General Equilibrium Effects of Environmental Gentrification

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Introduction

Research Question

Can environmental remediation lead to welfare losses?

- Evidence that burden of pollution isn't evenly distributed: Environmental Justice
- If pollution is regressive, uniform abatement is progressive
- Are welfare gains progressive?
- Hedonics only tell us so much

Introduction

Heterogeneous Preferences

Heterogeneous Preferences

- Households likely have varying preferences for "environment".
- Hard to claim that households are pollution loving.

What conditions might be necessary?

- Neighborhoods have multiple attributes, many endogenously determined.
- Preferences can be heterogeneous over all attributes.
- Households can move, but not freely.

Introduction

Avenues of Change

Examples of negative welfare change avenue?

- Rent can be more important than pollution remediation
- Preferences for segregration
- Moving costs

What about wealth accumulation?

- Renters vs. Owners
- Moving costs cause frictions

Introduction

Environmental Gentrification

Why is gentrification an issue?

- Increased Rents
- Displacement Costs
- Loss of ethnic enclaves, community
- Loss of access to labor markets

Why should economists care?

- Cost-benefit analysis
- Policy Recommendations
- Insufficiency of price changes

Introduction

Addressing The Research Question

How can one hope to address this question?

- Estimates of household preferences
- Estimates of moving costs
- Mechanism to conduct counterfactual simulations with endogenous attributes

Introduction

My Proposed Research

I propose a dynamic, general equilibrium framework based on the dynamic housing model of Bayer et. al (2011) (BMMT):

- Estimates are based on moving costs and expectations
- Endogenously determined public goods
- Wealth accumulation

Counterfactual Mechanism:

- Conduct a counterfactual simulation of a remediation
- Allow re-sorting according preferences and moving costs
- Simplifying assumptions
- Utility Accounting

Introduction

Empirical Setting

Setting

- San Francisco - Oakland - San Jose CSA
- 1994 - 2003, 2001 - 2008
- EPA's Toxic Release Inventory (TRI) Program

Data Sources

- Census 1990, 2000 tract data
- Dataquick Housing Transaction
- HMDA Demographic Information
- TRI Database

Dataquick/HMDA

Data

- All housing transactions in SJ-SF-OAK CSA
- 1990 - 2008
- Structural Characteristics
- Buyer/Seller Names
- Loan Amount/Lender Name
- HMDA: Race, income, age

Neighborhoods

Supertracts & Attributes

Supertracts

- Combine nearby census tracts into Supertracts
- Target population is 25,000 $\rightarrow$ 10,000 HH's

Attributes

- Only observe racial breakdown & income in 1990, 2000
- Use housing panel to impute attributes: Stocks and flows

Dynamic Model of Housing

Setting

Dynamic Housing Choice Model of BMMT (2011)

- Infinitely lived households $i \in \{1, \ldots, N\}$

Dynamic Model of Housing

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Households

- Wealth

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- Income

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Households

- Wealth
- Income
- Race

Dynamic Model of Housing

State Variables

Observed States

- X_{jt} - neighborhood observables
- Z_{it} - individual characteristics
- $d_{i,t-1}$ - decision variable

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- ξ_{ijt} - type/neighborhood unobservable
- ϵ_{ijt} - idiosyncratic error term

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Information Set & State Variable

- $\Upsilon_{it} = \{X_{jt}, \xi_{ijt}\}_{j=1}^{J}$
- $s_{it} = \{\Upsilon_{it}, Z_{it}, d_{i,t-1}\}$

Dynamic Model of Housing

Equilibrium & Market Assumptions

- Fixed housing supply
- Equilibrium prices equate neighborhood supply with neighborhood demand
- Households must choose a neighborhood each period, or leave town
- Households have perfect information about current state of each neighborhood
- Households form expectations over future states

Dynamic Model of Housing

Household's Problem

Lifetime Utility

$$E\left[\sum_{r=t}^{\infty}\beta^{r-t}\left(u(X_{jt}, Z_{it}, \xi_{jt}) - MC_{ir}I[j \neq d_{i,r-1}]\right)|s_{it}, \epsilon_{it}, d_{it}\right] \quad (1)$$

Dynamic Model of Housing

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With states following Markov Transition probabilities, optimal decisions follow: $d^{*}=d(s_{it},\epsilon_{it})$.

$$V(s_{it},\epsilon_{it})=\max_{j}\left\{u_{ijt}^{MC}+\beta E\left[V(s_{it+1},\epsilon_{it+1})|s_{it},\epsilon_{it},d_{i,t-1}=j\right]\right\} \tag{2}$$

Estimator

Four Stages - In Words

Estimation procedure advances in four separate stages:

- Estimate Value Functions
- Moving Costs/Marginal Utility of Wealth
- Expectations/Period Utility
- Flow Utility Decomposition

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$$v_{jt}^{\tau} = u_{jt}^{\tau} + \beta E_{\epsilon}\left[\max_{k} v_{kt+1}^{\tau_{t+1}} + \epsilon_{ikt+1}\right]$$

Stage 1

Household's Problem

Conditional on moving, household chooses j if:

$$v_{jt}^{\tau} + \epsilon_{ijt} > \max_{k \neq j} \; v_{kt}^{\tau} + \epsilon_{ikt}$$

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$$P_{jt}^{\tau} = \frac{e^{v_{jt}^{\tau}}}{\sum_{k=0}^{J} e^{v_{kt}^{\tau}}}$$

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Hotz and Miller (1993) and Berry (1994):

$$\widetilde{v}_{jt}^{\tau} = \log(\widehat{P}_{jt}^{\tau}) - \frac{1}{J} \sum_{k} \log(\widehat{P}_{kt}^{\tau})$$

Stage 2
Moving Costs

Psychological Moving Costs

- Neighborhood relationships
- Changing Schools
- Stress
- $PMC(Z_{it}, X_{d_{i,t-1}t})$

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Financial Moving Costs

- Industry Standard 6%
- $FMC(Z_{it}, X_{d_{i,t-1}t})$

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Identification?

- Frequency of "moves" vs. "stays"
- Higher FMC should lead less "moves"

Stage 2

Move vs. Stay

A household will decide to stay if:

$$v_{jt}^{\tau} + \epsilon_{ijt} > \max_{k \neq j} \left[v_{kt}^{\tau'} + \epsilon_{ikt} \right] - PMC(Z_{it}, X_{d_{i,t-1}} t)$$

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I have access to normalized choice specific utility functions:

$$\widetilde{v}_{jt}^{\tau} + \epsilon_{ijt} > \max_{k \neq j} \left[\widetilde{v}_{kt}^{\tau'} + \epsilon_{ikt} \right] - PMC(Z_{it}, X_{d_{i,t-1}t}) - \left(m_t^{\tau} - m_t^{\tau'} \right) \tag{3}$$

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$$P(d_{i,t} = j | d_{i,t-1} = j) = \frac{e^{\widetilde{v}_{jt}^{\tau}}}{e^{\widetilde{v}_{jt}^{\tau}} + \sum_{k \neq j} e^{\widetilde{v}_{kt}^{\tau} - FMC_{it}\gamma_i^f - PMC_{it}}} \tag{4}$$

With estimates of γ_f, normalization constants can be solved for and v's uncovered.

Stage 3

Uncovering Flow Utility

Recall CSVF:

$$v_{jt}^{\tau} = u_{jt}^{\tau} + \beta E \left[\log \left(\sum_{k=0}^{J} \exp \left(v_{kt+1}^{\tau t+1} - MC_{t+1}^{\tau t+1} I[k \neq j] \right) \right) | s_{it}, d_{it} = j \right]$$

Contrasting with Melnikov (2001) & Hendel and Nevo (2006), "Inclusive Value" assumption:

$$v_{jt}^{\tau} = \nu_0^{\tau} + \sum_{l=1}^{L} v_{j,t-l}^{\tau} \nu_{1,l}^{\tau} + \sum_{l=1}^{L} X_{j,t-l} \nu_{2,l}^{\tau} + \nu_3^{\tau} t + \varepsilon_{jt}^{\tau}$$

$$Price_{jt} = \eta_0 + \sum_{l=1}^{L} X_{j,t-l} \eta_{1,l} + \eta_2 t + \omega_{jt}$$

Stage 3
Simulating Expectation

Simulating u_{ijt}^{τ}:

1. Draw $(\varepsilon^{r}, \omega^{r})$

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Simulating u^{τ}_{ijt}:

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4. Use $(\varepsilon^r, \tau^r_{t+1})$ to calculate:

$$u^{\tau,r}_{jt} = v^{\tau}_{jt} - \beta \log \left(\sum_{k=0}^{J} \exp \left(v^{\tau_{t+1},r}_{kt+1} - MC^{\tau_{t+1},r}_{t+1} I[k \neq j] \right) \right).$$

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5. $u^{\tau}_{jt} = \frac{1}{R} \sum_r u^{\tau,r}_{jt}$

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5 $u^{\tau}_{jt} = \frac{1}{R} \sum_r u^{\tau,r}_{jt}$

Repeat for each(j, t, τ).

Stage 4

Flow Utility

How does u_{ijt}^{τ} vary with types and covariates?

$$u_{jt}^{\tau} = \alpha_w W_{\tau} + \alpha_{IN} IN_{\tau} + \alpha_R R_{\tau} + \alpha_X X_{jt} + \alpha_t T + \alpha_{W,X} W_{\tau}' X_{jt}' + \alpha_{IN,X} IN_{\tau}' X_{jt} + \alpha_{R,X} R_{\tau}' X_{jt} + \bar{\xi}_j + \xi_{jt}^{\tau}. \quad (5)$$

where price is converted to a user-cost per period.

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$$u^{\tau}_{jt} = \alpha_w W_\tau + \alpha_{IN} IN_\tau + \alpha_R R_\tau + \alpha_X X_{jt} + \alpha_t T \\ + \alpha_{W,X} W'_\tau X'_{jt} + \alpha_{IN,X} IN'_\tau X_{jt} + \alpha_{R,X} R'_\tau X_{jt} + \bar{\xi}_j + \xi^{\tau}_{jt}. \quad (5)$$

where price is converted to a user-cost per period.
Controlling for endogeneity of price:

$$u^{\tau}_{jt} + \hat{\gamma}_f r_{jt} = \alpha_w W_\tau + \alpha_{IN} IN_\tau + \alpha_R R_\tau + \alpha_X X'_{jt} + \alpha_t T \\ + \alpha_{W,X} W'_\tau X'_{jt} + \alpha_{IN,X} IN'_\tau X'_{jt} + \alpha_{R,X} R'_\tau X'_{jt} + \bar{\xi}_j + \xi^{\tau}_{jt}, \quad (6)$$

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Endogeneity of other attributes?

Estimation Results

Stage 2 - Moving Costs

Table: Moving Costs

	Coefficient	Standard Error	Coefficient	Standard Error
PMC Intercept			10.061	
Income X PMC	0.3217**	(.0047)	0.155	
FMC Intercept	3.255**	(.0200)	-0.618	
Income X FMC	-0.942**	(.0093)	-0.486	

Estimation Results

Stage 2 - Moving Costs

Table: Psychological Moving Costs

Year	N	Mean	Std Dev	Min	Max
1994	253	26.60	23.14	8.303	115.4
1995	253	13.97	11.35	7.513	92.82
1996	253	11.62	7.652	7.448	96.88
1997	253	10.25	2.703	6.916	42.88
1998	253	9.647	1.344	6.772	13.96
1999	253	9.492	1.354	6.677	13.38
2000	253	9.416	1.332	6.424	14.10
2001	253	9.489	1.292	6.527	14.61
2002	253	9.359	1.346	6.232	13.72
2003	253	9.277	1.286	6.255	13.37

Using $PMC = 10 \rightarrow \$432,338.$

Table: MWTP Estimates

Wealth	Race	Income	M.U. of Wealth	%White	Income	TRI
$50K	White	$80K	2.878	1,154	-35.58	-264.5
$50K	White	$160K	1.747	2,475	-29.84	-891.8
$50K	White	$320K	0.428	12,848	14.41	-5,823
$50K	Minority	$80K	2.878	303.7	-89.87	1,153
$50K	Minority	$160K	1.747	1,075	-119.3	1,443
$50K	Minority	$320K	0.428	7,129	-350.8	3,713
$150K	White	$80K	2.878	2,025	48.54	-1,150
$150K	White	$160K	1.747	3,910	108.7	-2,351
$150K	White	$320K	0.428	18,707	580.3	-11,780
$150K	Minority	$80K	2.878	1,175	-5.751	267.5
$150K	Minority	$160K	1.747	2,510	19.29	-15.37
$150K	Minority	$320K	0.428	12,989	215	-2,244
$250K	White	$80K	2.878	2,895	133.1	-2,048
$250K	White	$160K	1.747	5,343	248	-3,829
$250K	White	$320K	0.428	24,560	1,149	-17,817
$250K	Minority	$80K	2.878	2,045	78.79	-629.9
$250K	Minority	$160K	1.747	3,943	158.5	-1,494
$250K	Minority	$320K	0.428	18,841	783.7	-8,281

Table: MWTP Estimates - Neighborhood Fixed Effects

Wealth	Race	Income	M.U. of Wealth	%White	Income	TRI
$50K	White	$80K	2.878	-1,609	-76.46	-2,680
$50K	White	$160K	1.747	-2,076	-97.18	-4,871
$50K	White	$320K	0.428	-5,737	-260.6	-22,073
$50K	Minority	$80K	2.878	-2,459	-130.8	-1,263
$50K	Minority	$160K	1.747	-3,476	-186.6	-2,536
$50K	Minority	$320K	0.428	-11,456	-625.8	-12,537
$150K	White	$80K	2.878	-738.1	7.65	-3,566
$150K	White	$160K	1.747	-641.2	41.38	-6,330
$150K	White	$320K	0.428	121.9	305.2	-28,030
$150K	Minority	$80K	2.878	-1,588	-46.63	-2,148
$150K	Minority	$160K	1.747	-2,042	-48.06	-3,995
$150K	Minority	$320K	0.428	-5,597	-59.97	-18,494
$250K	White	$80K	2.878	131.9	92.2	-4,463
$250K	White	$160K	1.747	791.8	180.6	-7,808
$250K	White	$320K	0.428	5,974	873.9	-34,067
$250K	Minority	$80K	2.878	-718.2	37.91	-3,046
$250K	Minority	$160K	1.747	-608.6	91.2	-5,473
$250K	Minority	$320K	0.428	255.3	508.7	-24,531

Conclusion

Deficiencies & Extensions

Areas for improvement:

- TRI Facility Site counts vs. Toxicity weights
- Endogeneity in Stage 4
- Multiple Equilibria

Areas to extend:

- Multiple Racial categories
- Housing quantity decision
- Additional neighborhood attributes?