focusing on racially-restrictive covenants that were prevalent during the early-to-mid 20th century. Racially-restrictive covenants were clauses within property deeds that prohibited the sale, resale, or rental of a property to a range of non-white people but primarily targeting African-Americans. Covenants prevented people of color from living in particular areas within a city. We argue that by shaping the early socioeconomic characteristics of a city, racially-restrictive covenants have had a persistent effect on present-day house prices and the racial distribution in Minneapolis, Minnesota. We use a unique and newly constructed data set of all historic property deeds from 1910-1955 with information on racially-restrictive covenants for all lots in Hennepin County, Minnesota. We match this data with census and present-day tax assessor data to assess the long-term impact of these covenants. Using a regression discontinuity (RD) design around the unanticipated 1948 U.S. Supreme Court ruling that made racially-restrictive covenants unenforceable, we study the effects of covenants on present-day socioeconomic outcomes such as house prices and racial segregation. We find that houses that were covenanted have on average 15% higher present-day house prices compared to houses that were not covenanted. We also find a 1% increase in covenanted houses in a census blocks reduces black residents by 14% and reduces black home ownership by 19%.

Housing discrimination has taken many forms in the United States[1]. One of the instruments prevalent in American cities during the early-mid 20th century in was the usage of racial covenants. Starting in the decade before World War I, real estate platted neighborhoods and could decide racial restrictions when they divided lots. Because a single developer would build swaths of houses together, covenants legally prevented people of color from moving to particular neighborhoods. Thus, racial covenants effectively determined who could live where. Covenanting homes attracted higher prices relative to homes in the non-covenanted neighborhood, given similar geographic amenities. Even after covenants became unenforceable in 1948, covenanted properties saw relatively higher private and public initial investment near them, and resulted in persistent differences across city areas via path dependency (see David, 1985, Acemoglu, Johnson, and Robinson, 2001).

In this paper, we exploit the unanticipated 1948 Supreme Court ruling that rendered that racially-restrictive covenant contracts unenforceable (see Rothstein, 2017 and Brown and Smith, 2016)[2]. Using 1948 as a cut-off point and a fuzzy regression discontinuity design, we compare the present-day outcomes of houses and neighborhoods that were developed just before or after 1948 and were similar after controlling for observed characteristics but for their ability to implement racially-restrictive covenants. Our identifying assumption is that there are no differences in unobservable quality of real estate developed right before and after the decision, other than a time trend, and should not be correlated with any of the outcomes variables after controlling for observed characteristics.

Our primary findings are that the effects of racially-restrictive covenants are ever-present today and affect socioeconomic outcomes in a significant manner. In particular, we find that houses that were covenanted, have on average 15% higher 2018 house values compared to properties which were not covenanted. Our results are also consistent with hypothesis that covenant language was exercised in the deeds of amenity scarce areas (Kaul, 2019). The high prices of homes in amenity rich locations, such as near popular lakes, served as a mechanism to restrict people of color from moving in[3]. Additionally, we find that

[1]See **Appendix A.1** for a timeline of these events.

[2]The Supreme Court had reaffirmed the legality and enforceability of racial covenants in Corrigan v Buckley (1926). See Section 2 for more detailed discussion on this.

[3]Residents in these areas often employed other tools such as private investigators or buybacks to prevent affluent black families from moving in.

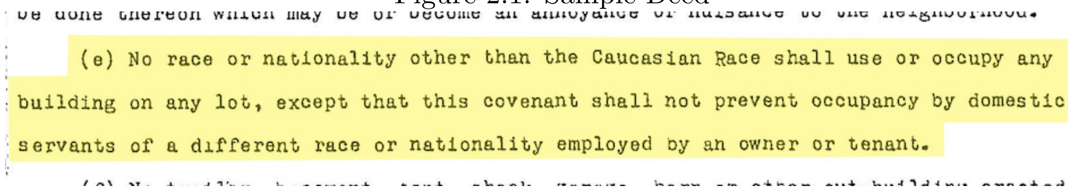
a 1% increase of covenanted lots within a census block results in a reduction of black resident population by 14% and reduction in black home ownership by 19% when calculating elasticities at mean value. We do not find a statistically significant relationship between total home ownership rate, non-white resident population, and home ownership rates and covenant share. The covenanted property deeds were used mostly used in locations that were less coveted and could not keep people of color out through the price mechanism, effectively keeping middle-class African-Americans and other minorities buying houses in certain middle-class neighborhoods (see Rothstein, 2017).

We are agnostic about the specific mechanism that leads to the persistence effects of covenants. We discuss three possible mechanisms for the persistent effect of covenants: private investment and home quality, public investment, and preference externalities. First, home owners may have chosen to invest more in covenant neighborhoods because they were perceived as “nicer” than non-covenanted neighborhoods. Alternatively, it is possible following the 1948 Supreme Court ruling that developers were able to respond quickly to no longer charging higher prices for covenanted homes and switched to lower quality materials in new homes. Second, public investment in covenanted neighborhoods is higher relative to non-covenanted neighborhoods because they had wealthier residents. Third, residence prefer to consume similar local private goods as their neighbors and hence, choose to live in areas with residents of similar preferences. Consumption complementarity among residents generate higher home prices that persist in the long-run.

To the best of our knowledge, this paper is the first to investigate the long-term impact of racial covenants used in private transaction contracts on present-day outcomes with such detailed data. Unlike many other American cities, Minneapolis did not have racially-segregated zoning policy because it began its expansion after the Supreme Court invalidated them. Racial covenants were truly one of the first housing discrimination instruments used in this region and affected the initial geographic distribution of race. Thus, we can draw a straight line from covenants to modern segregation and racial differences in the region.

In Section 2 we describes the use and history of racially restrictive covenants, while Section 3 provides Literature Review. Section 4 discusses our newly constructed data set using the original property deeds as well as additional sources. Section 5 discusses our empirical strategy. Section 6 discusses possible mechanisms for persistence and Section 7 concludes.

Figure 2.1: Sample Deed


(e) No race or nationality other than the Caucasian Race shall use or occupy any building on any lot, except that this covenant shall not prevent occupancy by domestic servants of a different race or nationality employed by an owner or tenant.

Note: This deed has sample language of a racially restrictive covenants. *Source: Mapping Prejudice Project*

2.2 Background to Covenants and Literature Review

2.2.1 Background to Racially-Restrictive Covenants

In Minneapolis, Minnesota, the first racially-restrictive deeds appeared in 1910. Soon thereafter, real estate companies began including the language within property deeds sold throughout the city. Outside Minneapolis, the Supreme Court decision of Buchanan v. Warley (1917) prohibited cities from enacting racial zoning policies. Increased racial tension and violence the following year led to the "Red Summer" of 1919 when white supremacists killed hundreds of African-Americans throughout the country. In response, real estate developers, public officials, and private citizens used the sale of private property to create a legally enforceable system of housing discrimination. The housing deeds at the point of sale included language which either explicitly prohibited many racial and ethnic groups from ever purchasing or residing in a home[4]. While primarily focused on preventing African-Americans from moving into neighborhoods, these clauses also excluded many other groups stating that the "premises shall not at any time be conveyed, mortgaged or leased to any person or persons of Chinese, Japanese, Moorish, Turkish, Negro, Mongolian or African blood or descent." See **Figure 2.1** as an example of such deeds [5].

The Supreme Court reaffirmed the legality and enforceablity of covenants when it ruled in Corrigan v Buckley (1926) that the resell of property to black families were void because of covenanted language. Following the ruling, if an individual seller wanted to sell to a minority group, past owners and even neighbors could void the transaction. With the Supreme Court decision in hand, the use of covenants became widespread across much of the United States, especially by real estate developers in growing cities. This system was buttressed in 1924 by the National Association of Real Estate Boards (NAREB) when it adopted an amendment in its charter the use of covenants as part of its "code of ethics." While it was possible for an individual realtor to not keep with the code, expulsion from

[4]Exceptions were allowed for domestic servants.

[5]For more samples see **Appendix A.2**.

Figure 2.2: Expansion of buildings and racial covenants in Minneapolis, 1910-1949

0.3

(a)

b

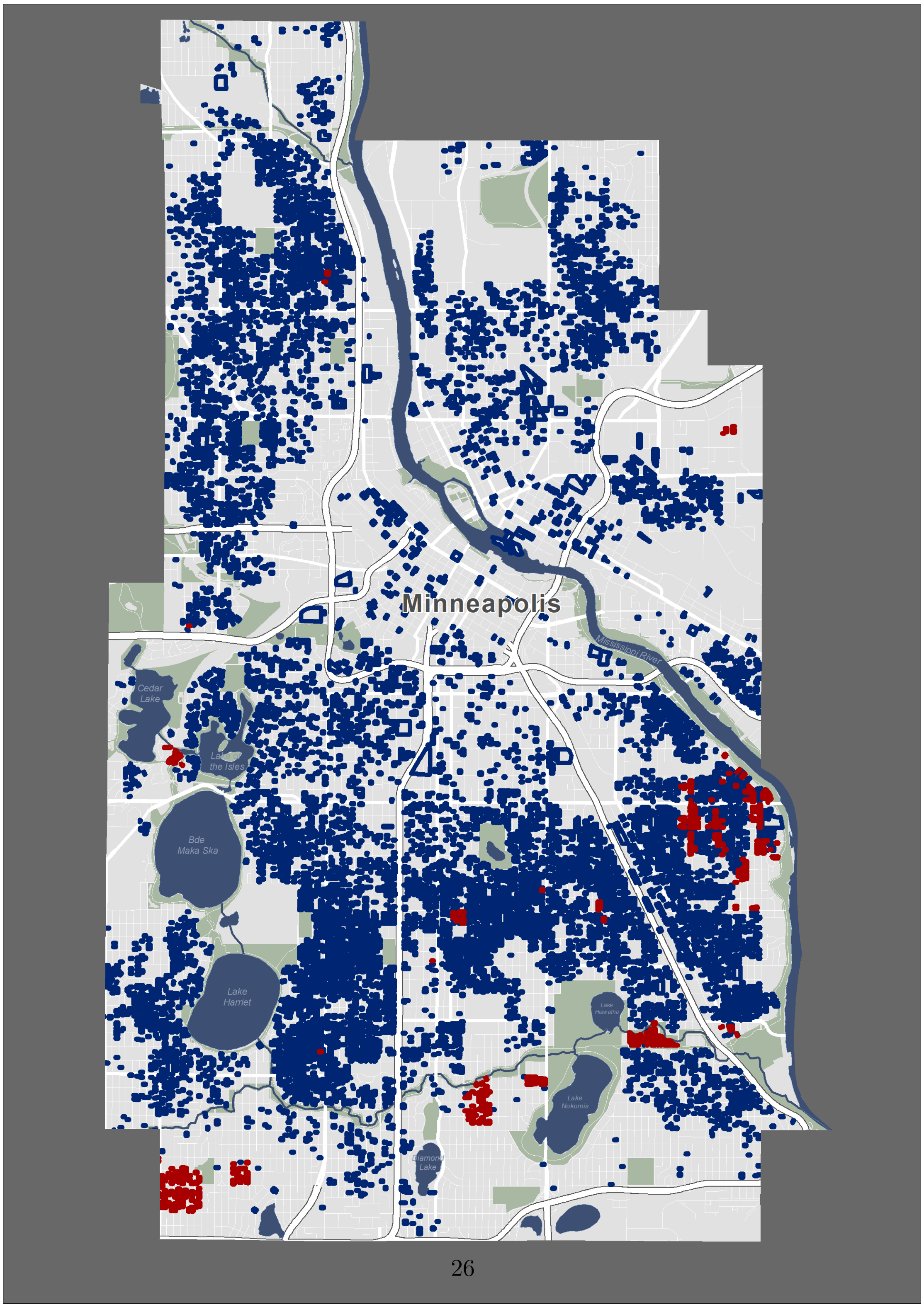


Figure 2.3: 1910-1919

0.3

the association resulted in "loss of the network of contacts and information critical to the practice of the real estate broker" (Jones-Correa, 2000). Developers would often advertise the use of covenants as part of their amenities in order to attract buyers and higher prices. Minneapolis and Hennepin County's urbanization occurred concomitantly with this national trend. Many real estate developers built new homes with covenants to address the city's swelling population which grew from 301,408 in 1910 to 521,718 by 1950. As more people moved into the city and racially-restrictive deeds spread, African-Americans were pushed into confined neighborhoods. Even as the number of black residents continued to grow, large parts of the city became completely white. The prevalence of covenants both locally and nationally cannot be understated. **Figure 2.2**, for example, shows that there was a continued geographical spread in the spatial use of covenants from 1921 and 1951. According to our data set (see the next section), at its peak 20% of extant homes in Hennepin County were covenanted in the year they were built.

After the Second World War, many real estate developers continued to promote covenants in their property deeds. While there were repeated challenges to the Corrigan decision, these were all dismissed by lower court levels and reaffirmed the idea that that the Supreme Court would not interfere with the right to discriminate in private agreements. However, a tide shifted when the Supreme Court, citing the Equal Protection Clause of the 14th amendment, decided in Shelley v. Kramer (1948) that racially restrictive covenants were no longer enforceable and their language in property deeds to be void. This decision was followed by the Minnesota Supreme Court in 1953 which banned racially restrictive covenant clauses in future property deeds. Congressional legislation passed the Fair Housing Act in 1968 explicitly banned housing discrimination on race. By this time, however, zoning and development of Minneapolis and Hennepin County slowed and even begun to decline. However, the racial makeup of neighborhoods determined in preceding decades persisted, where the region was highly segregated with white families primarily residing in suburban areas and black families within select neighborhoods parts of Minneapolis. This segregation has continued for more than fifty years, suggesting the highly long lasting effect that covenants had on the racial distribution of the region.

This paper aims to address the segregation determined through the use of covenants. We examine the income and racially characteristics of geographies from 1970, 1980, 1990, and 2010 to show that racially restrictive covenants had a long-lasting effect on these neighborhoods. We show that covenanted homes also continued to receive higher prices to similar non-covenanted homes.

2.3 Literature Review

Economists have long studied the importance of an economy's initial conditions and its influence on city development, technology adoption, and economic growth (see David, 1985 and Acemoglu, Johnson, and Robinson, 2001). In the case of cities, these channels are reinforced by agglomeration forces that can generate persistent inequality across neighborhoods (see Duranton and Puga, 2003, Rosenthal and Strange, 2004). Redding and Sturm, 2008, Ahlfeldt et al., 2015, and Heblich, Redding, and Sturm, 2015 show how initial market access, agglomeration and dispersion forces, and commuter access of Berlin and London were determining factors in the long-run neighborhood and city structure. Economics of density indicate that residential and production externalities are highly localized and an important determinant for incomes of immobile factors, such as land. This paper, studies the effect of initial conditions set by racially-restrictive covenants on long run land and house prices and the racial distribution of residents within a city. Our paper also connects with the literature assessing the role of local neighborhoods effects on inter-generational mobility and inequality (Chetty and Hendren, 2018a,b and Chetty et al., 2018) and industrial zoning and house prices (see Shertzer, Twinam, and Walsh, 2016).

Several studies have considered how a city's fundamentals contribute to spatial outcomes across races. Spatial discrimination, where black workers cannot freely move to certain neighborhoods, increases the cost to access of labor markets and contributes to higher black unemployment (see Zenou and Boccard, 2000). Many recent studies have examined the long-term effects of racial discrimination by focusing on credit access and the role of HOLC maps which disproportionately effected racial minority residents through "redlining" and giving worse credit ratings to neighborhoods of people of color (see Krimmel, 2017 and Appel and Nickerson, 2016). In an extensive study across the United States, Aaronson, Hartley, and Mazumder, 2018 use HOLC maps of 149 cities and a propensity score weighting approach to compare boundaries of similar plots of land. They show that credit access determined by HOLC maps had a significant impact on black home ownership, house values, rents, and vacancy rates[6]. Similarly, poorer and minority neighborhoods are typically zoned for new construction projects such as freeways to detriment of local residents (see Allen, Austin, and Swaleheen, 2015 and Brinkman and Lin, 2019). The racially-restrictive covenants studied in this paper, predate the policies of "redlining" and freeway construction and contributed to the geographic shape these

[6]Moreover, limited credit access generates long-lasting effects on inequality through multiple channels such as education investment, (Cameron and Taber, 2004), entrepreneurship ("Entrepreneurship and Bank Credit Availability"), or consumption (Carroll, 2001).

Table 2.1: Summary Statistics

	Non-covenanted	**Covenanted**
Total Home Value	283,377 (166,628)	307,989 (99,990)
Parcel Sq. Ft	6,888.64 (5,649.25)	5,995.12 (1,170.33)
Bedrooms	3.05 (0.92)	3.18 (0.73)
Bathrooms	1.73 (0.77)	1.78 (0.68)
Fireplace	0.57 (0.77)	0.78 (0.70)
2010 Med HH Income	73,613.12 (25975.02)	79,634.44 (18,243.86)
2010 Share 18+	0.79 (0.08)	0.77 (0.06)
2010 Share White	0.72 (0.16)	0.74 (0.09)
2010 Population	65.65 (35.10)	623.30 (15.82)
Observations	10,796	1,029

Note: This tables summary statistics. The variables House Value and Year Built are from Hennepin County Tax Assessor data. House Value is for 2017. Variables on income is from 2010 Census and the share of races is from 2010-2014 ACS estimates.

policies took. Thus, some of the effects captured by the the aforementioned papers is due to racially-restrictive covenants that shaped the city structure other discriminatory policies were enactedWe are currently working on including these features in future versions of this research.. Furthermore, unlike the HOLC maps that were drawn at a more aggregate neighborhood level, this paper can capture the granular effects of racial discriminatory policies since we can map racial covenants to houses in present-day Minneapolis.

2.4 Data

Our analysis uses the Mapping Prejudice racial covenants (MP) data, Hennepin County tax assessor data, the Census Bureau Decennial Survey from 1940, 1950, and 2010, and the American Community Survey from 2010.

2.4.1 Mapping Prejudice Data

The MP data comes from the Mapping Prejudice Project. [7]. This is a newly constructed data set using the original sale deeds of all property sales that occurred between 1910 and 1955. These are approximately 30,000 property deeds with 14,634 present-day houses with racial covenants in Hennepin county. Each deed had information on the date executed, the date of the deed, the parties in the transaction, and a geographical identifierUnfortunately, the deed information lacks the original price of sale because parties would not disclose them in their original filings to avoid property taxes. This practice continued until the 1970s when

[7]See their website for more details `https://www.mappingprejudice.org`

the Minnesota government began to crack down on the tax avoidance.. See **Appendix A.3** for more information on the MP data.

Of the houses that were built before 1950 and 8.0% have a racially restrictive covenant associated with them. 41% of covenanted land has a house built on it within 1 year. 51.7% of covenanted land has a house built on it after 1 year and before 1950. These covenants were added by real-estate developers onto farmland converted into new houses in rapidly urbanizing Minneapolis. 6.9% of already built houses have retro-actively added covenants with their sale deeds i.e. individual sellers/homeowners added covenants. For our main analysis we focus on houses/lots constructed between 1945-51. Of the extant houses constructed in this period, 19.7% were covenanted at some point.

2.4.2 Assessor Data

Hennepin County assessor office regularly compiles modern housing characteristics and valuations of homes for tax purposes. Our data set comes directly from the assessor's office and capture the housing characteristics between 2015-2018. This data includes the house's build year, geo-spatial location, square footage, lot size, number of stories, and other such characteristics. For our main analysis of houses/lots constructed between 1945-51. The mean home value over this period is $301,302.5 and was built in 1948 (see **Table 2.1**). Using the build year of the houses as well as their geographical location, we are able to identify and merge the MP and assessor data to determine which modern homes reside on covenanted lots.

2.4.3 Census and American Community Survey

We combine the above two data sets with demographic data from the Decennial Censuses of 1940, 1950, and 2010. The Census data on race of residents, age, and home ownership are available at census block level. The income data at census block group level is from the American Community Survey 2010. While the MP data covers all lots in Hennepin County, the census data from 1940 and 1950 covers Minneapolis only. This restricts our analysis to the city of Minneapolis. We have a total of total of 91 census enumeration districts (1940-50 census), 1806 census blocks (2010 census), 218 census block groups (2010 census), 76 census tracts (2010 census), and 18 zip codes in the final data set. In 2010, the average block is 61.1% white and 10.6% black with a mean annual income of $77,722 and $44,720 for all and black families, respectively. We summarize this data between covenanted and non-covenanted homes in **Table 2.1**.

Enumeration Districts for 1940 and 1950 Census

The census divisions have changed overtime with enumeration district being the 1940, 1950 equivalent in size but not geography to modern census tracts which started in 1970. We created these enumeration districts and mapped them to modern National Historical Geographic Information System (NHGIS) spatial identifier using old maps and location descriptions. We then the old joined enumeration districts identifiers with the present day home's NHGIS identifiers. Since this a cumbersome process, we have constructed the enumeration districts for the city of Minneapolis only. This is why our analysis, at this point, does not contain data from the remainder of Hennepin county.

2.5 Racially-Restrictive Covenants and House Prices

2.5.1 Empirical Strategy

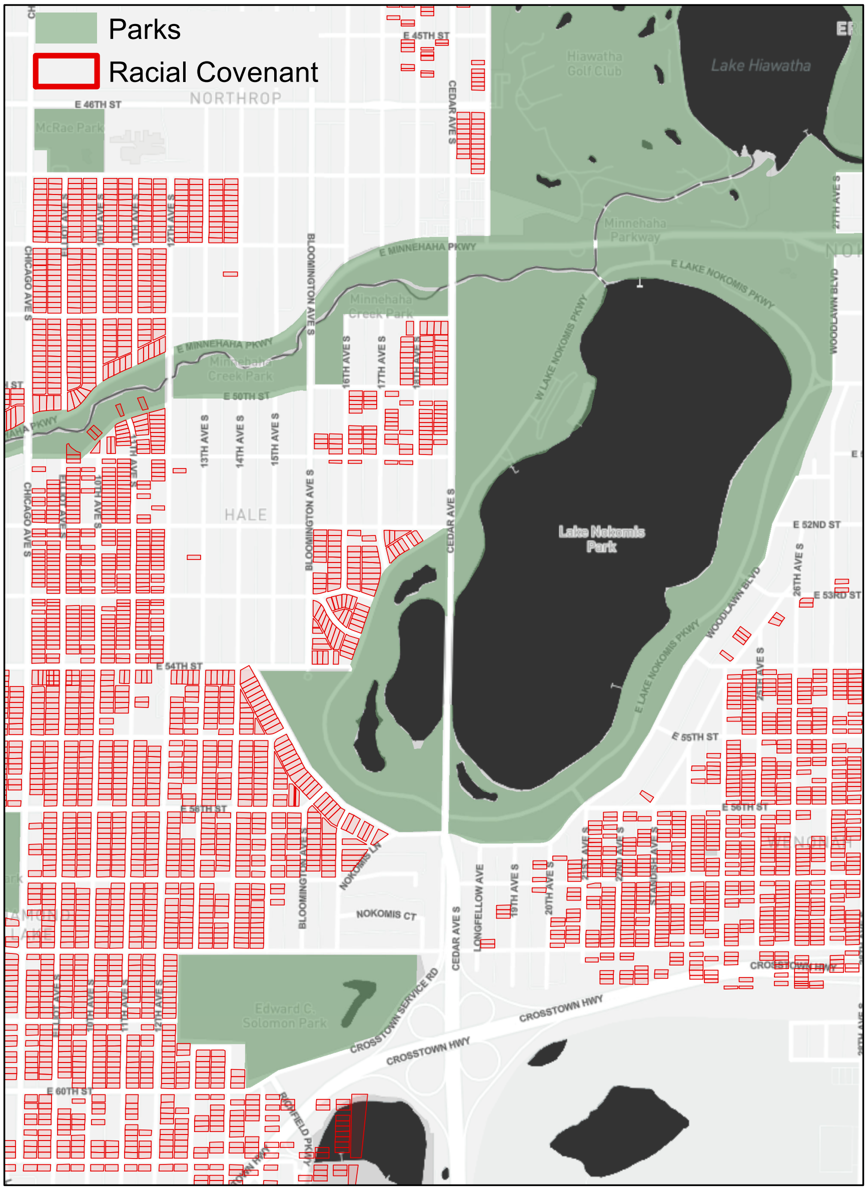
In order to understand the persistence of housing discrimination, our goal is to identify the causal effects of the historic racially-restrictive covenants on several modern socioeconomic and geographic outcomes. Our outcomes of interest then are divided between individual level and geographic variables where economies of density play a major role. The outcome variables are the individual house valuations in 2018.

The main variable of interest is the use of racially-restrictive covenants in a lot in the past. For individual house level analysis, this variable is a dummy of covenant use for that lot. For geographic area level analysis, this variable is the share of lots covenanted in a census block[8]. Thus, the treatment group is covenanted lots, while the control group is not-covenanted lots. We use census data and individual house characteristics as controls as described in the Section 4.

To causally identify the effects of racially-restrictive covenants on socioeconomic outcomes today, we need to address the endogeneity concerns in this problem. There is a possibility that locations (or lots) with better or worse unobserved quality increased the the likelihood of the lot being covenanted in the past. This is a problem for us if the unobserved quality is also correlated with the outcome variables like 2018 house prices. In addition, we only observe racially-restrictive covenants but not other types of non-racial covenants associated with that lot. These covenants could be correlated with the individual or geographic outcome variables. In fact, there is some evidence that the lots that were

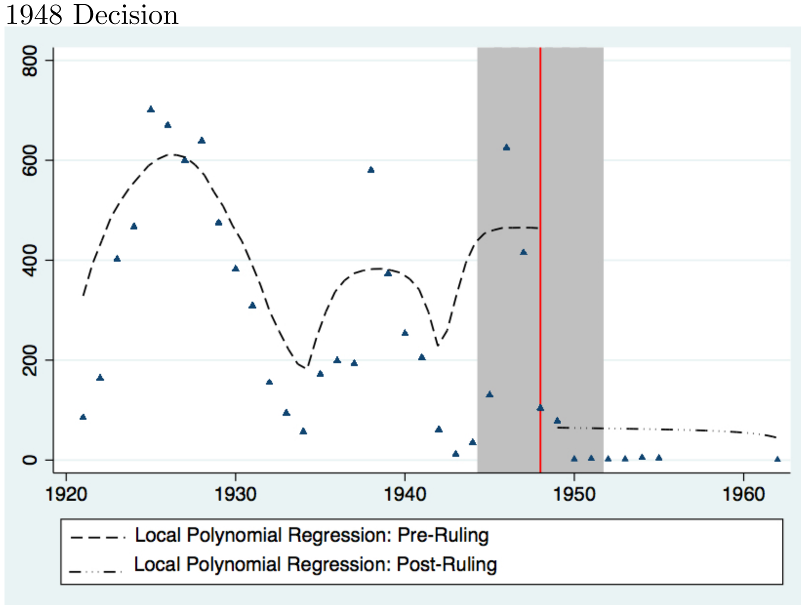
[8]Note that the independent variable is not whether a land deed has covenant attached to it but whether the covenant had any legal standing. This is applicable for 99% of new deeds we observe in the time frame between 1945-1951.

Figure 2.7: Racial Covenants and Amenities–Lake Nokomis



Note:This figure plots racial covenants around Lake Nokomis. Data from Mapping Prejudice project.

Figure 2.8: Regression Discontinuity on Covenant Deeds around 1948 Decision



Note: This figure presents the local polynomial regression of covenant deeds execution date around the discontinuity of the 1948 Supreme Court decision between 1920-1960. Data is from Mapping Prejudice. In 1948 covenants become legally unenforceable.

covenanted were in areas with low natural amenities (Kaul, 2019). At high amenity locations, such as houses near popular lakes, the price mechanism was enough to keep people of color out. In contrast, covenants were used mostly used in locations that were less coveted (and hence, cheaper) and could not keep people of color out. For real estate developers, using covenants was a mechanical way to increase the desirability of a particular area and increased the value of which houses were sold. In the southern Minneapolis area of Lake Nokomis, for example in **Figure 2.7**, show how most of the neighborhood as covenanted. The lake was actually embedded in marshland and considered an unattractive location to live. Covenants were able to transform the area into a middle-class white enclave for Minneapolis. Rothstein, 2017 argues that covenants became effective tools to keep middle-class African-Americans from buying houses in these neighborhoods. Thus, we expect a negative omitted variable bias in our OLS estimates. To alleviate this issue, we use a fuzzy regression discontinuity (RD) design.

2.5.2 Fuzzy Regression Discontinuity Design

We exploit the 1948 Supreme Court (SC) ruling that made racially restrictive covenants unenforceable to address endogeneity concerns discussed above. The RD design uses the 1948 ruling as a cutoff before which lots could be covenanted with some positive probability while after the SC ruling that probability fell to 0 (see **Figure** 2.8 which plots covenanted deeds over time). In the RD approach, identification of the covenants' effects comes from the change in these probabilities of being covenanted while no change in the unobservable quality of a lot being built within a narrow window around the 1948 cut-off point. The fuzzy RD model permits a non-linear time trend to account for unobservable quality to change over time. Using the data on the year of house-built and execution date of housing covenant deeds, we identify houses built right before and after the 1948 ruling. We restrict our analysis between three time windows: 1945-1951, 1946-1950, and 1947-1949. In addition, to the time trend, which we allow to be non-linear, we allow for other factors such as location income, density and location dummy variables to be correlated with the choice of racially-restrictive covenants.

The identifying assumption we make is that unobservable quality of location is not different immediately before and after 1948, other than a time trend, and should not be correlated with any of the outcomes variables listed above. Because the 1948 ruling that made covenants unenforceable was not anticipated, the cutoff point is as good as randomly assigned and does not suffer from the usual problems that RD in time designs suffer from. Contemporary observers expected that the 1948 ruling to move in a similar direction as the 1926 ruling by the U.S. Supreme Court upheld the legality of racially restrictive covenants (see Jones-Correa, 2000 and Rothstein, 2017). We model the fuzzy RD design as a 2SLS IV approach Angrist and Pischke, 2008. Our analysis consists of an individual and geographic level: household and census block level, respectively.

2.5.3 Empirical Model: House Level

An individual household j located in a census block i in present-day time period t (2018 for our dependent variable and 2010 for our independent variables) has house assessed value Y_{ijt}. The empirical model is given as:

$$\log Y_{ijt} = \alpha_0 + \alpha_1 1\{cov_{js}\} + \beta_1 X_{jt} + \beta_2 X_{it} + \theta\eta_i + \epsilon_{ijt} \quad (2.1)$$

$$1\{cov_{js}\} = \gamma_0 + \gamma_1 1\{pre1949_{ej}\} + f(Date_s) + \beta_2 X_{es} + \eta_e + \epsilon_{ejs} \quad (2.2)$$

where 1cov_{js} is dummy for a house covenanted in s time period 1945-1951 (or a sub-sample of this time period). X_{it} are census block/tract controls, X_{jt} are house characteristics, and η_i captures neighborhood dummy effects. γ_1 captures the probability of a lot being covenanted, given that it was built before the 1948 ruling (1948 is inclusive). e is a census enumeration district and η_e captures the enumeration district dummy effects. In addition to the linear time trend in the equation above, $f(Date_s)$ is an nth-order polynomial in time, estimated flexibly.

The individual house characteristics we use are parcel area (in square feet), number of bedrooms, fireplaces, bathrooms, roof type, construction type, exterior type, school district, and watershed district. In our robustness checks, we exclude many of these variables without any changes of our overall results. We restrict our analysis to lots that are residential but exclude multifamily apartment complexes. The analysis is limited to extant houses only. For census control variables at time $t = 2010$ we use block population density, share of people above 18, and share of white residents at block level, and median income at tract level. For past census controls, we use median household income (1950), population density (1940), and share white residents (1940) at the enumeration district level.

2.5.4 Individual House Price Results

The results of time-persistent effects of covenants on present-day house prices are presented in **Table 2.2**. The table presents the OLS (model I and II), first-stage (model III), and results from the fuzzy RD design (models IV and V) with log house valuations (2018) as a dependent variable. All models limits analysis to year of houses built 1945-1951, both years inclusive. The OLS results from model I and II find that a lot being covenanted increases the present-day house values by 4.9% (without home characteristics) and 2.9% (with home characteristics). Both models control for location characteristics, location dummy at zip-code level and clustered standard errors at census block level. However, this estimate suffers from omitted variable bias where the unobservable location quality is the omitted variable. We believe that the estimated effect of 2.9% has a negative bias since covenants were used less in the most coveted locations with better amenities. As discussed previously, the price mechanism in high amenity locations was enough to keep people of color out. The covenants were used mostly used in locations that were less coveted and could not keep people of color out using high home values (Kaul, 2019).

Model III presents the estimate from first-stage regression model of correlation between house being built right before the 1949 cutoff point and whether it was covenanted. After using location dummies and clustered standard errors at enumeration district level, we find

Table 2.2: Fuzzy RD Results: Individual House Values

	OLS (I)	OLS (II)	First-Stage (III)	RD-IV (IV)	RD-IV (V)
Dep. Var.	Log House Value	Log House Value	Covenanted	Log House Value	Log House Value
Covenanted	0.049***	0.029***		0.309***	0.133***
	(0.009)	(.007)		(0.050)	(0.030)
Dummy built 1948			0.194***		
			(0.011)		
Time Trend Poly	N	N	Y	Y	Y
1940 region Dummy	N	N	ED	ED	ED
2010 region Dummy	Zip	Zip	N	Zip	Zip
Housing Characteristics	N	Y	N	N	Y
1940/50 Census Controls	N	N	Y	Y	Y
2010 Census Controls	Y	Y	N	Y	Y
Clustered S.E.	Block	Block	ED	Block	Block
Observations	11,003	10,998	11,003	10,667	10,662
R-sq	0.608	0.811	0.80	0.581	0.806

Note: This table presents the OLS, first-stage, and IV results from the fuzzy RD design with log house values (2018) as a y-variable. The analysis is restricted to 1945-1951. The main explanatory variable is a dummy for being covenanted. The instrument is a dummy for a house being built before the RD cut-off point of 1948 (Dummy Built 1948). The time trend is a 2nd-degree polynomial. The 1940 region dummies are at census enumeration district level while the 2010 region dummy is at zip code. The individual house characteristics are parcel area (in square feet), number of bedrooms, fireplaces, bathrooms, roof type, construction type, exterior type, watershed district, and school district. The 2010 census control variables are census block population, share of people above 18, and share of white residents at block level, and median household income at census tract level. For past census controls, we use median household income (1950), population density (1940), and share white residents (1940) at the enumeration district level. We restrict our analysis to lots that are residential in nature, excluding apartment buildings. Standard errors are clustered at census block level or enumeration district level. The data comes from census (1940, 1950, 2010), ACS (2010), Hennepin county tax assessor data, and the Mapping Prejudice project.

that a house being built before the Supreme Court ruling increases the probability of it being covenanted by 0.194 times. A flexible time trend estimation around the cutoff point finds that a 2nd-degree polynomial is a best fit. This model also uses location controls for 1940 and 1950. **Appendix A.4.1** presents tests for valid instrument which reject the null hypothesis of dummy covenant being exogenous. The Shea's partial R-squared value is 0.1826, making dummy for being built before 1949 a valid instrument.

Models IV and V (preferred specification) presents the main results from the 2SLS IV fuzzy RD design with location dummies at zip-code without and with housing characteristics. Using a 2nd-degree polynomial time trend and clustering standard errors at block level, we find that a house using racially-restrictive covenants has, on average, 14.22% higher house value in 2018 in our preferred specification. The effect of being covenanted drops as we use location dummies for smaller geographic locations, moving from 18 zip-codes (14.22%) to 218 census block groups (3.7%). We believe that this captures some the externality of lots being covenanted which is positively correlated with higher public investment such as parks and negatively correlated with construction of highways (see **Appendix 2.10**). Additionally, as can been seen from **Appendix A.5.1**, the better rated parts (blue and green) of the HOLC maps mostly overlay with the covenants, suggesting more public and private investment near covenanted lots. For this reason, our preferred specification is model V[9].

Table 2.3 presents some robustness results from different bandwidth around the cut-off point of 1948 and a "Donut" RD. We find that our results do not change significantly as we change the bandwidth from 1945-1951 to either model II 1946-1950, where the 2018 house values are 13.54% higher or model III 1947-1949, where the 2018 house values are 13.42% higher. We do not go further out of the bandwidth 1945-1951 to not only stay closer to the boundary but also to not confound our results with effects of the Second World War. Model I, which represents the "Donut" RD results excluding years 1948 and 1949 to mitigate concerns about short-run selection or anticipation effects, finds similar results where the 2018 house values are 16.76% higher if they had racially-restrictive covenants. We also test the "Donut" RD results by removing year 1948 and 1947-49 and find similar statistically significant results.

We test for the possibility of over-fitting from global time trend polynomial in all our specifications by allowing for linear and higher order polynomials. Change in time trend

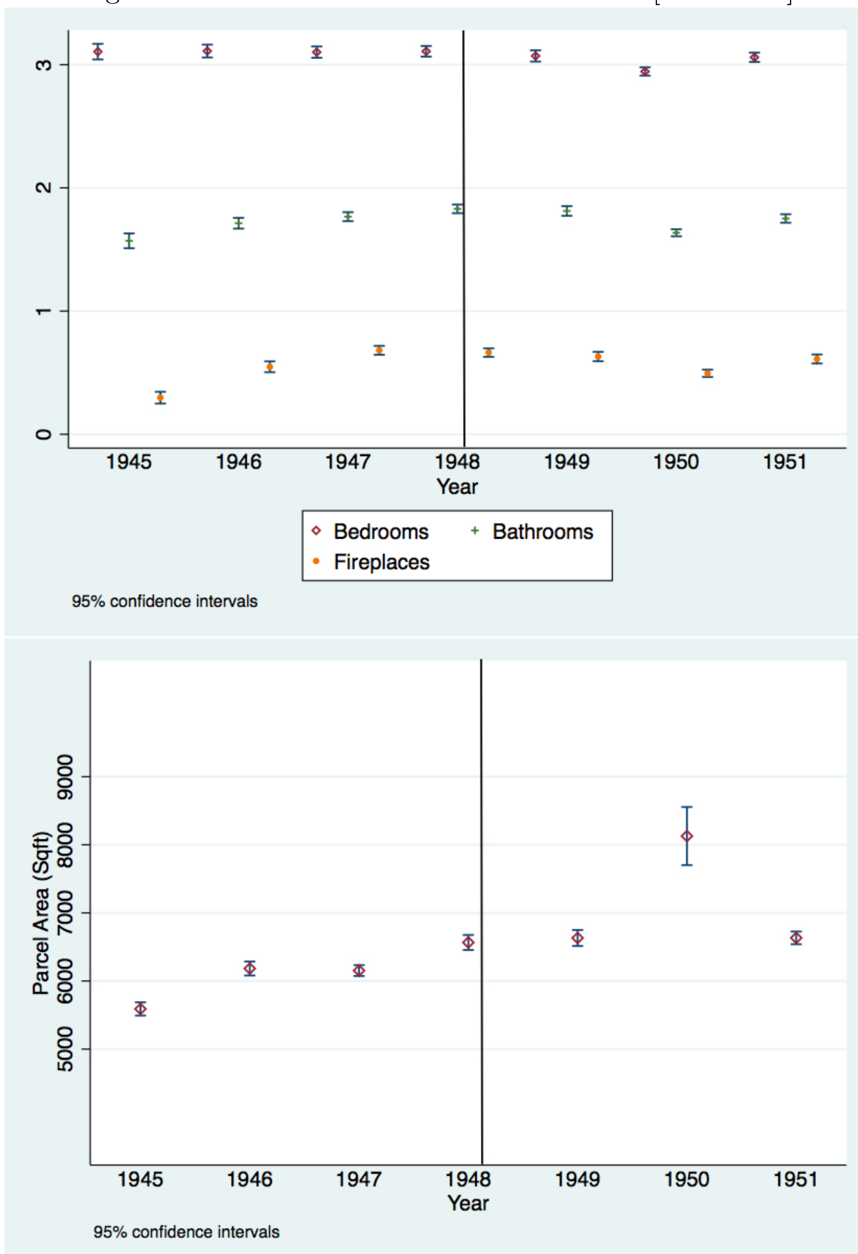
[9] We also explore the effect of covenants in the medium-term by examining homes sold between 1985-1990. In **Appendix A.4.3**, we show that covenants still had a significant effect on home prices by following a similar regression using 1990 census characteristics. We show that covenants cause an 11% increase in home sale prices from that period.

Table 2.3: Robustness Tests for Fuzzy RD Results at House-Level Analysis

	RD-IV (Donut) (I)	RD-IV (1946-1950) (II)	RD-IV (1947-1949) (III)	Placebo (1931-1940) (IV)
Dep. Var.	Log House Value	Log House Value	Log House Value	Log House Value
Covenanted	0.155***	0.127***	0.126***	-0.023
	(0.039)	(0.034)	(0.032)	(0.053)
Time Trend Poly.	Y	Y	Y	N
1940 region Dummy	ED	ED	ED	N
2010 region Dummy	Zip	Zip	Zip	Zip
Housing Characteristics	Y	Y	Y	Y
1940/50 Census Controls	Y	Y	Y	N
2010 Census Controls	Y	Y	Y	Y
Clustered S.E.	Block	Block	Block	Block
Observations	7,363	8,223	4,799	8,219
R-sqr	0.80	0.79	0.79	0.769

This table presents the IV results from the fuzzy RD design with log house values (2018) as a y-variable with cut-offs restricted to 1946-1950 (model II) and 1947-1949 (model III). Model I is a "Donut" RD with years 1945-1947 and 1950-1951 and Model IV presents placebo RD for 1931-1940 with placebo cut-off at 1935. The main explanatory variable is a dummy for being covenanted. The instrument is a dummy for a house being built before the RD cut-off point of 1948 (Dummy Built 1949). The time trend is a 2nd-degree polynomial. The 2010 fixed effects are at zip code level. The individual house characteristics are parcel area (in square feet), number of bedrooms, fireplaces, and bathrooms. The 2010 census control variables are census block population, share of people above 18, and share of white residents at block level, and median household income at census tract level. For census controls in first stage, we use median household income (1950), population density (1940), and share white residents (1940) at the enumeration district level. We restrict our analysis to lots that are residential in nature, excluding apartment buildings. Standard errors are clustered at census block level. The data comes from census (1940, 1950, 2010), ACS (2010), Hennepin county tax assessor data, and the Mapping Prejudice project.

Figure 2.9: House Characteristics over Time [1945-1951]



Note: This figure presents the mean and 95% confidence interval of home characteristics from 1945-1951. Characteristics are number of bedrooms, bathrooms, fireplaces, and house parcel area in square feet. Data is from Mapping Prejudice. In 1948, the Supreme Court rules that covenants are not legally enforceable.

polynomial does not result in any significant changes in our results. It can be seen from Model III in **Table 2.3**, our results are robust when we exclude the year 1950. Model IV in **Table 2.3** presents results placebo RD design at a different time period between 1931-1940 with cut-off point randomly selected at 1935. We unable to test for another geographic location since covenants data is not available for any other location. We also avoid testing at 1941-1944 so as to not confound our results with effects of the Second World War. Analysing data between 1931-1940, we find no statistically significant relation between covenants and present-day house valuations. This also is true if we randomly select 1933 or 1937 as a cut-off point. We also test for a smaller 2010 regional dummy in which we include in **Appendix A.4.2**. In narrower bands of our regional dummy, we see the effects of covenants tend to decline. We believe that this is evidence that covenants are exerting a positive externality on its immediate neighbors and prices are reflecting these neighborhood prices.

2.6 Discussion on Mechanisms of Persistent Effects

In this section, we discuss several possible mechanisms which may explain the reason for the long-run effects of housing covenants after 70 years. While we are agnostic per the exact mechanism which generates these effects, we hypothesize and provide evidence that the long-run persistent effect of covenants manifests through three different mechanisms: 1) private investment and home quality; 2) public investment; 3) preference externalities.

2.6.1 Private Investment and House Quality

The first channel is through differences in private investments of covenanted and non-covenanted lots. Given that the prices of homes in covenanted neighborhoods were higher than that of an identical home in a non-covenanted neighborhood, then home-owners may be more willing to continue to invest to maintain the quality of their home in a "nicer neighborhood." Our RD approach assumes that there is a fixed cost of investment–at least in the short-run–and build quality in home construction is inelastic to the Supreme Court ruling. Another possibility is for homes to have quality differences arising because of changes in unobservable build quality immediately after the Supreme Court ruling. For example, developers may begin using a lower quality windows or insulation because they may not be able to sell the homes as high as they anticipated. We plot mean and 95% confidence intervals of various house level characteristics before and after the 1948 ruling (see **Figure 2.9**). Characteristics like bedrooms, bathrooms, and fireplaces do not significantly change between 1945 and 1951 or around the cut-off date. Parcel area also remains roughly constant during this time period with the exception of 1950. Moreover, changes to lower quality materials does not change our underlying argument: covenanted homes which excluded people of color from living in them garner higher home prices today.

2.6.2 Public Investment

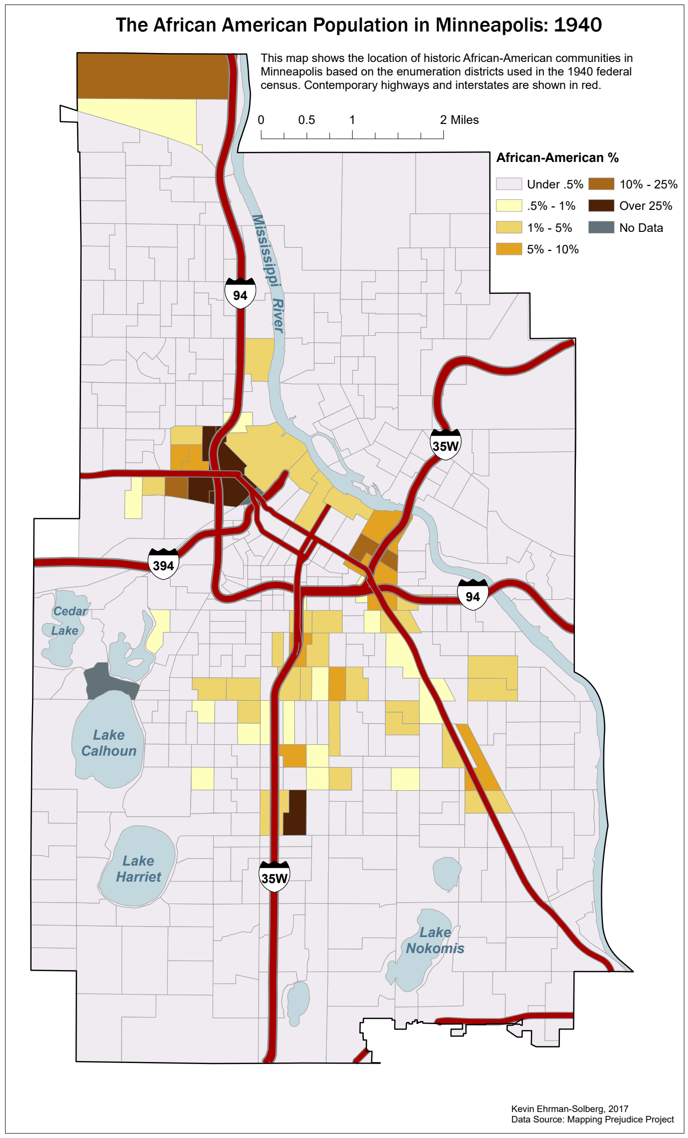
An alternative mechanism which may propagate differences in house prices over time is from public investment. Once neighborhoods had their initial conditions established, over the next several decades there could be disparities in investment of infrastructure, recreational, and public works between areas covenanted and non-covenanted areas. Because covenanted homes were purchased by more affluent and hence, politically more powerful groups, they could direct public policy in their favor. The development of parks and greenways nearby work to increase the local home values. In **Figure 2.10**, we discuss how highway development avoided covenanted areas in the 1950s. Similarly, covenanted areas also had access to cheaper credit from "redlining" of HOLC maps. See **Appendix A.5.1** for discussion on the role of HOLC maps. Public investment may explain differences in home prices across larger geographical areas, but homes within a narrower proximity with each other should not see differences in house prices resulting from these characteristics.

2.6.3 Preference Externality

The third channel is through a positive preference externality whereby covenants discourage dissimilar people from agglomerating. Analogously, covenants encouraged similar types of people to live in closer proximity with each other. Residents will prefer to consume similar local private as their neighbors Waldfogel, 2008. Hence, similar demand in a neighborhood will have higher demand and hence a higher price because this complementarity. Because home prices are a function of both local amenities, private and public, as well as house characteristics, then the initial condition of a neighborhood can have long-run effects on home prices. This coupled with house market frictions can lead to persistent effects of covenants.

In the next subsections, we investigate this possibility by showing the racial make-up of neighborhoods are highly persistent and reflect much of the 1940s and 1950s demographics of the enumeration districts they belonged in.

Figure 2.10: African-American Population and Highway Location



Note: This figure plots the African-American population in 1940 in Minneapolis and highway locations. The development of highways in the 1950s intentionally avoided areas where covenants were located. Instead, they cut through several areas where there were concentrations of African-American populations in the 1940s. The data comes from the Mapping Prejudice project.

Empirical Model: Census Block Level

In addition to estimating the effect of historic covenants on present-day house valuations, we also investigate covenants' effects on percent of non-white residents, percent of non-white home ownership and percent of non-white renting rates at census block level. We include only black residents and both black and other non-white residents in our analysis. Like the previous section, we model fuzzy RD design as a 2SLS IV approach. The empirical model at census block level i is given as:

$$Y_{it} = \alpha_0 + \alpha_1 \%\text{cov}_{is} + \beta_1 X_{it} + \theta \eta_i + \epsilon_{it} \tag{2.3}$$

$$\%\text{cov}_{is} = \gamma_0 + \gamma_1 \%\text{built}_{is} + f(Date_s) + \beta_1 X_{es} + +\eta_e \epsilon_{es} \tag{2.4}$$

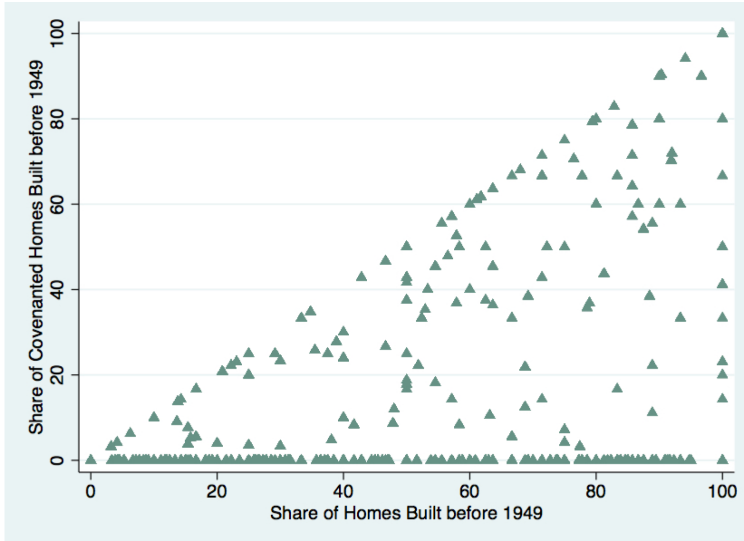
where Y_{it} is the percent of minority population, percent of minority home ownership, and percent of minority renting rates at census block level at time $t = 2010$. $\%\text{cov}_i$ is the share of lots that were covenanted within the 2010 census blocks i. X_i: are census block and tract level controls and s is time period 1945-1951 (or a smaller time window within). $\%\text{built}_{is}$ is the share of houses within block i that were built right before the 1948 cutoff point. **Figure 2.11** shows the relationship between the our main variable of interest ($\%\text{cov}_i$) and the instrument ($\%\text{built}_{is}$). e is a census enumeration district and eta_e captures the enumeration district dummy effects.

For these models, the dependent variables are percent. We also transform these variables using the inverse hyperbolic sine (or arcsinh) transformation to to approximate a normal distribution and to reduce the effect of outliers. This transformation is preferable to the logarithm transformation as taking logarithm would drop zero-valued observations. It also has the added advantage whereby going from zero to one will have a substantially significant effect on the outcome variables. The results section presents results using arcsinh dependent variables. Appendix D presents the results from the model with percentages as dependent variables. While the arcsinh doesn't change the sign of significant variables, the magnitudes do differ in the transformed and un-transformed variables. See Section 6.2 for more discussion on this.

Segregation Results

This section presents results on the time-persistent effect of the covenants on the racial spatial structure of Minneapolis by studying the effects of covenants on census block level.

Figure 2.11: Share of Census Block Built and Covenanted before 1948



Note: This figure consider all home built between 1945-1951. It plots the share of homes built before 1949 against share of home covenanted and built before 1949. *Source: Mapping Prejudice Project*

Table 2.4: RD Results at Block Level: Covenants and Home Ownership Rates

Dependent Var.	Arcsin % Covenanted (I) First-Stage	Arcsin % ownership (II) All races	Arcsin % ownership (III) Black	Arcsin % ownership (IV) Non-white
Arcsin % homes covenanted		-0.025 (0.018)	-0.189*** (0.058)	0.086 (0.069)
Percent of homes built <= 1948	0.006*** (0.000)			
1940 Region Dummy	ED	ED	ED	ED
2010 Region Dummy	Y	Y	Y	Y
1940/50 Census controls	Y	Y	Y	Y
2010 Census Controls	N	Y	Y	Y
Clustered SE	ED	Block	Block	Block
Observations	1,782	1,772	1,772	1,772
R-sqr	0.232	0.699	0.601	0.570

This table presents the first-stage and IV results from the fuzzy RD design with arcsinh percentage of home ownership across races as dependent variables. The analysis is restricted to homes built 1945-1951. The main explanatory variable is the percentage of census block built 1945-1948 and covenanted. The instrument is the percentage of census block built 1945-1948. The 2010 census control variables are census block population, share of white residents , share of vacant houses at block level, and median household income at census tract level. For census controls in first stage, we use median household income (1950), population density (1940), and share white residents (1940) at the enumeration district level. We restrict our analysis to lots that are residential in nature, excluding apartment buildings. Standard errors are clustered at census block group level. The data comes from census (1940, 1950, 2010), ACS (2010), and the Mapping Prejudice project.

Table 2.5: RD Results at Block Level: Covenants, Renting, and Population by Race

Dependent Var.	Arcsin % population (I) Black	Arcsin % population (II) Non-white	Arcsin % rental (III) Black	Arcsin % rental (IV) Non-white
Arcsin % of homes	-0.140*	-0.055	0.035	-0.096
covenanted	(0.077)	(0.060)	(0.133)	(0.147)
1940 Region Dummy	ED	ED	ED	ED
2010 Region Dummy	Tract	Tract	Tract	Tract
1940/50 Census controls	Y	Y	Y	Y
2010 Census Controls	N	Y	Y	Y
Clustered SE	Block	Block	Block	Block
Observations	1,772	1,772	1,545	1,545
R-sqr	0.605	0.558	0.520	0.498

This table presents the IV results from the fuzzy RD design with arcsinh percentage of renting across races and arcsinh percentage of minority population as dependent variables. The analysis is restricted to homes built 1945-1951. The main explanatory variable is the percentage of census block built 1945-1948 and covenanted. The instrument is the percentage of census block built 1945-1948. The 2010 census control variables are census block population, share of owners , share of vacant houses at block level, and median household income at census tract level. For census controls in first stage, we use median household income (1950), population density (1940), and share white residents (1940) at the enumeration district level. We restrict our analysis to lots that are residential in nature, excluding apartment buildings. Standard errors are clustered at census block group level. The data comes from census (1940, 1950, 2010), ACS (2010), and the Mapping Prejudice project.

For this analysis, we only consider home built between 1945 and 1951, both years inclusive. **Figure 2.11** graphically presents the first-stage of our analysis, plotting share of houses built within a census block between 1945-1948 out of all homes built between 1945-1951 against share of houses built and covenanted within a census block between 1945-1948. As can be seen from the figure, there are many census blocks that had all of their houses built between 1945-1948 covenanted. Model I in **Table A.2** presents the first-stage regression results. We find that a 1% increase in percentage of houses built before 1949 in a census block, increases the likelihood of houses covenanted by 0.104%. For this analysis, we use 1940 enumeration district location dummy and also cluster standard errors at this level. For census controls in first stage, we use median household income (1950), population density (1940), and share white residents (1940) at the enumeration district level. Models II, III, and IV in **Table A.2** study effect of covenants on home ownership rates across different races. The dependent variable is inverse hyperbolic sine (or arcsinh) transformation of percent home ownership. There is no statistically significant effect between home ownership rates and percent of block being covenanted if we consider ownership rates across all races or the non-white population (includes all races that are not white). However, as can be seen in Model III, we find a statistically significant coefficient of -0.045 between percent of homes covenanted and black home ownership. Calculating the arcsinh elasticity at the means, we find that a 1% increase in covenanted houses within a block, reduces the black home ownership rates by 19%.

Additionally, as can be seen in Model I in **Table 2.4** we find a statistically significant coefficient of -0.047 between percent of homes covenanted and black residents within a block. Calculating the arcsinh elasticity at the means, we find that a 1% increase in covenanted houses within a block, reduces the black resident rates by 14%. We do not find statistically significant relationship between non-white resident population and larger share of blocks being covenanted (Model II). We also do not find statistically significant relationship between renting rates of minorities and larger share of blocks being covenanted. While results in **Tables 2.4 and 2.5** are with transformed arcsinh dependent variable, see **Tables A.2 and A.3** in **Appendix A.4.4** for untransformed dependent variable in percentages. The sign and the statistical significance does not change with the transformation, but the magnitude of the effects varies slightly.

These results are indicative of the fact that most racial covenants specifically prevented African-American families from buying or renting these houses. They are also indicative of the fact the most non-black minorities moved into Minneapolis much after covenants were made unenforceable. Thus, the time-persistent effects are seen more starkly among the African-American population whose initial settlement took place around the time racial covenants were legally enforceable.

2.7 Conclusion

In this paper, we document the effects of racially-restrictive housing covenants on present day outcomes such as current house valuations, racial segregation, and home ownership by African-Americans. We use a unique and newly constructed data which analyzes all historic sales deeds in Minneapolis and identifies lots that used racially restrictive covenants. After mapping these covenanted lots to present-day geography of Minneapolis and using regression discontinuity design around the unanticipated 1948 Supreme Court ruling that made racially-restrictive covenants unenforceable, we document that racial covenants have had time-persistent effects and have significantly affected the socioeconomic geography of Minneapolis. In particular, we document that houses that were covenanted have on average 15% higher present-day house values compared to houses that were not covenanted. We also find that census blocks with larger share of covenanted lots have smaller black population and lower black home ownership rates. Our results are consistent with theory that racially-restrictive covenants were effective in keeping middle-class African Americans and other minorities from buying houses in certain middle-class neighborhoods.

While we find large effects of the a historic racial housing policy on present-day outcomes, the current research cannot shed light on policies to alleviate the inequality created by racial covenants. Further research is required to provide policy proposals to mitigate the time-persistent effects of racial covenants. However, our current research sheds light on the existence of these persistent effects. Subsequent studies could examine how covenants effected the neighborhoods and house ownership non-white non-black residents and religious groups. Additionally, our current analysis uses regression discontinuity design to causally study the effect of racial covenants. Given the study design of this paper, the results show the local effect near the boundary of the 1948 decision which may not extend away from the boundary. We expect a non-parametric approach which matches similar lots near each other would help us understand the effects of covenants a life-time after they fell.

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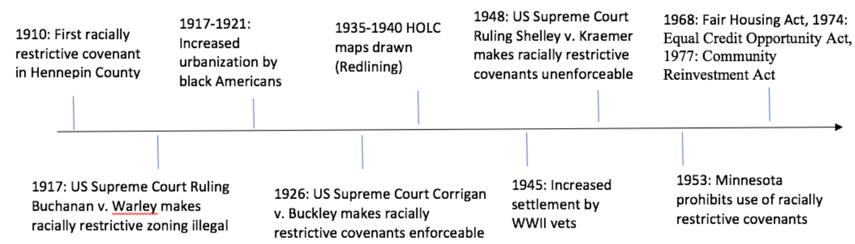
Appendix A

Appendix for the Long Shadow of Racial Discrimination

A.1 Timeline of Housing Discrimination and Policies



Note: The abolition of covenants pre-date other fair housing policies such as the Fair Housing Act (1968) or the Equal Credit Opportunity Act (1974).

A.2 Sample Racial Covenants

A.2.1 Sample 1

4. That no building shall be left with paper exposure or with the exterior incomplete.

5. That the said land or buildings thereon shall never be rented, leased or sold, transferred or conveyed to, nor shall same be occupied exclusively by person or persons other than of the Caucasian Race.

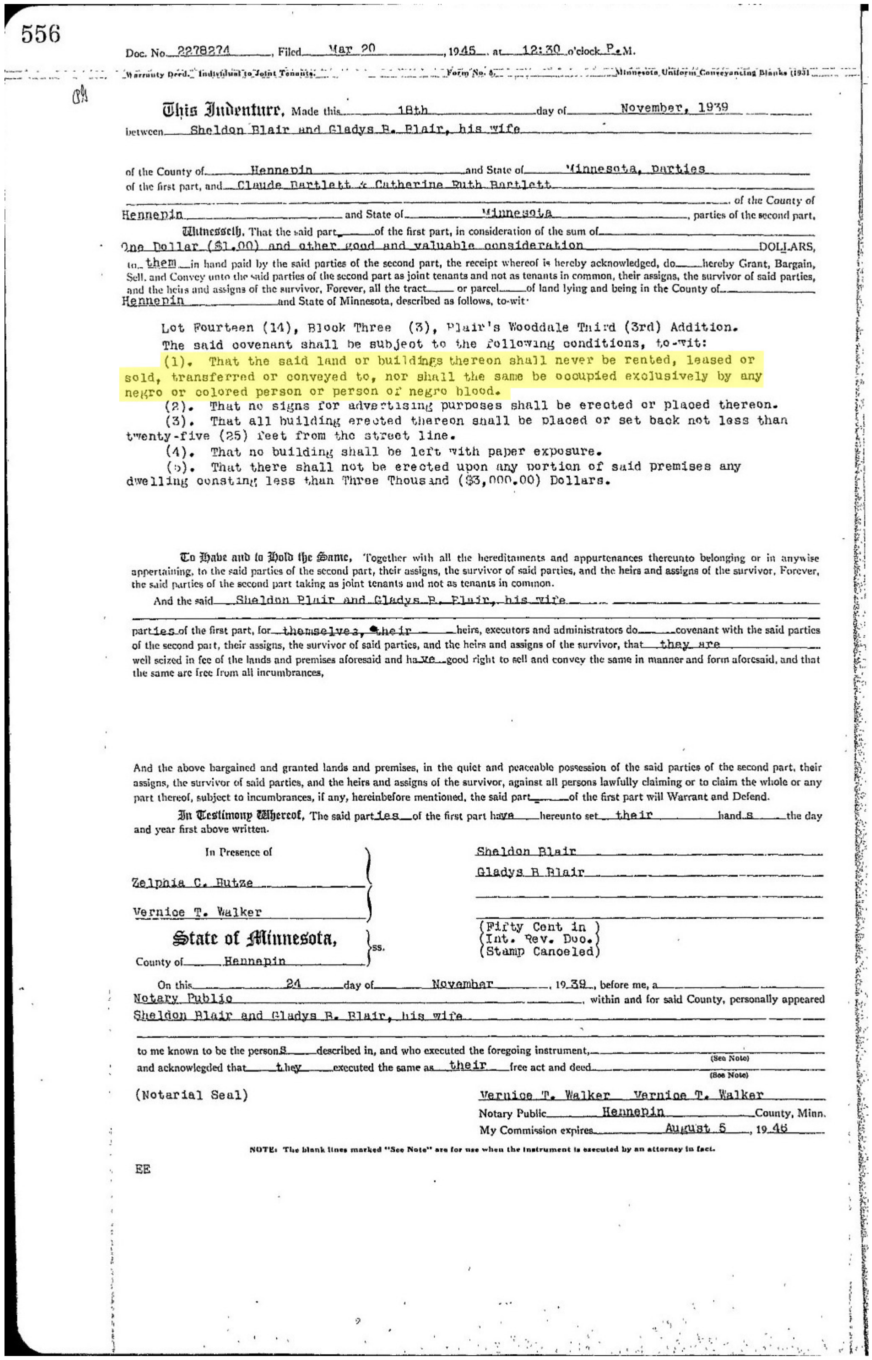
6. The forgoing covenant and restriction shall run with the land and shall bind the grantee herein and the heirs, executors, administrators, successors and assigns of said grantee until the first day of January A.D. Nineteen hundred and Forty.

A.2.2 Sample 2

E. No persons of any race other than the Aryan race shall use or occupy any building or any lot, except that this covenant shall not prevent occupancy by domestic servants of a different race domiciled with an owner or tenant.

F. No trailer, basement, tent, shack, garage, barn or other outbuilding erected in the tract shall at any time be used as a residence temporarily or permanently, nor shall any structure of a temporary character be used as a residence.

A.2.3 Sample 3



556

Doc. No. 2278274, Filed Mar 20, 1945, at 12:30 o'clock P.M.

Warranty Deed. Individual to Joint Tenants. Form No. 6 Minnesota Uniform Conveyancing Blanks (1931)

This Indenture, Made this 18th day of November, 1939 between Sheldon Blair and Gladys B. Blair, his wife

of the County of Hennepin and State of Minnesota, parties of the first part, and Claude Bartlett & Catherine Ruth Bartlett of the County of Hennepin and State of Minnesota, parties of the second part,

Witnesseth, That the said part of the first part, in consideration of the sum of One Dollar ($1.00) and other good and valuable consideration DOLLARS, to them in hand paid by the said parties of the second part, the receipt whereof is hereby acknowledged, do hereby Grant, Bargain, Sell, and Convey unto the said parties of the second part as joint tenants and not as tenants in common, their assigns, the survivor of said parties, and the heirs and assigns of the survivor, Forever, all the tract or parcel of land lying and being in the County of Hennepin and State of Minnesota, described as follows, to-wit:

Lot Fourteen (14), Block Three (3), Blair's Wooddale Third (3rd) Addition.

The said covenant shall be subject to the following conditions, to-wit:

(1). That the said land or buildings thereon shall never be rented, leased or sold, transferred or conveyed to, nor shall the same be occupied exclusively by any negro or colored person or person of negro blood.

(2). That no signs for advertising purposes shall be erected or placed thereon.

(3). That all building erected thereon shall be placed or set back not less than twenty-five (25) feet from the street line.

(4). That no building shall be left with paper exposure.

(5). That there shall not be erected upon any portion of said premises any dwelling consting less than Three Thousand ($3,000.00) Dollars.

To Have and to Hold the Same, Together with all the hereditaments and appurtenances thereunto belonging or in anywise appertaining, to the said parties of the second part, their assigns, the survivor of said parties, and the heirs and assigns of the survivor, Forever, the said parties of the second part taking as joint tenants and not as tenants in common.

And the said Sheldon Blair and Gladys B. Blair, his wife parties of the first part, for themselves, their heirs, executors and administrators do covenant with the said parties of the second part, their assigns, the survivor of said parties, and the heirs and assigns of the survivor, that they are well seized in fee of the lands and premises aforesaid and have good right to sell and convey the same in manner and form aforesaid, and that the same are free from all incumbrances,

And the above bargained and granted lands and premises, in the quiet and peaceable possession of the said parties of the second part, their assigns, the survivor of said parties, and the heirs and assigns of the survivor, against all persons lawfully claiming or to claim the whole or any part thereof, subject to incumbrances, if any, hereinbefore mentioned, the said part of the first part will Warrant and Defend.

In Testimony Whereof, The said parties of the first part have hereunto set their hands the day and year first above written.

In Presence of

Zelphia C. Hutze

Vernice T. Walker

Sheldon Blair

Gladys B Blair

(Fifty Cent in Int. Rev. Doc. Stamp Canceled)

State of Minnesota, County of Hennepin } ss.

On this 24 day of November, 19 39, before me, a Notary Public within and for said County, personally appeared Sheldon Blair and Gladys B. Blair, his wife

to me known to be the persons described in, and who executed the foregoing instrument, (See Note) and acknowledged that they executed the same as their free act and deed. (See Note)

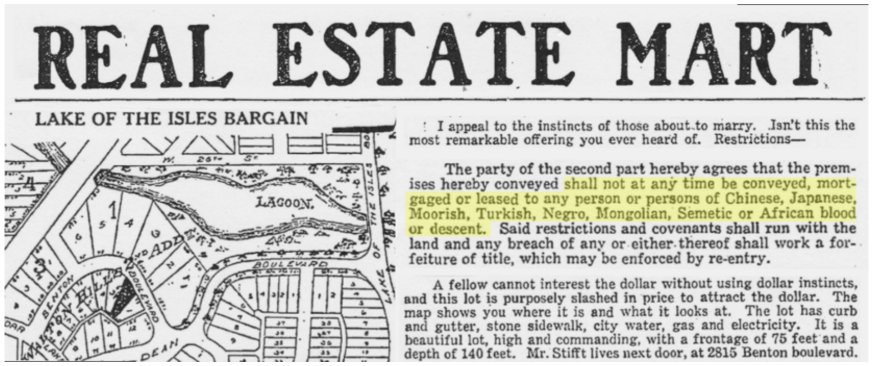
(Notarial Seal)

Vernice T. Walker Vernice T. Walker
Notary Public Hennepin County, Minn.
My Commission expires August 5, 19 46

NOTE: The blank lines marked "See Note" are for use when the instrument is executed by an attorney in fact.

EE

A.2.4 Sample 4



REAL ESTATE MART

LAKE OF THE ISLES BARGAIN

I appeal to the instincts of those about to marry. Isn't this the most remarkable offering you ever heard of. Restrictions—

The party of the second part hereby agrees that the premises hereby conveyed shall not at any time be conveyed, mortgaged or leased to any person or persons of Chinese, Japanese, Moorish, Turkish, Negro, Mongolian, Semetic or African blood or descent. Said restrictions and covenants shall run with the land and any breach of any or either thereof shall work a forfeiture of title, which may be enforced by re-entry.

A fellow cannot interest the dollar without using dollar instincts, and this lot is purposely slashed in price to attract the dollar. The map shows you where it is and what it looks at. The lot has curb and gutter, stone sidewalk, city water, gas and electricity. It is a beautiful lot, high and commanding, with a frontage of 75 feet and a depth of 140 feet. Mr. Stifft lives next door, at 2815 Benton boulevard.

A.3 Mapping Prejudice Data

The MP data is compiled by a team of geographers, historians, and researchers who combed through tens of thousands of property deeds to uncover racial covenants. Every property deed from *1910-1970* in Hennepin County was scanned and digitized using an optical character recognition software (OCR). These OCR documents were then separated into two sets: one where there are definitely not any racial covenants and the remainders. Categorization into the first group is based on the date that the deed was executed (there were no covenants after 1953). Identifying racial covenants in the second group was determined by the crowd-sourcing software Zooniverse. The Zooniverse crowd-sourcing strategy had users go through a training set of racially restricted deeds. After completing the training, users would individually go through each deed identifying whether there was any racial covenant data. Each deed would be reviewed by several users before it was classified as covenanted or not. Once deeds including racial covenants were identified, a geographer would then assign a spatial identifier based on information in the deed. Assignment of a geographical marker is based on the contemporaneous address found in the deed and are updated to reflect the present-day block and lot information. We assume that the number of racial covenants exceeds those of which we identify.

We then combine the MP data with with 2018 tax assessor data from Hennepin County containing not only values of the homes and land, but also housing characteristics such as the number of stories, home square footage, lot size, and so forth. We then limit our analysis to homes which are categorized as single-family detached dwelling, single-family attached dwelling, and multi-family residential, excluding multi-family apartments and commercial real-estate. Per our identification strategy, we restrict our analysis to homes built between 1945-1951 for our empirical strategy. This gives us 994 covenants out of 10,037 extant homes. These homes are then mapped to the 2010 Census block, block group, and tract which we combine with 2010 Census block level information on residents' races (white, Hispanic, black, Asian, etc.). The census information includes population, home ownership rates, and rental rates by race. We complement the census data with the contemporaneous American Community Survey 2010-2014 data on median household income by race at the block group level.

For historical data, we join our data set with information from the decennial census in 1940, 1950, 1970, and 1980. For the 1940 and 1950 census, the lowest level of available data is the enumeration district, equivalent in size to modern-day census tracts. It should be noted that the classification of enumeration districts from this period is different than the 2010 census tracts, and thus homes within the same 2010 census tract may have fallen into different historical enumeration districts. In contrast, 1970 and 1980 data contains block group level data on the 2010 geographies and avoid this difference. The 1970 census data contain information on white, black, and "other" home ownership, rental rate, income, and population. Whenever variables were described as "Spanish" or "other" there was no overlap between the two so we treat them a single racial group. We impute the average income by race from the 1980 census data using the midpoint of ranges of incomes and the number of families in that range.

A.4 Robustness Tests

A.4.1 Tests for Valid Instruments

Tests of endogeneity
Ho: variables are exogenous
Robust regression F(1,1776) = 13.926 (p = 0.0002)
(Adjusted for 1777 Census Blocks Clusters)
Shea's partial R-squared
0.1826

This table presents the valid instruments tests for the IV regressions in **Table 2.2**. The endogenous variable is a dummy for a covenanted house and the instrument is a dummy for house being built before 1949. The analysis is restricted to 1945-1951. The data comes from census (1940, 1950, 2010), ACS (2010), Hennepin county tax assessor data, and the Mapping Prejudice project.

A.4.2 House Level Block Group Region

Robustness Tests for Fuzzy RD Results at House-Level Analysis

	RD-IV (I)	RD-IV (II)
Dep. Var.	Log House Value	Log House Value
Covenanted	0.057*	0.025
	(0.032)	(0.022)
Time Trend Poly	Y	Y
1940 region Dummy	ED	ED
2010 region Dummy	Block Group	Block Group
Housing Characteristics	N	Y
1940/50 Census Controls	Y	Y
2010 Census Controls	Y	Y
Clustered S.E.	Block	Block
Observations	10,667	10,662
R-sqr	0.733	0.865

This table presents the IV results from the fuzzy RD design with log house values (2018) as a y-variable with cut-offs restricted to 1945-1951. The main explanatory variable is a dummy for being covenanted. The instrument is a dummy for a house being built before the RD cut-off point of 1948 (Dummy Built 1949). The time trend is a 2nd-degree polynomial. The 2010 fixed effects are at zip code level. The individual house characteristics are parcel area (in square feet), number of bedrooms, fireplaces, bathrooms, roof type, construction type, exterior type, school district, and watershed district. The 2010 census control variables are census block population, share of people above 18, and share of white residents at block level, and median household income at census block group level. For census controls in first stage, we use median household income (1950), population density (1940), and share white residents (1940) at the enumeration district level. We restrict our analysis to lots that are residential in nature, excluding apartment buildings. Standard errors are clustered at census block level. The data comes from census (1940, 1950, 2010), ACS (2010), Hennepin county tax assessor data, and the Mapping Prejudice project.

Table A.1: Fuzzy RD Results: Individual House Sale Prices (1985-1989)

	RD-IV (1985-1989)
Dep. Var.	Log Sale Prices
Covenanted	0.107^{***}
	(0.052)
Sale Year Dummy	Y
Time Trend Poly.	Y
1940 region Dummy	Y
1980 region Dummy	Zip
Housing Characteristics	Y
1940/50 Census Controls	Y
1980 Census Controls	Y
Clustered S.E.	Block
Observations	563
R-sqr	0.6295

Note: This table presents the IV results from the fuzzy RD design with log sales prices 1985-1989 as a y-variable. The analysis is restricted to houses built 1945-1951. The main explanatory variable is a dummy for being covenanted. The instrument is a dummy for a house being built before the RD cut-off point of 1948 (Dummy Built 1948). The time trend is a 2nd-degree polynomial. The 1940 region dummies are at census enumeration district level, while the 1980 region dummies are at zip code. The individual house characteristics are parcel area (in square feet), number of bedrooms, fireplaces, and bathrooms. The 1980 census control variables are census block population, share of home owners, and share of white residents at block level. For past census controls, we use median household income (1950), population density (1940), and share white residents (1940) at the enumeration district level. We restrict our analysis to lots that are residential in nature, excluding apartment buildings. Standard errors are clustered at census block level or enumeration district level. The data comes from census (1940, 1950, 1980), Hennepin county tax assessor data, and the Mapping Prejudice project.

A.4.3 House Price Results: Robustness

There is a concern that the results presented above can be masking some of the affects of racial assortative sorting and preference for living among people of one's own race. While these factors can and do exist, this section attempts to assuage these concerns by analyzing house sale prices from 1985-1990. In all of our analysis, we only consider newly built houses between 1945-1951. Given that people tend to occupy their new houses for 30-40 years, if we consider data from 1985-1989 which is about 40 years later, we can alleviate some of the issues associated with sorting as non-frequent movement of house owners prevents new home owners from moving in. We focus on 1985-1989, both years inclusive, since we do not have enough sale price data before 1985. After 1989, the effects of sorting can start taking place. We run the following model for our analysis:

$$\log Y_{ijt} = \alpha_0 + \alpha_1 1\{cov_{js}\} + \beta_1 X_{jt} + \beta_2 X_{it} + \theta\eta_i + \xi t_i + \epsilon_{ijt} \tag{A.1}$$

$$1\{cov_{ejs}\} = \gamma_0 + \gamma_1 1\{pre1949_{ej}\} + f(Date_s) + \beta_2 X_{es} + \eta_e + \epsilon_{ejs} \tag{A.2}$$

Y_{ijt} is the sale price of a house between 1985-1989. 1cov_j: Dummy for a house covenanted in s time period 1945-1951 (or a sub-sample of this time period). X_i Census block/tract controls, X_j house characteristics,

Table A.2: RD Results at Block Level: Covenants and Home Ownership Rates

Dep. Var.	Percent Covenanted First-Stage(I)	Percent ownership (II) All Races	Percent ownership (III) Black	Percent ownership (IV) Non-White
Percent of homes covenanted		-0.028 (0.027)	-0.045** (0.022)	0.034 (0.027)
Percent of homes built $\leq$ 1948	0.104*** (0.026)			
1940 region Dummy	ED	ED	ED	ED
2010 region Dummy	N	Tract	Tract	Tract
1940/50 Census Controls	Y	Y	Y	Y
2010 Census controls	N	Y	Y	Y
Clustered S.E.	ED	Block group	Block group	Block group
Observations	1,789	1,770	1,770	1,770
R-sqr	0.210	0.643	0.788	0.827

This table presents the first-stage and IV results from the fuzzy RD design with percentage of home ownership across races as dependent variables. The analysis is restricted to homes built 1945-1951. The main explanatory variable is the percentage of census block built 1945-1948 and covenanted. The instrument is the percentage of census block built 1945-1948. The 2010 census control variables are census block population, share of white residents , share of vacant houses at block level, and median household income at census tract level. For census controls in first stage, we use median household income (1950), population density (1940), and share white residents (1940) at the enumeration district level. We restrict our analysis to lots that are residential in nature, excluding apartment buildings. Standard errors are clustered at census block group level. The data comes from census (1940, 1950, 2010), ACS (2010), and the Mapping Prejudice project.

η_i is neighborhood dummy variable, and t captures sale year time trend. γ_1 captures the probability of a lot being covenanted, given that it was built before the 1948 ruling. e is a census enumeration district and eta_e captures the enumeration district fixed effects. In addition, the linear time trend in the equation above, $f(Date_s)$ is an nth-order polynomial in time, estimated flexibly.

Table A.1 presents results of the effect of covenants on house sale prices between 1985 and 1989, where effects of sorting are minimized. The sale price of covenanted lots is 11.27% higher than non-covenanted lots. We recommend treating the results from this model as suggestive rather than accurate measure of the magnitude of the effects of covenants on house sale prices. First, we have few observations (563) in this model and are constrained by frequency and data on house sales during this time period. Second, we use the house characteristics from 2018 assessor data since house characteristics from 1980 assessor data don't exist. Nonetheless, the house characteristics we use are parcel area (in square feet), number of bedrooms, fireplaces, and bathrooms which are unlikely to alter much over time. In-spite of these issues, we find that house values of non-covenanted lots were depressed in the time period where effects of sorting are minimized suggesting significant effect of covenants on house sale prices.

Table A.3: RD Results at Block Level: Covenants, Renting Rates, and Population by Race

Dep. Var.	Percent Black (I)	Percent Non-White (II)	Percent Renting (III) Black	Percent Renting (IV) Non-White
Percent of homes covenanted	-0.047*	0.059	0.063	0.004
	(0.028)	(0.042)	(0.064)	(0.082)
1940 region Dummy	ED	ED	ED	ED
2010 region Dummy	N	Tract	Tract	Tract
1940/50 Census Controls	Y	Y	Y	Y
2010 Census controls	Y	Y	Y	Y
Clustered S.E.	Block group	Block group	Block group	Block group
Observations	1,770	1,770	1,543	1,543
R-sqr	0.758	0.815	0.535	0.603

This table presents the IV results from the fuzzy RD design with percentage of renting across races and percentage of minority population as dependent variables. The analysis is restricted to homes built between 1945-1951. The main explanatory variable is the percentage of census block built between 1945-1948 and covenanted. The instrument is the percentage of census block built between 1945-1948. The 2010 census control variables are census block population, share of owners , share of vacant houses at block level, and median household income at census tract level. For census controls in first stage, we use median household income (1950), population density (1940), and share white residents (1940) at the enumeration district level. We restrict our analysis to lots that are residential in nature, excluding apartment buildings. Standard errors are clustered at census block group level. The data comes from census (1940, 1950, 2010), ACS (2010), and the Mapping Prejudice project.

A.4.4 More Group Level Results

This appendix presents results on the time-persistent effect of the covenants on the racial spatial structure of Minneapolis by studying the effects of covenants on census block level using percentage home ownership rates across different races and percentage of minority residents as a dependent variable. While results in **Tables A.2 and A.3** are with transformed untransformed dependent variable in percentages, see Section 6.2 with transformed arcsinh dependent variable. Models II, III, and IV in **Table A.2** study effect of covenants on home ownership rates across different races. The dependent variable is percent home ownership. There is no statistically significant effect between home ownership rates and percent of block being covenanted if we consider ownership rates across all races or the non-white population (includes all races that are not white). However, as can be seen in Model III, we find a statistically significant coefficient of -0.045 between percent of homes covenanted and black home ownership. This implies that a 1% increase in covenanted houses within a block, reduces the black home ownership rates by 0.045%.

Additionally, as can be seen in Model I in **Table A.3** we find a statistically significant coefficient of -0.047 between percent of homes covenanted and black residents within a block. Thus a 1% increase in covenanted houses within a block, reduces the black resident rates by 0.047%. We do not find statistically significant relationship between non-white resident population and larger share of blocks being covenanted (Model II). We also do not find statistically significant relationship between renting rates of minorities and larger share of blocks being covenanted.

A.5 Public Investment

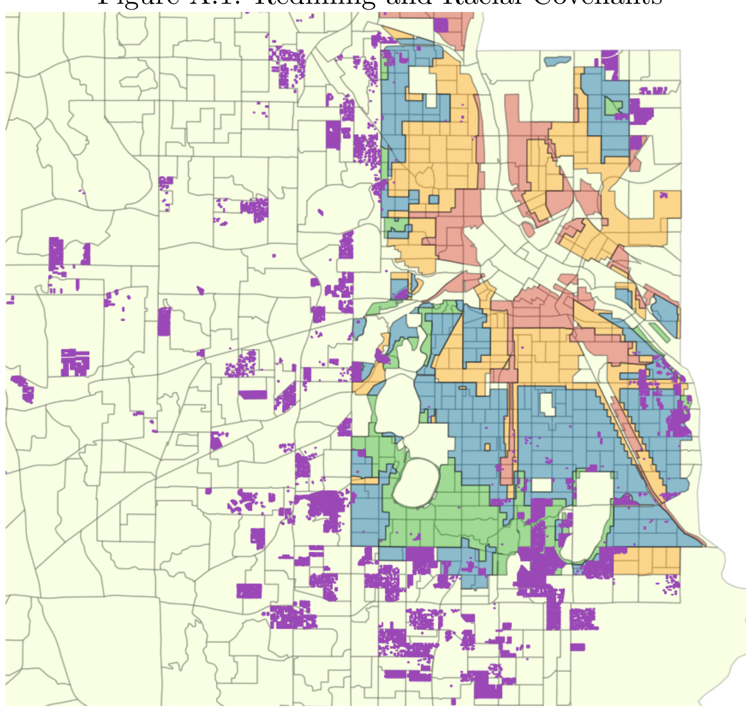
A.5.1 HOLC and Racial Covenants

The Homeowners' and Loan Corporation (HOLC) effected neighborhood make-up and contributed to persistent racial inequality. These zoning grades are strongly correlated with covenanted and non-covenanted neighborhoods. Covenanted neighborhoods were considered less risky than non-covenanted neighborhoods. Type A: Best (Green) – newer or areas still in demand. Type B: Still Desirable (Blue) – areas expected to remain stable for many years. Type C (Yellow): Definitely Declining – areas in transition. Type D: Hazardous (Red) – older areas considered risky. As can be seen from **Figure A.1**, the covenants overlay either green or blue parts of the HOLC map.

A.5.2 Covenants and other Racial Housing Instruments

Covenants stand in contrast to other forms of housing discrimination because they were determined by private contracts and not part of a government policy. This made covenants more idiosyncratic and spread out across a city. During the Great Depression, the federal government set up the Homeowners' and Loan Corporation (HOLC) to limit the number of foreclosures. The HOLC created a series of maps for over 200 American cities based on neighborhood housing age, vacancy rates, home quality, and other housing characteristics but also the demographic make-up of neighborhoods such as race and immigration status. Areas with predominantly African-American population would be rated the lowest making access to credit harder for these residents. The prevalence of covenants and racial demographics of neighborhoods were direct determinants in establishing HOLC maps used to assess different neighborhoods for credit ratings. **Appendix A.5.1** shows a map of Minneapolis' credit rating where covenanted homes are consistently in neighborhoods with higher credit ratings. The federal, state, and local governments also based zoning

Figure A.1: Redlining and Racial Covenants



Note: This figure overlays the HOLC map with racial covenants. The racial covenants are in purple. Type A: Best (Green) – newer or areas still in demand. Type B: Still Desirable (Blue) – areas expected to remain stable for many years. Type C (Yellow): Definitely Declining – areas in transition. Type D: Hazardous (Red) – older areas considered risky *Source: Mapping Prejudice Project* projects, highway construction, and affordable housing on the racial backgrounds of neighborhoods. Construction of the interstate highway system, for example, disproportionately targeted black communities throughout the United States (see Connerly, 2002).