# Household Mobility and Local Government Finance in U.S. Cities

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## Abstract

In this paper, we examine how household mobility is affected by the choice of local government finance method (taxation vs. debt finance) for U.S. cities. We develop a discrete time dynamic optimization model that implies the optimal strategy for a resident household is to remain in the city during periods of debt finance and move out when future tax liabilities come due. The optimal strategy for households outside the city is to avoid moving into a city that is paying off past debt with high current taxes. To investigate the degree to which tax and debt policy affect household relocation decisions we estimate empirical models of in- and out-migration for a panel dataset of 150 Fiscally Standardized Cities between 2007 and 2012. Results indicate that although both increases in debt finance and taxes are associated with greater out-migration, the tax effects are much stronger. Further, higher current taxes have large negative effects on in-migration whereas debt finance has insignificant effects. The importance of these results is that the equivalence of taxation and debt finance suggested by the Ricardian Equivalence Theorem does not hold for U.S. cities. The observed difference is due to the greater salience of taxes relative to the implied future tax liabilities associated with debt financing. The lack of equivalence follows directly from optimizing behavior with full current information in the presence of household mobility.

JEL codes: H20, H31, H60
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## 1. Introduction

In the United States, local governments retain considerable powers with respect to how they are organized, what public services they provide, and how they finance expenditures. In terms of key finance methods, they can either collect tax revenue or issue debt in the form of municipal bonds. This leads to significant variations in reliance on tax finance and debt finance both across regions and over time among cities. For example, among the 150 Fiscally Standardized Cities in the United States between 1987 and 2014, the yearly per capita tax revenue ranges from $431 to $10, 392 in 2014 real dollars, and the amount of yearly per capita long-term debt issued ranges from $0 to $12,634 in 2014 real dollars. The debt-to-tax ratio among these cities ranges from 0 to 7.22.[1]

Of course, tax and debt finance are related to each other. How to balance the use of these two finance methods strategically has always been a very important question for local governments. If local governments choose to rely less on taxes, for a given level of public expenditure, that requires greater reliance on debt. The important question is whether greater reliance on debt finance, relative to tax finance, by a local government has any impact on economic activities, and migration in particular.

In economic theory, there have been two popular views on the effects of public debt. The "conventional" view holds that the issuance of government debt increases households' perceived wealth which savings and capital accumulation. The alternative view of government debt is summarized in the Ricardian equivalence theorem which states that for a given pattern of government spending, tax financing and debt financing are equivalent and the government's choice between these two methods does not affect consumers' perceived wealth and economic behavior. In the basic setting of the Ricardian Equivalence

[1] Fiscally standardized cities database is constructed by the Lincoln Institute of Land Policy. It contains 150 largest cities in the United States across over 120 categories of government finance data. Motivation and methodology of constructing the FiSC database are provided in Section 4.1. Reliance of debt over tax is measured by the ratio of the amount of long-term debt issued and tax revenue in one year for a city. The larger this value, the heavier a city relies on debt finance over tax finance. The minimum tax revenue per capita ($431) occurred in Dover, DE in 1987. The maximum tax revenue per capita ($10,392) occurred in Washington, D.C. in 2007. The minimum amount of long-term debt issued per capita ($0) occurred in several cities over the years. The maximum amount of long-term debt issued per capita ($12,634) occurred in Orlando, FL in 1987. The minimum debt to tax ratio occurred in several cities over the years. The maximum debt to tax ratio occurred in Orlando, FL in 1987.

Theorem, governments can rely less on current taxes and finance their expenditure by issuing municipal bonds to the public. The taxpayers are assumed to perfectly foresee the increase in tax liability required in future periods required for the government to pay off the debt. Therefore, instead of spending the extra income benefit from lower taxes, they increase their saving to prepare for the increase in the future tax burden. The additional income benefit from the lower tax in the current time period becomes savings, and therefore it has no significant effect on economic behavior.

Despite years of theoretical and empirical debate, the Ricardian equivalence theorem remains highly controversial. Barro (1989) discusses five major theoretical objections to the Ricardian equivalence theorem: finite lives, imperfect capital markets, uncertain future income, distortionary taxation and the full employment assumption. When applied to state and local finance, household mobility across fiscal jurisdictions raises a further objection to the relevance of the Ricardian approach (Wellisch and Richter (1995)). The possibility that households will, in the future, be in a different fiscal jurisdiction reduces the expected discounted value of tax liabilities associated with a debt finance and implies that tax and debt finance will not have equivalent effects. The objection is related to the finite lives case in that the relevant lifetime is time spent in a particular jurisdiction. Because inter-jurisdictional moving rates are considerably higher than mortality rates, the objection has more force. Further, the 'operational bequest motive' emphasized by Barro (1974) would be largely absent in the case of moving rather than dying. The countervailing consideration, for homeowners, is the extent to which future tax liabilities are capitalized in the price of homes. If higher future tax liabilities are reflected in housing prices, current residence will be end up paying for the future tax liabilities in the form of lower housing prices when they move.

One way in which this preference for debt over tax finance will be manifested is that households may make location choices on the basis of tax and debt financing decisions. The optimal strategy would be to leave jurisdiction that choose current tax finance and move to jurisdictions that choose a policy of debt finance and low current taxes. In this way they can enjoy the amenities of debt financed public expenditures while avoiding the future tax liabilities. The traditional Tiebout (1956) model also allows households to

move in response to local government public finance policies. In the Tiebout model the relocation decision is based on preferences concerning the level of taxes and expenditures, whereas in the case of debt versus tax finance the relocation decision may be based on a pure tax avoidance motive.

This paper estimates how the debt and taxation policies affect location choices using a panel of 150 U.S. cities. The main finding is that the choice of debt versus tax finance influences both in- and out-migration. Increases in current taxes have stronger effects on leaving than equivalent increases in debt issues. Higher current taxes have stronger (negative) effects on entering than equivalent increases in debt issues. These findings are consistent with differing salience of tax and debt policy. Households may simply be more aware of the current levels of taxation than the implied future levels of taxation associated with debt finance. However, the differing response to tax and debt issue is predicted by rational behavior of agents that are fully aware of future tax liabilities. They choose to remain during period of debt finance and strategically relocate when future tax liabilities are assessed.

The research in this paper contributes to the literature on local public finance by examining the effect of local government debt and tax finance choices on migration behaviors at the city level in the United States. Most existing studies have used data at the state level or only focused on a small region, such as cities or counties within a specific U.S. state. In contrast, we use data for the 150 Fiscally Standardized Cities, available in the FiSC database to obtain more meaningful comparisons of financing at the city level in the United States. These data correct for varying city government responsibilities by standardizing the public service packages provided. The provision of public services differs among U.S. cities as some cities take the full responsibility for public services within their jurisdictions while other cities share responsibilities with other local governments such as the county government, school districts, and special districts. To account for the overlying government structures, the FiSC database is created by adding local government finance data of the city government to a portion of the finance data of the overlying governments. By doing so, this database permits more rigorous and meaningful comparisons among U.S. cities.

The paper is organized as follows. Section 2 reviews relevant previous studies. Section 3 presents a discrete time dynamic model in which we analyze the relationship of household mobility and local government choice of taxation and debt finance. Section 4 presents the empirical models and estimation results. Section 5 summarizes and provides policy implications.

## 2. Literature Review

Several earlier studies have discussed the Ricardian Equivalence Theorem. David Ricardo, in his work "Essay on the Funding System" (1820), was the first to notice whether it makes a difference to finance a war with tax revenue or to issue government bonds paid back by future taxes. He concluded that the two alternatives resulted in the same value of government spending. Barro (1974) provides the theoretical foundation for the Ricardian Equivalence Theorem within the context of an overlapping-generations model. He concludes that "changes in the relative amounts of tax and debt finance for a given amount of public expenditure would have no effect on aggregate demand, interest rates, and capital formation."

Previous literature tests Ricardian Equivalence Theorem by either challenging the assumptions or showing empirically that the neutrality does not hold in the economy. Wellisch and Richter (1995) develop a model that predicts the neutrality thesis of local public finance does not hold in general when we allow for household mobility and debt serviced by local residence-based taxes. The main reason for the non-neutrality result is that such taxes create locational distortions. As for the empirical works, Adj and Alm (2016) study a developing country, Indonesia, and find that debt finance increases the interest rate and current consumption, stimulates imports, but dampens future consumption. Their findings support the conventional view on public debt. As for a similar study in the developed countries, Hayo and Neumeier (2017) find that only 7% of the 2,000 surveyed Germans consume less and save more of their income in response during the public debt accumulation period between 2008 and 2012 in Germany. Their finding challenges the Ricardian Equivalence Theorem. There are also studies find negative effects of high

government debt levels on economic growth. (Reinhart and Rogoff, 2010; Cecchetti, Mohanty and Zampolli, 2011; Checherita-Westphal and Rother, 2012).

As for the literature on mobility reaction to public policy, Fox, Herzog and Schlottman (1989) examine the metropolitan fiscal structure effects on Tiebout-like voting with feet decisions and find that more progressive tax policy tends to encourage out-migration. Grassmueck (2011) focuses his study on intra-county migration in Philadelphia and finds that higher adjusted property taxes and higher government spending for certain local public goods and services play a positive role on attracting migrations from other municipalities.

This study also addresses policy salience which may contribute to the different reactions to debt and tax policy. Previous studies have looked at the salience of some specific taxes. Chetty, Looney and Kroft (2009) study sales tax and excise taxes and find different tax responses to taxes with different degrees of salience. Consumers tend to react more to the taxes that are included in posted prices comparted to the taxes that are applied at the register. Bradley (2013) discusses property tax salience, in particular. He finds that the probability of delinquency decreases with increased salience of the property tax. Our study not only addresses tax policy salience, but also implicitly compares the relative degrees of salience for city tax and debt policies.

In the next section we present a discrete time dynamic model that is used to investigate the relationship between relocation choices of households and local public finance choices between taxation and debt.

## 3. Theoretical Model: A Discrete Time Dynamic Optimization Model

In order to investigate the relationship between the relocation choice and local public finance choice between tax and debt, we propose a discrete time dynamic optimization model with following assumptions: 1) a representative agent lives at one location with the objective of maximizing his life-time utility and a budget constraint; 2) this representative agent has a move-out probability, $\mu$; 3) the local governments at

that location has two choices – tax finance and debt finance to finance the local expenditures; 4) the representative agent has the full knowledge of local government finance choices and perfect foresight of the future outcomes (e.g. if the local government uses a tax cut and rely more on debt finance at current period, then there will be an increase in the future tax liability to pay off the debt principle and interests.); 5) a constant discount factor, $\beta$. If people know that the local government is increasing debt issuance in recent years, then they would expect increased future tax liability to pay off the debt. In this case, a rational citizen will have a preference of moving out of the city so that he could avoid the increased future tax liability but enjoys the public service offered with the current increase in debt finance. That rationale sets up the basic for our model.

There are two agents in this discrete time dynamic optimization model. The local government and the representative agent. The local government faces a sequence of per capita lump-sum tax revenues and has a budget constraint with tax revenues $\{\tau_t\}$, a sequence of debt liabilities $\{d_t\}$, a sequence of expenditures $\{e_t\}$, and a sequence of populations $\{n_t\}$. The local government budget constraint describes the local government finance choices between debt and tax. The revenues, debt, and expenditures must be balanced as in equation (1).

$$\tau_t n_t + d_t n_t = e_t n_t + (1 + r) d_{t-1} n_{t-1} \quad (1)$$

Meanwhile, the representative agent faces the sequence of future lump-sum tax liabilities $\{\tau_t\}$, a sequence of future labor income $\{\omega_t\}$, and a probability of moving at each time *t*, $\mu_t$. Define $\{c_t\}$ as the choice of consumption at time *t* for him. The agent's saving is in terms of bond holdings, $\{b_t\}$. The bond holdings of this agent are not limited to be only the government bonds issued by the local government at his location, but could also be bonds issued by other municipalities, corporate bonds or any other bonds purchased from the capital market. The interest rate is *r* and held constant in the model. The objective of this agent is to maximize utility by choosing the amount of consumption for each time period. Therefore, this dynamic optimization problem can be written as the problem set up by equations (2) and (3).

$$\max_{c_t} \sum_{t=0}^{\infty} \beta^t U(c_t) \tag{2}$$

$$\text{s.t.} \quad b_{t+1} = (1+r)b_t + \omega_t - c_t - \tau_t \tag{3}$$

The Bellman equation for this dynamic optimization problem is equation (4).

$$\begin{aligned} V(b_t, \tau_t, \tau_{t+1}, \dots) = \max_{b_{t+1}, \tau_{t+1}} \{ & U((1+r)b_t + w_t - \tau_t^S - b_{t+1}) \\ & + \beta\mu V^M(b_{t+1}, \tau_{t+1}^M, \tau_{t+2}^M, \dots) \\ & + \beta(1-\mu)V^S(b_{t+1}, \tau_{t+1}^S, \tau_{t+2}, \dots)\} \end{aligned} \tag{4}$$

The term $\beta\mu V^M(b_{t+1}, \tau_{t+1}^M, \tau_{t+2}^M, \dots)$ is the discount value of future utility if the agent moves out of this location at *t+1*. The term $\beta(1-\mu)V^S(b_{t+1}, \tau_{t+1}^S, \tau_{t+2}, \dots)$ is the discount value of future utility if this agent stays at current location at *t+1*. Therefore, the component $\beta\mu V^M(b_{t+1}, \tau_{t+1}^M, \tau_{t+2}^M, \dots) + \beta(1-\mu)V^S(b_{t+1}, \tau_{t+1}^S, \tau_{t+2}, \dots)$ is the expected discount utility weighted by the probability of moving.

From the Bellman equation we derive the effect of a tax increase on welfare at time *t* by differentiating equation (4) with respect to $\tau_t^S$. The effect of a tax increase on welfare at current time period *t* is shown by equation (5).

$$\frac{\partial V(b_t, \tau_t, \tau_{t+1}, \dots)}{\partial \tau_t^S} = -U'(c_t^S) \tag{5}$$

In order to compare the welfare effect of tax finance and debt finance, we also need the welfare effect of debt finance at the current period. However, it is not possible to get the welfare effect of current debt finance directly as there is no local government debt variable specified in this model. But, knowing that debt finance will increase future tax burdens for residents, the welfare effect of current debt finance can be equivalent to the welfare effect of the corresponding future tax increase. Therefore, we can obtain the welfare effect of debt finance by deriving the welfare effect of a future tax increase for the stayers. For simplicity, we assume the debt matures at a future time *t+1*. To derive the effect of $\tau_{t+1}^S$ on welfare, we need to expand the last term in equation (4), which is the discounted value function of future utility when

the agent does not move out of the original location at *t+1*. Then we can rewrite the Bellman equation (4) as equation (6).

$$\begin{aligned} V(b_t, \tau_t, \tau_{t+1}, \dots) = \max_{b_{t+1}, \tau_{t+1}} \{ & U((1+r)b_t + w_t - \tau_t^S - b_{t+1}) \\ & + \beta\mu V^M(b_{t+1}, \tau_{t+1}^M, \tau_{t+2}^M, \dots) \\ & + \beta(1-\mu)U\left((1+r)b_{t+1} + w_{t+1} - \tau_{t+1}^S - b_{t+2}\right) \\ & + \beta^2\mu(1-\mu)V^M(b_{t+2}, \tau_{t+2}^M, \tau_{t+3}^M, \dots) \\ & + \beta^2(1-\mu)^2 V^S(b_{t+2}, \tau_{t+2}^S, \tau_{t+3}, \dots)\} \end{aligned} \tag{6}$$

Taking the derivative of equation (6) with respect to $\tau_{t+1}^S$, we get the welfare effect of a future tax increase for the stayers at time *t+1*, which is shown in equation (7).

$$\frac{\partial V(b_t, \tau_t, \tau_{t+1}, \dots)}{\partial \tau_{t+1}^S} = -\beta(1-\mu)U'(c_{t+1}^S) \tag{7}$$

In fact, the municipal bonds mature in several years after they are issued. So, the increased tax burden does not only include the amount of tax revenue to pay off the debt principle at the maturity date, but also includes a sequence of interest payments over time. Therefore, to get the true total tax increase effect on utility from bond financing, we multiply equation (7) by (1+*r*), yielding equation (8).

$$\frac{\partial V(b_t, \tau_t, \tau_{t+1}, \dots)}{\partial \tau_{t+1}^S}(1+r) = -\beta(1-\mu)U'(c_{t+1}^S)(1+r) \tag{8}$$

Then the difference in the welfare effect between debt and tax finance is shown by equation (9) as the difference of equation (8) and (5).

$$\frac{\partial V(b_t, \tau_t, \tau_{t+1}, \dots)}{\partial \tau_{t+1}^S}(1+r) - \frac{\partial V(b_t, \tau_t, \tau_{t+1}, \dots)}{\partial \tau_t^S} = U'(c_t^S) - \beta(1-\mu)U'(c_{t+1}^S)(1+r) \tag{9}$$

The first order necessary condition for the Bellman equation (4) in this problem is shown in equation (10).

$$-U'(c_t^S) + \beta\mu V_{b_{t+1}}^M(b_{t+1}, \tau_{t+1}^M, \tau_{t+2}^M, \dots) + \beta(1-\mu)U'(c_{t+1}^S)(1+r) = 0 \tag{10}$$

Rearranging the first order condition we obtain equation (11).

$$U'(c_t^S) - \beta(1-\mu)U'\left(c_{t+1}^S\right)(1+r) = \beta\mu V_{b_{t+1}}^M(b_{t+1}, \tau_{t+1}^M, \tau_{t+2}^M, \dots) \quad (11)$$

The left-hand-side of equation (11) is equal to the right-hand-side of equation (9). Equating equation (9) and (11), we obtain equation (12).

$$\frac{\partial V(b_t, \tau_t, \tau_{t+1}, \dots)}{\partial \tau_{t+1}^S}(1+r) - \frac{\partial V(b_t, \tau_t, \tau_{t+1}, \dots)}{\partial \tau_t^S} = \beta\mu_t V_{b_{t+1}}^M(b_{t+1}, \tau_{t+1}^M, \tau_{t+2}^M, \dots) \quad (12)$$

Equation (12) indicates the difference in welfare effects between debt finance and tax finance in a non-Ricardian consumer regime in which, $0 < \mu \leq 1$. For a constant discount rate and a given value function for the destination location, a local government's heavy reliance on debt financing over tax financing is related to a large move out probability. When $\mu = 0$, we have the Ricardian consumer regime in which debt finance and tax finance are equivalent. The Ricardian consumer regime is shown by equation (13).

$$\frac{\partial V(b_t, \tau_t, \tau_{t+1}, \dots)}{\partial \tau_{t+1}^S}(1+r) - \frac{\partial V(b_t, \tau_t, \tau_{t+1}, \dots)}{\partial \tau_t^S} = 0 \quad (13)$$

The difference between the Ricardian consumer regime and the Non-Ricardian consumer regime is whether mobility is allowed. The preceding model takes the probability of moving as exogenous. In the context of the model, a trivial test of the Ricardian Equivalence Theorem would be simply to test whether the probability of moving is non-zero. A more telling test would be whether a larger move out probability is associated with a greater share of debt financing. A political hypothesis suggests that a larger share of movers would influence localities to prefer debt financing to tax finance.

One difficulty is that the fraction of movers may be too small to influence local financing decisions. In fact, we would not expect the percentage of movers to be exogenous in the context of a model of local financing decisions and expect the causation running from local tax and debt financing to moving to be much stronger than the other way around. Therefore, we choose to test whether debt and tax financing decisions affect the moving in and out decisions. In a pure Ricardian world, taxation and debt financing are equivalent because the future tax liabilities associated with an issuance of debt is exactly offset by taxes. If

individuals can and do move, this equivalence fails. Future tax liabilities associated with debt issue can be avoided by moving. The more debt is issued, the more increase in future tax burden, leading to a larger incentive for moving out to avoid the future tax liability. Similarly, for those who move in, tax finance may be more important than debt issue in discouraging in-migration. Those moving in are likely to be highly mobile individuals who will rationally discount future tax in this particular jurisdiction. They will prefer locations with low current taxes because they expect to move before the tax liabilities associated with debt financing come due.

## 4. Empirical Methodology

This section attempts to use a proper empirical strategy to examine the degree to which people's locational preference in respond to the local government finance choice between tax and debt finance. A panel data set of 150 large U.S. cities between 2007 and 2012 is estimated. The main model is the fixed effects regression with instrumental variables.

### 4.1 Data

We use a panel dataset of 150 Fiscally Standardized Cities in the United States from 2007 to 2012 to investigate how local government finance choices have been affecting people's relocation decisions in U.S. cities. The local government finance data is collected from the Fiscally Standardized Cities (FiSC) database constructed by Lincoln Institute of Land Policy. A significant advantage of this FiSC database is that it accounts for different government structures by adding local government finance data of the city government to a portion of the finance data of the overlying governments, including counties, independent school districts, and special districts. Therefore, this database allows meaningful comparisons across these Fiscally Standardized Cities.

Migration data is collected from the U.S. Census Bureau migration flow estimates based on the American Community Survey (ACS). The ACS program combines consecutive yearly datasets to produce

the average yearly county to county migration flow data within 5 years. There are six estimates datasets available from 2005-2009 to 2010-2014. Given that these estimates are the average estimates from survey data over every 5-year, we consider the 5-year flow estimates as the estimates for the middle year in each 5-year, i.e. the 2005-2009 county-to-county flow estimates is considered as the estimates for 2007 and used to match 2007 FiSC data. We use the main county in which the FiSC locates to match the city finance dataset with the county migration dataset. As a result, we have 900 observations in our panel dataset.

Summary statistics are reported in Table 1. All the FiSC data on finance variables are in 2014 real dollars.

**Table 1 Summary Statistics**

| Variables | Mean | Standard Deviation | Minimum | Maximum | Observations |
|---|---|---|---|---|---|
| Out Migration Rate | 0.0586 | 0.0213 | 0.0307 | 0.2186 | 900 |
| In Migration Rate | 0.0570 | 0.0222 | 0.0013 | 0.1437 | 900 |
| Long-Term Debt Issued Per Capita | 926 | 773 | 0 | 5,959 | 1,050 |
| Debt Outstanding Per Capita | 6,976 | 4,057 | 637 | 23,970 | 1,050 |
| Debt Issuance Tax Ratio | 0.4664 | 0.3522 | 0 | 2.4208 | 1,050 |
| Tax Revenue Per Capita | 1,981 | 896 | 739 | 10,392 | 1,050 |
| Intergovernmental Revenue Per Capita | 2,072 | 920 | 606 | 6,191 | 900 |
| Population | 430,663 | 780,886 | 16,354 | 8,287,000 | 900 |
| Population 0 | 0.1489 | 0.3562 | 0 | 1 | 900 |
| Population 1 | 0.2444 | 0.4300 | 0 | 1 | 900 |
| Population 2 | 0.2033 | 0.4027 | 0 | 1 | 900 |
| Population 3 | 0.1100 | 0.3131 | 0 | 1 | 900 |
| Population 4 | 0.0722 | 0.2590 | 0 | 1 | 900 |
| Population 5 | 0.0567 | 0.2313 | 0 | 1 | 900 |
| Population 6 | 0.1644 | 0.3709 | 0 | 1 | 900 |

Below is a list of the variables and their construction methods.

- $\ln(OutRate_{i,t})$: log of the probability of a representative resident move into a county within a specific year. County move out probability is used as a proxy for the FiSC move out probability. The move out probability is constructed by dividing the number of population moved out of a specific county over a year by the total county population at the beginning of that year.

- $\ln(InRate_{i,t})$: log of the probability of a representative resident move into a county within a specific year. County move in probability is used as a proxy for the FiSC move in probability. The move in probability is constructed by dividing the number of population moved into a county over a year by the total county population at the beginning of that year.
- $\ln(DebtIssue_{i,t})$: log of the amount of long-term debt issued per capita by a FiSC in a year.
- $\ln(DebtStock_{i,t})$: log of debt outstanding per capita kept by a FiSC in a year.
- $\ln(DebtReliance_{i,t})$: log of the ratio of the per capita long-term debt issued and tax revenue by a FiSC in a year. This is a measurement of reliance on debt finance over tax finance by the city government.
- $\ln(Tax_{i,t})$: log of per capita tax revenue by a FiSC in a year.
- $\ln(InterRev_{i,t})$: log of per capita intergovernmental revenue by a FiSC in a year.
- Population: dummy variables indicate city population.
    - Population 0 = 1 if population ≤ 100,000, 0 otherwise;
    - Population 1 = 1 if 100,000 < population ≤ 200,000, 0 otherwise;
    - Population 2 = 1 if 200,000 < population ≤ 300,000, 0 otherwise;
    - Population 3 = 1 if 300,000 < population ≤ 400,000, 0 otherwise;
    - Population 4 = 1 if 400,000 < population ≤ 500,000, 0 otherwise;
    - Population 5 = 1 if 500,000 < population ≤ 600,000, 0 otherwise;
    - Population 6 = 1 if population > 600,000, 0 otherwise.

    Population 0 is used as the reference group.

## 4.2 Empirical Models

In this section, we present the empirical strategy to investigate how differently local public finance factors affect household mobility. To provide a comprehensive picture of the analysis on mobility, we estimate the effects of public finance policy on both move out and move in decisions. Firstly, we estimate the model in

log-log form to obtain elasticities. The log-log model is specified by equation (14) and (15). Then, to perform a direct test of the Ricardian Equivalence Theorem, we estimate equation (14) and (15) in levels of variables. Debt, tax, intergovernmental revenue variables are per capita values and in 2014 real dollars.

$$ln(OutRate_{i,t}) = \beta_0 + \beta_1\, ln(Debt_{i,t}) + \beta_2\, ln(Tax_{i,t}) + \beta_3\, ln(InterRev_{i,t}) + \sum_{k=1}^{k=6} \gamma_k Population\_k_{i,t} + \mu_i + \theta_t + \varepsilon_{i,t} \quad (14)$$

$$ln(InRate_{i,t}) = \beta_0 + \beta_1\, ln(Debt_{i,t}) + \beta_2\, ln(Tax_{i,t}) + \beta_3\, ln(InterRev_{i,t}) + \sum_{k=1}^{k=6} \gamma_k Population\_k_{i,t} + \mu_i + \theta_t + \varepsilon_{i,t} \quad (15)$$

The debt variable is specified in three ways: the amount of long-term debt issued per capita, debt outstanding per capita, and debt reliance. When the debt reliance variable is included in the estimation, the tax variable is dropped out of the regression to avoid potential correlation between the debt to tax ratio and tax revenue. Looking at equation (14) and (15) together raises the suspicion of error correlation across these two equations. We perform the Breusch-Pagan tests for three pairs of equations with different debt variable specifications. Detailed test statistics are reported in Table 2. The Breusch-Pagen tests for the three pairs of regressions all show that there is no significant correlation of errors across the move-out and move-in equations. Therefore, using seemingly unrelated regressions is not necessary.

The basic estimating model we use is to estimate equations (14) and (15) separately by fixed-effect regressions with controls for both year and city fixed-effects. What's more, equation (12) shows a relationship but not causality. To control for the endogeneity, we use the one-year-lagged debt variables as instrument variables for the debt variable specifications. Then, we estimate the same model by using variables in levels to perform a direct test of the Ricardian Equivalence Theorem. By estimating the model in levels, we can check implications on how the absolute dollar values of financing between tax revenues and municipal bonds would affect people's relocation decisions.

**Table 2 Breusch-Pagan Test Results (In Logs)**

| Debt variable: $ln\ DebtIssue_{i,t}$ | | |
|---|---|---|
| Correlation Matrix of Residuals | Move Out Equation | Move In Equation |
| Move Out Equation | 1.0000 | |
| Move In Equation | 0.0313 | 1.0000 |
| Breusch-Pagan Test of Independence | $\chi^2(1)$=0.873 | p-value=0.3501 |
| Debt variable: $ln\ DebtStock_{i,t}$ | | |
| Correlation Matrix of Residuals | Move Out Equation | Move In Equation |
| Move Out Equation | 1.0000 | |
| Move In Equation | 0.0282 | 1.0000 |
| Breusch-Pagan Test of Independence | $\chi^2(1)$=0.714 | p-value =0.3980 |
| Debt variable: $ln\ DebtTaxRatio_{i,t}$ | | |
| Correlation Matrix of Residuals | Move Out Equation | Move In Equation |
| Move Out Equation | 1.0000 | |
| Move In Equation | 0.0229 | 1.0000 |
| Breusch-Pagan Test of Independence | $\chi^2(1)$=0.466 | p-value =0.4946 |

## 4.3 Empirical Results

In this subsection, first we report the elasticities by estimating the log-log models. Then we perform the direct Ricardian Equivalence Theorem Test by estimating the models in levels.

### *IV Regressions in Log-Log Form: Elasticities*

Table 3 shows the fixed-effect estimators with instrumental variables for the move-out equation (14) and move-in equation (15). From columns (1) – (3) in Table 3, we can see that citizens in these 150 large U.S. cities are likely to move out when the local governments issue large amounts of debt or rely more on debt finance than tax finance, but they do not seem to react to the stock of debt outstanding. This finding is consistent with the hypothesis derived from the discrete time dynamic model, even though the relationship is not quite strong, only significant at the 10% level and with an elasticity of 0.04 for debt issuance per capita and 0.03 for debt issuance and tax ratio. Still, we can see that citizens tend to have more incentive to

move out to avoid future increase in tax liability. The move out reaction is significant and strong for changes in tax revenue, however. Increases in per capita tax liability induce local citizens to move out of the current city they live in.

The difference in reactions to debt and tax policy may be explained by the different salience degrees of local public tax and debt policy. People pay sales tax, income tax, property tax, and all kinds of other taxes to their local governments in their everyday lives. But, they may be relatively uninformed about the debt financing used by their local governments. Therefore, they may know and care more about the tax policy changes than the debt policy changes. A second possible interpretation for the different reactions to debt and tax finance could be attributed to tax capitalization. On one hand, cities rely more on debt finance may have relatively low property tax liability. According to the theory of tax capitalization (Yinger, 1988), a decrease in property tax liability will increase the house value, making people wealthier. On the other hand, cities that rely more on tax finance may have relatively low housing values, making people less wealthy. Therefore, people who live in cities that rely more on tax finance may be more likely to move out than those who live in cities that rely more on debt finance. Given the relatively low house values caused by high tax capitalization, residents may tend to be wealthier in cities that rely more heavily on debt financing. A third possible explanation for the difference in reactions to debt and tax finance is that when debt finance is chosen over tax finance, even though the rational relocation strategy is to move out to avoid a future tax burden increase, some people may want to stay during the debt accumulation periods and benefit from the "free" public good financed by local public debt and start to move out as long as tax starts to increase. By doing so, they could avoid at least part of the future tax increase.

**Table 3 IV Regressions with Fixed-Effects (In Logs)**

| VARIABLES | (1) Move Out | (2) Move Out | (3) Move Out | (4) Move In | (5) Move In | (6) Move In |
|---|---|---|---|---|---|---|
| ln $DebtIssue_{i,t}$ | 0.0410* | | | 0.1653 | | |
| | (0.0213) | | | (0.1139) | | |
| ln $DebtStock_{i,t}$ | | -0.0099 | | | 0.1166 | |
| | | (0.0314) | | | (0.1789) | |
| ln $DebtTaxRatio_{i,t}$ | | | 0.0346* | | | 0.1749 |
| | | | (0.0209) | | | (0.1165) |
| ln $TaxRev_{i,t}$ | 0.1187** | 0.1521*** | | -0.4730* | -0.2704 | |
| | (0.0491) | (0.0351) | | (0.2627) | (0.1999) | |
| ln $InterRev_{i,t}$ | 0.0121 | 0.0142 | 0.0282 | -0.0576 | -0.0512 | -0.0884 |
| | (0.0268) | (0.0229) | (0.0257) | (0.1434) | (0.1305) | (0.1435) |
| Population 1 | 0.0205 | 0.0319 | 0.0259 | 0.0788 | 0.1226 | 0.0692 |
| | (0.0375) | (0.0315) | (0.0363) | (0.2006) | (0.1796) | (0.2028) |
| Population 2 | 0.0208 | 0.0097 | 0.0248 | 0.2246 | 0.1963 | 0.2163 |
| | (0.0487) | (0.0414) | (0.0470) | (0.2601) | (0.2356) | (0.2627) |
| Population 3 | -0.2057*** | -0.2147*** | -0.2091*** | 0.2300 | 0.2091 | 0.2359 |
| | (0.0555) | (0.0472) | (0.0536) | (0.2965) | (0.2687) | (0.2996) |
| Population 4 | -0.1873*** | -0.1941*** | -0.1985*** | 0.2073 | 0.1981 | 0.2282 |
| | (0.0622) | (0.0530) | (0.0601) | (0.3323) | (0.3016) | (0.3356) |
| Population 5 | -0.2048** | -0.1829** | -0.2210** | 0.3110 | 0.4216 | 0.3436 |
| | (0.0949) | (0.0802) | (0.0916) | (0.5074) | (0.4568) | (0.5117) |
| Population 6 | -0.2173** | -0.1938** | -0.2289** | 0.3137 | 0.4291 | 0.3376 |
| | (0.0988) | (0.0836) | (0.0954) | (0.5281) | (0.4761) | (0.5330) |
| Constant | -3.9934*** | -3.9185*** | -2.9148*** | -0.0934 | -1.6431 | -2.1775* |
| | (0.3590) | (0.3806) | (0.2013) | (1.9193) | (2.1676) | (1.1241) |
| Observations | 885 | 900 | 885 | 885 | 900 | 885 |
| Year Fixed-Effect | YES | YES | YES | YES | YES | YES |
| City Fixed-Effect | YES | YES | YES | YES | YES | YES |

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

For columns (4) – (6) in Table 3, the estimating results for the move in decisions are less interesting than those for the move out decisions. Only the tax revenue per capita is significantly and negatively affecting people's move in incentives, however the relation is relatively weak. People are less likely to move to some city with a relatively large tax liability. The reason why most of the explanatory variables are insignificant in affecting people's move-in decisions could be that outsiders may not know the city's finance conditions before they actually move in. In other words, public policy may be less salient for the outsiders than insiders.

None of the estimated intergovernmental revenue effects are significant. This result could also be attributed to the low salience of this public policy to the general public as it is not directly related to peoples' lives.

City size matters for the moving out decisions. In larger cities, it is less likely that people will move out. This could be interpreted as people who live in large cities tend to get used to all kinds of amenities such as transportation networks, shopping malls, restaurants, super centers, and many public goods and services. Their move decisions are also discouraged by the jobs they have and the relatively higher income they can earn in large cities.

### *IV Regressions in Levels: Direct Test of the Ricardian Equivalence Theorem*

To conduct a direct test of the Ricardian Equivalence Theorem, we estimate the same IV regressions in levels of all the variables for both move-out and move-in decisions. First, we perform the Bruesch-Pagen Test of Independence for each pair of the move-out and move-in equations. Test results in Table 4 show that we cannot reject the independence of these two equations, i.e., no correlation of errors, at the 5% level. Therefore, we can estimate the two equations separately by using IVs for correcting the reverse causality.

Table 5 reports the regression results. For the move-out decisions, the debt issuance and stock amounts do not seem to matter whereas the increase in tax liability significantly encourages people to move out. Again, we see different reactions to changes in debt and tax policy. None of the debt issuance, debt stock or tax liability would affect the move-in decision. The significance level and signs of the intergovernmental revenue variable and population dummies are consistent as in the log-log models.

**Table 4 Breusch-Pagan Test Results (In Levels)**

| Debt variable: $DebtIssue_{i,t}$ | | |
|---|---|---|
| Correlation Matrix of Residuals | Move Out Equation | Move In Equation |
| Move Out Equation | 1.0000 | |
| Move In Equation | 0.0559 | 1.0000 |
| Breusch-Pagan Test of Independence | $\chi^2(1)$=2.808 | p-value=0.0938 |
| Debt variable: $DebtStock_{i,t}$ | | |
| Correlation Matrix of Residuals | Move Out Equation | Move In Equation |
| Move Out Equation | 1.0000 | |
| Move In Equation | 0.0557 | 1.0000 |
| Breusch-Pagan Test of Independence | $\chi^2(1)$=2.794 | p-value =0.0946 |
| Debt variable: $DebtTaxRatio_{i,t}$ | | |
| Correlation Matrix of Residuals | Move Out Equation | Move In Equation |
| Move Out Equation | 1.0000 | |
| Move In Equation | 0.0579 | 1.0000 |
| Breusch-Pagan Test of Independence | $\chi^2(1)$=3.015 | p-value =0.0825 |

The direct test of the Ricardian Equivalence Theorem is conducted by a Chi-square test on the equality of the coefficients on the debt and tax variables for each regression, except for the regression with debt tax ratio. Test results are reported in Table 6. For the move-out decisions, the coefficients on debt issuance per capita and tax revenue per capita are significantly different from each at the 10% level and the coefficients on debt outstanding per capita and tax revenue per capita are significantly different from each other at the 1% level. The results indicate the different effect from debt and tax policy on move out decisions, challenging the Ricardian Equivalence Theorem. As for the move-in decisions, we cannot reject the equality of the debt and tax effect on the relocation decisions, indicating that the choices between debt and tax finance does not matter for the outsiders before they actually move into some cities.

**Table 5 IV Regressions with Fixed-Effects (In Levels)**

| VARIABLES | (1) Move Out | (2) Move Out | (3) Move Out | (4) Move In | (5) Move In | (6) Move In |
|---|---|---|---|---|---|---|
| $DebtIssue_{i,t}$[2] | 0.0027 | | | 0.0060 | | |
| | (0.0025) | | | (0.0041) | | |
| $DebtStock_{i,t}$ | | 0.0003 | | | 0.0004 | |
| | | (0.0004) | | | (0.0006) | |
| $DebtTaxRatio_{i,t}$ | | | 0.0035 | | | 0.0136 |
| | | | (0.0055) | | | (0.0092) |
| $TaxRev_{i,t}$ | 0.0094*** | 0.0104*** | | -0.0033 | -0.0010 | |
| | (0.0020) | (0.0017) | | (0.0034) | (0.0027) | |
| $InterRev_{i,t}$ | 0.0009 | 0.0010 | 0.0015 | 0.0004 | 0.0005 | 0.0005 |
| | (0.0011) | (0.0011) | (0.0011) | (0.0018) | (0.0017) | (0.0019) |
| Population 1 | 0.0014 | 0.0019 | 0.0019 | 0.0023 | 0.0032 | 0.0020 |
| | (0.0033) | (0.0031) | (0.0033) | (0.0054) | (0.0049) | (0.0056) |
| Population 2 | 0.0015 | 0.0003 | 0.0015 | 0.0039 | 0.0010 | 0.0039 |
| | (0.0044) | (0.0041) | (0.0045) | (0.0074) | (0.0065) | (0.0075) |
| Population 3 | -0.0278*** | -0.0285*** | -0.0288*** | 0.0011 | -0.0008 | 0.0015 |
| | (0.0049) | (0.0047) | (0.0050) | (0.0082) | (0.0074) | (0.0084) |
| Population 4 | -0.0258*** | -0.0263*** | -0.0280*** | -0.0004 | -0.0020 | -0.0002 |
| | (0.0055) | (0.0052) | (0.0055) | (0.0091) | (0.0083) | (0.0093) |
| Population 5 | -0.0250*** | -0.0248*** | -0.0275*** | 0.0050 | 0.0049 | 0.0050 |
| | (0.0082) | (0.0079) | (0.0083) | (0.0136) | (0.0125) | (0.0140) |
| Population 6 | -0.0269*** | -0.0269*** | -0.0295*** | 0.0075 | 0.0071 | 0.0066 |
| | (0.0086) | (0.0083) | (0.0086) | (0.0142) | (0.0130) | (0.0146) |
| Constant | 0.0494*** | 0.0478*** | 0.0687*** | 0.0585*** | 0.0568*** | 0.0511*** |
| | (0.0056) | (0.0059) | (0.0052) | (0.0092) | (0.0093) | (0.0087) |
| Observations | 900 | 900 | 900 | 900 | 900 | 900 |
| Year Fixed-Effect | YES | YES | YES | YES | YES | YES |
| City Fixed-Effect | YES | YES | YES | YES | YES | YES |

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

[2] Variables of $DebtIssue_{i,t}$, $DebtStock_{i,t}$, $TaxRev_{i,t}$, and $InterRev_{i,t}$ are in per capita values and in thousands of dollars.

**Table 6 Direct Test of the Ricardian Equivalence Theorem**

| Testable Hypothesis | Move Out Equations | Move In Equations |
|---|---|---|
| Debt Issue = Tax Revenue | $\chi^2$ (1) = 2.95<br>Prob. > $\chi^2$ = 0.0860 | $\chi^2$ (1) = 2.08<br>Prob. > $\chi^2$ = 0.1496 |
| Debt Outstanding = Tax Revenue | $\chi^2$ (1) = 31.85<br>Prob. > $\chi^2$ = 0.0000 | $\chi^2$ (1) = 0.25<br>Prob. > $\chi^2$ = 0.6174 |

Our findings challenge the Ricardian Equivalence Theorem from three perspectives. First, we find that local residents do react changes in debt policy following the incentive to move out when the local government increases debt issuance or relies more on debt policy than tax policy. Second, the results suggest that current taxations would have a stronger effect on the decision to move than debt issue, indicating the neutrality of debt and tax policy may not hold. Future tax liabilities associated with debt issue can be avoided by moving. Rational individual would wait until the taxes come due and then move. Third, the argument on policy salience challenges the assumption of full knowledge of the finance policy required by the Ricardian Equivalence Theorem. Our findings show that the different levels of salience of tax and debt policy might play an important role in people's reactions to the changes in these two policies. Tax policy is more directly related to people's life and much more salient then debt policy, therefore people react to tax policy changes more than to debt policy changes. What's more, local residents know more about the local public policy than the outsiders.

## 5. Conclusions and Policy Implications

Our study examines household relocation decisions in response to local government finance choices between taxation and debt finance. The theoretical prediction from our discrete time dynamic optimization model indicates that heavier reliance on debt finance gives residents an incentive to move out to avoid future increases in tax liability. Their move-out decision also reveals their preference for local government finance policy as more mobile individuals prefer debt finance so that they can enjoy "free" debt-financed

public goods and services. Our empirical results are consistent with the testable hypothesis derived from the discrete time dynamic model.

The empirical findings from 150 U.S. large cities between 2007 and 2012 show that both increases in debt finance and increases in tax finance are associated with greater out-migration, but increases in current tax liabilities have much stronger effects. Furthermore, higher current taxes have large negative effects on in-migration, whereas debt finance has statistically insignificant results. These results suggest that taxation and debt finance have different effects, not the equivalence suggested by the Ricardian Equivalence Theorem.

Our results may be due to different levels of policy salience that play an important roles in peoples' decisions. Tax policy is more salient than debt policy as people pay taxes directly. What's more, some people may want to stay during the debt accumulation periods as they can enjoy the "free" public services. When the tax liability starts to increase, they may start to move out. In that way, they can avoid at least part of the tax liability. This interpretation of policy salience is also supported by our insignificant finding for intergovernmental transfer reactions and the inactive reactions to public policy for outsiders.

Fundamentally, our findings challenge the Ricardian Equivalence Theorem as we find that people do react to tax and debt policy differently. City tax and debt finance policy clearly have different effects on peoples' relocation decisions. The full knowledge of public fiscal policy assumption required for the Ricardian Equivalence result may not hold in reality.

Using lower tax reliance and greater debt finance may stimulate aggregate demand as such public finance policy gives people more income by reducing their tax burden. That is expected to stimulate economic growth, at least in the short run. However, debt finance may encourage people to move out as they may be afraid of the future increase in the tax liability, especially when the local government is very heavily involved in debt finance. The move out reaction may not be very strong for the local government to worry about in the short run, but in the long run, the necessary increase in tax liability to paying off the

debt will encourage more people to move out. What is more important is that the increase in business-related taxes and income tax may cause business, capital, and labor to move out, causing a negative effect on the local economy in the long run. Another adverse outcome is that more people and economic activity moving out may cause a shrinking tax base, reducing the local government's ability to pay off debt and force the local government to either issue more debt or increase tax rates. It is very likely that debt finance and tax cuts may benefit the local economy by encouraging consumption. Still, the local government should balance tax and debt finance carefully, not only considering the short run effects of stimulating aggregate demand, but also considering the long run potential outcomes. Naïve policy focused on low taxes in the short run followed by debt service in the long run can have negative consequences such as, (a) driving out business, capital and labor, (b) higher tax liability in the future, and (c) reduced saving and capital accumulation, etc.

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