ABSTRACT

Title of Dissertation: THREE ESSAYS ON THE UNDERSTANDING OF URBAN DEVELOPMENT

Yi Niu, Ph.D., 2012

Directed By: Associate Professor Chengri Ding
Urban and Regional Planning and Design

Cities started the unprecedented growth about one hundred years ago. Their importance and significance are reflected by their high productivities and spatial concentrations. The understanding on urban development would help improve urban management and policies and increase wellbeing of urban residents. The three related essays in this dissertation try to improve the understanding from the perspectives of employment centers and agglomeration economies, interactions between labor and housing markets, and the behavior of local governments.

The first essay examines the role of employment centers on economic development. The theoretical literature suggests that agglomeration economies are the main force behind the formation and evolution of employment centers, as well as behind economic growth in general. Applying the birth model to employment centers in Maryland, I find agglomeration effects are increased by the centers, particularly those with high employment size or industrial diversity. Ignoring employment

centers may overestimate the agglomeration effects when using the fixed distance measurement. Policy implications are local officials may use employment centers as a vehicle to promote economic growth.

In the second essay I test the impact of job loss on housing foreclosures. A great challenge in this study, as well as in interactions between labor and housing markets in general, is the geographic mismatch between employment and residential locations. This partially explains the mixed effects of job loss on foreclosures found in the literature. In order to gauge this effect, I develop a job loss vulnerability index using home-work commuting pairs. After fixing the attenuation bias from measurement errors, I find that job loss plays an important role in foreclosure decisions. This essay provides evidence for impact from labor market bust to housing market depression.

The third essay estimates the spending pattern of off-budget revenues. The literature assumes different spending preferences of budgetary and off-budget revenues, but empirical evidence are scarce due to the lack of off-budget data. I use land revenues to proxy off-budget revenues in Chinese cities. I find that off-budget revenues do not crowd out budgetary expenditures, and they tend to support visible and tangible projects, rather than some other traditional public spending items that are not quite obvious.

THREE ESSAYS ON THE UNDERSTANDING OF URBAN DEVELOPMENT

By

Yi Niu

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Advisory Committee:
Associate Professor Chengri Ding, Chair
Dr. James R. Cohen
Professor Gerrit J. Knaap
Professor Erik Lichtenberg
Professor Lori Lynch
Assistant Professor Charles Towe

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Chapter 1: Introduction

Cities are one of the most significant landscapes created in human civilization. Despite a long history of thousands of years, cities did not start the unprecedented growth until about one hundred years ago. In 1800, only 3% of worldwide population lived in cities. The urbanization rate increased to 14% in 1900, 50% in 2010, and is projected to reach 69% in 2050.[1] The importance of cities is associated with their high productivities and spatial concentration. In 2000, the top 38 cities in the European Union occupied 0.6% of land, but accommodated about 25% of its population and 30% of its GDP (Henderson and Thisse, 2004). In Japan in 1998, the three main metropolitan areas (Tokyo and Kanagawa prefectures, Aichi prefecture, and Osaka and Hyogo prefectures) covered 5.2% of land, 33% of its population and 42% of its GDP. In cities such as Shanghai, Mumbai, New York and Paris, the local population account for 1.15%, 1.78% 6.18% and 17.85% of the national total, and produce 1.41%, 3.12%, 8.5% and 27.9% of the national GDP, respectively.[2]

While holding the similar importance and significance, cities distinguish themselves from each other in many different ways. Some large cities in the United States such as Phoenix, San Diego, Houston and Dallas grew their population by 11.3, 2.7, 2.3 and 1.7 times from 1950 – 2000, while Pittsburgh, Buffalo, Detroit and Cleveland lost population by 50.5%, 49.5%, 48.6% and 47.8%, respectively; the cities of Atlanta and Barcelona have similar population sizes (2.5 and 2.8 million in 1990,

[1] The data come from United Nations (2011) and http://www.edge.org/q2007/q07_12.html#brand.
[2] The statistical years are around 1990.

respectively), but the land area of the former is 26.4 times as large as the latter; 88% of American workers used a vehicle to get to work in 2005, when most workers in Chinese cities commute by bicycle and public transportation; Silicon Valley and Route 128 mainly consist of high technology firms, while New York, Chicago and Los Angeles are clustered with a variety of industries.

However, the driving forces behind urban development are similar. For economic cities, literature support the following reasons to explain the existence of cities: 1) scale economies in production – that enterprises become more efficient at large scales of operation, which favor the formation of large enterprises and employment concentration; 2) agglomeration economies – that a firm benefits from being adjacent to other business enterprises, which encourage the cluster of firms; 3) transportation costs, which influence where a firm locates and enhance the spatial concentration of jobs; 4) retail agglomeration, that the geographic concentration of retail outlets reduces the costs of shopping trips and comparison shopping (O'Sullivan, 1999; Brueckner, 2007). Factors that discourage urban development are associated with negative consequences resulting from city size. These factors include high costs on living and commuting, pollution costs, crime, and the concentration of low-income people.

Besides the economic forces, government plays an important role in urban growth and dynamics. City governments need to correct market failures in urban growth and spatial development. While government policies generally include stabilization policy, income redistribution and resource allocation (Musgrave and

Musgrave, 1980), city governments (local governments) are primarily responsible for the provision of public goods and services (resource allocation), including education, highways, police and fire protection, parks and sewers. Negative externalities among different types of land uses are common and need to be addressed to increase social welfare for city residents.

In examining the micro-foundation of city growth and development, three main agents that play important roles have been identified as residents (workers), firms and governments. The city landscape is influenced by each of them as well as by interactions among them. Accordingly, city has two most dynamic markets that determine the wellbeing and health of city economy. The two dynamic markets are labor market and housing market. Residential land covers about 80% of urban land, and accounts for the largest share of households' assets. Through the housing market people find shelters to live, make their residential location decisions, and make portfolio investments. The interactions between labor market and housing market influence urban dynamics as well.

Given these understandings and theories, this dissertation tries to do empirical researches in urban development. The empirical researches are based on existing theories or theoretical hypothesis on the behaviors of firms, residents and governments. The empirical results provide evidence that test the validity of these theories or hypothesis. The tests, as well as the estimation of the hypothetical effects, also provide important policy implications to urban policy makers and planners.

This dissertation tries to improve the understanding of urban development from three respects: agglomeration economies and employment centers, interactions between labor market and housing market, and the behaviors of local governments. While each topic is broad, I narrow down my research questions to be more specific. The first essay asks whether employment centers have effects on economic development. The second essay asks whether job loss affects housing foreclosures. The third essay asks whether local governments spend off-budget revenues differently from the way they spend on-budget revenues.

Answering these three questions is important to both urban scholars and policy makers. Regarding urban development and growth, what I discuss extensively in theory are agglomeration economies, and what I observe prominently in reality are employment centers (including CBD and sub-centers). Therefore, the first essay exploring the role of employment centers not only provides evidence on agglomeration effects, but also generates important policy implications on urban development. The second essay contributes to the impact from labor market bust to local housing markets, which is understudied largely because of the spatial segregation between workplace and residence. This essay is also associated with the foreclosure literature in terms of the effects of trigger events, which obtain mixed evidence. The third essay sheds light on one consequence of economic and fiscal decentralization, the rise of off-budget revenues. This is important because literature assume different spending patterns of on-budget and off-budget revenues, but empirical evidence is scarce due to data unavailability. This study improves our understandings on local governments' behaviors in urban development.

I apply the following methodologies to answer the above research questions. In the first essay I identify employment centers in Maryland by the conventional thresholds on employment density and total employment size. Then I employ the birth model developed by Carlton (1983) and Rosenthal and Strange (2003, 2005) in estimating the effects of agglomeration and employment centers on the location decisions of new establishments. I distinguish the effects of employment centers by their industrial diversities and employment sizes. The second essay links workplace to residence via the commute information. I develop the job loss vulnerability index for each residential neighborhood as the indicator for unemployment risk, based on job loss measures at workplace and the commute data from workplace to residence. Then I regress the number of foreclosures on the job loss index as well as other controls. In the third essay I first disclose the expenditure behaviors of budgetary revenues by an accounting type of regression analysis. I then estimate a demand model to examine whether off-budget revenues crowd out budgetary expenditures. The off-budget revenues are proxied by land revenues, which account for 80-90 percent of total off-budget revenues in Chinese cities. Finally I estimate the effects of on-budget and off-budget revenues on the size and performance of a variety of public sectors.

I employ small geographic level data (Census Tract and Transportation Analysis Zone or TAZ) in the State of Maryland and city-level data in China for the three empirical studies. The data for Maryland mainly include establishments, employment, foreclosures and commute patterns, while the data for China involve on-budget and off-budget fiscal information as well as city characteristics. Estimating

the effects of employment centers requires the small geographic level data, because centers accommodate a large number of jobs but cover a small piece of land.[3] Testing the job loss effect on foreclosures prefers the small geographic level data as well, because this effect occurs at the household level, and the aggregate of broad areas such as state and metropolitan area would impair the efficiency, and also generate more potentially omitted variables. When using census tracts within Maryland, for example, the sample size increases, and the state's foreclosure policies are the same to every tract in one period. In the third essay on off-budget behaviors I use the city-level data in China, where the off-budget land revenues are mostly controlled and allocated by city and county governments. So the city-level aggregation is able to capture most of the off-budget revenues.[4]

The three dissertation essays produce interesting results. First, strong effects are present from employment centers to local economic development, particularly from the centers with high diversities or large employment sizes. These centers should be favored in local urban policies. Second, job loss increases foreclosures to a large extent: a one percent increase in the job loss index raises foreclosures by 0.85 percent. This finding is different from traditional literature that use state or county level unemployment rate proxying the individual worker's unemployment risk, and end up with mixed results. This finding also provides strong evidence for the impacts from labor market to housing market. Third, off-budget revenues do not crowd out budgetary expenditures in Chinese cities, and are disproportionately associated with public sector activities that are visible and tangible. It raises concerns over the

[3] For example, 19 employment centers in Maryland occupy 1% of land and accommodate 36% of jobs.
[4] Different from the U.S., a city in China consists of several counties,

budgetary control and expenditure behaviors. In sum, underestimating the roles of employment centers, job loss and off-budget funds would more or less bias our understandings on urban economic growth, labor and housing market dynamics, and the behaviors of local governments, respectively.

Chapter 2: Employment Centers and Economic Development – Evidence from the State of Maryland

2.1 Introduction

A great deal of attention in the recent literature has been given to the role and effect of agglomeration, or clusters of economic activities, on the formation of cities and their dynamics. Forces that lead to concentration of industries in employment centers as well as of aggregate activity in cities are known as agglomeration economies. Agglomeration economies provide economic benefits to firms or businesses located in centers or close to existing establishments based on microfoundations of knowledge spillovers, labor pooling, input sharing, home market effects, and consumption effects (Rosenthal and Strange 2004). These micro-foundations are theorized into different types of agglomerative economies: one is called localization economies (the Marshall-Arrow-Romer (MAR) externality) and the other is urbanization economies (the Jacobs externality). The former usually refers to external effects generated from the same industry while the latter is associated with the diversity of industrial structure (Glaeser et al. 1992).

The literature presents convincing evidence to positive effects of agglomerative economies on industrial productivity, economic growth, and wages. Significant and substantial positive effects of urbanization economies are found in studies by Combes et al (2012), Fogarty and Garofalo (1988), Moomaw (1983), Tabuchi (1986), and Sveikauskas (1975). While both localization and urbanization

economies are estimated by Henderson (1986 and 2003), Nakamura (1985), and Rosenthal and Strange (2003 and 2005), the evidence for localization economies is strong and robust while the significance of the urbanization economies cannot be determined.

The agglomerative economies are main forces behind the formation and evolution of employment centers. As employment is decentralized responding to falling transportation costs, jobs and businesses tend to concentrate in geographically confined areas, which in turn creates employment centers and transforms metropolitan areas into a polycentric form. Theoretical models have shown that firms leave the CBD to reduce congestion costs, but concentrate in employment subcenters for agglomeration benefits (Anas & Kim 1996; Berliant & Konishi 2000; Fujita & Ogawa 1982; Fujita, Thisse & Zenou 1997; and Helsley & Sullivan 1991). Multiple subcenters have emerged in large metropolitan areas in the United States like Los Angeles, Chicago, New York, San Francisco, Boston, Baltimore-DC, Atlanta, and Cleveland and focuses have been on the identification of employment subcenters (Bogart & Ferry 1999; Giuliano et al. 2007; and McDonald & Prather 1994).

Although agglomerative effects are very important in the formation and development of employment centers, there are relatively few attempts to empirically examine the impacts of employment centers on economic development. Fujita and Ogawa (1982) conclude that agglomeration and commuting costs are associated with number of employment centers. Kohlhase and Ju (2007) find both agglomeration economies and diseconomies in employment centers of Houston, which differ by

industrial groups. Feser, Renski and Goldstein (2008) examine the connection between clusters and economic development in the Appalachia region and find no supporting evidence for positive impact of employment centers. Despite those studies, I still have quite limited knowledge about the magnitude of agglomeration effects inside or outside employment centers.

The objective of this paper is to answer the following two related research questions. The first is whether there are effects of employment centers on economic growth, and if so, whether different industries exhibit different effects. The second research question is whether the economic growth effects are affected by characteristics of employment centers. I especially focus on the association of economic growth with size and industrial composition of employment centers.

To answer these questions, the research framework is designed as follows. First, I develop a measure used to identify employment centers. Second, I use size and diversity index to classify them into two types of categories. One is by size (large, medium, and small) and the other is by diversity level (low-level diverse, medium-level diverse and high-level diverse). Third, I use GIS to calculate employment of all sectors or own sector within one mile to gauge urbanization or localization economies, respectively.[5] Fourth and finally, I use an establishment-birth model, first developed by Carlton (1983) and used by Rosenthal and Strange (2003; 2005), to examine the effects of urbanization and localization economies on new firms as well as how the effects are affected by the presence and characteristics

[5] Kohlhase and Ju (2007) and Rosenthal and Strange (2009) also use one mile cutoff value in their studies.

of employment centers/subcenters. Through the Tobit estimator that yields unbiased and consistent results while conventional OLS model is biased, I examine both direct and indirect effects of employment centers, which have not been found in the literature. The direct effect is captured by a dummy variable for employment centers and the indirect effect is captured by interactive terms between the center dummy variable and variables of localization and urbanization. The hypothesis is that the presence of employment centers may bias the estimated effects of both localization and urbanization externalities if they are absent from regression models. I believe that this paper contributes to our general understanding of agglomerative effects not only by incorporating centers and their characteristics but also by proposing a research design/framework that can be applicable elsewhere.

This paper is organized as follows. The second section describes the study area and data sets used in this paper, as well as the research design. Section 3 identifies employment centers and characterizes them. Section 4 describes my empirical approaches, and section 5 presents estimated results. Section 6 finishes off with final remarks and conclusions.

2.2 Study Area, Data and Research Design

The study area is the state of Maryland. As a small state, Maryland does not have a strong industrial base, particularly in the manufacturing sector. In terms of employment by the second quarter of 2007, Health Care and Social Assistance represents the largest sector in the State, followed by Education; Retail Trade; and

Professional, Science & Technical Services. Public Administration, Construction, and Administrative & Waste services rank the fifth, sixth, and seventh, respectively.

Data used in the paper come from the Quarterly Census of Employment and Wages (QCEW) data from 2007 Quarter 2 to 2008 Quarter 2. This data set contains over 1.6 million establishments with information of unique id, monthly employment, NAICS code, physical address, wage, etc. The unique id enables us to identify births of new establishments. I use the geocoding function of GIS software to pinpoint geographic locations of jobs and firms. More than 80% of total establishments are matched. The geocoded data is then aggregated into TAZs (Traffic Analysis Zones) as my basic spatial analysis unit. There are 4,113 TAZ tracts.[6] I then use the detailed location information of industrial establishments and jobs to identify centers and to create variables. Maryland Property View and Centerline datasets are used to measure property value and transportation accessibility. Finally, all variables are organized and/or generated from GIS functions.

Three criteria were used in selecting industries for this study. First, they are important industries in terms of agglomeration and have been studied by other related literature. Second, their presence in Maryland should be sizable. Third, their growth rates in the study period should not be trivial. Although Maryland does not have strong manufacturing bases, this does not preclude us to examine agglomerative effects. Arzaghi and Henderson (2008) imply that agglomeration economies exist not

[6] A few counties do not have TAZ, then I use block group instead. I prefer TAZs as the study unit rather than census tract or block group because TAZs are delineated based on function, while census tract and block group are delineated based on population (Giuliano & Small 1991). It should be pointed out that no theory tells us what the right unit of spatial analysis is.

only in manufacturing but also in business and financial services. Given those, three service sectors are included in the study. They are: Finance and Insurance; Professional, Scientific and Technical Services (labeled as Professional Services here); and Administrative and Support and Waste Management and Remediation Services (labeled as Administrative & Waste Services). Those sectors are important to the state in terms of employment share and new establishments. In addition, Construction becomes the fourth sector to be included in this study.[7] Construction sector is important to Maryland as it represents 7.4% of total workers in Maryland in 2007 (Quarter 2) and accounts for 12.2% of total new establishments from the second quarter 2007 to the second quarter 2008.

2.3 Employment Centers in the State of Maryland

I use two criteria to identify employment centers. One is the minimum employment density of nine workers per acre and the other is a total of at least 10,000 employees.[8] This minimum employment density is lower than one used by Giuliano and Small (1991) to reflect overall difference between Maryland and Los Angeles metropolitan areas. I identify 19 centers.

Studies have shown the importance of employment centers to the development of metropolitan areas (Cumbers & MacKinnon 2004; Bogart & Ferry 1999; and Giuliano & Small 1991). The State of Maryland is not an exception. These 19

[7] Henderson (2003) also examines the agglomerative effect of the Construction economy.
[8] Giuliano and Small (1991) use 10 workers per acre and 10,000 or 7,000 workers up to regions as cutoffs to delineate employment centers while Bogart and Ferry (1999) use 8 employees per acre and minimum of 10,000 jobs. Small and Song (1994) define employment centers to have at least employment density of 20 workers per acre and total 20,000 jobs.

centers occupy around one percent of land but house a quarter of all establishments, provide 36.2% of total jobs, and contribute 44.3% of wage incomes. They are also growth engines by capturing 21% of new start-ups and nearly one-third new-establishment jobs in the State during the study period.

Employment density of employment centers is much higher than that in the rest of the State. The average employment density of all centers is 18.3 workers per acre, or 11,712 workers per square mile while the overall employment density is 327 workers per square miles for the State. The wage difference between centers and non-centers may be used to indicate the effect of high employment density or agglomerative economy. On an average, workers in the centers earn 35% higher wages than their counterparts in firms outside the centers (Table 1).

Table 1: Characteristics of Employment Centers in Maryland

Employment Center	County	Area (Acre)	Employment	Workers per Acre	Annual Wage	Diversity Index
Bethesda - Germantown (along I-270 and M-355)	Montgomery	16019.7	364078	22.7	61394	11.096
Downtown Baltimore	Baltimore City	6915.3	234522	33.9	56614	9.543
Greenbelt - College Park (along Route 1)	Prince George	7870.9	92222	11.7	46511	9.732
Columbia	Howard	6133.5	73069	11.9	54973	9.311
Towson	Baltimore	2830.8	71639	25.3	47707	9.572
Hunt Valley	Baltimore	3316.7	55794	16.8	51931	9.955
Annapolis	Anne Arundel	2720.9	50185	18.4	43216	8.300
Silver Spring	Montgomery	1685.2	44141	26.2	53775	8.217
Reisterstown Rd	Baltimore	3593.6	40767	11.3	40017	10.609
Frederick	Frederick	2718.2	40333	14.8	42481	10.796
Landover	Prince George	2346.6	34641	14.8	63356	9.318
Woodlawn	Baltimore	1783.6	33989	19.1	55440	5.300
Salisbury (along Route 13)	Wicomico	2696.7	28380	10.5	35724	10.849
Linthicum Heights	Anne Arundel	1581.4	19482	12.3	84510	4.712
Largo	Prince George	1611.6	17833	11.1	44129	9.950
St. Charles - Waldorf	Charles	1256.3	15472	12.3	28694	7.406
Bel Air	Harford	1474.5	13960	9.5	32998	9.061
Hagerstown	Washington	857.4	13417	15.6	34525	6.802
Westminster	Carroll	1072.3	10585	9.9	33866	7.464
All Employment Centers		68485.1	1254506	18.3	53828	8.842
Outside Employment Centers		6622150.0	2212166	0.33	41370	12.691

Nineteen centers demonstrate substantial variations in terms of size and industrial composition. Bethesda---Germantown and Downtown Baltimore are the two largest centers, accommodating 364,078 and 234,522 employees, respectively. Only those two centers exceed 100,000 employments. Both have high employment density, ranked as the 4th and the 1st among the 19 centers, as well as high annual wage, ranked as the 3rd and the 4th. Nine centers with less than 40,000 workers are grouped as small centers. They include Westminster, Hagerstown, Bel Air, St. Charles – Waldof, Largo, Linthicum Heights, Salisbury, Woodlawn and Landover.

They are generally associated with lower job density and annual wage than other centers. The remaining eight centers are classified as medium sized group.

The inverse of Herfindahl index is used to characterize the 19 centers in terms of industrial diversity. The index is calculated as:

$$\text{Diversity index} = 1/\sum_{k=1}^{20} s_k^2$$

where s_k is the employment share of the k^{th} 2-digit industry in each center. There are totally 20 2-digit industries based on NAICS industry classification.[9] This index value equals one if the center is fully concentrated in a sector, and increases as a center becomes more diverse.

I use the index values to group the 19 centers into three types. Type I includes five specialized centers, dominated by quite a few sectors. Two of them are One-Sector Dominant Specialized centers. One is Linthicum Heights in Anne Arundel, in which Manufacturing sector accounts for 41.72% of total jobs in the center (two other largest sectors are Transportation and Warehouse, each contributes 11% of total jobs in the center). Linthicum Heights is the only manufacturing base in the State.[10] The other One-Sector Dominant Specialized center is Woodlawn in Baltimore in which Public Administration is the most dominant sector with nearly 40%of jobs and no other sector makes up more than 10% of jobs. The remaining three centers in Type I

[9] The 20 sectors are: Accommodation and Food; Administrative and Waste Services; Arts, Entertainment and Recreation; Construction; Education; Finance and Insurance; Health Care and Social Assistance; Information; Management; Manufacturing; Professional, Scientific and Technical Services; Real Estate; Retail Trade; Transportation and Warehouse; Utilities; Wholesale; and others.
[10] Except Salisbury in Wicomico, no other centers have more than 10% of manufacturing employment.

are specialized in two or three sectors. They are Hagerstown, St. Charles – Waldorf and Westminster. Hagerstown is specialized in Health Care and Social Assistance (29.08%), Public Administration (19.62%), and Information (8.27%); St. Charles – Waldorf is dominated by Retail Trade (28.05%), Accommodation and Food (16.67%), and Health Care and Social Assistance (8.53%); Westminster is concentrated with Health Care and Social Assistance (28.7%), Public Administration (13.7%), and Retail Trade (8.4%). These three centers have a common feature that the three largest sectors make up more than half of the total employment. All five centers in Type I have the diversity index value less than 8.

On contrast, Type III is diversified centers in which none of industrial sectors dominates. This group includes nine centers with the diversity index value larger than 9.5. Nine centers are: Bethesda – Germantown, Salisbury, Frederick, Reisterstown Rd, Hunt Valley, Largo, Greenbelt – College Park, Towson, and Downtown Baltimore. These nine centers have common features of (1) there are more than seven sectors with more than 5% of jobs (except Downtown Baltimore); (2) no single sector has more than 20% of jobs. The remaining five out of 19 centers belong to Type II characterized by diversified sectors with a moderately dominated sector (at least 20% of employment in four of the centers).

By industrial sectors, the State Capital Annapolis and some county seats such as Hagerstown and Westminster are home to a plenty of government jobs. Construction has substantial presence in Largo and Greenbelt - College Park while professional services are concentrated in Columbia, Bethesda – Germantown, Silver

Spring, Towson, Landover and Frederick. Finance and Insurance firms tend to locate in Hunt Valley and Reisterstown Rd. Public Administration is well present across centers by at least 10% share of jobs.

The State's centers are primarily located in its geographic center, particularly around Baltimore City and areas between Baltimore and DC cities (Figure 1). Two corridors (I-270 and Route #1) are the two most dominant areas of industrial concentration. Figures 1 also illustrates that employment centers may have irregular geographic shapes that make it hard to fully capture agglomerative economies using fixed distance buffer zones (one or five miles), subject to potential estimation biases from regression analyses (Fotheringham & Rogerson 1993; Fotheringham & Wong 1991).

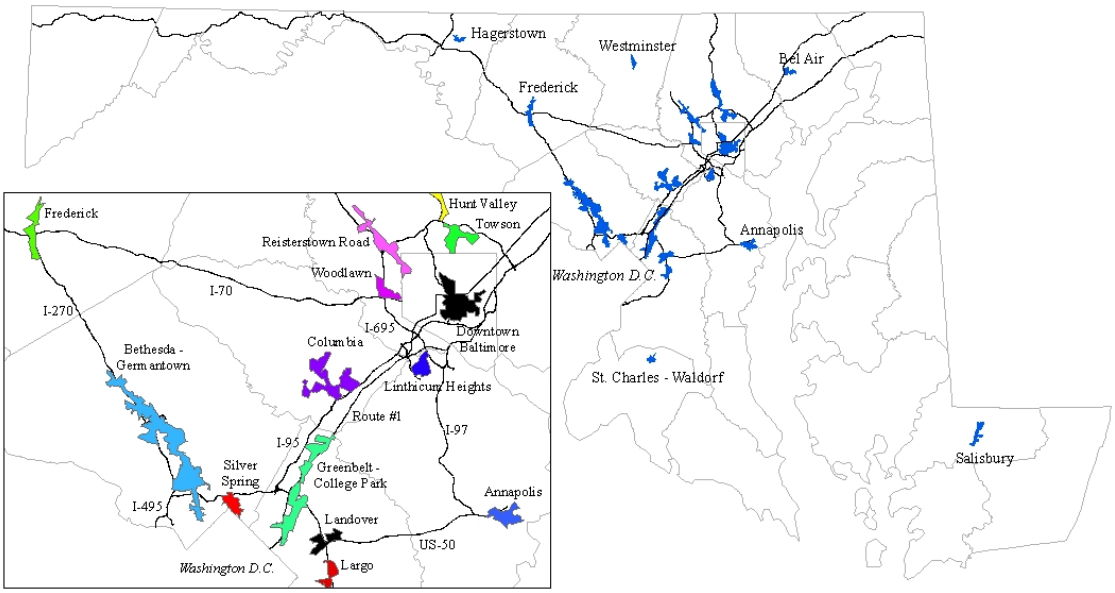

Figure 1: Nineteen Centers in Maryland and a Detail Map for Baltimore - Washington Region

2.4 Empirical Models and Variables

I use the birth model, which is first developed by Carlton (1983) and then used by Rosenthal and Strange (2003), to estimate agglomerative effects. The underlined theory is that new establishments have a tendency to locate near existing firms or jobs to enjoy agglomerative economies, or jobs or existing firms create a business environment in a way that is appealing and attractive to new firms. In a simple framework, I assume a firm makes an independent location decision to maximize its profit. Normalizing the price of output to one, the profit of an establishment equals $\pi(Z) = g(Z)F(X) - C(X)$, where g(Z) shifts the production function F(X), Z contains local characteristics, and X contains inputs that cost C(X). Given all other things equal and the presence of agglomerative economies (localization, urbanization or both), an establishment aims to locate close to other establishments/jobs in the same sector or in all sectors to fully capture agglomerative effects. Therefore, locations of existing establishments affect location choices of new firms.

In the base model, I use the number of new establishments per acre in TAZs as the dependent variable. Independent variables include urbanization economy, localization economy, as well as the control variables. The model is expressed as:[11]

(1) $$N_{ij} = \alpha_0 + \alpha_1 U_i + \alpha_2 L_{ij} + \alpha_3 C_i$$

[11] Similar model specification is used by Rosenthal and Strange (2003, 2005, and 2010).

where i denotes tract, j denotes sector, N_i is the number of births per acre, U_i is urbanization economy, L_{ij} is localization economy, and C_i contains all other control variables.

New establishments during 2007 Quarter 2 and 2008 Quarter 2 are identified. But I exclude those opened by existing Multi-unit firms because their location decisions are likely affected by existing establishments in the same firm. Within 1 mile radius of TAZ centroids, total employment of all jobs and total employment in the own industry are used as proxies to urbanization economy (U_i) and localization economies (L_i), respectively. Since agglomerative effects decline very rapidly with distance, I believe that the 1 mile geographic scope is likely to capture most, if not all, of such externalities (Kohlhase & Ju 2007; and Rosenthal & Strange 2010). If urbanization and localization economies are both present, I should observe positive and significant α_1 and α_2.

My control variables, represented by C_i, include factors that may influence locations of new establishments. The competition factor is captured by firms per worker inside and outside the own industry. Congestion factor is controlled via average property value and average speed in peak hours in each TAZ. Because agglomeration raises congestion level, a failure to capture congestion effects may upwardly bias agglomerative effects. I control transportation accessibility by four variables: distance to the nearest interstate highway ramp, distance to the nearest Maryland/US highway, and two dummy variables representing whether there is a bus station and metro station, respectively, within a one mile radius of the TAZ. If these

types of transportation infrastructure influence a firm's location decisions in the past and at present, missing them will bias coefficients for agglomeration variables. Finally, I also control for county fixed effects. They will hopefully capture county-level policies, zonings, natural endowment, local tax structure, etc.

The second model extends the model (1) by including dummy variables (EC) for centers and interactive terms of localization and urbanization economies with the dummy variables to capture the effects from employment centers. The model is expressed as:

$$(2) \qquad N_{ij} = \beta_0 + \beta_1 EC_i + \beta_2 U_i + \beta_3 L_{ij} + \beta_4 EC_i * U_i + \beta_5 EC_i * L_{ij} + \beta_6 C_i$$

It is expected that (1) signs of β_1, β_4, and β_5 are significantly positive and (2) these significant positive signs imply that employment centers enhance agglomeration economies, and missing the center dummy may cause overestimation of agglomeration effects.

The third model estimates the scale effects of employment centers. If there is a scale effect, the chance to establish a new firm is higher inside large-size centers than inside small-size centers. In order to examine scale effect, I group 19 centers into three sizes: small, medium, and large centers, and create corresponding dummy variables. Three sizes of centers are: small centers with less than 40,000 employments, medium centers with employment between 40,000 and 100,000, and large centers with more than 100,000 workers. I create dummy variables for the three

groups by centers' employment sizes and they are: DEC^{low}, DEC^{med} and DEC^{high} The model is expressed as:

$$(3) \qquad N_{ij} = \gamma_0 + \gamma_1 DEC_i^{small} + \gamma_2 DEC_i^{medium} + \gamma_3 DEC_i^{large} + \gamma_4 U_i + \gamma_5 L_{ij} + \gamma_6 C_i$$

The undermined understanding behind this model specification is that the effect of centers is correlated with center size as demonstrated by increasing returns and continuously rising of the world largest cities like New York and Tokyo. Therefore, If a scale effect is present, I expect that I have $\gamma_3 > \gamma_2 > \gamma_1$, and all of these coefficients are positively significant. Similar to equation (2), I also include interaction terms between these three sizes of centers and urbanization/localization economies, in order to estimate agglomerative effects in centers with different scales.

In the fourth model I try to estimate the impact of industrial composition on the agglomerative economies. I hypothesize that new firms are more likely to be created in locations close to diverse centers than to specialized centers. I create dummy variables for the three groups by the diversity index values and they are: $DIEC^{low}$, $DIEC^{med}$ and $DIEC^{high}$, representing centers with low-, medium-, and high-level diversity index values, respectively. The model is expressed as:

$$(4) \qquad N_{ij} = \delta_0 + \delta_1 DIEC_i^{low} + \delta_2 DIEC_i^{med} + \delta_3 DIEC_i^{high} + \delta_4 U_i + \delta_5 L_{ij} + \delta_6 C_i$$

The undermined understanding behind the model specification is that new firms are more likely located in locations with more diverse industrial mixes (Duranton and Puga 2000). So I expect that the magnitude of coefficients follows the order of $\delta 3 > \delta 2 > \delta 1$, if all of them are significant, implying that the chance for a new firm to be

created is higher in diverse centers than in specialized ones. Similar to function (2), I also generate interaction terms between these three groups of centers and urbanization/localization economies, in order to estimate the impact of industrial composition on agglomerative effects.

Table 2 lists descriptive statistics of variables. It shows that Professional Services has the highest birth density, 0.0025 per acre, and the strongest localization effects, 593.8 own industry workers on average within 1 mile of the TAZ's centroid. On the contrary, Construction has the least localization effects, as well as the 2nd lowest birth density. These simple facts may imply strong localization effects in the creation of new establishments. Professional Service tends to have small-size firms with the firms/worker ratio of 0.36, while Finance and Insurance tends to have large-size firms with the firms/worker ratio of 0.15. The indicators of firms per worker inside and outside the own industry suggest that, Construction, Professional Services and Administrative & Waste Services all have stronger competition, while Finance & Insurance has less competition than other industries. Bus stations serve more than a half of all TAZs and average distance to the nearest highway is about 3.3 miles. Average peak hour speed is 24 miles.

2.5 Empirical Results

Those four models are all estimated with the Tobit estimator because a large part of TAZs do not have any new establishments during the study period. The presence of significant number of zeros in the dependent variables causes

conventional OLS estimator bias (Wooldridge 2002), while the Tobit model will produce unbiased and consistent results.

2.5.1 Agglomeration Economies

Columns (1) in Table 3 and Table 4 present the estimated results of equation (1), where variables for employment centers and interaction terms are not included. I find strong evidence for both urbanization economies and localization economies, present in all four industrial sectors. The magnitudes of the elasticities reveal that Finance & Insurance has the largest urbanization effects and Professional Services sector has the largest localization effects. Construction has both the least urbanization and localization effects among four sectors.[12] Based on estimated coefficients I calculate corresponding elasticities. I find that, doubling total employment within one mile increases the birth density of new establishments by 30.5% in Finance & Insurance, 26.9% in Professional Services, 15.6% in Administrative & Waste Services, and 5.7% in Construction; doubling employment in own industry within one mile increases birth density of new firms by 20.2% in Professional Services, 14.3% in Finance & Insurance, 12.9% in Administrative & Waste Services, and 9.7% in Construction. These results suggest a positive effect of agglomeration and its variation across sectors.

Most of the control variables have coefficients with expected signs. Local competition in own industry encourages births of new establishments, while in other

[12] In Tobit model $Y = XB = \beta_1 x_1 + \beta_2 x_2 + ...,$ the marginal effect of x_1 does not equal to β_1, but $\beta_1 * \Phi(XB/\sigma)$, as discussed in Appendix. So I need to consider marginal effects or elasticities when comparing agglomeration effects across sectors.

industries discourages births. This may imply the tradeoff between competition and monopoly in externality-generating activities like research and development (Glaeser et al. 1992). Cheap locations may be favorable to firms particularly in Administrative & Waste Services, but are less likely to affect firms in other sectors. Professional Services sector is sensitive to congestion level, which has little impact on location choice for other three industries. Adjacency to transportation facilities such as highways, bus stations and metro stations could also save transportation costs for firms, and thus encourages local births. High housing prices tend to discourage new firms, as shown by negative coefficients for all cases although only Administration and Waster Services has significant coefficients at least 95% level and both Construction and Finance and Insurance have significant coefficients at margin. Transportation variables have mixed results. Highways tend to affect firms in Construction and Finance and Insurance while the presence of Metro Stations tends to affect location decisions for Professional Services and Administrative and Waste Services. Those results are pretty robust in Tables 3 and 4.

Table 2: Summary Statistics of Variables

Industries	Variables	Obs.	Mean	Std Dev.	Min	Max
Construction (NAICS 23)	Number of new establishments per acre	4113	0.00095	0.00382	0	0.11383
	Localization	4113	283.78	566.44	0	4857
	Firms/workers own industry	4113	0.24920	0.40351	0	6
	Firms/workers other industries	4113	0.19882	0.33000	0	9
Finance and Insurance (NAICS 52)	Number of new establishments per acre	4113	0.00064	0.00549	0	0.16707
	Localization	4113	314.92	1193.06	0	12079
	Firms/workers own industry	4113	0.14561	0.32650	0	4
	Firms/workers other industries	4113	0.19013	0.27314	0	6
Professional Services (NAICS 54)	Number of new establishments per acre	4113	0.00252	0.01302	0	0.34150
	Localization	4113	593.80	1677.23	0	13679
	Firms/workers own industry	4113	0.36050	0.62123	0	12
	Firms/workers other industries	4113	0.18754	0.28185	0	6
Admin. & Waste Services (NAICS 56)	Number of new establishments per acre	4113	0.00083	0.00493	0	0.14775
	Localization	4113	358.01	955.06	0	8597
	Firms/workers own industry	4113	0.20802	0.43908	0	9
	Firms/workers other industries	4113	0.19658	0.31186	0	9
Common to all industries	Dummy: employment center	4113	0.11695	0.32140	0	1
	Urbanization	4113	5290.13	11434.23	0	112100
	Property price	4006	203.0	155.1	13.3	7220.3
	Average speed in peak hours	4084	24.1	3.5	13.5	39.3
	Distance to the nearest interstate highway ramp (feet)	4113	17429.3	24443.4	0.2	204887.8
	Distance to the nearest Maryland/US highway (feet)	4113	2867.0	2760.6	4.6	37015.0
	Dummy: metro station within 1 mile	4113	0.13	0.34	0	1
	Dummy: bus station within 1 mile	4113	0.56	0.50	0	1

Table 3: Urbanization Effects and Employment Centers

	Construction			Finance and Insurance			Professional Services			Administrative and Waste Services		
	NAICS 23			NAICS 52			NAICS 54			NAICS 56		
Model	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Employment Center		1.47E-03	2.68E-04		**9.23E-03**	**9.47E-03**		**8.75E-03**	3.88E-03		**3.29E-03**	1.41E-03
		(1.87)	(0.28)		(4.09)	(3.48)		(4.49)	(1.65)		(2.61)	(0.94)
Urbanization	**5.62E-08**	3.36E-08	-9.14E-08	**5.48E-07**	**4.13E-07**	**4.37E-07**	**7.27E-07**	**6.02E-07**	1.48E-07	**2.11E-07**	**1.64E-07**	-4.37E-08
	(2.67)	(1.38)	(-1.48)	(9.00)	(6.10)	(2.67)	(14.14)	(10.36)	(1.06)	(6.66)	(4.48)	(-0.43)
Urbanization * Employment Centers			**1.45E-07**			-2.73E-08			**5.34E-07**			**2.34E-07**
			(2.24)			(-0.16)			(3.58)			(2.19)
Competition inside the industry	**1.49E-03**	**1.52E-03**	**1.51E-03**	2.44E-03	2.49E-03	2.49E-03	**2.64E-03**	**2.86E-03**	**2.76E-03**	-1.62E-04	-3.97E-05	-1.11E-04
	(3.13)	(3.21)	(3.17)	(1.22)	(1.25)	(1.25)	(3.29)	(3.57)	(3.46)	(-0.20)	(-0.05)	(-0.14)
Competition outside the industry	**-1.70E-03**	**-1.58E-03**	**-1.59E-03**	**-1.42E-02**	**-1.20E-02**	**-1.20E-02**	**-5.54E-03**	**-4.38E-03**	**-4.25E-03**	**-4.94E-03**	**-4.56E-03**	**-4.57E-03**
	(-2.15)	(-2.00)	(-2.02)	(-3.53)	(-3.03)	(-3.04)	(-2.64)	(-2.09)	(-2.05)	(-3.02)	(-2.79)	(-2.80)
Property Value	-5.24E-06	-4.60E-06	-4.74E-06	-1.75E-05	-1.16E-05	-1.17E-05	-3.47E-06	-1.68E-06	-1.51E-06	**-1.83E-05**	**-1.62E-05**	**-1.64E-05**
	(-1.84)	(-1.62)	(-1.66)	(-1.69)	(-1.16)	(-1.16)	(-0.69)	(-0.37)	(-0.34)	(-3.24)	(-2.89)	(-2.92)
Average Speed in Peak Hours	5.24E-05	6.31E-05	4.51E-05	2.24E-04	3.32E-04	3.36E-04	**6.41E-04**	**7.07E-04**	**6.55E-04**	-5.05E-05	-1.96E-05	-4.53E-05
	(0.58)	(0.69)	(0.49)	(0.76)	(1.12)	(1.13)	(2.74)	(3.03)	(2.82)	(-0.33)	(-0.13)	(-0.29)
Distance to the nearest Interstate Highway Ramp	**-3.55E-08**	**-3.46E-08**	**-3.74E-08**	**-1.51E-07**	**-1.37E-07**	**-1.36E-07**	-7.44E-08	-6.67E-08	-7.71E-08	-3.30E-08	-3.00E-08	-3.52E-08
	(-2.37)	(-2.31)	(-2.49)	(-2.25)	(-2.05)	(-2.03)	(-1.71)	(-1.54)	(-1.79)	(-1.24)	(-1.12)	(-1.32)
Distance to the nearest MD Highway	-2.11E-08	-1.83E-08	-3.80E-08	-3.17E-07	-2.70E-07	-2.65E-07	9.68E-08	1.27E-07	5.27E-08	4.85E-08	5.93E-08	2.25E-08
	(-0.26)	(-0.23)	(-0.47)	(-0.94)	(-0.81)	(-0.80)	(0.43)	(0.57)	(0.24)	(0.33)	(0.40)	(0.15)
Dummy: Metro Station within 1 Mile	1.03E-03	7.58E-04	1.14E-03	1.84E-03	-1.59E-04	-2.32E-04	**6.59E-03**	**4.97E-03**	**6.62E-03**	**2.51E-03**	1.90E-03	**2.45E-03**
	(1.50)	(1.09)	(1.59)	(0.87)	(-0.07)	(-0.10)	(3.81)	(2.81)	(3.64)	(2.22)	(1.64)	(2.07)
Dummy: Bus Station within 1 Mile	**1.25E-03**	**1.22E-03**	**1.57E-03**	2.98E-03	2.60E-03	2.52E-03	2.93E-03	2.66E-03	**4.06E-03**	7.66E-04	6.74E-04	1.29E-03
	(2.04)	(2.00)	(2.51)	(1.34)	(1.17)	(1.11)	(1.80)	(1.63)	(2.44)	(0.72)	(0.64)	(1.18)
Summary Measures												
Log Likelihood	2181.58	2183.32	2185.96	158.17	166.56	166.57	1448.85	1458.89	1465.49	978.79	982.17	984.73
Uncensored	1017	1017	1017	333	333	333	1112	1112	1112	683	683	683
Total Obs.	3999	3999	3999	3999	3999	3999	3999	3999	3999	3999	3999	3999
County Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: t value in the parenthesis. Coefficients are in bold when significant at 5%.

Table 4: Localization Effects and Employment Centers

	Construction			Finance and Insurance			Professional Services			Administrative and Waste Services		
	NAICS 23			NAICS 52			NAICS 54			NAICS 56		
Model	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Employment Center		1.09E-03	-6.47E-04		**1.11E-02**	**1.11E-02**		**8.08E-03**	**4.30E-03**		**3.23E-03**	2.14E-03
		(1.52)	(-0.72)		(5.19)	(4.86)		(4.22)	(1.98)		(2.65)	(1.55)
Localization	**1.80E-06**	**1.61E-06**	3.88E-07	**4.32E-06**	**3.28E-06**	**3.38E-06**	**4.84E-06**	**4.16E-06**	**1.90E-06**	**2.57E-06**	**2.10E-06**	5.30E-07
	(4.82)	(4.07)	(0.69)	(8.61)	(6.21)	(2.12)	(15.43)	(11.88)	(2.66)	(7.22)	(5.26)	(0.51)
Localization * Employment Centers			**2.47E-06**			-1.22E-07			**2.94E-06**			1.82E-06
			(3.19)			(-0.07)			(3.66)			(1.65)
Competition inside the industry	**1.63E-03**	**1.65E-03**	**1.63E-03**	2.27E-03	2.40E-03	2.40E-03	**2.63E-03**	**2.84E-03**	**2.77E-03**	-3.78E-05	7.35E-05	-1.43E-06
	(3.43)	(3.49)	(3.45)	(1.13)	(1.21)	(1.21)	(3.29)	(3.56)	(3.50)	(-0.05)	(0.09)	(0.00)
Competition outside the industry	**-1.68E-03**	**-1.57E-03**	**-1.53E-03**	**-1.55E-02**	**-1.24E-02**	**-1.24E-02**	**-5.47E-03**	**-4.38E-03**	-3.97E-03	**-5.00E-03**	**-4.58E-03**	**-4.51E-03**
	(-2.13)	(-1.99)	(-1.96)	(-3.79)	(-3.12)	(-3.11)	(-2.62)	(-2.11)	(-1.93)	(-3.05)	(-2.81)	(-2.77)
Property Value	-4.80E-06	-4.44E-06	-4.82E-06	**-2.20E-05**	-1.38E-05	-1.38E-05	-4.60E-06	-2.61E-06	-2.23E-06	**-1.93E-05**	**-1.71E-05**	**-1.71E-05**
	(-1.71)	(-1.59)	(-1.73)	(-2.02)	(-1.34)	(-1.34)	(-0.84)	(-0.54)	(-0.48)	(-3.39)	(-3.03)	(-3.02)
Average Speed in Peak Hours	4.14E-05	5.56E-05	3.68E-05	-3.62E-06	1.91E-04	1.92E-04	**5.48E-04**	**6.29E-04**	**5.88E-04**	-9.44E-05	-5.15E-05	-6.14E-05
	(0.46)	(0.61)	(0.41)	(-0.01)	(0.64)	(0.65)	(2.35)	(2.70)	(2.55)	(-0.62)	(-0.34)	(-0.40)
Distance to the nearest Interstate Highway Ramp	**-3.50E-08**	**-3.39E-08**	**-3.62E-08**	**-1.71E-07**	**-1.45E-07**	**-1.45E-07**	-7.62E-08	-6.81E-08	-7.34E-08	-3.56E-08	-3.16E-08	-3.39E-08
	(-2.34)	(-2.27)	(-2.44)	(-2.52)	(-2.17)	(-2.17)	(-1.76)	(-1.58)	(-1.72)	(-1.34)	(-1.19)	(-1.28)
Distance to the nearest MD Highway	-1.07E-08	-5.87E-09	-2.13E-08	-4.23E-07	-3.20E-07	-3.19E-07	4.01E-10	4.64E-08	2.27E-08	3.76E-08	5.37E-08	3.61E-08
	(-0.13)	(-0.07)	(-0.26)	(-1.24)	(-0.96)	(-0.96)	(0.00)	(0.21)	(0.10)	(0.26)	(0.37)	(0.25)
Dummy: Metro Station within 1 Mile	4.72E-04	2.58E-04	2.16E-04	**4.49E-03**	1.28E-03	1.25E-03	**6.71E-03**	**5.08E-03**	**6.07E-03**	**2.52E-03**	1.87E-03	2.26E-03
	(0.67)	(0.36)	(0.30)	(2.17)	(0.59)	(0.57)	(3.91)	(2.88)	(3.44)	(2.23)	(1.62)	(1.92)
Dummy: Bus Station within 1 Mile	1.08E-03	1.04E-03	**1.25E-03**	3.92E-03	3.14E-03	3.12E-03	3.10E-03	2.78E-03	**3.59E-03**	8.72E-04	7.39E-04	1.04E-03
	(1.76)	(1.71)	(2.05)	(1.76)	(1.42)	(1.40)	(1.91)	(1.72)	(2.22)	(0.83)	(0.70)	(0.97)
Summary Measures												
Log Likelihood	2189.25	2190.39	2195.54	153.59	167.12	167.12	1448.85	1475.26	1482.05	978.79	985.78	987.20
Uncensored	1017	1017	1017	333	333	333	1112	1112	1112	683	683	683
Total Obs.	3999	3999	3999	3999	3999	3999	3999	3999	3999	3999	3999	3999
County Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: t value in the parenthesis. Coefficients are in bold when significant at 5%

2.5.2 Agglomeration Effects and Centers

Columns (2) in Table 3 and 4 show results of equation (2) without the interactive terms and suggest three findings. First, employment centers encourage births of new establishments, as expected. The coefficient of the center dummy variable is positive and significant when either urbanization or localization economy is controlled, in three sectors except Construction. Second, the localization variable remains significant with the inclusion of employment center dummy variable but urbanization variable becomes insignificant in Construction. These results suggest that localization effects are stronger and more robust than urbanization effects. A similar conclusion is obtained by Henderson (2003) and Rosenthal and Strange (2003), respectively. The third finding is the magnitudes of coefficients for both urbanization and localization variables decline after controlling the effect of centers. Controlling centers decreases the elasticity of localization economy from 0.202 to 0.174 in Professional Services, from 0.143 to 0.11 in Finance & Insurance, from 0.129 to 0.106 in Administrative & Waste Services, and from 0.097 to 0.087 in Construction. Controlling centers makes the elasticity of urbanization economy decline from 0.305 to 0.232 in Finance & Insurance, from 0.269 to 0.224 in Professional Services, from 0.156 to 0.121 in Administrative & Waste Services, and from 0.057 to insignificant. These results suggest that, without capturing the effect of centers, the measures of using fixed distance buffer zones may lead to overestimation in both localization and urbanization effects.

Columns (3) in Table 3 and 4 report the results of equation (2) with the employment center dummy variable and interactive terms. The center dummy variable captures the direct effect while the interactive term captures the indirect effect of centers on new firm development. If only interactive terms have significant coefficients while the center dummy variable has an insignificant coefficient, the results suggest that centers more likely affect births of new firms through urbanization and localization economies. The results reveal that the center dummy variable becomes insignificant for all cases except Finance and Insurance and Professional Services in localization effect.

To better understand the effects of centers, marginal effects of dummy and interactive variables are calculated (see Appendix for details).[13] Results in Table 5 reveal that centers strongly promote urbanization economies and localization economies. The results of urbanization economies are computed based on columns (3) in Table 3. Across four sectors, marginal effects of urbanization economies are all positive and significant inside centers. Estimated coefficients imply that at the mean level, inside centers, doubling total employment within 1 mile increases the birth density by 207% in Finance and Insurance, 147% in Professional Service, 78% in Administrative Service, and 27% in Construction. Outside centers, however, doubling total employment increases birth density by only 11.9% in Finance and

[13] It would be easy to interpret these results in linear models, as discussed in Section 4. But in nonlinear models such as Probit, Logit and Tobit, the magnitude, significance and even signs of interaction terms are not necessarily consistent with the real interaction effects (Ai and Norton 2003). I find that all eight interaction terms have positive and significant marginal effects, which measures the absolute change in urbanization/localization from inside to outside centers. Notably, for Finance and Insurance, two interaction terms are both insignificant and exhibit negative signs. However, after calculating their marginal effects, I find they are both positive and significant. It implies that centers strongly promote urbanization and localization economies for this sector. Ignoring marginal effects would underestimate the role of centers in this research.

Insurance, and has insignificant effects in other three sectors. In terms of marginal effect, from inside to outside centers, urbanization economies significantly declines by 245.2% in Construction, 117.1% in Administrative and Waste Services, 84.7% in Professional Services, and 51.2% in Finance and Insurance.

Table 5: Marginal Effects of Urbanization and Localization inside/outside Employment Centers

			Construction	Finance and Insurance	Professional Services	Administrative and Waste Services
			NAICS 23	NAICS 52	NAICS 54	NAICS 56
Marginal Effects of Urbanization Economies		Average Effect	-1.60E-08	**2.36E-08**	4.56E-08	-2.25E-09
			(-1.36)	(2.98)	(1.69)	(-0.18)
	a	Outside employment center	-1.84E-08	**2.17E-08**	2.88E-08	-5.47E-09
			(-1.48)	(2.67)	(1.06)	(-0.43)
		Inside employment center	**1.27E-08**	**4.44E-08**	**1.88E-07**	**3.19E-08**
			(2.10)	(5.76)	(10.97)	(4.97)
Urbanization from inside to outside employment	b	Absolute Change	**-3.10E-08**	**-2.28E-08**	**-1.59E-07**	**-3.74E-08**
			(-2.33)	(-2.16)	(-5.13)	(-2.69)
		Percentage Change	**-245.2%**	**-51.2%**	**-84.7%**	**-117.1%**
			(-1.98)	(-2.67)	(-5.88)	(-2.88)
Marginal Effects of Localization Economies		Average Effect	1.45E-07	**1.84E-07**	**4.84E-07**	1.02E-07
			(1.34)	(2.38)	(3.54)	(0.81)
	a	Outside employment center	8.08E-08	**1.64E-07**	**3.75E-07**	6.78E-08
			(0.69)	(2.12)	(2.66)	(0.51)
		Inside employment center	**5.99E-07**	**3.97E-07**	**1.32E-06**	**4.09E-07**
			(5.21)	(5.87)	(12.24)	(5.53)
Localization from inside to outside employment centers	b	Absolute Change	**-5.18E-07**	**-2.33E-07**	**-9.41E-07**	**-3.41E-07**
			(-3.21)	(-2.28)	(-5.40)	(-2.29)
		Percentage Change	**-86.5%**	**-58.7%**	**-71.5%**	**-83.4%**
			(-4.40)	(-2.84)	(-6.57)	(-2.56)

Notes: t value in the parenthesis, computed based on delta method. Coefficients are in bold when significant at 5%.

Localization effects are influenced similarly by employment centers. The results for localization economies in Table 5 are computed based on columns (3) in Table 4. Estimated coefficients imply that at the mean level, inside employment centers, doubling employment in own industry within one mile increases birth density

by 137% in Professional Services, 136% in Finance and Insurance, 75% in Administrative and Waste Services, and 53% in Construction. Outside employment centers, however, doubling employment in own industry increases birth density by only 4% in Finance and Insurance, 3% in Professional Services, and has insignificant effects in other two sectors. In terms of marginal effect, from inside to outside centers, localization effects decline by 86.5% for Construction, 83.4% for Administrative and Waste Services, 71.5% for Professional Services, and 58.7% for Finance and Insurance. These results are consistent with polycentric city theory that centers provide firms with strong agglomeration economies.

Such comparisons also support my hypothesis that ignoring employment centers would generate some problems in estimating agglomeration effects using a distance buffer (e.g., one or five miles). The first problem is the overestimation on agglomeration effects when overlooking effects of employment centers. The large size and irregular geographic shape of employment centers make it difficult to capture their direct and indirect effects with distance buffer. The second problem is that, using distance buffer fails to distinguish different magnitudes of agglomeration effects inside and outside employment centers. However, as the results above have shown, the effect of geographic shapes on agglomeration effects may not be trivial.

2.5.3 Scale Effects

Table 6 presents the results on scale effects of equation (3).[14] Estimated results reveal that large centers have larger impacts on creation of new establishments than small-size centers, as expected. For urbanization economies, the estimated elasticities using the coefficients from Table 6 (the columns (1)) suggest that large centers are not significant in Construction; increase birth density by 150.1% in Finance & Insurance, 52.7% in Professional Services, and 55.9% in Administrative & Waste Services; Medium centers only raise birth density in Finance & Insurance by 88.9%. For localization economies, the estimated elasticities using the coefficients from Table 6 (the columns (2)) suggest that large centers are not significant in Construction and Professional Services sectors; increase birth density by 165.9% in Finance & Insurance, and 65.2% in Administrative & Waste Services. Medium centers only raise birth density in Finance & Insurance by 84.7%. For both urbanization and localization economies, medium sized centers may or may not influence Professional Services and small centers do not affect birth density in Construction, Finance & Insurance, or Administrative & Waste Services, and may or may not affect Professional Services.

Scale effects consist of both direct and indirect effects, which means centers with certain sizes could encourage births of new establishments directly, or encourage births by boosting agglomeration economies. Coefficients of dummy variables for small, medium and large centers in Table 6 suggest that large centers have stronger

[14] Other control variables are not reported due to limited space. Columns (1) control urbanization and interactions, and columns (2) control localization and interactions.

direct effects than other centers. After controlling for interaction terms, large centers gain positive and significant coefficients for Finance & Insurance in columns (1) and (2), and for Administrative & Waste Services in column (2), while most of medium and small centers have insignificant coefficients.

Positive and significant coefficients for interactions between large centers and urbanization/localization economies imply strong indirect effects of large centers, rather than of small ones. From small to large centers, the marginal effects of interaction terms increase in most sectors, accompanied with the rise in significance level. They also indicate that large centers significantly promote urbanization and localization effects across all four industries. However, medium centers promote urbanization only in Professional Services, and small centers have insignificant effects across all four sectors. Therefore, the effects I find in section 5.2 that employment centers foster agglomeration economies are primarily from large centers, not small ones.

2.5.4 Diversity Effects

Table 7 presents results on diversity effects from equation (4).[15] Estimated results reveal that diverse centers have larger impacts on creation of new establishments than specialized ones, implying that diversity encourages growth. For urbanization economies, the estimated elasticities using the coefficients of Table 7 (the columns (1)) suggest that highly diverse centers increase birth density by 41.3% in Construction, 130.9% in Finance & Insurance, 53.1% in Professional Services, but

[15] Other control variables are not reported due to limited space.

do not have significant effects in Administrative & Waste Services; Medium diverse centers raise birth density only in Administrative & Waste Services by 114.4%. For localization economies, the estimated elasticities using the coefficients of Table 7 (the columns (2)) suggest that highly diverse centers do not have significant effects in Construction and Administrative & Waste Services sectors, but increase birth density by 147.1% in Finance & Insurance, and 48.7% in Professional Services; Medium diverse centers raise birth density only in Administrative & Waste Services by 87.8%. For both urbanization and localization economies, medium diverse centers only affect Administrative & Waste Services, while lowly diverse centers do not have significant effects on any of the four sectors.

Diversity effects consist of both direct and indirect effects, which means centers with certain diversities could encourage births of new establishments directly, or encourage births by boosting agglomeration economies. Coefficients of dummy variables for lowly, medium and highly diverse centers in Table 7 indicate that highly diverse centers have stronger direct effects than others. After controlling for interaction terms, highly diverse centers gain positive and significant coefficients for Finance & Insurance and Professional Services sectors, in both columns (1) and (2). Most of medium diverse centers and all of lowly diverse centers have insignificant coefficients.

Positive and significant coefficients for interactions between highly diverse centers and urbanization/localization economies imply strong indirect effects of diverse centers, rather than specialized ones. From lowly to highly diverse centers,

the marginal effects of interactions increase in many sectors, accompanied with the rise in the significance. They also indicate that highly diverse centers significantly promote urbanization and localization effects in most sectors. Medium diverse centers promote urbanization and localization only in Professional Services, and lowly diverse centers do not have such effects across all four sectors. Therefore, the effects I find in section 5.2 that centers foster agglomeration economies should be largely from diverse centers, not specialized ones.

Table 6: Scale Effects of Employment Centers

	Construction		Finance and Insurance		Professional Services		Administrative and Waste Services	
	NAICS 23		NAICS 52		NAICS 54		NAICS 56	
Model	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Urbanization	-7.92E-08		**4.81E-07**		1.57E-07		-3.41E-08	
	(-1.28)		(2.92)		(1.12)		(-0.33)	
Localization		4.38E-07		**3.66E-06**		**1.88E-06**		6.51E-07
		(0.77)		(2.29)		(2.62)		(0.62)
Small Centers (<40,000)	6.27E-03	1.30E-04	3.97E-03	-1.12E-03	**2.55E-02**	2.77E-03	5.48E-03	1.97E-03
	(1.20)	(0.05)	(0.24)	(-0.13)	(1.90)	(0.42)	(0.64)	(0.45)
Medium Centers (40,000 - 100,000)	1.53E-03	1.25E-04	8.86E-03	7.15E-03	-2.11E-03	5.08E-03	2.83E-03	1.25E-03
	(0.77)	(0.09)	(1.62)	(1.87)	(-0.42)	(1.44)	(0.88)	(0.51)
Large Centers (> 100,000)	1.95E-03	2.75E-05	**1.49E-02**	**1.60E-02**	4.85E-03	3.36E-03	2.90E-03	**4.15E-03**
	(1.38)	(0.02)	(3.78)	(4.90)	(1.42)	(1.00)	(1.29)	(2.00)
Small Centers * Urbanization	-6.73E-07		-1.49E-07		-1.92E-06		-3.06E-07	
	(-1.36)		(-0.10)		(-1.53)		(-0.39)	
Medium Centers * Urbanization	2.45E-08		-7.83E-08		**1.03E-06**		9.06E-08	
	(0.18)		(-0.23)		(3.25)		(0.41)	
Large Centers * Urbanization	1.19E-07		-1.27E-07		**4.99E-07**		**2.12E-07**	
	(1.76)		(-0.71)		(3.21)		(1.92)	
Small Centers * Localization		-2.34E-06		1.41E-05		4.75E-06		-4.54E-07
		(-0.67)		(0.83)		(0.61)		(-0.08)
Medium Centers * Localization		1.23E-06		2.74E-06		**3.05E-06**		1.81E-06
		(1.01)		(0.84)		(2.31)		(0.99)
Large Centers * Localization		**2.71E-06**		-9.24E-07		**3.00E-06**		1.46E-06
		(3.11)		(-0.54)		(3.45)		(1.27)
Summary Statistics								
Log Likelihood	2189.80	2198.84	168.82	170.57	1469.63	1482.23	985.79	988.18
Uncensored	1017	1017	333	333	1112	1112	683	683
Total Obs.	3999	3999	3999	3999	3999	3999	3999	3999
County Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES

Notes: other variables are all controlled but not reported due to limited space. Coefficients are in bold when significant at 5%.

Table 7: Diversity Effects of Employment Centers

	Construction		Finance and Insurance		Professional Services		Administrative and Waste Services	
	NAICS 23		NAICS 52		NAICS 54		NAICS 56	
Model	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Urbanization	-8.56E-08		**4.64E-07**		1.76E-07		-4.11E-08	
	(-1.39)		(2.85)		(1.26)		(-0.40)	
Localization		4.18E-07		**3.52E-06**		**1.94E-06**		5.60E-07
		(0.74)		(2.21)		(2.72)		(0.54)
Lowly Diverse Centers	1.14E-02	1.91E-03	1.55E-02	5.00E-03	3.26E-02	-3.20E-03	1.74E-02	9.40E-04
	(1.57)	(0.38)	(0.49)	(0.25)	(1.55)	(-0.29)	(1.30)	(0.18)
Medium Diverse Centers	-3.30E-03	-3.64E-03	1.25E-02	6.38E-03	-5.16E-03	5.48E-03	8.26E-03	6.00E-03
	(-0.91)	(-1.40)	(1.29)	(0.93)	(-0.63)	(1.05)	(1.58)	(1.82)
Highly Diverse Centers	1.50E-03	3.65E-04	**1.29E-02**	**1.41E-02**	4.97E-03	**5.22E-03**	7.06E-04	1.80E-03
	(1.39)	(0.35)	(4.19)	(5.45)	(1.85)	(2.08)	(0.40)	(1.11)
Lowly Diverse Centers * Urbanization	-1.14E-06		-2.27E-06		-3.25E-06		-1.61E-06	
	(-1.70)		(-0.77)		(-1.66)		(-1.29)	
Medium Diverse Centers * Urbanization	2.09E-07		-4.86E-07		**1.35E-07**		-5.19E-09	
	(0.91)		(-0.78)		(2.71)		(-0.02)	
Highly Diverse Centers * Urbanization	1.27E-07		-8.54E-08		**4.88E-07**		**2.41E-07**	
	(1.94)		(-0.50)		(3.23)		(2.24)	
Lowly Diverse Centers * Localization		-6.14E-06		-2.69E-05		4.32E-06		-2.36E-06
		(-0.71)		(-0.59)		(0.25)		(-0.30)
Medium Diverse Centers * Localization		4.39E-06		3.03E-06		2.62E-06		8.62E-07
		(1.34)		(0.30)		(1.73)		(0.42)
Highly Diverse Centers * Localization		**2.16E-06**		-5.46E-07		**2.81E-06**		1.83E-06
		(2.72)		(-0.32)		(3.41)		(1.63)
Summary Statistics								
Log Likelihood	2192.67	2197.67	190.84	197.69	1481.48	1488.35	993.10	999.50
Uncensored	1017	1017	333	333	1112	1112	683	683
Total Obs.	3999	3999	3999	3999	3999	3999	3999	3999
County Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES

Notes: other variables are controlled but not reported due to limited space. Coefficients are in bold when significant at 5%.

2.6 Conclusions and Policy Implications

Many studies have used refined data such as census tracts to examine localization and urbanization economies. A conventional approach uses a fixed buffer distance (such as one or five miles) to measure the influence of local economic activities on the development of new firms, and receives positive evidences on at least one of them (localization and urbanization economies) if not both are present. This study, however, finds that both localization and urbanization economies may be subject to overestimation if the effects of employment centers are not taken into account, particularly in large metropolitan areas. It is found that both urbanization and localization effects consistently become smaller when the employment center dummy variable and interactive variables are included. I believe that the irregular geographic shapes of employment centers are the primary reason for the potential bias from using fixed buffer distances to capture localization and urbanization economies (Fotheringham & Rogerson 1993; Fotheringham & Wong 1991).

This paper concludes that the impact of employment centers on localization and urbanization economies can be substantial. Urbanization effects decline by 51% - 245% whereas localization effects decline by 58% - 87% from inside to outside centers. Finance & Insurance and Professional Services sectors are more likely to exhibit agglomerative effects than Construction.

This study shows that effects of employment centers are affected by their characteristics such as size and industrial composition. More specifically, large employment centers tend to generate more new firms than small ones, and foster

stronger agglomeration effects. Highly diverse centers tend to attract more new firms, and foster stronger agglomeration effects than specialized ones. These conclusions are not surprising and are more or less consistent with the mainstream findings in the literature.

The findings from this paper have two prominent policy implications. The first is that size of centers matters. Certainly negative consequences such as congestion costs increase with size, but the results of this study suggest that they may be outweighed by potential agglomeration economies so that overall impact will still be positive. Economic development policy thus should favor further concentration of economic activities around existing activities. The second implication is that industrial diversity matters. Planning efforts such as coordinated zoning practice, policy initiatives and industrial incentives should target more diverse employment centers if there are not any strong and obvious sectoral externalities. Although it should be cautious that findings from this study may not be applied to other states, the general approach developed should be. That is, the research framework developed in the paper can be replicated and applicable in other studies in the subject.

Chapter 3: Job Loss and Housing Foreclosures – Evidence from the State of Maryland

3.1 Introduction

The understanding of determinants of a homeowner's decision on mortgage default is of great importance to housing finance scholars/professionals and policymakers. Attentions to mortgage defaults are also driven by the understanding of close interactions between labor and housing markets, which play critical roles in the wellbeing of city residents (Whitehead, 1999).[16] Housing tenure, supply, equity and mortgage default have shown impacts on labor mobility, employment growth and employment outcomes.[17] Meanwhile, fluctuations in labor market may affect the income flow of workers, and thus affect housing demand, price and mortgage payments. Works by Reichert (1990), Baffoe-Bonnie (1998), Johnes and Hyclak (1999) and Hwang and Quigley (2006) find significant impact from employment change to housing price and stock.

One of the direct linkages from labor market to housing market is proposed by the "double trigger" theory on foreclosure (Riddiough, 1991). According the theory,

[16] The importance of labor market and housing market dynamics are associated with high urbanization rate, a fraction of total labor forces working in agricultural sector, and dominant residential land use. For specifically, urbanization in USA is 80 percent in 2010, agricultural sector employs about 2-3 per cent of USA's labor forces, and residential land use accounts for up to 80 per cent of all lands (excluding roads and open space) in American metropolitan areas.

[17] For housing tenure on unemployment, see McCormick (1983), Hughies and McCormick (1991), Green and Hendershott (2001), Dohmen (2005), Battu et al. (2008), and Dujardin and Goffette-Nagot (2009); for negative equity on labor market flexibility, see Henley (1998); for housing supply on wage and employment, see Glaeser et al. (2006) and Saks (2008); for mortgage default on unemployment, see Herkenhoff and Ohanian (2012).

negative equity is a necessary condition, but not a sufficient one for foreclosures. For a homeowner to decide to walk away from his/her property, a "trigger" event that causes liquidity constraint is essential. Job loss is one of the main trigger events. Literature support this notion that the job loss triggers foreclosures, but find mixed evidence (Bajari et al., 2008; Foote et al., 2008; Danis and Pennington-Cross, 2008; Gerardi et al., 2009). This is largely due to the fact that job loss is measured in much larger geographic areas than foreclosures, which may not reflect the true effect of job loss.[18]

A fundamental challenge to examine the interactions between labor and housing markets is rooted in the spatial separation of workplace and residence. Unless data are aggregated into metropolitan areas in which both labor markets and housing markets are confined into the same geographic boundary, any analysis at smaller aggregate levels will encounter the challenge of geographic mismatches of job and residential locations. For example, only 3.6 per cent and 43.8 per cent of workers work and live at the same census tracts and counties in Maryland, respectively. The spatial separation is substantial. In 2005, workers travel for 16 miles or 26 minutes on average from their homes to workplaces.[19] Therefore, the employment fluctuations occurred in one site may affect housing markets miles away.

The objective of this paper is to examine the effect of job loss on foreclosures at the neighborhood (census tract) level. In order to do so, a direct measure should be

[18] For example, researches generally use state or county level unemployment rate to proxy the unemployment risk of individual borrowers. See the literature review in the second section of this paper for details.

[19] http://faculty.msb.edu/homak/homahelpsite/webhelp/Driving_Patterns_in_the_US_-_ABC_-_Feb_2005.htm

developed first to connect labor markets to housing markets at the disaggregate level. Accordingly, I develop a job loss vulnerability index using the home-work commuting data to link labor markets (job changes) and housing markets (foreclosures) at the census tract level. The index indicates the extent to which a worker may be affected by the job loss. The value of the index increases with the share of workers to the places with job loss and with the size of job loss. I believe that the index enables us to quantify the effect of job loss at a tract on foreclosures at other tracts that have commuters between them. The index also enables us to do so using secondary data, which is quite important given data available. I then develop a reduced form model to estimate the effect of job loss on foreclosures.

I proceed as follows. Section 2 reviews the literature on housing foreclosures. Section 3 presents the basic theoretical framework and econometric specification. Section 4 describes the data and variables. Section 5 presents job loss and foreclosures in Maryland. Section 6 discusses the results of the econometric analysis and their implications. Section 7 concludes.

3.2 Literature

Housing foreclosure has been extensively studied. Studies based on the put option theory pay particular attention to negative equity in foreclosure decisions and conclude that if the market value of a house is below the mortgage balance, the borrower should simply walk away and leave the house to the bank (Foster and Van Order, 1984; Quigley and Van Order, 1991; Quercia and Stegman, 1992). Empirical evidences supporting the theory of "ruthless" default, however, are quite weak, if

exist at all. Using individual loan data, studies show that only 4% - 8% of "underwater" borrowers eventually end up in foreclosures (Foster and Van Order, 1984 and 1985; Vandell, 1992; Foote et al., 2008).[20] This weak support to the theory of "ruthless" default is also found in Guiso et al. (2009) using survey data. The literature implies that transaction costs are probably not enough to explain this contradiction (Vandell, 1995).

Recent advances toward the understanding of foreclosure behaviors suggest that the negative equity is a necessary condition but not a sufficient one for foreclosures (Foote et al., 2008; Mayer et al., 2009). A distressed borrower with positive equity is always better off by selling his house, paying off the mortgage, and keeping whatever remains from the sale. Underwater borrowers may not decide to default if they expect house price appreciation in future (Foote et al., 2008). Mortgage default may occur when negative equity reaches a certain level. For example, when borrowers are 50% underwater, Guiso et al. (2009) suggest 17% them would strategically default, while Buhtta et al. (2010) suggest 50%.

Riddiough (1991) proposes the so-called "double trigger" theory to explain foreclosure behaviors. Under this theory, liquidity constraint is the trigger for a homeowner to decide to walk away from the property with negative equity, and the liquidity constraint is caused by job loss, divorce, or accidents that could generate cash flow problems. The "double trigger" theory is theoretically supported by Elmer

[20] Foster and Van Order (1984 and 1985) find that only 4.2% of borrowers with estimated loan-to-value ratios of 110% or higher actually defaulted on their mortgages. Vandell (1992) find only 5% - 8% of borrowers with market loan-to-value ratios higher than 110% defaulted. The Massachusetts loan data used by Foote et al. (2008) indicate that about 6.4% of borrowers having negative equity in the 4th Quarter of 1991 actually foreclosed during the subsequent three years.

and Seelig (1999). They show the linkage between financial and income shocks, insolvency, and mortgage default through a three-period theoretical framework. Empirical support for the "double trigger" theory is quite overwhelming. Webb (1982) and Vandell and Thibodeau (1985) are among the early researches examining cash flow influences on default. Webb finds that borrowers' occupations with greater income variability are associated with higher delinquency rate, and Vandell and Thibodeau find small effect from equity, but important roles of income loss and social disruptions. Foote et al. (2008) conclude that default occurs when two things happen simultaneously: negative equity and an adverse life event. Buhtta et al. (2010) show that almost all observed defaults can be attributed to liquidity shocks when equity shortfall is less than 10% of the house value. Elul et al. (2010) use credit card utilization rates to identify illiquidity, and find a significant impact.

With regard to trigger events that cause cash flow problems, many studies have focused on job loss or unemployment which is likely the major immediate cause of income variability (Webb, 1982). The only one research using individual survey data I have found is Herkenhoff (2012), who concludes that job loss makes someone 8.2% more likely to default. Bajari et al. (2008) find that a one standard deviation increase in the county-level unemployment rate is associated with 10% greater hazard of mortgage default, which is statistically significant but much smaller than the effects of other factors.[21] Similar positive impact with small magnitude of the county-level unemployment rate on individual defaults/foreclosures is also found in recent literature including Foote et al. (2008), Buhtta et al. (2010), and Elul et al.

[21] A one standard deviation increase in housing price, for example, increases the hazard by 200%.

(2010). [22] Meanwhile, Gerardi et al. (2009) find it insignificant, and Towe and Lawley (2010) find it negatively associated with foreclosures. Less support on the positive impact of unemployment on mortgage defaults or foreclosures is found if unemployment data is measured at larger geographic units (such as state or MSA). For example, Elmer and Seelig (1999) and Doms et al. (2007) find unemployment rate and employment decline at the MSA or state level are insignificant when some controls are included. Ambrose and Capone (1998) and Danis and Pennington-Cross (2008) find higher state-level unemployment rate is associated with lower delinquency and default probabilities. Elmer and Seelig (1999), Deng et al. (2000), Demyanyk and Van Hemert (2008), and Sherlund (2008) use the state-level unemployment rate, but find mixed results.

It should be cautious in interpreting the mixed results of unemployment or job loss on foreclosures for the following reasons. First, it may not be appropriate to use the state or MSA level unemployment data as they might miss much of the local variation in unemployment and thus the underlying effect on default (Sherlund, 2008). Quercia and Stegnan (1992) also indicate that using national, regional or local indices may not reflect events or changes in the individual circumstances of borrowers who default. Second, the effects identified through aggregation may include broader consequences of living in a depressed metropolitan area. For example, lenders in depressed areas may be under pressure from state and local governments, as well as financial regulators, to offer greater forbearance to defaults

[22] Foote, Gerardi and Willen (2009) find that the default probability increases by 800% when the subprime mortgage is present, but only increases by 10% when the unemployment rate rise by one standard deviation.

(Ambrose and Capone, 1998). Third, using the mean of such large groups could substantially enlarge standard errors and make estimated coefficients insignificant (Tielemans et al., 1998). Census 2010, for example, indicates that the average population is larger than 100,000 at the county level, and larger than 6,000,000 at the state level. The measurement errors at these unemployment rates may also shrink the impact of unemployment to a large extent (Lindo, 2012).

There are studies that examine factors such as loan characteristics, interest rate and moral constraints on foreclosures. Loan characteristics and interest rate may matter, but are not the major driving force of foreclosures (Quercia and Stegman, 1992; Vandell, 1995; Mayer et al., 2009). Since ruthless defaults do not constitute the major part of foreclosures, the moral constraint and contagion effect may play secondary or small roles in foreclosure behaviors. Consider the contagion effect as an example: a one unit increase in neighboring foreclosures increases the hazard of foreclosure by only 4% in Maryland (Towe and Lawley, 2010).

3.3 The Model

I use the framework developed by Bajari et al. (2008). I assume that a borrower starts the mortgage at time t_0 and decides whether to pay the mortgage at time t. The negative equity, which could solely cause the ruthless default, is expressed as

$$1 - \frac{L_t}{V_t} = 1 - H(\frac{V_t}{V_{t0}}) < 0 \qquad (1)$$

where V_t denotes housing value at time t, and L_t denotes the outstanding principal on the mortgage. Assuming constant loan-to-value ratio at t_0 and similar interest rates thereafter to all borrowers, it is usually the house price depreciation $\frac{V_t}{V_{t0}}$ that generates the negative equity. But the negative equity alone does not have strong explanation on mortgage defaults, and probably only serves as the necessary condition. To make the default happens, trigger events are required to shrink borrowers' financial liquidity and payment ability. This is expressed as:

$$(Y_t - C_t) - P_t = R_t(TE_t; X_t) - P_t < 0 \qquad (2)$$

where Y_t is income, C_t is necessary consumption, and P_t is mortgage payment. $Y_t - C_t$ is the disposable income after consumption that could be used for mortgage payment, and is a function of household attributes X_t and trigger events TE_t such as unemployment, divorce and health problems. Equation (2) makes it hard for a borrower to pay his mortgage normally, and equation (1) excludes the borrower's other options like home sale and refinance other than foreclosure. Thus the borrower defaults when

$$D_t = \mathrm{I}(1 - H(\frac{V_t}{V_{t0}}) < 0) \times \mathrm{I}(R_t(TE_t; X_t) - P_t < 0) = 1 \qquad (3)$$

Because P_t is a function of V_{t0} if down payment ratio is given, the borrower's default decision function is $D_t(\frac{V_t}{V_{t0}}; TE_t; X_t)$, depending on housing price change, trigger events, and the borrower's attributes. As my data is based on

neighborhood (census tract), according to the individual's default function, I define the number of foreclosures in neighborhood i at year t as the function $F_{i,t}(\frac{V_{i,t}}{V_{i,t0}}; TE_{i,t}; X_{i,t}; N_{i,t})$, where $N_{i,t}$ denotes the number of borrowers in that neighborhood.

A reduced-form model of (3), which will be estimated, is expressed as the following:

$$F_{i,t} = \beta_0 + \beta_1 TE_{i,t} + \beta_2 \frac{V_{i,t}}{V_{i,t0}} + \beta_3 X_{i,t} + \beta_4 N_{i,t} + \varepsilon_{i,t} \quad (4)$$

where I use job loss at the neighborhood level as the primary trigger event ($TE_{i,t}$) during my study period. In this paper, I focus on job loss as the trigger event. I therefore expect that the coefficient (β_1) is positive and significant. The coefficient β_2 is expected to be negatively significant.

3.4 Data and Variables

3.4.1 Data

The question of job loss effect on foreclosures is examined in the State of Maryland. I use data from several sources. The first one is the foreclosure data obtained from Realty Trac, a private corporation specializing in collecting foreclosure records in the country. This data contains individual foreclosure fillings from public court records in the state, extending from the 1st quarter of 2006 to the 3rd quarter of

2009.[23] Each record contains the date of the filling, the physical address of the property, and foreclosure activities. I geocoded these properties on GIS map according to their physical addresses. Three types of foreclosure activities are recorded in the data: a notice of default, a notice of foreclosure sale (auction), and a bank-owned property (REO). Many properties appear multiple times in the database under different activities. I use the first foreclosure filling for an individual property as the beginning of the foreclosure process.[24] In doing so, I eliminate multiple entries for properties with more than one foreclosure activities. The foreclosure records are then aggregated to the census tract level.

Two data sources are used for employment. One is the Quarterly Census of Employment and Wage (QCEW) and the other is the Longitudinal Employer-Household Dynamics (LEHD). QCEW data are collected quarterly, containing over 1.6 million establishments with information such as monthly employment, NAICS code, physical address, quarterly wage, ownership, etc. All the employment covered by Unemployment Insurance and Unemployment Compensation for Federal Employees are included in this data, representing about 99.7% of all civilian employment in the United States.[25] I geocoded the first quarter of 2005 and 2006, and the second quarter of 2007 and 2008 on GIS map.[26] LEHD is an annual data published by U.S. Census Bureau at the block level, which covers 98 percent of

[23] As a judicial state, Maryland's foreclosure process is conducted through the court system.
[24] Some properties do not have a notice of default before auction or REO possibly because the data missed some fillings. So I use the first filling as the start of foreclosure process.
[25] See BLS website for QCEW data (http://www.bls.gov/cew/cewfaq.htm#Q01) as well as Appendix A in http://www.dllr.state.md.us/lmi/emppay/emplpayrpt2006.pdf
[26] This data is from Maryland's Department of Labor, Licensing, and Regulation, and is used under strict confidentiality rules. The data I have include the first quarter in 2005 and 2006, and all the quarters since the first quarter of 2007. Around 86% - 92% of employment is successfully geocoded.

nonagricultural, private wage and salaried employment.[27] It reports annual statistics from 2002-2009 at census block level after having adjusted the data for confidential protection. A key data from LEHD is its Workplace Area Characteristics (WAC), which documents the number of workers by their workplace location.[28] I aggregate it to the census tract following the technical document's suggestions (Anderson et al., 2008). The synthetic Origin-Destination (OD) data in LEHD indicate the number of workers living in tract i and working in tract j, similar to the commute data from the Census Transportation Planning Package (CTPP) 2000. This type of home-work linkage data is used to construct an index (job loss vulnerability index, see the following section) that links spatially separated labor markets and housing markets at the census tract level.

Other sources including Census 2000, Home Mortgage Disclosure Act (HMDA) database, and Equifax provide other explanatory variables in function (4).

3.4.2 Variables

The spatial separation of residential and employment locations is the fundamental in urban landscape. This spatial separation, however, imposes challenges in examining the linkage between labor and housing markets in general and between foreclosures and job loss in particular at small geographic units such as census tracts

[27] LEHD data miss certain amount of public employment, especially federal employment (Anderson et al., 2008). Because this sector did not have significant job losses during the recent depression, it should not affect much of my job loss estimates.

[28] The other two parts are: Residential Area Characteristic data (RAC), counting the number of workers by their residence location; and Origin-Destination data (OD), counting how many workers living in block i and working in block j. WAC is real data, while RAC and OD are both synthetic data (Anderson et al. 2008).

or blocks. In order to link foreclosure activities and job loss, I develop a job loss vulnerability index. The index is expressed as follows:

$$JL_{i,t} = \sum_{j} C_{i,j,t-1} \frac{D_{j,t}}{R_{j,t-1}} \tag{5}$$

where $JL_{i,t}$ is the job loss vulnerability at census tract i in time t; $C_{i,j,t-1}$ is the number of workers who live at tract i and work at tract j in period t-1; $D_{j,t}$ is the number of job losses from t-1 to t at tract j; and $R_{j,t-1}$ denotes the total jobs at tract j in period t-1.

I use three different measures as the proxy of job losses ($D_{j,t}$) at census tracts. The first is net employment loss. It proxies the extent of labor market bust and workers usually suffer higher unemployment risk when net employment loss expands (Reichert, 1990; Baffoe-Bonnie, 1998; Johnes and Hyclak, 1999; Hwang and Quigley, 2006). The second measure for job losses is job destruction (Davis and Haltiwanger, 1999). At each census tract, the job destruction represents employment losses summed over all establishments that contract or shut down between time t-1 and t. This measurement provides information on the job turnover within the census tract, and two census tracts with exactly the same employment change could have quite different job destructions and creations.[29] Given the QCEW data I have, I compute job destruction during 2007 Quarter 2 – 2008 Quarter 2 and 2008 Quarter 2

[29] Hall (1995) and Davis et al. (1996) find close connection between increases in job destruction and increases in unemployment rate, especially for workers who consider themselves permanently laid off. Job destruction has been used extensively in measuring the job loss (Hall, 1995 and 1999).

– 2009 Quarter 2.[30] The difference between job destruction and job creation is the net employment change, as indicated by the following equation.

Job Destruction = Job Creation – Net Employment Change

The third measure for job losses is the job destruction due to firm closures. This actually captures a part of the job destruction discussed above. I employ this measure to avoid the potential endogeneity, because a homeowner's job loss and foreclosure could be both caused by other reasons including health problems and other accidents. Job loss due to the closure of an establishment, however, should be considered as an exogenous shock (Kuhn et al., 2009).

I collect a set of control variables used in (4). They capture three kinds of factors: housing price change, subprime mortgages and household characteristics. Housing price depreciation could generate negative equity in mortgages, and is closely associated with the increase in mortgage defaults and foreclosures (Christopher et al., 2009). Although unable to estimate housing equity due to the data limitation, this research controls for the 3-year house price change at the county level, using the data from Maryland Department of Planning. I control for subprime characteristics because subprime mortgages are more likely to end up in foreclosure than prime purchase mortgages (Gerardi et al., 2009). The subprime characteristics are represented by four different variables. The first one is the share of high cost and

[30] The measurement over the same quarter or month helps avoid seasonal adjustments in establishments' employment. I do not have the unique id of establishments in QCEW data before 2007, so I can only measure job destruction since 2007 Quarter 2.

high leverage loans during 2004 – 2007, a period when subprime lending peaked.[31] This variable is expected to be positively correlated with foreclosures. The second one is the share of originations that were second lien mortgages and the third one is the share of originations for refinancing during 2004-2006. Those two variable are created using HMDA data. Multiple liens increase the combined loan to value ratio, and are found to increase mortgage defaults (Bajari et al., 2008; Elul et al., 2010).[32] The fourth variable is the credit score of borrowers, which is widely employed for subprime lending (Bajari et al., 2008; Foote et al., 2008; Gerardi et al., 2009). I obtain credit scores (FICO) from Equifax, and measure the share of low-score borrowers with scores less or equal to 639 in 2006.

I control the household characteristics at the census tract level, obtained from 2000 Decennial Census. I include a variable on the share of minority population, which is expected to be positively associated with foreclosures (Guiso et al., 2009; Sherlund, 2009; Chan et al., 2011); I include a variable on the share of residents with bachelor degree or above, which is expected to be negatively associated with mortgage defaults and foreclosures (Bajari et al., 2008; Sherlund, 2009); and I include a variable on average household size, which is expected to be positively associated with foreclosures (Bajari et al., 2008). Finally, I include the median age. It is

[31] Only few subprime loans have been originated since mid 2007 (Lewis, 2011). High cost means annual percentage rate interest 3 percentage points or more over prevailing Treasury rates at the time of origination, and high leverage refers to the income leverage used by borrowers to obtain the loan (HUD, 2008). This variable is created by HUD using HMDA database.

[32] The literature yields a mixed result on the impact of refinancing on foreclosures. Chan et al. (2011) find home purchase loans have higher default rates than refinances, possibly because refinancers have longer housing tenure. Similarly, Gerardi et al. (2013) indicate refinances decrease foreclosures. Conversely, Towe and Lawley (2010) find a positive relationship between refinance and foreclosure, and suggest that the ratio of refinance loans captures the extent to which households have extracted equity from their houses.

expected to positively correlate with foreclosures, because older people are more likely to have health problems that are one type of trigger events.

Table 8 lists descriptive statistics of variables. It shows that the three job loss indices are measured differently, but do not have quite large differences in terms of the mean and standard errors. The housing price in Maryland started to decline during 2007-2008, but on average it was still higher than three years before. Subprime lending variables mostly cover the period of 2004-2006, when a large part of subprime mortgages were issued. About 11.8 percent of loans were given to borrowers with low credit scores, 12.5 percent had high cost and high leverage, 14.1 percent had second liens, and 58.1 percent were used to refinance. Demographic characteristics indicate that almost 30 percent population in Maryland are African Americans, almost one third population hold the bachelor degree or higher, median age is 36.9, and average household size is 2.6. Subprime lending variables, demographic characteristics, and housing units are all time invariant.

Table 8: Summary Statistics of Variables

	Variable	Vintage	Obs.	Mean	Std. Err.
Dependent	Log (number of foreclosures)	October 2007 - October 2009	2416	2.6577	1.1095
Job loss indices	Log (net employment loss)	2007-2009	2416	4.0742	0.6184
	Log (job destruction)	April 2007 - April 2009	2432	5.2866	0.6547
	Log (job destruction from the closure of establishments)	April 2007 - April 2009	2432	4.2835	0.6575
Housing	Three year county-level house price change	2007-2008	2416	0.2593	0.2074
	Log (housing units)	2000	2416	7.3520	0.5803
Subprime lending	Share of loans with low credit score (<639)	2006	2416	0.1183	0.1036
	Share of high cost and high leveraged loans	2004-2006	2416	0.1248	0.0741
	Share of loans that were second liens	2004-2006	2416	0.1410	0.0382
	Share of loans for refinance	2004-2006	2416	0.5813	0.1054
Demographic information	Share of African Americans	2000	2416	0.2970	0.3216
	Share of people with bachelor degree	2000	2416	0.3288	0.2036
	Log (median age)	2000	2416	3.5967	0.1477
	Log (household size)	2000	2416	0.9535	0.1462

3.5 Foreclosures and Job Losses in Maryland

House prices in Maryland are quite volatile in the past ten years. They increased from 2001 to 2006, and started to decline around 2007. The depreciation is strong in certain regions. For example, in 2009, the median price declined by 28% from the peak in Dorchester County, 26% in Caroline County, and 21% in Washington County. The housing price depreciation is accompanied by active foreclosures in the state. Figure 2 shows that housing foreclosures have a breakneck increase from 2006 in the state.[33] In 2006, only 3,366 properties started the foreclosure process with 3,475 foreclosure fillings, while in 2008, 25,254 properties started the foreclosure process with 37,606 fillings.

[33] My foreclosure data ends by October 2009, and could not show the total foreclosures during the whole year.

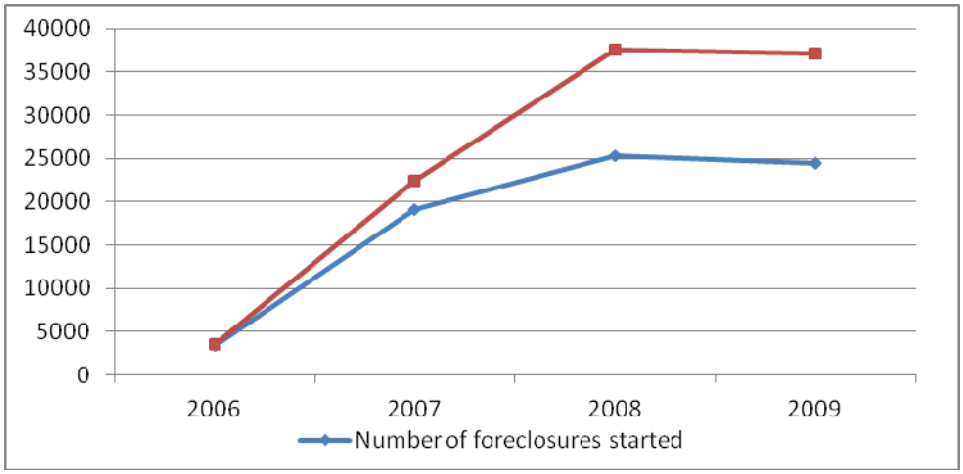

Figure 2: Housing Foreclosures in Maryland, 2006-2009

Maryland has a moderate rate of housing price depreciation but ranks high in foreclosures in the nation. From Maryland's house price peak of 2007 Quarter 2, the 5-year house price index is -21.72 in the state, close to the national average of -17.43 (data published by Federal Housing Finance Agency). In some states with highest foreclosure rates in the nation, such as Nevada, Arizona, Florida and California, their housing price indices was -55.15, -41.89, -40.29, and -40.09, respectively. Maryland ranks 13th in foreclosure rate in 2009 in the nation (RealtyTrac, 2010). The spatial variation of foreclosures is quite striking. Figure 3 shows that high foreclosure rates mostly cluster in Baltimore City and regions around Washington D.C., including Prince George's County and part of Charles, Frederick and Montgomery Counties.[34]

During the similar period when foreclosures rose, job loss also expanded substantially. In November 2007, the monthly unemployment rate in Maryland bottomed out at 3.1%, with 93,452 workers unemployed; in February 2010, the unemployment rate reached the peak of 8.6%, with 256,898 workers unemployed

[34] My data shows this spatial concentration did not change significantly over years.

(Figure 4, data published by BLS). During the period of 2006 Quarter 1 – 2007 Quarter 2, when the recent recession in labor market had not started, only 28% census tracts experienced the loss of total jobs, and these net losses were 13,019. During 2007 Quarter 2 – 2008 Quarter 2, however, 68% census tracts lost jobs, and these net losses increased to 132,809, ten times as big as the net loss one year before.

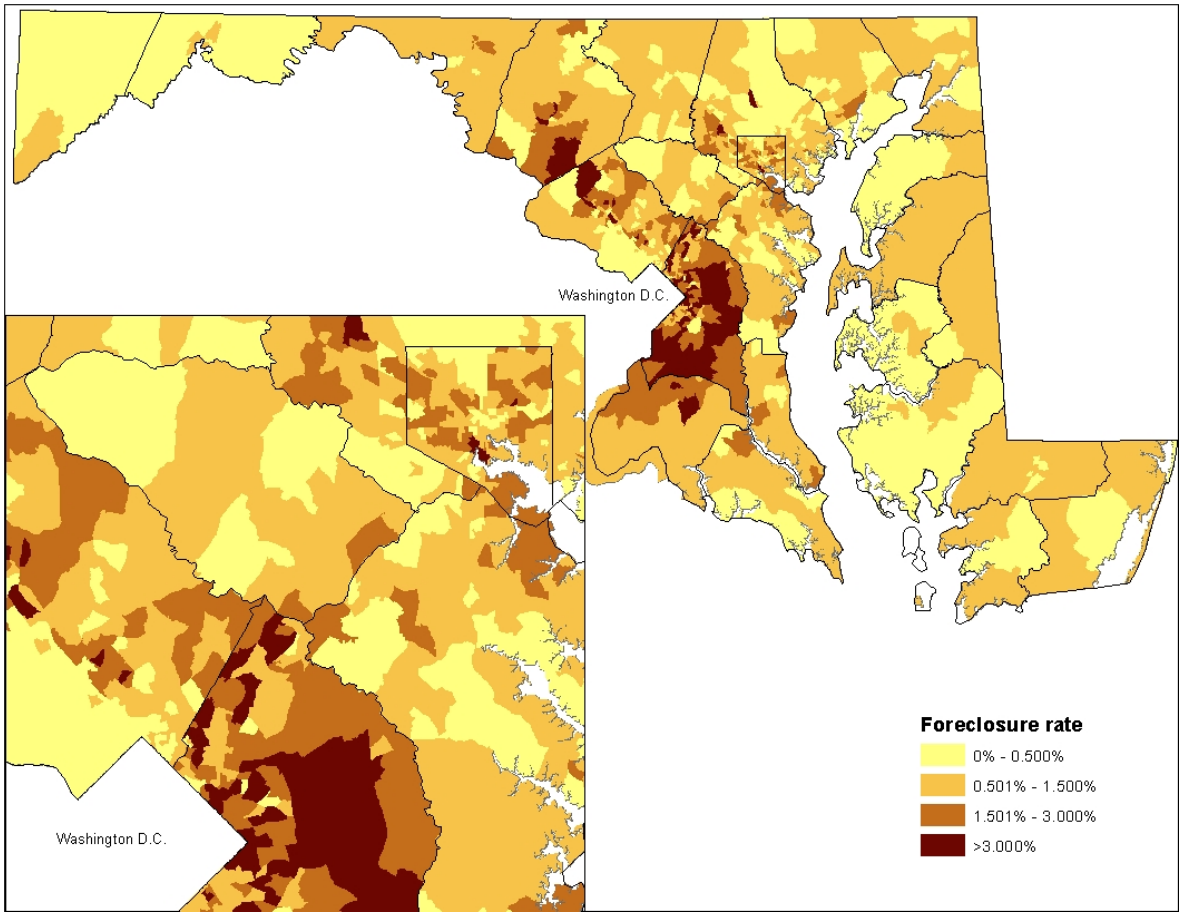

Figure 3: Foreclosure Rate in Maryland, 2008

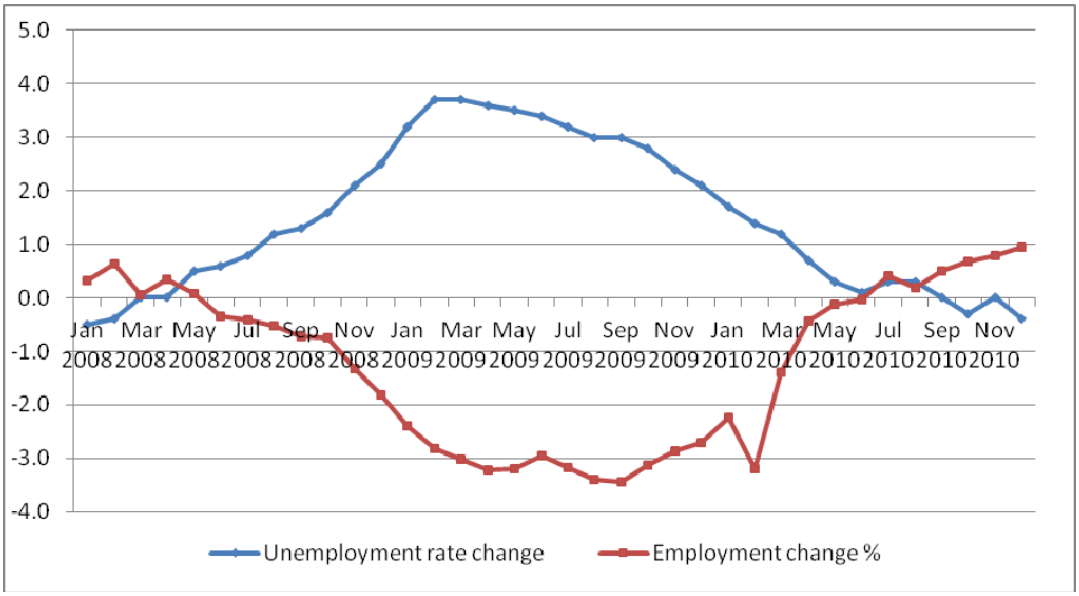

Figure 4: Changes of Employment and Unemployment Rate in Maryland

Source: Bureau of Labor Statistics

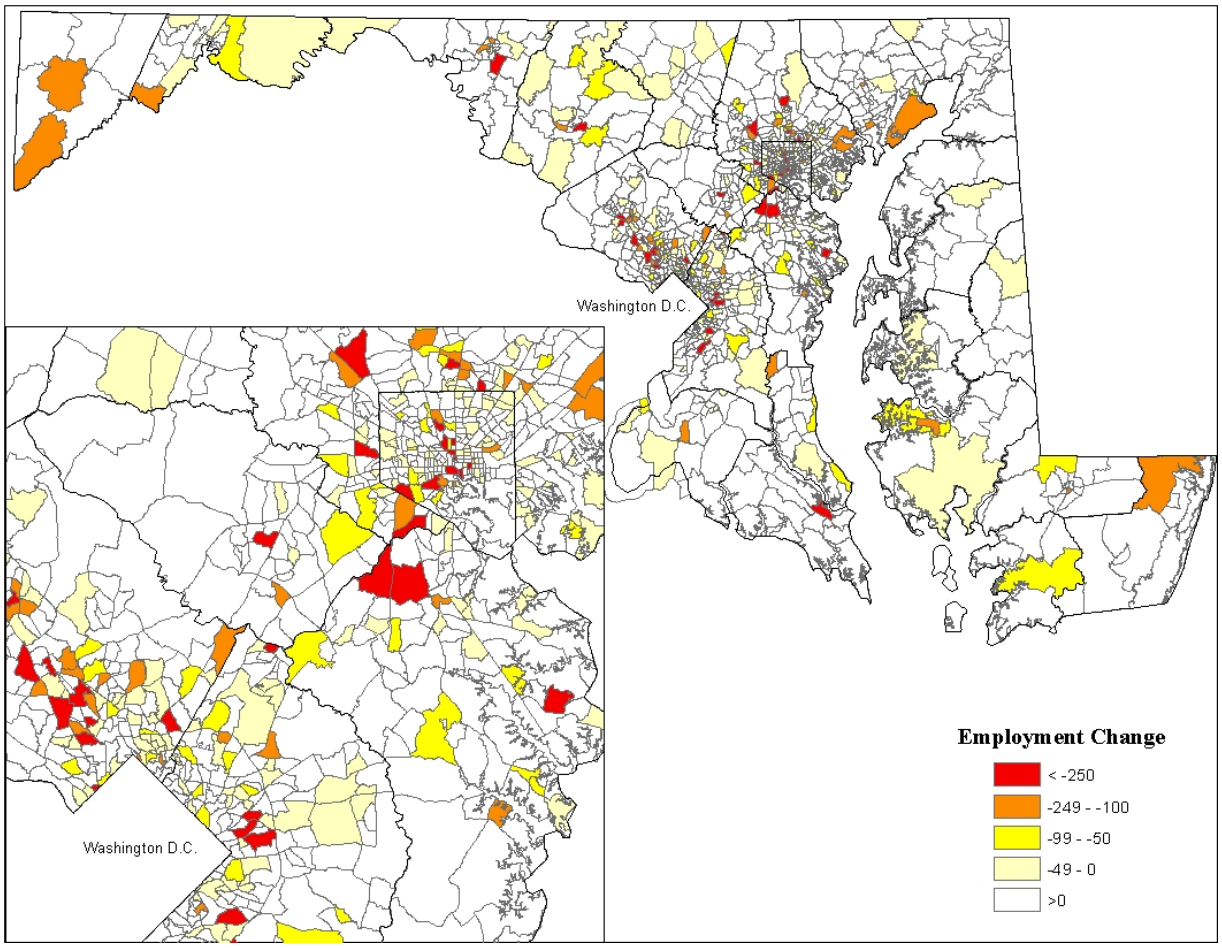

Figure 5: Employment Change, 2006 Quarter 1 - 2007 Quarter 2

Data source: QCEW data.

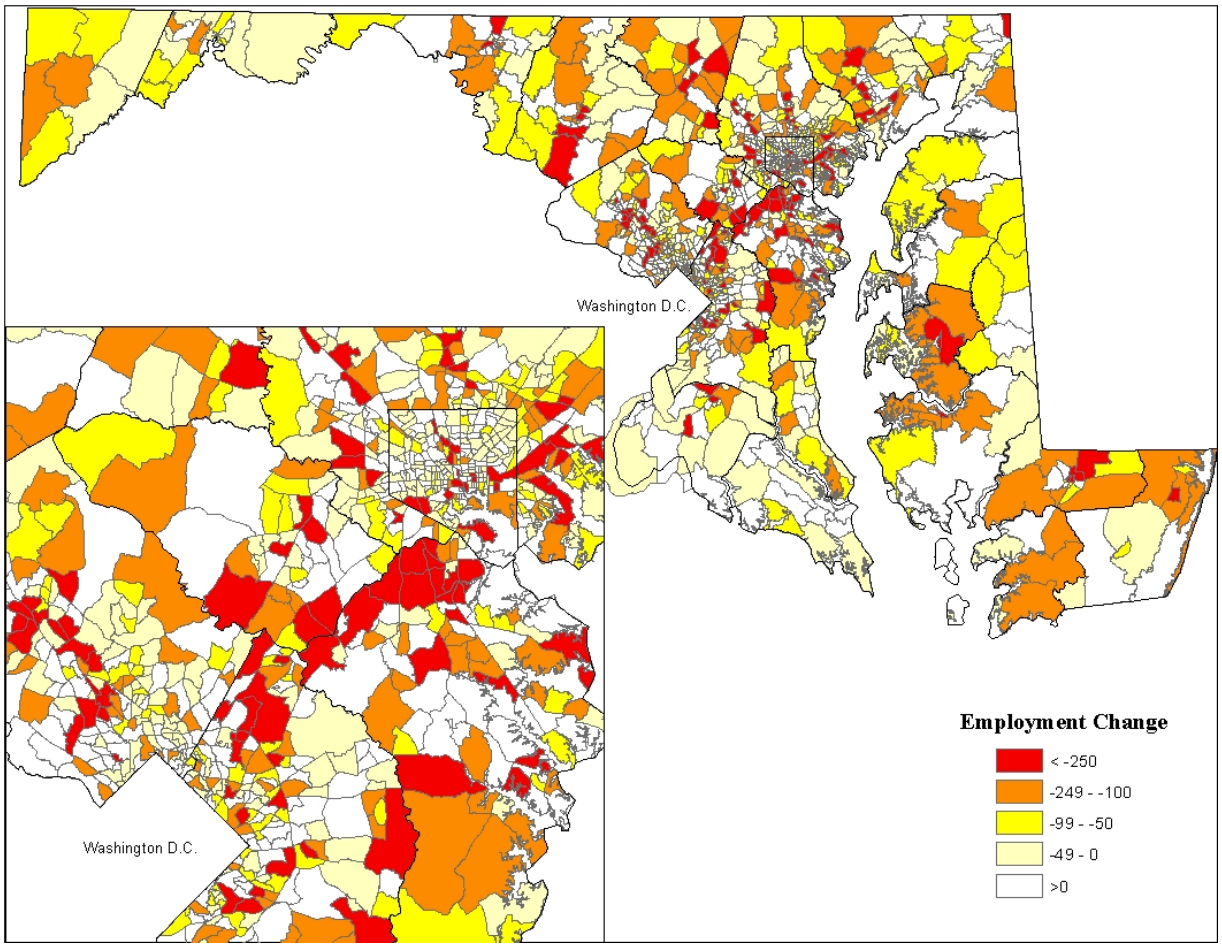

Figure 6: Employment Change, 2008 Quarter 2 - 2009 Quarter 2

Data source: QCEW data.

Figure 5 and 6 illustrate the wide spatial variation of employment changes in Maryland in those two different periods. As shown in Figure 6, a lot of job losses clustered around Baltimore City and Washington D.C. suburbs. A close comparison of Figure 2 and Figure 6 leads to conclude that 1) job losses and foreclosures usually do not occur at the same locations (census tracts); and 2) some sorts of geographic patterns or connections between locations of job losses and locations of foreclosures may exist.

Table 9 presents the commuting pattern in Maryland, by the number of workplaces people travel to. The amount of commute destinations is considerable. 88.2 percent of tracts, accommodating 93.5 percent of workers, have more than 50 workplaces to commute; 58.0 percent of tracts, accommodating 73.6 percent of workers, have more than 100 workplaces to commute. On average, people living in one tract travel to 131 tracts for work. Only one tract in Baltimore County does not have any residents commuting to other places, and workers living from one tract in Ann Arundel County commute to 284 tracts spread over eight states.[35] The extent to which jobs and workers are spatially mismatched is inversely correlated with the size of geographic areas. CTPP 2000 indicates that in Maryland, only 3.6 percent ofworkers live and work in the same tract, and 43.8 percent live and work in the same county.

Table 9: The Commuting Pattern in Maryland by Census Tracts

Number of workplaces	Number of home tracts	Share	Associated workers	Share
1-50	143	11.79%	165,127	6.47%
51-100	366	30.17%	507,728	19.90%
101-150	449	37.02%	1,004,202	39.37%
151-200	217	17.89%	703,286	27.57%
201-250	33	2.72%	144,252	5.66%
251-284	5	0.41%	26,261	1.03%
Total	1,213	100.00%	2,550,856	100.00%

Data source: CTPP 2000

Although significant portions of population and jobs in Maryland are located in areas within the D.C. metropolitan areas, the majority of Maryland's workers have jobs located in the same state. For instance, nearly 83% of all Maryland's workers

[35] These states are Delaware, D.C., Georgia, Maryland, North Carolina, Pennsylvania, South Carolina and Virginia. 76.8 percent of these workers commute within Maryland, but in 11 different counties.

hold jobs in Maryland (Table 10). Out of Maryland's workers who commute to outside Maryland for jobs, nearly two-thirds commutes to D.C. It is interesting to find out that it was the presence of strong federal agencies and the economic stimulus program had helped D.C. to gain job growth during the 2008 economic recession while all adjacent states lost employment. For instance, from 2007 to 2009, number of jobs increased by 2.2 percent in D.C., while in surrounding states, it shrank by 5.4 percent in New Jersey, 5.3 percent in Delaware, 3.5 percent in Maryland, and 3.4 percent in Virginia(data published by BEA). Those figures suggest that Maryland's workers are less affected by job losses in other adjacent states. Excluding data/areas outside Maryland in my analysis thus will have little effect on empirical results and general conclusions with regard to the impact of job losses on foreclosures.

Table 10: The Commute Pattern of Maryland's Workers across States

	# of workers	Share
live in Maryland total	2,550,856	100%
Live in Maryland and work in…		
Maryland	2,109,258	82.7%
D.C.	275,287	10.8%
Virginia	112,953	4.4%
Delaware	23,090	0.9%
Pennsylvania	12,516	0.5%
West Virginia	4,721	0.2%
New Jersey	1,895	0.1%
Others	11,136	0.4%

Data source: CTPP 2000.

Time lags should be considered while examining the connection between job losses and foreclosures because the foreclosure process usually starts several months after the mortgage default. Lender Processing Services (LPS) data indicates 5-7 months delay on average from the first time 60+ days payment late until foreclosure

notice is issued during 2006-2009, and the delay keeps rising over time (Herkenhoff and Ohanian, 2012). At the beginning of 2008, the foreclosure started 233 days, or nearly eight months, on average after delinquency (Lewis, 2011). As initial delinquencies should occur almost three quarters before the foreclosure process, I need to measure job loss with time lags when examining its impact on foreclosures.

3.6 Results

Different estimates on the effect of job losses on foreclosure are carried. The first one is from OLS estimates. The second one is from IV estimates in order to capture the attenuation bias from the classical measurement errors. Finally I check the robustness of my results with different specifications of foreclosure delays as well as function forms.

Two econometric issues arise. One is associated with the choice between random effects vs. fixed effects. In my estimates, I choose random effects for the following reasons. First, most of my explanatory variables are time invariant, and their coefficients could not be estimated under fixed effects. Second, most of the explanatory variables for foreclosure activity are already controlled, and I would expect very few, if any, missed variables that could be captured by fixed effects at the census tract level. Third, choosing between fixed effects and random effects is a tradeoff between omitted variable bias and measurement error bias (Hauk and Wacziarg, 2009). If the unobserved heterogeneity at the census tract level is trivial as I expect, and the measurement error could be significant as I will discuss later, then random effects should be a better choice.

The other is related to the concern of endogeneity of job loss, since job loss can be caused by the melting down of housing markets. Specifically, an increase in foreclosures may hurt local financial and real estate industries and cause local layoffs. Subprime crisis is one of the causes of the recent depression with historically high unemployment rate and layoffs (Tatom, 2010). The causation from foreclosures to job loss, however, is less certain in this research since foreclosure process takes time (it lasts at least 5-7 month during 2008-2009) and many of distressed borrowers cured (Herkenhoff and Ohanian, 2012). Thus I believe that using data on job losses occurred three quarters before the start of the foreclosure process helps us to avoid the potential endogenous problem. In other words, the connection of foreclosures to job losses occurred three quarters ago is considered to be weak, if present. In addition, job loss may be caused by regional trends that may be indirectly influenced by housing market bust, but less likely affected by foreclosure at microscope level such as census tract.

3.6.1 OLS Estimates

OLS estimation results with random effects are reported in Table 11. As expected, I find a positive effect of job loss on foreclosures. The results show that the variable of job loss vulnerability index has positive and significant coefficients when it is calculated by three different job loss measures. The coefficients suggest that a one per cent increase in the index value of job loss vulnerability by net employment loss is associated with 0.42 percent increase in foreclosures; a one per cent increase in the index value of job loss vulnerability by job destruction is associated with 0.47 per cent increase in foreclosures; and a one percent increase in the index value of job loss

vulnerability by job loss due to firm closures is associated with 0.28 percent increase in foreclosures. Since job destruction contains more information on local job turnover, its higher elasticity than using net employment loss is expected. The same logic holds for job loss by establishment closures. Since job loss by firm closures represents a fraction of total job destruction, a smaller elasticity of job loss vulnerability is expected.

Table 11: OLS Estimates of Effects of Job Loss on Foreclosures

Dependent variable: Log (number of foreclosures three quarters later)						
	(1)		(2)		(3)	
	Coef.	t value	Coef.	t value	Coef.	t value
Log (net employment loss)	0.4211	(6.55)				
Log (job destruction)			0.46867	(5.41)		
Log (job destruction due to establishment closure)					0.2841	(4.24)
County level house price change rate from 3 years ago	-0.4527	(-5.45)	-0.4875	(-5.89)	-0.5551	(-6.63)
Share of low FICO score	1.0879	(2.41)	1.1464	(2.53)	1.0069	(2.15)
Share of high cost and high leverage loans	1.7704	(0.80)	1.9777	(0.88)	1.9586	(0.87)
Share of originations that are second liens	8.5747	(5.16)	8.1925	(4.8)	8.6189	(5.02)
Share of loans for refinance	0.2057	(0.21)	0.1039	(0.1)	0.3099	(0.31)
Log (housing units)	0.5057	(6.91)	0.4710	(5.15)	0.6199	(7.22)
Share of African American	0.7764	(3.65)	0.8763	(4.15)	0.8124	(3.85)
Share of people with bachelor degree	-0.5559	(-2.56)	-0.4652	(-2.12)	-0.5679	(-2.58)
Log (average household size)	1.2449	(5.46)	1.2147	(5.28)	1.3569	(5.82)
Log (median age)	0.8990	(3.81)	0.8763	(3.72)	0.8471	(3.49)
Year dummy	YES		YES		YES	
obs.	2416		2416		2416	
R-sq	0.59		0.56		0.55	

Notes: t values are computed based on robust standard errors. There are 64 samples with zero foreclosure, and I arbitrarily use Log (foreclosure+0.5) for them when computing the dependent variable.

Estimated results show that many of other explanatory variables have expected signs of coefficients at significant level of 99%. The coefficient of housing units is positive at 99% significant level, controlling the neighborhood size. The

magnitude of the coefficient implies that a one per cent increase in housing price depreciation rate is associated with 0.11-0.14 per cent increase in foreclosure. This small effect of housing price rate change is consistent with the finding by Towe and Lawley (2010) in Maryland.

Table 11 leads to mixed conclusions on the effects of loan characteristics. The FICO score has positive coefficients across three columns at the 5% significance level. Increasing the share of borrowers with low credit scores by one percent will generate 0.12-0.14 percent increase in foreclosures. The share of high cost and high leverage loans as well as the share of loans for refinance has an insignificant coefficient, respectively, suggesting these two factors have little impact on foreclosures in Maryland. The second liens have a strong effect on foreclosures, whose coefficient implies that a one per cent increase is associated with 1.16-1.22 per cent increase in foreclosures. This result is consistent with the findings by Bajari et al. (2008).

As expected, foreclosure increases with the share of minority population, decreases with the share of higher education population, increases with average household size and median age. Those results are quite significant and robust.

3.6.2 IV Results

Measurement errors in job loss data need to be acknowledged for the following two reasons. First, spelling errors or missing physical addresses of establishments and the geocoding systems all produce blockcoding errors. This type of errors is mostly small in distance but large in frequency (Anderson et al. 2008).

This happened to both LEHD and QCEW data. Second, in order to protect confidentiality, LEHD adjusted the employment data by workplace and synthesized the OD matrix, and CTPP rounded up its commute data, which I use to connect the workplace and the residence. They together generate measurement errors in my job loss indices. Both Angrist and Krueger (1999) and Hausman (2001) state that the classical measurement error that is uncorrelated with other regressors causes attenuation bias, or biases the estimated coefficients toward zero. This bias could be addressed by employing an alternative noisy measure as an instrument, as long as the measurement errors in the instrument and the problematic variable are independent.

I build instruments for job loss variables in the following way. Since LEHD and QCEW data were geocoded independently by different entities using different software, and QCEW data was not adjusted for confidentiality, I believe these two data contain independent measurement errors in job loss by workplace. Thus job loss indicators from LEHD could instrument for job loss indicators from QCEW, vice versa. In order to capture measurement errors from the commute data that connect job loss at workplace to the corresponding residential neighborhoods, I use the OD matrix from LEHD as the instrument for the commute data in CTPP 2000. The OD data is synthesized based on the real commute data, so it should be strongly correlated with the commute data in CTPP. The two data sources are collected by different entities and use different methods in confidential protection, so I believe their measurement errors should be uncorrelated.[36] The 2SLS estimation results with

[36] Actually, if some correlation between the measurement errors still exists, I at least capture a large part of the attenuation bias. In that case, the estimated impact of job loss is considered as conservative, or may be slightly smaller than the real impact.

instrument are presented in Tables 12 and 13. Table 12 presents the first-stage estimates, showing that the net employment loss from LEHD data is highly predictive to job destruction variables created by QCEW data; similarly, job destruction is also strongly correlated with net employment loss, supported by the large coefficient, t value, and F statistics. Table 13 presents the results of 2SLS estimates. It shows that the magnitude of the effects of job loss on foreclosure increases substantially after correcting the measurement errors, as expected. Specifically, the elasticities of job loss vulnerability for net employment loss increased from 0.42 of OLS estimates to 0.85 of 2LSL estimates; for total job destruction increased from 0.47 to 0.87; and for job destruction due to firm closure increased from 0.28 to 0.77, respectively. These results suggest strong impact of job loss on foreclosures. Other explanatory variables more or less lose significance in Table 13, because IV estimation generally enlarges their standard errors. But most of the explanatory variables still keep the signs that are consistent with my expectations.

Table 12: First Stage Estimates: Net Employment Loss as an Instrument for Job Destruction

	Coef.	t value
Use net employment loss as instrument for job destruction:		
Log (net employment loss)	0.7342	(54.88)
F-statistics	142.7	
Use net employment loss as instrument for job destruction from dead establishments:		
Log (job destruction from dead establishments)	0.8314	(52.34)
F-statistics	157.0	
Use job destruction as instrument for net employment loss:		
Log (job destruction)	0.7575	(54.88)
F-statistics	143.8	

Notes: all other explanatory variables for foreclosures are controlled but not reported.

Table 13: 2SLS Estimates of Effects of Job Loss on Foreclosures

Dependent variable: Log (number of foreclosures three quarters later)						
	(1)		(2)		(3)	
	Coef.	t value	Coef.	t value	Coef.	t value
Log (net employment loss)	0.8520	(6.33)				
Log (job destruction)			0.871853	(7.35)		
Log (job destruction due to establishment closure)					0.7700	(7.19)
3-year county house price change rate	0.0327	(0.16)	-0.0415	(-0.22)	-0.2537	(-1.39)
Share of low FICO score	0.9700	(1.96)	1.0795	(2.17)	0.7602	(1.46)
Share of high cost and high leverage loans	1.8119	(0.81)	2.1821	(0.96)	2.3932	(1.03)
Share of originations that are second liens	8.1284	(4.49)	7.5108	(4.21)	7.8385	(4.36)
Share of loans for refinance	-0.0891	(-0.09)	-0.2265	(-0.22)	-0.0303	(-0.03)
Log (housing units)	0.1700	(1.39)	0.1605	(1.47)	0.2460	(2.36)
Share of African American	0.8297	(3.88)	0.9987	(4.42)	1.0050	(4.43)
Share of people with bachelor degree	-0.5206	(-2.44)	-0.3580	(-1.70)	-0.5261	(-2.45)
Log (average household size)	1.0774	(4.63)	1.0578	(4.45)	1.2197	(5.28)
Log (median age)	1.0208	(4.18)	0.9575	(4.08)	0.9700	(4.00)
Year dummy	YES		YES		YES	
obs.	2416		2416		2416	
R-sq	0.55		0.55		0.53	

3.6.3 Robustness Check

I use two different approaches to check the robustness of my estimates. In the first approach, different time lags are used to reflect foreclosure delays whereas in the second approach different function forms are used to estimate function (4).

Although the average time from the first delinquency to the start of foreclosure process is 7-9 months in my study period, there is a wide variation of this duration across counties. For instance, in March 2011, the average duration from last payment to Notice of Intent to Foreclosure (NOI) ranges from 59 days in Garrett

County to 171 days in Montgomery County.[37] To reflect the impact of inconsistent foreclosure delays, I use three different time lags. They are one-quarter and two-quarter delays, and their results are compared with those of three-quarter delay. Table 14 reports the estimates with one quarter and two quarter lags.[38] Comparing Table 14 with Table 11 and 13, I obtain two main findings. The first one is that results are robust with regard to the effect of job loss on foreclosures. All the key variables are positive at 99% significant level. The second finding is that the 2SLS estimator yields larger coefficients than the OLS estimator. This result is consistent for different time lags, leading to conclude that OLS estimates bias the job loss effect toward zero if measurement errors are present. It is interesting to note that there is not a general pattern about the effects of job loss on foreclosure with respect to time lag/delay for foreclosure.

[37] Maryland's emergency bill signed in April 2008 requires lenders to wait 45 days after default before issuing an NOI, and 90 days after default before filling for foreclosures. See http://dllr.maryland.gov/finance/industry/pdf/noirptmar2011.pdf

[38] Because my foreclosure ends in the third quarter of 2009, I am unable to implement foreclosure delay of four quarters.

Table 14: Robustness with Different Foreclosure Delays

Dep: Log (number of foreclosures with the delay of…)		
	1 quarter	2 quarter
OLS Estimates		
Log (net employment loss)	0.2671	0.3723
	(4.87)	(5.72)
Log (job destruction)	0.5964	0.5210
	(7.03)	(6.06)
Log (job destruction due to establishment closure)	0.3721	0.3344
	(5.42)	(4.90)
IV 2SLS Estimates		
Log (net employment loss)	0.7137	0.6587
	(4.22)	(4.32)
Log (job destruction)	0.8452	0.8424
	(6.69)	(7.07)
Log (job destruction due to establishment closure)	0.7268	0.7649
	(4.11)	(3.95)

Notes: other explanatory variables are controlled but not reported here. t value based on robust standard errors are reported in the parenthesis.

Table 15: Robustness with Linear Models, IV 2SLS

Dependent variable: number of foreclosures three quarters later						
	(1)		(2)		(3)	
	Coef.	t value	Coef.	t value	Coef.	t value
Net employment loss	0.4252	(9.20)				
Job destruction rate			0.0256	(1.90)		
Job destruction rate due to establishment closure					0.1636	(12.76)
County level house price change rate from 3 years ago	-18.4809	(-7.18)	-16.3382	(-7.69)	-7.0076	(-2.14)
Share of low FICO score	-3.1697	(-0.32)	1.3910	(0.19)	-6.9791	(-1.17)
Share of high cost and high leverage loans	99.7694	(8.06)	93.1863	(9.79)	99.7894	(13.53)
Share of originations that are second liens	79.5176	(3.92)	129.9382	(7.99)	117.5964	(10.16)
Share of loans for refinance	-36.4996	(-4.91)	-21.8674	(-3.67)	-25.9601	(-6.04)
Share of African American	27.1486	(8.67)	20.1344	(7.95)	22.8426	(12.23)
Number of housing units	-0.0003	(-0.25)	0.0072	(6.54)	0.0049	(10.34)
Share of people with bachelor degree	1.6063	(0.40)	2.8838	(0.95)	0.3534	(0.15)
Average household size	8.2857	(4.47)	12.9835	(9.15)	12.8556	(12.23)
Median age	0.7007	(4.91)	0.3082	(2.80)	0.4397	(5.45)
Year dummy	YES		YES		YES	
obs.	2416		2416		2416	
R-sq	0.43		0.49		0.48	

Notes: t values are computed based on robust standard errors.

Table 16: Robustness with Poisson Model, IV GMM

Dependent variable: number of foreclosures three quarters later						
	(1)		(2)		(3)	
	Coef.	t value	Coef.	t value	Coef.	t value
net employment loss rate	0.0161	(14.75)				
job destruction rate			0.0031	(6.03)		
job destruction rate due to establishment closure					0.0056	(2.91)
County level house price change rate from 3 years ago	-1.2020	(-11.31)	0.0884	(0.81)	-0.3058	(-3.45)
Share of low FICO score	2.2184	(5.18)	2.1100	(4.99)	2.1369	(4.88)
Share of high cost and high leverage loans	6.1663	(8.44)	6.5177	(8.56)	6.1840	(7.90)
Share of originations that are second liens	6.5378	(5.19)	7.0667	(5.43)	8.1503	(6.22)
Share of loans for refinance	-2.1466	(-4.59)	-1.9062	(-4.00)	-1.5203	(-3.25)
Number of housing units	0.0000	(1.87)	0.0002	(2.35)	0.0003	(2.56)
Share of African American	0.5636	(5.52)	0.3808	(3.68)	0.3558	(3.00)
Share of people with bachelor degree	-0.0138	(-0.09)	0.0846	(0.62)	-0.0316	(-0.23)
Average household size	0.3139	(4.57)	0.4697	(6.83)	0.5373	(7.06)
Median age	0.0278	(6.65)	0.0256	(6.01)	0.0225	(5.08)
Year dummy	YES		YES		YES	
obs.	2416		2416		2416	

Notes: t values are computed based on robust standard errors.

Table 15 presents estimates using a linear function form instead of the log-log form, in order to check whether different function forms significantly change my results. Estimated results are basically consistent with my main findings. First, I observe positive coefficients for the three job loss variables, though one of them in column (2) is not significant at 5% level. A one percent rise in job loss indices by net employment loss, job destruction and job destruction from establishment closure increases foreclosures by 1.26 percent, 0.26 percent and 0.61 percent, respectively. Second, many other explanatory variables obtain expected coefficients with high significance. Compared to results in Table 11, some loan characteristics including high cost and high leverage loans and share of refinance become significant, while the

share of low FICO score, the share of people with bachelor degree, and housing units lose significance in some or all columns. Other variables have the same signs with similar significance. Finally, both of the log-log and linear function forms in Table 11, 13 and 15 show strong prediction power. The R square ranges from 0.53 to 0.59 in Table 11 and 13, and 0.43 to 0.49 in Table 15(a).

In Table 16 I use Poisson Model, because when the dependent variable is count data, the linear model may be biased. After comparing these results with former ones, I obtain following findings. First, all the three key variables are positive and significant at 1% level after I correct the potential bias from linear model. A one percent rise in job loss indices by net employment loss, job destruction and job destruction from establishment closure increases foreclosures by 1.12 percent, 0.74 percent and 0.49 percent, respectively. Second, most of other explanatory control variables gain high significance compared to the log-log and linear function forms. Only the education variable is not significant. Overall, the comparisons between these results imply that the strong job loss effect on foreclosures found in this paper is quite robust.

3.7 Conclusions

The interactions between labor market and housing market are of great importance to policy scholars and policy makers. But the spatial separation of job locations and residential locations makes it difficult to examine the interactions. Based on job loss vulnerability index developed in this paper, I am able to link housing market to labor market at the disaggregated level. I believe that it helps us to

better understand the effect of job loss on foreclosures. More importantly, this index is calculated from secondary data that are widely available throughout USA metropolitan areas and my approach can be applicable in similar researches in other regions.

Using the job loss vulnerability index, this paper examines the effect of job loss on foreclosures at census tracts. Using both the OLS and 2SLS estimators, I conclude that the effect of job loss on foreclosures is strongly present in Maryland and the effect is found to be greater than other studies using state or county data on unemployment. More specifically, my results show that a one percent increase in job loss increases foreclosures in corresponding residential neighborhoods by about 0.85 percent. I also find that measurement errors can lead to substantial attenuation bias toward zero. The general conclusion of job loss effect on foreclosures holds when different measures of job loss are used. To check the robustness, different approaches are used and I find that the general conclusion about the positive and significant job loss effect on foreclosures is upheld. For instance, this effect is unlikely subject to the time lag or foreclosure delay. Finally, my study on the linkage between job loss and foreclosures can be used to support the "double trigger" theory. Therefore, a reduction in trigger events such as job loss is critical to target at stable housing markets and neighborhoods.

Chapter 4: Do Off-Budget Revenues Have the Same Expenditure Behaviors as On-Budget Revenues? Evidence from Chinese Cities

4.1 Introduction

Economic and fiscal decentralization in China in the past three decades has proved to be fruitful, as implied by outstanding performance of major macroeconomic indicators (such as GDP, per capita GDP and per capita income).[39] Decentralization, however, can weaken fiscal control and raise local competition that may in turn increase off-budget activities, particularly when local officials face tight budgetary constraints (Thomas 2006; Peterson and Kaganova 2010).[40] Off-budget revenues have grown so rapidly that they have become a critical source of public operations for subnational governments in China (Eckaus 2003). Land revenues, the largest source of off-budget revenues, for instance, were equivalent to 38.9 percent of total fiscal revenues in subnational governments in 2006.[41] As intergovernmental transfers contribute 45 percent to total fiscal revenue on average, the ratio of land revenues to own tax revenues in subnational governments can be as high as 0.7.

[39] See Lin and Liu (2000) on the relationship between fiscal decentralization and economic growth in China.

[40] "Off-budget" or the so-called "extra-extra budget" revenues refers to "out-of-system," "unregulated," "off-record," and "self-raised" revenues in Chinese economic literature. Those terms are nearly identical (Fan 1998). The off-budget revenues derive from public land leasing and rentals and revenues from direct government undertakings and it is difficult to determine the magnitude of the off-budget revenues because of lack of systematic recording in fiscal system (Eckaus 2003).

[41] The number increased to 65.9% in 2010 (source: Pan, J. and J. Li, 2011, *Real Estate Bluebook*, Zhongguo Sheke wenxian Press, Beijing).

There are both benefits and costs associated with off-budget revenues. On the benefit side, off-budget revenues increase revenue flexibility that facilitates policy adjustments in response to changing circumstances, which is widely anticipated in the process of rapid urbanization, as is the case in China. Revenue flexibility is of particular importance when budgetary constraint is tight (Thomas 2006). Revenue flexibility is also important for capacity building, so that local governments can make more effective and intelligent policy decisions. There are many empirical studies that suggest a positive association between government spending and economic growth (Aschauer 1989; Barro 1990; Easterly and Rebelo 1993; Zagler and Dürnecker 2003; and Zhang and Zou 1989).[42]

On the cost side, off-budget activities can cause distortions on supply and demand in the local economy and erode fiscal control, damaging the effectiveness of government budgeting. A weakening of fiscal control undermines the role of budgeting in managing the economy and formulating public objectives and priorities (Schick 2007). Off-budget revenues are raised and used ad hoc, without the rigorous fiscal scrutiny that the tax structure is normally subject to. The lack of accountability and transparency associated with off-budget revenues leads to potential fraud, abuse, corruption, and the boondoggle of public resources (Bennett and DiLorenzo 1983; Ding 2007; Ma 2009; and Liu 2010). Furthermore, the fiscal risk of local government increases with off-budget revenues (Liu 2010).

[42] A few empirical studies, however, documents a negative correlation between capital expenditure, particularly in public investments in transport and communication, and real per capital GPD growth (Devarajan et al. 1996; Holtz-Eakin 1994; and Hulten and Schwab 1991).

Despite the importance to public policy and management, few empirical studies systematically examine the behaviors of off-budget activities largely due to the data unavailability (Joulfaian and Marlow 1991; Kraan 2004; and Schick 2007). Bennett and DiLorenzo (1982) implicitly support the notion that fiscal pressure would lead to the development of off-budget activities, based on a study on five states in the USA that exacted tax or expenditure limitations on local governments. Marlow and Joulfaian (1989) provide evidence that the size of off-budget activities is a function of the demand for total government activity. They also argue that local governments evade expenditure limitations, which may be caused by withering fiscal revenues of a declining economy or the regulation-imposed tax base shriveling, by placing governmental expenditures off-budget.[43] In a subsequent study, Joulfaian and Marlow (1991) find that, local governments suffering from strong constraints on fiscal budgets, or low levels of fiscal decentralization, can induce a large amount of off-budget activities as the substitution, and thus have stronger fiscal autonomy than it appears. Berument (2002) concludes that off-budget items have larger expansionary effects on the economy than budgetary items using Turkish national monthly data from 1988-2002.

Even though there are studies that show off-budget activities across Chinese cities are substantial (Ding and Song 2009; Liu 2010; Zhan 2011), the literature is by and large silent on expenditure behaviors and efficiency of public sectors. A few empirical studies focus on off-budget activities' consequences and association with fiscal decentralization. The work by Eckaus (2003) is perhaps the only published

[43] The 1993/1994 fiscal and tax reform in china, for instance, substantially altered tax revenue sharing between the central and subnational governments, causing tax base reduction at subnational levels.

paper examining the consequence of off-budget revenues in China by performing regression analysis on provincial data. Eckaus concludes that (1) off-budget revenues may impair the economic growth potential, but the magnitude of the impact is small and may increase with the economy; (2) there is no evidence suggesting that off-budget revenues are developed to correct market failures and to address income inequalities; (3) the off-budget revenues are an important source in supporting primary and secondary schools. Jin, Qian and Weingast (2005) find that subnational governments have an independent and discreet power in disposing off-budget revenues, implicitly suggesting that fiscal autonomy grows along with fiscal decentralization.[44] Work by Zhang and Zou (1998) and Jin and Zou (2005) show the importance of including off-budget activities in measuring the fiscal decentralization. Zhan (2011) explains that economic development and political stability are primary driving forces behind the central intervention in local off-budget practices.

This paper empirically examines expenditure patterns of off-budget revenues by asking two related research questions. The first is whether off-budget revenues affect the size and performance of public sector activities; and if so, what kinds of public sector activities are affected. The second question is whether there is a crowding out effect of off-budget revenues on budgetary expenditure. These questions are examined using three different estimations. The first is an accounting type regression analysis, which is used to explain the expenditure behaviors of budgetary revenues. The second is to estimate a demand-supply type of model to examine the crowding out effect of off-budget revenues on budgetary expenditures.

[44] Spending guidelines on land revenues have been developed since 2007 and more proceeds from land leasing have been channeled into farmland protection and reclamation initiatives.

The third is to estimate the size and performance of public sector activities with regressors of off-budget and budgetary revenues along with other control variables.

The paper is organized as the follows. Section 2 illustrates the fiscal pressure, land revenues, and urban development in China in general. Section 3 presents the model. Section 4 describes the data and variables while Section 5 discusses and interprets estimation results. Section 6 makes final remarks and draws conclusions.

4.2 Fiscal Pressure, Land Revenues and Urban Development in China

Off-budget revenues are usually driven by fiscal pressure, political motivation and a desire for flexible spending power by local governments. The former provides incentive for local governments to seek alternative sources to increase revenues, whereas the latter is important when the promotion of local officials is dependent upon local economic performance that can be enhanced by local spending powers.

4.2.1 Fiscal Pressure

Before 1993, the fiscal situation of subnational governments was better than that of the central government. The central government had been running a small but consistent fiscal deficit while subnational governments had been running a small but consistent fiscal surplus for most years (they had deficits only in six out of sixteen years from 1978 to 1993).[45] However, 1994 marks a turning point. After that year, the annual growth rate of the fiscal balance for both the central government and subnational governments are extraordinary, but in different directions (Figure 7). The

[45] There were only two years in which the central government's fiscal situation was better than that of subnational governments.

former has rapidly rising fiscal surplus whereas the latter ran into enormous deficits especially starting in 2001-2002 when fiscal pressure on subnational governments began to mount.

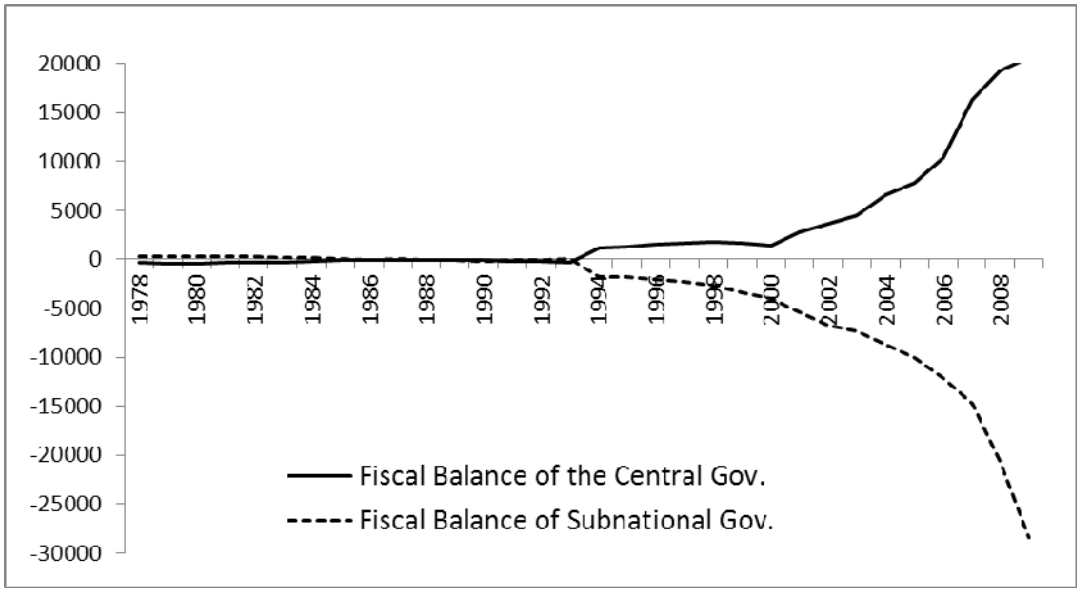

Figure 7: Fiscal Balance (100 Million RMB)

Data Source: China Statistical Yearbook

There is no systematic data available that reflects the magnitude of fiscal deficit at the city level. As a result, I use the ratio of intergovernmental transfers over city's own tax revenue as an indicator. For the 285 cities studied, the ratio steadily grew from just 1.10 in 1999 to 1.94 in 2006 (Figure 8). The trend of a rising intergovernmental transfer ratio is consistent for all city sizes except super-large cities. It is worth noting that the ratio for super-large cities declined while it increased significantly for small cities and towns. This suggests that small cities and towns received favorable treatment for intergovernmental transfers, perhaps

motivated by the preference for fiscal equalization over city size.[46] For large and medium sized cities, the ratios were close to the national average and their trends resembled the nation's pattern.

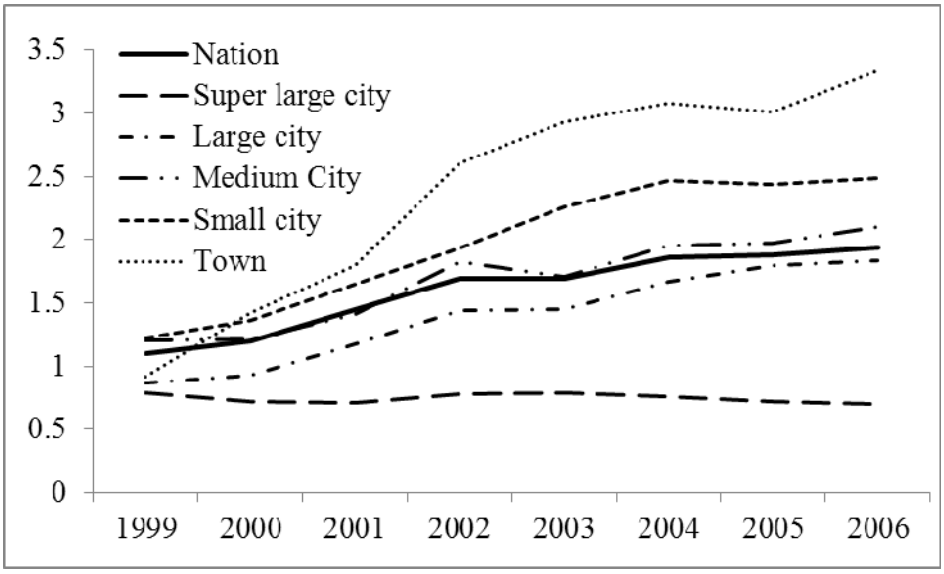

Figure 8: Ratio of Intergovernmental Transfer over Local Own Revenue

Data Source: China County Public Finance Statistical Yearbook

4.2.2 Land Institution and Land Market Development

The importance and dominance of land revenues in city finance has a lot to do with the unique land institution settings that empower subnational governments in land assembling and land markets. The following stylized facts illustrate the unique land institutions in China (Ding 2003; 2007).

[46] Fiscal equalization may also manifest in the trend of regional differentiation. There was little variance of the ratio of intergovernmental transfers over own revenues across regions (East, Central, and West) in 1999. But regional gaps started to increase since 2001. The ratio of transfers over own revenues in the west was about 2.85 times as big as in the east in 2006 whilst it was 1.77 times as big as in 2001 (Figure is not reported due to space limitation, but will be available upon requested).

- Land ownership is geographically divided. Land in cities (including towns) is owned by the state while land in rural areas is owned by collective communes residing on it.
- Land Use Rights system (LURs) introduced in late 1980s, which virtually is land leasing system, is applied to only land in cities and towns. That means land use rights and ownership cannot be separated in rural areas.[47] Land markets, which are land use rights markets, exist in cities and towns, not in rural areas.
- Use rights of state owned land can be leased out to developers and individuals who must pay land conveyance fees in a lumpy and upfront fashion. Leasing periods range 40-70 years, depending on land use types. Acting as the representative of the state, cities and countries are principle agents to lease land use rights as well as the beneficiary of land conveyance fees and land proceeds. Since land conveyance fees are virtually a sum of 40-70 leasing prices, the size of land revenues is remarkable.
- Because ofConstitution's ban on land development on a collectively owned land, in which the ownership must be converted via land requisition becomes a prerequisite for land development. [48] Acting as the State's representative, city and county governments are only authorized

[47] Limited access to land use rights on collectively owned land is permitted for the development of towns and village enterprises.
[48] Exception goes to the land development for the purpose of supporting and improvement of existing rural residents.

entities in land requisition, making them a monopoly-like agent in land supply for urban development.

Two main drivers for the rapid increase in land transactions of urban land markets are fiscal pressure and the desire for flexible land revenues. The development of land markets in China is characterized by three distinct periods. The first period begins with the adoption of LURs to 1999, marked by rapid development of land leasing activities but not land prices. For instance, there were 52,086 lots of 5,588 hectares for a unit price of around 480,000 per hectare in 1993. They grew at annual growth rates of 28.53 percent and 55.55 percent for a number of lots and total leased areas, respectively while land prices grew at a much lower pace, only 4.39 percent of the annual growth rate from 1993 to 1999.[49] The second period runs from 1999 to 2003 in which land prices skyrocketed. The annual growth rates for the number of lots and total areas were similar to the previous period, but land prices changed at an annual growth rate of 42 percent, ten times more the previous period. Unit land price increased from 660,000 RMB per hectare in 1999 to 2.68 million RMB per hectare in 2003. The third period is from 2004-2007 in which land markets were adjusted by a national effort to cool off land markets. The number of lots declined consistently at an average annual growth rate of -23 percent while the total areas leased declined from 2003-2005 and then resumed to grow from 2005-2007. Unit land price rose at about 18 percent of the annual growth rate.

[49] Data in the paragraph come from statistical yearbooks of land management.

4.2.3 Off-budget Revenues, Land Revenues, and Urban Infrastructure Financing

The off-budget expenditure remains by and large unreported. Despite enormous efforts and substantial progress on curbing off-budget levies, governments continue to raise large amounts of "self-raised funds" to support rising demand from industrialization and urbanization.

Off-budget revenues take different forms, ranging from fees and levies, commercial incomes, revenues from asset sales (not land), and land revenues from public land sales and rents. Although the number of financial sources for off-budget revenues (all others except land) is significant, their total size is not; particularly compared to land revenues which are the largest and most dominating source. Land revenues account for more than 80-90 percent of total off-budget incomes (including uncounted ones) for subnational governments, even taking into account the fact that it is difficult, if not impossible, to count all off-budget revenues.

Land revenues were only 2.69 billion RMB in 1993, but soared to 52.17 billion RMB in 1999, a remarkable annual growth rate of 63.91 percent. Land revenues increased at a much higher rate in the period from 1999-2003, growing to 1112.71 billion RMB in 2003. That is equivalent to a 115 percent of annual growth rate.

The importance of land revenues to local public finance is best illustrated in comparison to budgetary revenues. Figure 9 shows that land revenues were less than 20 percent of city own revenues before 2001. But they quickly jumped over 50 percent in 2003 and remained at that level thereafter. It also shows that the ratio

increases with city size. For super-large and large cities, for instance, land revenues were equivalent to 60-75 percent of city own revenues during 2003-2006 while the ratios were about 47-55 percent for medium cities and less 36-43 percent for small cities and towns. These figures were consistent with others studies that show land revenues were equivalent to 60 percent of total revenues at the city level.[50] Those patterns are consistent with other findings. Proceeds from land leasing in Beijing and Shanghai, the two largest cities in China, for instance, were equal to 40-50 percent of total fiscal revenue in 2009 (Liu 2010).

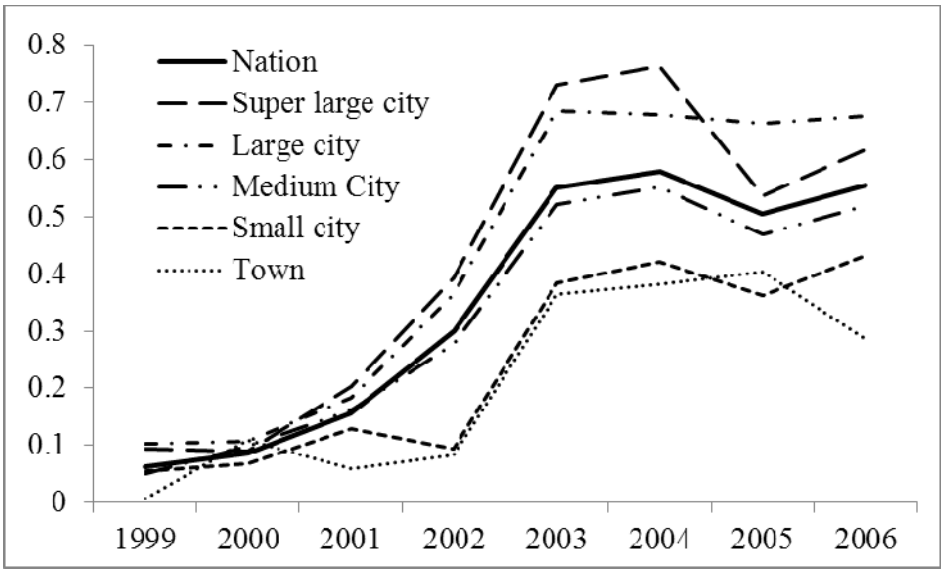

Figure 9: Ratios of Land Revenue over Local Own Revenue

Data Source: China County Public Finance Statistical Yearbook and China Land Resources Yearbook.

These numbers are more impressive taking into account the fact that the majority of land revenues were generated from just a fraction of total leased land.. It was not until 2004 when the State Council mandated that all land should be leased out through auction, open bidding and tender regardless of the type and purpose of land

[50] Source: http://www.mof.gov.cn/zhengwuxinxi/diaochayanjiu/200806/t20080620_47504.html.

development. Before 2004, only commercial development including commercial housing was leased through a competitive land market while other types of land uses were arranged through negotiation. Land leased to commercial development was a small fraction of total leased land. For instance, land areas that were leased for commercial uses through auction, open bidding, and tender accounted for less than a quarter of total leased land in 2000-2001. Land was usually provided to industrial development at either a much lower (than land market) cost or free of charge in order to boost investments, businesses, and tax bases at local levels (cities or counties).

The rapid growth of land revenues is jointly caused by (inflated) demand for housing and monopolistic operations of local governments in land leasing and land taking. The average price difference between payments to peasants in land requisition and prices charged to developers are in the order of a factor of 10-20. For instance, in one village in Fujian province, the local government paid about 10,000 RMB per *mu* to farmers and sold to developers for 200,000 RMB per mu if zoned industrial or for more than 750,000 RMB per *mu* if zoned residential (Investigating Group of Land Acquisition Reform of Ministry of Land and Resources 2003).[51] Land revenues dropped in the period of 2003-2005 but resumed growth in 2005-2007. [52]

Land revenues largely go to finance capital projects, particularly urban infrastructure in spatial expansion areas. Financing urban infrastructure through land leasing and bank loans securitized on land and property valuation accounts for 80–

[51] Mu is an area unit, which is 666.67 square meters.
[52] Total land conveyance fees dropped in 2008, reflecting the impact of the global economic crisis, but increased in 2009 and 2010. Land revenue dropping in 2003-2005 is largely because of the mandatory halt of land leasing by the State Council to cool off over-heated investments and economy in 2004. See Ding (2007) for socioeconomic issues related to land taking.

90% of infrastructure financing by subnational governments in China.[53] That is to say, cities can direct proceeds from public land leasing to finance urban infrastructure or use land as collaterals to borrow money. A survey shows that land financing directly (public land leasing) and indirectly (land used as collateral) accounted for 95-100 percent of the construction of urban spatial expansion in 2005 for Shaoxing and Jinhua in Zhejiang province (Ding 2007).[54] Land based infrastructure financing creates outstanding off-budget government liabilities that are more than 30 percent of GDP (Liu 2010), and most of the liabilities are related to land collateral.[55]

4.3 The Model

Three different models are estimated. The first model, serving the purpose of a reference, is an accounting model to estimate marginal share of each budgetary expenditure item. It is expressed as:[56]

$$E_{ijt}^{b} = h_i + k_t + \alpha_j R_{it}^{b} + u_{ijt} \qquad (1)$$

where R_{it}^{b} denotes the total budgetary revenues (including city own revenues and intergovernmental transfers) in city *i* at year *t*, E_{ijt}^{b} denotes budgetary expenditure in expenditure item *j*, h_i and k_t denote city and year fixed effects, and u_{ijt} is the

[53] World Bank and Development Research Center of the State Council of China (2005).
[54] Both cities were fast growing in late1990s and beginning of 21st century. Shaoxing doubled her population in eight years (1998-2006) while Jinhua tripled.
[55] Number of cities unlocking land values to finance urban infrastructure increases worldwide (Peterson 2009).
[56] It is mandated that subnational governments should maintain a fiscal balance in which both deficit and surplus are zero. So in theory, total revenue and total expenditure should be same. In practice, however, total revenue and total expenditure is different partly because of fiscal imbalance and partly because of revenue remittance to upper level governments in China. Both total revenue and total expenditure are used in (1) estimations (Table 2).

disturbance term. Since this model captures the accounting sheet of a budgetary report, it is expected that all coefficients of expenditure items positive and significant to at least the 0.05 level. Because of the accounting nature of the balance sheet, it is expected that all estimated coefficients should add up to a unit. That is: $\sum_j E_{ijt}^b = \sum_j \alpha_j R_{it}^b = R_{it}^b$.

The second model, a demand-supply type, is developed to estimate the existence and magnitude of crowding out effects of off-budget expenditure on budgetary expenditure, and if the effect exists, where. The model is expressed as:[57]

$$E_{ijt} = E_{ijt}^b + E_{ijt}^{nb} = F(R_{it}^b, X_{ijt}) \qquad (2)$$

where E_{ijt} is the total government expenditure on item *j* in city *i* at time *t*, and E_{ijt}^{nb} denotes off-budget expenditure; X_{ijt} contains city characteristics that influence local preference and demand for item j. $F(\cdot)$ is a demand function for public good *i* controlled by total revenues. Equation (2) says that all government services demanded from individuals and the private sector are supported by total expenditures, which are the sum of budgetary and off-budget revenues.

[57] I assume public expenditure on each category in China is determined by both government revenue and local characteristics. One way to think of this is, suppose the share of public expenditure on item j is determined by local features, i.e., $\frac{E_j}{R} = G(X)$, after transformations I get $E_j = R * G(X) = F(R, X)$.

Assuming that a fraction of off-budget revenues, denoted by γ_j, goes to each expenditure item, I have $E_{ijt}^{nb} = \gamma_j R_{it}^{nb}$ and substituting this equation into (2) and rearranging yields:

$$E_{ijt}^{b} = F(R_{it}, X_{ijt}) - \gamma_j R_{it}^{nb} \tag{3}$$

If there is a crowding out effect, it is expected that γ_j will be positive.

Equation (3) is estimated by the following reduced form:

$$E_{ijt}^{b} = h_i + k_t + \beta_{1j} R_{it} + \beta_{2j} R_{it}^{nb} + \delta_j X_{ijt} + u_{ijt} \tag{4}$$

To address the potential issue of heteroscedasticity all variables in (4) are normalized by population. It is expected that β_{1j}>0, as government expenditure increases with total government revenue; β_{2j} may be insignificant if there is not a crowding out effect and significantly negative if there is.

The third model is to establish a statistical relationship between off-budget revenues and the size or performance of public sector activities, which is specified as:

$$\Delta O_{ijt} = h_i + k_t + \beta_{3j} R_{it}^{b} + \beta_{4j} R_{it}^{nb} + \beta_3 Z_{ijt-1} + \mu_{ijt} \tag{5}$$

where ΔO_{ijt} denotes the growth of the size or performance of public sector activities *j* from t-1 to *t* in city *i*; Z_{ijt-1} is a vector of control variables; and μ_{ijt} is the disturbance term. Both β_{3j} and β_{4j} are coefficients. All variables are normalized by population.

I expect that β_{3j} is positive and significant at least at 0.05 level regardless the type j of the size or performance of public sector activities. I break public sector's activities into two types according to their nature of finance. The first type needs a reliable revenue stream and cannot (and should not) be financed by volatile off-budget revenues (e.g. school teachers in primary and secondary schools and employment in the public sector etc.).[58] The second type of the size or performance of public sector activities (such as library books and infrastructure) can increase in a lumpy fashion so that off-budget revenues can finance it. Therefore, I expect (1) β_{4i} is not significant for the first type of the size or performance of public sector activities; and (2) β_{4i} is significant for the second type if it is correlated with off-budget revenues and is insignificant if not. That is, the coefficients of β_{4i} by different type of public sector activities can be either significant or insignificant. I then infer expenditure behaviors/preferences of off-budget revenues by examining β_{4i}. Without expenditure data on off-budget revenues available (this will be true in the foreseeable future), I believe this indirect approach helps us better understand the behavior of off-budget revenues.

4.4 Data and Variables

My empirical analysis is based on panel data consisting of 285 cities for the period of 1999-2006. The panel data is constructed from four different statistical yearbooks of 2000-2007 covering years of 1999-2006. The first data source is the

[58] Pre-higher education schools include elementary, secondary (middle), and high schools in China. For simple discussion school teachers refer to teachers only in pre-higher education schools throughout this paper.

China City Statistical Yearbooks, which provide city characteristics such as population, GDP, fixed investments, employment, etc. The second one is the China Urban Construction Statistical Yearbooks (UCS), providing data on urban infrastructure, including paved road, urban roads and squares, open space, sewers, streetlights, etc. The third source is the China County Public Finance Statistical Yearbook (CPFS), containing detailed budgetary revenue and expenditure information by category, at both the city and county level. The fourth source is the China Land Resources Statistical Yearbook, containing information on public land leasing including land conveyance fees at the city level.

Budgetary expenditure items are organized by the following seven categories: Capital Construction, Education, Social Security, Administration, Agriculture, Police and Judicial Departments, and Miscellaneous Expenditures.[59] Those seven categories are used in my estimations. The total amount of budgetary revenues (R_{it}^{b}) is the sum of local tax revenues plus intergovernmental transfers while off-budget revenues (R_{it}^{nb}) are approximated by land conveyance fees.

There are two kinds of variables used to determine the demand side of the public sector. One kind is a universal factor such as GPD per capita and population included in all estimates across activity measures. It is expected that per capita public sector demand increases with GDP per capita and decreases with population size (Shelton (2007). The other kind of variables is specific and exclusive to each of

[59] Excluding others, there were eight expenditure categories before 2002 (including 2002), and eleven after 2003 (including 2003). Seven categories used in this paper are comparable throughout the studying period.

activity measures. For instance, manufacturing GDP is a factor of urban infrastructure but not for primary education or social security while the number of student enrollments is a key factor in the determination of the number of teachers but not for urban infrastructure.

Public sector activities are measured in the following areas: school teachers, number of buses, library books, sewer, water pipelines, sewage treatment capacity, land used for public facilities, urban paved road, urban road and public squares, inter-city transportation, and open space.

Table 17 presents descriptive statistics. It shows that, on average, 53.4 percent of total fiscal revenues were collected and retained by cities, while 89.3 percent of total expenditures were spent on local activities. Local fiscal revenues could finance only 64.9 percent of local public goods. Education is the largest expenditure item comprising 13.7 percent of total budgetary revenues. Administration accounts for 8.44 percent, followed by Capital Construction (7.69%), Police & Judicial Dep. (5.87%), Agriculture (4.70%), and Social Security (4.13%). On average, 45 percent of total expenditure is not classified into any categories in the budgetary reporting sheet. Capital Construction has the largest variation across prefectures. Shanghai paid 31 billion RMB and Shenzhen paid 10.3 billion RMB in 2004. The land revenue was equivalent to 40 percent of local own revenues, or 26 percent of local expenditures. The ratio of land revenues to local own fiscal revenues rose from 0.063 in 1999 to 0.554 in 2006.

Table 17: Summary Statistics of Fiscal Data, 1999-2006

Variables		Obs.	Mean	Std. dev	Share (%)
On-budget Revenues and Expenditures	Local Own Revenue	2274	298752.9	807296.3	53.38
	Total Revenue	2274	559655.8	1141581.0	100.00
	Local Expenditure	2274	460623.6	963758.4	89.28
	Total Expenditure	2274	515951.5	1065230.0	100.00
Local On-budget Expenditures (consistent items)	Education	2274	76730.3	120262.4	13.71
	Administration	2274	47232.8	59649.7	8.44
	Capital Construction	2274	43023.4	181876.9	7.69
	Police & Judicial Departments	2274	32858.9	68093.4	5.87
	Comprehensive Agriculture	2273	26306.3	33211.6	4.70
	Social Security	2274	23088.7	48494.8	4.13
	Miscellaneous expenditures	2273	211122.5	494771.8	37.72
	Others	2274	99032.2	201797.9	17.70
Off-budget Revenue	Land Revenue	2249	134594.1	379373.2	
Depedent Variables in Equation (5): Log growth rate of…	Teachers for Primary Education	1933	0.011	0.061	
	Government Departments Employment	1989	0.005	0.089	
	Public Institutions Employment	1880	-0.002	0.660	
	Land for Highways	2279	0.042	0.114	
	Land for Railroads	2157	0.023	0.189	
	Urban Paved Roads	1956	0.112	0.201	
	Urban Roads & Squares	1932	0.100	0.307	
	Land Used to Facility Inter-city Transport	1933	0.027	0.371	
	Greenland	1931	0.091	0.433	
	Land for Rural Roads	2279	0.004	0.104	
	Street Lights	1942	0.177	0.328	
	Sewer	1948	0.088	0.225	
	Sidewalk	1939	0.087	0.306	
	Bus	2109	0.077	0.230	
	Library Books	1886	0.045	0.405	
	Water Pipelines	1959	0.074	0.310	
	Sewage Treatment Capacity	1291	0.131	0.542	
	Land for Public Facilities	1917	0.069	0.378	
Demand and Control Variables	Population	2383	411.03	290.35	
	Population share of city proper	2346	0.32	0.24	
	GDP per capita	2383	11158.76	14055.46	
	GDP growth in the 2nd ind.	2374	1.14	0.13	
	GDP share of the 2nd ind.	2380	0.45	0.11	
	GDP share of the 3rd ind.	2380	0.35	0.08	
	Teacher / student	1929	526.40	100.12	
	Student in primary education p.c.	1932	0.16	0.03	
	Unemployment p.c.	2380	50.21	58.90	
	Government retirees p.c.	1933	64.90	25.02	
	Log (share of urbanized population)	2558	-0.61	0.48	
	Log (student growth rate in past 3 years)	1932	-0.01	0.08	
	Log (population growth rate in past 3 years)	1992	0.09	0.22	
	Log (built-up area growth rate in past 3 years)	1990	0.17	0.27	
	Log (growth rate of paved roads in past 3 years)	1956	0.11	0.20	

Notes: in the last column, I compute the share of local own budgetary revenue in total budgetary revenue, local budgetary expenditure in total budgetary expenditure, and local expenditure by categories in total budgetary revenue.

4.5 Empirical Results

4.5.1 Budgetary Expenditure Behaviors

The accounting relationship between budgetary expenditures by items and total local budgetary revenues is estimated by the equation-by-equation OLS estimator with two-way fixed effects that help to correct for unobserved heterogeneities across cities and omitted variables. In doing so, the estimate issue of correlated error terms across equation ($E[\varepsilon_{i,h}{}' \varepsilon_{i,k}] \neq 0$ for the same prefecture i when item $h \neq k$) is dealt with.

Table 18 reports estimated results of equation (1). Interpreting the table suggests the following findings, as expected. First, all expenditure items have positive and significant coefficients at the 0.01 level. Second, the sum of all coefficients is expected to be equal to 1 and the Chi-square test cannot reject the null hypothesis of unitary value of summed coefficients. Third, the sum of the coefficients of the six major expenditure items is about 45.6 percent. Finally, the model performs well for all items indicated with a high explanatory power of the independent variable. Budgetary revenue can explain the variance of expenditure by categories. The variance of the dependent variables is explained by 78-98 percent.

Table 18: Marginal Preferences of Expenditure of Budgetary Revenues

	Total Budgetary Revenue		R-square
Capital Construction	0.112***	(3.58)	0.98
Education	0.093***	(20.61)	0.98
Social Security	0.027***	(2.96)	0.79
Admin.	0.074***	(13.04)	0.97
Police & Judicial Dep.	0.070***	(9.93)	0.98
Agriculture	0.025***	(3.48)	0.87
Miscellaneous	0.468***	(11.47)	0.97
Others	0.131***	(6.66)	0.90

Notes: both city and year fixed effects are controlled.[60] The heteroskedasticity-robust t values reported in the parenthesis. * denotes significance at 10 percent level, ** denotes significance at 5 percent level, and *** denotes 1 percent level.

The estimated coefficients in Table 18 reveal expenditure preference of budgetary revenues. As indicated by the magnitude of the coefficients, the expenditure priority of additional budgetary revenues follows the order of Capital Construction, Education, Administration, Police & Judicial Dep., Social Security, and Agriculture (by absolute effect). More specifically, the coefficients in Table 18 imply that among one additional yuan (RMB) increase of budgetary revenue, 0.112 yuan goes to Capital Construction, 0.093 yuan to Education, 0.74 yuan to Administration, 0.70 yuan to Police & Judicial Departments, 0.27 yuan to Social Security, 0.25 yuan to Agriculture, and 0.468 yuan to Miscellaneous. Nearly half of each dollar of budgetary revenues goes toward unspecified expenditure items (Miscellaneous expenditures), raising questions about fiscal management and supervision. Put into comparable terms, I calculate elasticities to indicate the effect of budgetary revenues on expenditure items. Elastisicities calculated from the coefficients in Table 18 show that a one percent increase in budgetary revenues will increase 1.42 percent of

[60] I also use Seemingly Unrelated Regressions (SUR), which generated similar coefficients. As SUR does not allow heteroskedasticity, and the cross-equation correlations may be largely captured by city and year fixed effects, I report OLS results here with two-way fixed effects.

expenditure on Capital Construction, which is the highest in six expenditure categories; 1.20 percent on Police and Judicial Departments; 0.85 percent on Administration; 0.70 percent on Education; 0.65 percent on Social Security; and 0.51 percent on Agriculture, respectively. Education, Social Security, and Agriculture are the least favored areas for any additional budgetary revenues.

4.5.2 Do Off-budget Revenues Crowd out Budgetary Expenditure?

Table 19 presents the OLS estimated results of equation (4) with two-way fixed effects. Specific control variables to each expenditure items are included. Interpretation of the table implies the following findings with regard to key variables. First, budgetary revenues have a significant coefficient at the 0.01 level across cases and the magnitude of the coefficients tend to decline with control variables. Second, land revenues do not have a significant coefficient for all budgetary expenditure items, even though half of the cases have the expected sign. This leads to the conclusion that a crowding out effect of off-budget revenues is not statistically found. The robustness of this conclusion is tested through different estimators and the conclusion holds in general.[61]

[61] I use the 2SLS and the GMM estimators with two-way fixed effects to test the robustness by treating land revenues to be endogenous. The results change lightly for Capital Construction and Administration at margin. Their results not reported here to save space.

Table 19: OLS Estimates of Equation (4)

	Capital Construction		Education		Social Security		Administration		Police & Judicial Dep.		Agriculture	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Land revenue p.c.	-0.0048	-0.0041	0.0005	0.0020	-0.0006	-0.0003	-0.0041	-0.002536	0.0020	0.0013656	-0.0038	-0.0033
	(-0.22)	(-0.20)	(0.06)	(0.28)	(-0.14)	(-0.07)	(-1.09)	(-0.97)	(0.57)	(0.36)	(-0.73)	(-0.64)
Total gov. revenue p.c.	0.0631***	0.0462*	0.0588***	0.0334***	0.0188***	0.0198**	0.0510***	0.0266***	0.0481***	0.0227***	0.0154***	0.0154***
	(2.64)	(1.78)	(14.91)	(6.09)	(3.24)	(2.57)	(7.34)	(6.70)	(7.55)	(4.86)	(3.47)	(5.93)
GDP p.c.		0.0034		0.0045***		-0.0004		0.0046***		0.0048***		0.0001
		(0.79)		(6.52)		(-0.58)		(5.18)		(4.56)		(0.16)
Population		-0.1163		-0.0495		-0.0900*		0.001835		0.0738**		-0.1128*
		(-0.90)		(-0.85)		(-1.69)		(0.06)		(2.39)		(-1.95)
GDP growth rate in the 2nd		92.8878***										
		(3.61)										
GDP growth rate in the 3rd		6.0908										
		(0.90)										
Teacher / Student				0.0828***								
				(2.76)								
Student in primary edu.				483.9162***								
				(2.78)								
Unemp. p.c.						0.0503						
						(1.48)						
Gov. retirees p.c.						0.5230**						
						(2.44)						
Gov. emp. p.c.								0.1465**				
								(2.44)				
Pop. share of city proper										72.0286**		
										(2.49)		
Share of Agricultural												42.7430**
												(2.34)
R2	0.97	0.97	0.98	0.98	0.81	0.82	0.96	0.98	0.98	0.98	0.88	0.89
Obs.	1901	1901	1901	1900	1901	1898	1901	1867	1901	1867	1900	1619

Notes: both city and year fixed effects are controlled. Heteroskedasticity-robust t values are reported in the parenthesis. * denotes significance at 10% level, ** denotes 5% level, and *** denotes 1% level.

Control variables yield mixed results. Per capita GDP is positively correlated with budgetary expenditures in Education, Administration, and Police & Judicial Departments at the 0.01 level.[62] The coefficients imply that a one percent increase in per capita GDP is associated with 0.26 percent increase in budgetary expenditures on Education; 0.41 percent increase on Administration, and 0.63 percent increase on Police & Judicial Departments. Population in general is not a factor affecting budgetary expenditure, except that it is correlated with budgetary expenditure in Police & Judicial Department at the margin. Budgetary expenditure in Capital Construction is positively correlated with manufacturing GDP growth rate at 0.01

[62] Per capita GDP is also positively correlated with Miscellaneous.

level, and the elasticity is as high as 0.88. Higher teacher/student ratio and larger student enrollment significantly increase budgetary expenditure in Education, as expected. The coefficients suggest that 0.21 percent and 0.38 percent increases in budgetary expenditure in Education are associated with a one percent increase in teacher/student ratio and a one percent increase in student enrollment, respectively. Budgetary expenditure in Social Security increases with the ratio of retirees from the public sector over the total population. The estimated coefficient shows that a one percent increase in the ratio of retirees over the total population is associated with 0.34 percent increase in the budgetary expenditure in Administration. It is anticipated that police patrolling increases as masses of migrants from rural areas surge into cities. Without good data on migrants and floating population, I use the population share in the city proper as a proxy that is positively correlated with budgetary expenditure in Police & Judicial Departments. The estimation produces the expected results. The estimated coefficient suggests that a one percent increase in the population share is associated with 0.25 percent increase in budgetary expenditure in Police & Judicial Departments. As expected, the share of agricultural population is positively corrected with budgetary expenditure in Agriculture. The elasticity of agriculture population is 0.39.

4.5.3 Size and Performance of Public Sector Activities and Land Revenues

Since there is no categorized expenditure data available on off-budget revenues, I use an indirect approach to examine the associations between land revenues and the size or performance of public sector activities. That is, to regress measures of the size or performance of public sector activities with off-budget

revenues controlled by budgetary revenues and other variables specific to each type of public activities. Dependent variables used to measure the size or performance of public sector activities are broken into two categories based on nature of financing. The first category requires reliable funding sources and is not expected to correlate with off-budget (here land) revenues. This category includes the number of school teachers, employment in governments and their branches, employment in public institutions, land for highways, and land for railroads. Construction of highways and railroads has a much larger geographic area than the territory of city prefectures and requires financial commitment at a higher administrative level (provinces and the state). The second and final category does not require reliable funding sources and can correlate with land revenues. The measures in this category include urban paved roads, urban roads & public squares, land for inter-regional transport, land for rural roads, open space & parks, number of street lights, sewer length, sidewalk (areas), number of buses, library books, water pipeline, sewage treatment capacity, and land for public facilities. I use the association between the size/performance of public sector activities and land revenue to implicitly suggest expenditure preferences and patterns of off-budget revenues. [63] A log-linear functional form is used for the estimations.

Table 20 shows the estimated results on public sector's activities that are not expected to correlate with land revenues. As expected, land revenues do not have significant coefficients while budgetary revenues are only significant for employment in government branches, employment in public institutions, and land for rural roads.

[63] The land for inter-regional transportation in urban proper mainly captures railway stations, bus stations, and airports, as not many highways and railroads go through urban proper.

Unexpectedly, the growth rate of schoolteachers is not associated with budgetary revenues. This may suggest that education expenditure has not benefited from economic growth at the city level. A close examination of the control variables reveals the following. First, stock level variables in one year have a negative coefficient, implying that growth rates converge. Stock level variables have elasiticities ranging from -0.86 to -0.36. Second, population has negative coefficients except one activity measure (employment in public institutions), implying that growth rates decrease with city size. Third, per capita GDP has a positive correlation with the growth rate in land for highways, suggesting a positive relationship between GDP and highway development. The negative relationship between per capita GDP and employment in public institutions may be caused by privatization taking place in that period. Fourth, and particularly to specific control variables, the growth rate of schoolteachers is associated positively with that of student enrollment; the growth rate of employment in public institutions is associated positively with the share of urbanized population.

Table 20: The Size or Performance of Public Activities that Should Not Be Correlated with Land Revenues

	Log growth rate of. . .				
	Teachers for primary education	Gov Dep Emp	Public Institution Emp	Land for Highways	Land for Rail Roads
Statistical Ara	Whole city	Whole city	Whole city	Whole city	Whole city
Log (land revenue)	-0.0004	-0.0037	-0.0098	0.0023	-0.0017
	(-0.14)	(-1.18)	(-0.52)	(0.82)	(-0.55)
Log (total budgetary rev)	0.0122	0.1885*	0.3619**	0.0989***	0.0172
	(0.85)	(1.87)	(2.17)	(2.61)	(0.60)
Log (stock per capita last year)	-0.3472***	-0.5427***	-0.8608***	-0.4624***	-0.4659***
	(-6.84)	(-5.78)	(-25.46)	(-9.28)	(-13.13)
Log (GDP per capita)	0.0186	-0.0116	-0.3645*	0.1397***	0.0068
	(1.28)	(-0.24)	(-1.87)	(2.89)	(0.15)
Log (population)	-0.2720***	-0.4318***	0.0719	-0.1848**	-0.4216***
	(-6.98)	(-7.17)	(0.17)	(-2.12)	(-9.38)
Log (pop. growth rate) past 3 years	0.1864***	0.1753***	0.1499	0.1067	0.1170**
	(2.64)	(2.78)	(0.89)	(1.47)	(2.26)
Log (2nd industry share in GDP)				-0.0683	-0.0426
				(-1.16)	(-0.54)
Log (3rd industry share in GDP)				-0.021	-0.0362
				(-0.30)	(-0.39)
Log (share of urbanized population)		0.0532	0.2783*		
		(1.58)	(1.79)		
Log (student growth rate)	0.2861***				
	(3.69)				
R2	0.52	0.44	0.50	0.42	0.55
Obs.	1798	1798	1706	1451	1398

Notes: both city and year fixed effects are controlled. The heteroskedasticity-robust t values are reported in the parenthesis. * denotes significance at 10% level, ** denotes 5% level, and *** denotes 1% level.

Table 21 shows the size or performance of public sector activities that are correlated with land revenues. It shows that land revenues are positively correlated with urban paved roads, urban roads and public squares, interregional transportation, and open space and parks. Surprisingly, budgetary revenues affect the growth rates of only urban paved road and open space and parks. Budgetary revenues are less likely to be used to finance the development of public squares and land for interregional transport hubs. The coefficients reveal that a one percent increase in land revenues is associated with a 0.015 – 0.016 percent increase in urban paved

roads, and inter-city transportation; and with a 0.038 percent increase in open space, suggesting that the impact of land revenues on the growth rates of those activity measures is significant. The coefficient of budgetary revenues is significantly positive for urban paved roads and open space, but not significant for land for inter-regional transport facilities. Interestingly, elasticities of budgetary revenues are larger than elasticities of land revenues. Stock level variables with a one-year lag all have a negative coefficient, implying a trend of convergence in those activity measures Population has negative coefficients, suggesting that smaller cities have larger growth rates, all other things being equal. The growth rates of urban paved roads and urban paved roads & public squares are positively associated with the growth rate of population, respectively. Specific variables to each type of activity measures show that the share of secondary GDP is positively associated with urban paved roads & public squares and land for inter-regional transport facilities while the share of the tertiary GPD is significant only for land used for inter-regional transport facilities. Urban open space tends to increase with the share of urbanized population.

Table 21: The Size or Performance of Public Activities That are Correlated with Land Revenues

	Log growth rate of…			
	Urban paved roads (area)	Urban roads & squares	Land used to facility inter-city transport	Open space and parks
Statistical Ara	Urban proper	Urban proper	Urban proper	Urban proper
Log (land revenue)	0.0148** (2.53)	0.0158** (2.41)	0.0157* (1.69)	0.0380*** (2.68)
Log (total budgetary rev)	0.0770* (1.91)	0.0802 (1.52)	-0.0622 (-1.00)	0.1891* (1.93)
Log (stock per capita last year)	-0.3552*** (-7.79)	-0.2730*** (-4.23)	-0.3652*** (-6.93)	-0.5623*** (-8.31)
Log (GDP per capita)	0.0397 (0.96)	-0.1308** (-2.28)	-0.0138 (-0.22)	-0.0166 (-0.15)
Log (population)	-0.2617*** (-5.32)	-0.2401*** (-3.36)	-0.2571*** (-2.76)	-0.3632*** (-4.10)
Log (pop. growth rate) past 3 years	0.0610** (2.04)	0.1121** (2.10)	0.0662 (0.87)	0.0740 (0.95)
Log (2nd industry share in GDP)	-0.0180 (-0.30)	0.1167* (1.78)	0.2085** (2.10)	
Log (3rd industry share in GDP)	-0.0539 (-1.31)	0.0532 (1.10)	0.1570* (1.67)	
Log (share of urbanized population)				0.0647 (0.88)
Obs.	1641	1610	1647	1723
R2	0.44	0.37	0.31	0.38

Notes: both city and year fixed effects are controlled. The heteroskedasticity-robust t values are reported in the parenthesis. * denotes significance at 10% level, ** denotes 5% level, and *** denotes 1% level.

Table 22 shows the estimated results reporting uncorrelated size or performance of public sector activities with land revenues. They include land for rural roads, street lights, sewer, number of buses, library books, water pipelines, sewage treatment capacity, and land for public facilities. Insignificant coefficients suggest that those activity measures are unlikely to benefit from land revenues. Budgetary revenues have a positive and significant coefficient on all except water pipeline, sewage treatment capacity, and land for public facility. Elasticities show that magnitude of budgetary revenues is relatively mild as they range from 0.10 to 0.25. The insignificant coefficient of sewage treatment capacity may be due to the

lumpiness nature of growth. Consistent with previous tables, stock level variables in one year lag all have a negative coefficient, with elasticities of -0.77 – -0.49, while population has negative coefficients significantly for all but library books. The population growth rate is positively correlated with that of buses. A close examination of specific variables related to activity measures reveals that the growth rate of library books is positively correlated with the share of urbanized population; the growth rate of built-up areas is positively correlated with sewer and land for land for public facility; and growth rate of urban paved roads is positively correlated with street light and sidewalk.

Table 22: The Size or Performance of Public Activities That are not Correlated with Land Revenues

		Log growth rate of…							
	Land for Rural Roads	Street Lights	Sewers	Sidewalks	Buses	Library books	Water Pipelines	Sewage Treatment Capacity	Land for Public Facilities
Statistical Ara	Whole city	Urban proper	Urban proper	Urban proper	Urban proper	Urban proper	Urban proper	Urban proper	Urban proper
Log (land revenue)	-0.0037	0.0144	0.0084	0.0089	0.0077	0.0104	-0.0113	0.0252	-0.0097
	(-1.24)	(1.43)	(1.42)	(0.85)	(1.00)	(1.10)	(-0.78)	(0.88)	(-0.71)
Log (total budgetary rev)	0.0910**	0.2395***	0.2509***	0.1369**	0.0968**	0.3389***	0.0629	0.2881	-0.0833
	(2.02)	(2.80)	(2.97)	(2.07)	(2.05)	(3.55)	(1.00)	(1.18)	(-0.92)
Log (stock per capita last year)	-0.3596***	-0.5228***	-0.5534***	-0.4881***	-0.5077***	-0.5886***	-0.7672***	-0.5820***	-0.6246***
	(-3.66)	(-15.70)	(-7.72)	(-4.24)	(-15.78)	(-7.27)	(-12.80)	(-9.48)	(-9.30)
Log (GDP per capita)	-0.0356	0.0588	0.0210	0.1063	0.1342**	0.1276	0.0571	0.1133	-0.0051
	(-0.71)	(0.67)	(0.36)	(1.52)	(2.42)	(1.42)	(0.59)	(0.63)	(-0.06)
Log (population)	-0.3499***	-0.4663***	-0.3751***	-0.2915***	-0.4236***	-0.3987***	-0.4752***	-0.6901	-0.3882***
	(-4.51)	(-7.41)	(-5.70)	(-3.15)	(-8.56)	(-3.82)	(-6.92)	(-5.76)	(-5.01)
Log (pop. growth rate) past 3 years	0.1204	0.0577	-0.0064	-0.0464	0.0899***	-0.0053	-0.0691*	-0.0361	-0.0779
	(1.01)	(1.54)	(-0.18)	(-1.33)	(3.17)	(-0.10)	(-1.78)	(-0.55)	(-1.64)
Log (2nd industry share in GDP)	0.1029							0.3320	
	(1.22)							(1.07)	
Log (3rd industry share in GDP)	-0.0106							0.0341	
	(-0.19)							(0.13)	
Log (share of urbanized population)					0.0265	0.3897**			
					(0.57)	(2.31)			
Log (built-up area growth rate) past three years			0.0677***				0.0455		0.2064***
			(2.67)				(1.52)		(4.45)
Log (growth rate of paved road)		0.2215***		0.3787***					
		(3.47)		(5.03)					
Log (student growth rate)						0.2441***			
						(3.07)			
Obs.	1448	1628	1736	1628	1958	1749	1754	1240	1718
R2	0.33	0.40	0.37	0.38	0.43	0.39	0.41	0.41	0.37

Notes: both city and year fixed effects are controlled. The heteroskedasticity-robust t values are reported in the parenthesis. * denotes significance at 10% level, ** denotes 5% level, and *** denotes 1% level.

4.6 Final Remarks and Conclusions

Perhaps the increase of off-budget revenues is inevitable when local governments face tight fiscal constraint during fiscal decentralization. Off-budget revenues bring in benefits and costs to local governments. Benefits are associated with fiscal flexibility and fiscal capacity. Fiscal flexibility is of great importance since it enables local governments to respond to local needs in a timely fashion while

fiscal capacity is critical since local governments can promote economic growth through public expenditure. The cost side of off-budget revenues is usually linked to mismanagement in public finance and abuse, fraud, and corruption.

Although off-budget revenues have drawn a lot of attention, few studies on their expenditure preferences are available. This paper uses an indirect approach (regression models) to examine expenditure preferences and patterns. The indirect approach is composed of a demand-supply type of model and statistical regression between land revenues and the size or performance of public activities of the public sector. Based on estimated results using a panel data of 285 Chinese cities between 1999 and 2006, I conclude the following. First, a crowding out effect of off-budget revenues on budgetary expenditure is not found. Second, the size or performance of public sector activities that require reliable financial sources are not correlated with land revenues, as expected. Specifically, in this category land revenues from land sales and rents are volatile and are not likely used to finance schoolteachers, employment in government branches, employment in public institutions, and inter-regional transportation (such as highways and railroads). Third, the size or performance of public sector activities that do not require reliable finance sources are not necessarily correlated with land revenues. Some do and others do not. Land revenues are more likely spent on urban paved roads, public squares, open space, and land for inter-regional transport facilities while land revenues are not likely spent on library books, buses, sewer, and sewage treatment capacity. The former can be viewed as image (or high profile) projects that can make local officials look good while the latter's benefits and social functions may not be directly tangible and

visible. Given limited measures in the size or performance of public sector activities, land revenues tend to be spent on basic infrastructure and physical improvement on urban environment that are tangible as a part of a local economic development strategy while there is a tendency to ignore the needs of human capital (education) and less visible infrastructure (sewer and sewage treatment).

Recognizing the potential risk associated with dominant off-budget activities and related issues and challenges, Chinese governments have begun to experiment with reforms. Policy initiatives like introducing a property tax in cities of Shanghai and Chongqing in 2011, allowing to some cities to experiment with local government issued bonds in 2011 and moving land revenues into a budgetary management scheme are moves in the right direction. However, these actions alone are not enough. A comprehensive and more rapid reform in the fiscal and tax system, including fiscal relationships between the central and subnational governments and among subnational governments is urgently needed. The comprehensive fiscal and tax reform should include, though not be limited to, property taxation, land revenues, and local bonds. More specifically, the property tax should be rapidly expanded as a substitute to land revenues, whose dominance should be diminished, if not completely phrased out. Land revenues should be channeled into land funds whose expenditure should be spread across multiple years and into projects that benefit social welfare like education, public safety, public health, and public assistance for low-income households.

Chapter 5: Conclusions

The three related essays in this dissertation contribute to the understanding of urban development. I find significant effects of employment centers on economic development, strong impact from labor market bust to housing market depression, and different spending preferences between on-budget and off-budget revenues in local governments.

The first essay in Chapter 2 concludes that employment centers foster agglomeration economies. From inside to outside centers, urbanization effects decline by 51% - 245% and localization effects decline by 58% - 87%. It implies that, if centers are omitted, the conventional method of using fixed distance in estimating agglomeration effects may suffer from potential bias. I also find that the effects of employment centers are affected by their characteristics such as size and industrial diversity. Large or diverse centers tend to generate more new firms than small or specialized ones. These findings provide prominent policy implications, that in order to encourage local economic growth, planners and policy makers should favor the development of employment centers, particularly those with large sizes or high diversities.

The second essay in Chapter 3 finds that job loss largely increases housing foreclosures. I present the significant spatial separation between workplace and residence, which generally hinders the studies of interactions between labor and housing markets. In order to overcome this challenge, I use the commute data at census tract level to connect residence and workplace, and build the job loss

vulnerability index for each residential neighborhood. After correcting the attenuation bias from measurement errors, I conclude that a one percent increase in the job loss index increases foreclosures in corresponding residential neighborhoods by about 0.85 percent. This finding provides evidence for the so-called trigger events, and is different from the traditional literature that use state or county level unemployment rate and report mixed results on the effect of job loss. I also provide evidence for the interactions between labor market and local housing markets. The policy implication is that, the efforts in stabilizing local labor market and reducing layoffs may help reduce housing foreclosures.

The third essay in Chapter 4 studies the spending behaviors of off-budget revenues. The literature hypothesizes that governments tend to spend off-budget revenues differently from the way they spend budgetary revenues. But the data on off-budget activities is hard to collect to test this hypothesis. I use land revenues to proxy the off-budget revenues in Chinese cities. I find that off-budget funds do not crowd out budgetary expenditures. I also find off-budget revenues tend to support those public goods that are more visible and tangible, in my research including urban paved roads, public squares, open space, and inter-regional transport facilities. Different from budgetary revenues, off-budget revenues do not support some important but not quite obvious public goods such as library books, buses, sewers, etc. These findings raise concerns over the budgetary control and spending behaviors in local governments.

Appendix

Appendix A: Marginal Effects in Tobit Model with Interaction Terms

In a model with left censoring or corner solution at Y=0, and assume the residual u has normal distribution N(0, σ^2). The model is: $Y^* = XB = \beta_1 x_1 + \beta_2 x_2 + ... + \beta_n x_n$ and I observe Y=Y* if Y*≥0; Y=0 if Y*<0. Then it is easy to show that $E(Y \mid X) = \Phi(XB/\sigma)XB + \sigma\phi(XB/\sigma),$ and the marginal effect of x_i is $\Phi(XB/\sigma)*\beta_i$, where $\Phi(\cdot)$ represents the standard normal cumulative density function, $\phi(\cdot)$ is the standard normal probability function, and σ is the standard deviation of the residual. When an interaction term x_1x_2 is added, I have $Y^* = XB = \beta_1 x_1 + \beta_2 x_2 + \beta_{12} x_1 x_2 + ... + \beta_n x_n$. I can show that the marginal effect of x_1 is $\frac{\partial E(Y \mid X)}{\partial x_1} = (\beta_1 + \beta_{12} x_2) * \Phi(XB/\sigma),$ which depends on not only β_1 but also β_{12}, x_2 as well as $\Phi(XB/\sigma)$. After some directives and transformations, the marginal effect of the interaction term x_1x_2 is

$$\frac{\partial^2 E(Y \mid X)}{\partial x_1 \partial x_2} = \frac{\beta_2}{\sigma}\phi(XB/\sigma) * (\beta_1 + \beta_{12} x_2) + \beta_{12}\Phi(XB/\sigma),$$ if x_2 is continuous; or

$$\frac{\partial^2 E(Y \mid X)}{\partial x_1 \partial x_2} = (\beta_1 + \beta_{12}) * \Phi(XB/\sigma)\Big|_{x2=1} - \beta_1 * \Phi(XB/\sigma)\Big|_{x2=0},$$ if x_2 is a dummy,

which depends on not only β_{12}, but also β_1, β_2, x_2, σ, and $\Phi(XB/\sigma)$. It at least suggests three points. First, the interaction effect could be nonzero even if β_{12}=0. Second, the significance of the interaction effect and β_{12} are not necessarily consistent. Third, the sign of the interaction effect and β_{12} may be different. Therefore, I report the

marginal effects of agglomerative effects inside/outside centers in Table 5. The standard errors used to compute t-value are estimated via delta method.

Bibliography

Ai, C, and Norton, E. (2003). Interaction terms in logit and probit models. Economic Letters, 80, 123-129.

Akai, N. and Sakata, M. (2002). Fiscal Decentralization Contributes to Economic Growth: Evidence from State-level Cross-section Data for the United States. Journal of Urban Economics 52, 93-108.

Ambrose, Brent., and Capone, Charles. (1998). The conditional probability of mortgage default. Real Estate Economics 26(3), 359-90.

Anas, A., & Kim, I. (1996). General equilibrium models of polycentric urban land use with endogenous congestion and job agglomeration. Journal of Urban Economics, 40, 232-256.

Anderson, Fredrik., Freedman, Matthew., Roemer, Marc., and Vilhuber, Lars. (2008). LEHD OnTheMap technical documentation. http://www.vrdc.cornell.edu/onthemap/doc/otm_public_master.pdf

Arzaghi, M., & Henderson, V. (2008). Networking off Madison Avenue. Review of Economic Studies, 75, 1011-1038.

Aschauer, D. (1989). Is Government Spending Productive? Journal of Monetary Economics 23, 177-200.

Baffoe-Bonnie, John. (1998). The dynamic impact of macroeconomic aggregates on housing prices and stock of houses: A national and regional analysis. Journal of Real Estate Finance and Economics 17(2), 179-97.

Bajari, Patrick., Chu, Chenghuan Sean., and Park, Minjung. (2008). An empirical model of subprime mortgage default from 2000 to 2007. Working Paper.

Barro, R. (1990). Government spending in a simple model of endogenous growth. Journal of Political Economy 98, 103-125.

Battu, Harminder., Ma, Ada., and Phimister, Euan. (2008). Housing tenure, job mobility and unemployment in the UK. The Economic Journal 118, 311-328.

Bayer, Patrick., Ross, Stephen., and Topa, Giorgio. (2008). Place of work and place of residence: Informal hiring networks and labor market outcomes. Journal of Political Economy 116(6): 1150-96.

Bennett, J. and Dilorenzo, T. (1982) Off-budget activities of local government: the bane of the tax revolt. Public Choice 39, 333-342.

Berliant, M., & Konishi, H. (2000). The endogenous formation of a city: Population agglomeration & marketplaces in a location-specific production economy. Regional Science and Urban Economics, 30, 289-324.

Berument, H. (2002). Making Spending On-Budget or Off-Budget: Does It Make a Difference? DOI: http://www.unc.edu/~berument/papers/trfp02.pdf

Bhutta, Neil., Dokko, Jane., and Shan, Hui. (2010). How low will you go? The depth of negative equity and mortgage default decisions. Working Paper.

Bogart, W., & Ferry, W. (1999). Employment centers in greater cleveland: Evidence of evolution in a formerly monocentric city. Urban Studies, 36, 2099-2110.

Carlton, W. (1983). The location and employment choices of new firms: An econometric model with discrete and continuous endogenous variables. Review of Economics and Statistics, 65, 440-449.

Chan, Sewin., GEdal, Michael., Been, Vicki., and Haughwout, Andrew. (2011). The role of neighborhood characteristics in mortgage default risk: Evidence from New York City. Working Paper.

Combes, P., Duranton, G., Gobillon, L., & Roux, S. (2012). Sorting and local wage and skill distributions in France. Regional Science and Urban Economics, forthcoming.

Crampton, Graham. (1999). Urban labour markets. Handbook of Urban and Regional Economics, volume 3, 1499-1557.

Cumbers, A., & MacKinnon, D. (2004). Introduction: clusters in urban and regional development. Urban Studies, 41, 959-969.

Danis, Michelle., and Pennington-Cross, Anthony. (2008). The delinquency of subprime mortgages. Journal of Economics and Business 60: 67-90.

Davis, Steven., and Haltiwanger, John. (1999). Gross job flows. Handbook of Labor Economics, volume 3: 2711-2797.

Davis, Steven., Haltiwanger, John., and Schuh, Scott. (1996). Job creation and destruction. MIT Press, Cambridge, MA.

Department of Labor, Licensing and Regulation (DLLR) of Maryland. (2011). Notices of intent to foreclose in Maryland, March 2011 report. http://dllr.maryland.gov/finance/industry/pdf/noirptMar2011.pdf

Devarajan, S., Swaroop, V., and Zou, H. (1996). The composition of public expenditures and economic growth. Journal of Monetary Economics 37, 313-344.

Ding, C. (2003) Land Use Policy Reform in China: Assessment and Prospects, Land Use Policy, 20(2): 109-20.

Ding, C. (2007) Policy and Praxis of Land Acquisition in China. Land Use Policy, 24(1), 1-13.

Ding, C. and Song, Y. (2009) Property Tax for Sustainable Urban Development, in Smart Growth in China, edited by Song Y. and C. Ding, Cambridge, USA: Lincoln Institute of Land Policy.

Dohmen, Thomas. (2005). Housing, mobility and unemployment. Regional Science and Urban Economics 35(3): 305-325.

Doms, Mark., Furlong, Fred., and Krainer, John. (2007). Subprime mortgage delinquency rates. Working Paper.

Dreher, A., Sturm, J. and Ursprung, H. (2006) The impact of globalization on the composition of government expenditures: Evidence from panel data. Public Choice, 134(3), 263-292.

Dujardin, Claire., and Goffette-Nagot, Florence. (2009). Does public housing occupancy increase unemployment? Journal of Economic Geography 9(6): 823-51.

Duranton, G., & Puga, D. (2000). Diversity and specialization in cities: Why, where and when does it matter? Urban Studies, 37, 533-555.

Easterly, W. and Rebelo, S. (1993) Fiscal policy and economic growth. Journal of Monetary Economics, 32 (3), 417-458.

Eckaus, R. (2003) Some consequences of fiscal reliance on extrabudgetary revenues in China, China Economics Review, 14, pp.72-88.

Elmer, Peter., and Seelig, Steven. (1999). Insolvency, trigger events, and consumer risk posture in the theory of single-family mortgage default. Journal of Housing Research 10(1): 1-25.

Elul, Ronel., Souleles, Nicholas., Chomsisengphet, Souphala., Glennon, Dennis., and Hunt, Robert. (2010). What triggers mortgage default? American Economic Review 100: 490-494.

Fan, G. (1998) Market-oriented economic reform and the growth of off-budget local public finance, in D. Brean (ed.) Taxation in Modern China, London and New York, Routledge.

Feser, E., Renski, H., & Goldstein, H. (2008). Clusters and economic development outcomes: An analysis of the link between clustering and industry growth. Economic Development Quarterly, 22, 324-344.

Fogarty, M., & Garofalo, P. (1988). Urban spatial structure and productivity growth in the manufacturing sector of cities. Journal of Urban Economics, 23, 60-70.

Foote, Christopher., Gerardi, Kristopher., and Willen, Paul. (2008). Negative equity and foreclosure: theory and evidence. Journal of Urban Economics 64(2), 234-45.

Foster, Chester., and Van Order, Robert. (1984). An option-based model of mortgage default. Housing Finance Review 3(4): 351-72.

Foster, Chester., and Van Order, Robert. (1985). FHA terminations: a prelude to rational mortgage pricing. AREUEA Journal 13(3): 273-91.

Fotheringham, A., & Rogerson, P. (1993). GIS and spatial analytical problems, International Journal of Geographic Information Systems, 7(1), 3-19.

Fotheringham, A., & Wong, D. (1991). The modifiable areal unit problem in multivariate statistical analysis, Environment and Planning A, 23, 1025-1044.

Fujita, M., & Ogawa, H. (1982). Multiple equilibrium and structural transition of non-monocentric urban configuration. Regional Science and Urban Economics, 12, 161-96.

Fujita, M., Thisse, J., & Zenou, Y. (1997). On the endogenous formation of secondary employment centers in a city. Journal of Urban Economics, 41, 337-358.

Gerardi, Kristopher., Shapiro, Adam., and Willen, Paul. (2009). Subprime outcomes: risky mortgages, homeownership experiences, and foreclosures. Working Paper.

Gerardi, Kristpher., and Willen, Paul. (2009). Subprime mortgages, foreclosures, and urban neighborhoods. The B.E. Journal of Economic Analysis & Policy 9(3), Article 12.

Giuliano, G., & Small, K. (1991). Subcenters in the Los Angeles region. Regional Science and Urban Economics, 21, 163-182.

Giuliano, G., Redfearn, C., Agarwal, A., Li, C., & Zhuang, D. (2007). Employment concentrations in Los Angeles, 1980-2000. Environment and Planning A, 39, 2935-2957.

Glaeser, E., Kallal, H., Scheinkman, J., & Shleifer, A. (1992). Gowth in cities. Journal of Political Economy, 100(6), 1126-1152.

Glaeser, Edward., Gyourko, Joseph., and Saks, Raven. (2006). Urban growth and housing supply. Journal of Economic Geography 6(1): 71-89.

Green, Richard., and Hendershott, Patric. (2001). Home-ownership and unemployment in the US. Urban Studies 38(9): 1509-20.

Guiso, Luigi., Sapienza, Paola., and Zingales, Luigi. (2009). Moral and social constraints to strategic default on mortgages. NBER Working Paper.

Hall, Robert. (1995). Lost jobs. Brookings Papers on Economic Activity 1: 221-273.

Hall, Robert. (1999). Labor-market frictions and employment fluctuations. Handbook of Macroeconomics, volume 1: 1138-1170.

Hauk, William., and Wacziarg, Romain. (2009). A monte carlo study of growth regressions. Journal of Economic Growth 14: 103-147.

Helsley, R., & Sullivan, A. (1991). Urban subcenter formation. Regional Science and Urban Economics, 21, 255-275.

Henderson, V. (1986). Efficiency of resource usage and city size. Journal of Urban Economics, 19, 47-70.

Henderson, V. (2003). Marshall's scale economies. Journal of Urban Economics, 53, 1-28.

Henley, Andrew. (1998). Residential mobility, housing equity and the labour market. The Economic Journal 108, 414-27.

Herkenhoff, Kyle. (2012). Job loss, defaults, and policy implications. Working Paper.

Herkenhoff, Kyle., and Ohanian, Lee. (2012). Foreclosure delay and U.S. unemployment. Working Paper.

Holtz-Eakin, D. (1994) Public-sector capital and the productivity puzzle, Review of Economics and Statistics, 76 (1), 12-21.

HUD (US Department of Housing and Urban Development). (2008). U.S. housing market conditions, 2nd quarter 2008.

Hughes, Gordon., and McCormick, Barry. (1987). Housing markets, unemployment and labor market flexibility in the UK. European Economic Review 31, 83-113.

Hulten, C. R. and Schwab R. M. (1991). Public capital formation and the growth of regional manufacturing industries. National Tax Journal, 26, 1-274.

Hwang, Min., and Quigley, John. (2006). Economic fundamentals in local housing markets: Evidence from U.S. metropolitan regions 46(3): 425-53.

Jin, H., Qian, Y. and Weingast, Barry. (2005) Regional decentralization and fiscal incentives: Federalism, Chinese style. Journal of Public Economics 89(9), 1719-1742.

Jin, J. and Zou, H. (2003) Soft-budget constraint on local governments in China. In Rodden, Jonathan., Eskeland, Gunnar., and Litvack, Jennie (Eds.), Fiscal decentralization and the challenge of hard budget constraints,. MIT Press, 289-324.

Jin, J. and Zou, H. (2005) Fiscal decentralization, revenue and expenditure assignments, and growth in China. Journal of Asian Economics 16, 1047-1064.

Johnes, Geraint, and Hyclak, Thomas. (1999). House prices and regional labor markets. Annals of Regional Science 33, 33-49.

Joulfaian, D. and Marlow, Michael. (1991) The relationship between budgetary and off-budget government. Economic Letters, 35(3), 307-310.

Keefer, P. and Knack, S. (2007) Boondoggles, rent-seeking, and political checks and balances: public investment under unaccountable governments. Review of Economics and Statistics, 89 (3), 566-572.

Kohlhase, J., & Ju, X. (2007). Firm location in a polycentric city: The effects of taxes & agglomeration economies on location decisions. Environment and Planning C: Government and Policy, 25, 671-691.

Kristopher, Gerardi., Hale Shapiro, Adam., and Willen, Paul. (2008). Subprime outcomes: risky mortgages, homeownership experiences, and foreclosures. Working Paper.

Kuhn, Andreas, Lalive, Rafael, and Zweimuller, Josef. (2009). The public health costs of job loss. Journal of Health Economics 28: 1099-1115.

Lichtenberg, E. and Ding, C. (2009) Local Officials as Land Developers: Urban Spatial Expansion in China. Journal of Urban Economics, 66 (1), 57-64.

Lin, Y. and Liu, Z. (2000) Fiscal decentralization and economic growth in China. Economic Development and Cultural Change 49(1), 1-21.

Lindo, Jason. (2012). Aggregation and the relationship between unemployment and health. Working Paper.

Liu, L. (2010) Strengthening Subnational Debt Financing and Managing Risks, Review of Economic Research, Ministry of Finance, China. 16, 46 F-9

Liu, Lili. (2010). Strengthening Subnational Debt Financing and Managing Risks, the World Bank (http://siteresources.worldbank.org/INTDEBTDEPT/Resources/468980-1207588563500/4864698-1207775351512/SSDebt_English.pdf).

Ma, Jun. (2009) If You Can't Budget, How Can You Govern?-A Study Of China's State Capacity, Public Administration and Development, 29, 9-20.

Marlow, M, and Joulfaian D. (1989) The Determinants of Off-budget Activity of State and Local Governments. Public Choice, 63, 113-123.

Marlow, M. (1995). The influence of special district governments on public spending and debt. Applied Economics, 27, 569-573.

Mayer, Christopher, Pence, Karen., and Sherlund, Shane. (2009). The rise in mortgage defaults. Journal of Economic Perspectives 23(1): 27-50.

McCormick, Barry. (1983). Housing and unemployment in Great Britain. Oxford Economic Papers 35, 283-305.

McDonald, J., & Prather, P. (1994). Suburban employment centres: The case of Chicago. Urban Studies, 31(2), 201-218.

Mittnik, S. and Neumann, T. (2003) Time-series evidence on the nonlinearity hypothesis for public spending, Economic Inquiry, 41(4), 565-573.

Moomaw, R. (1983). Is population scale a worthless surrogate for business agglomeration economies? Regional Science and Urban Economics, 13, 525-545.

Nakamura, R. (1985). Agglomeration economies in urban manufacturing industries: a case of Japanese cities. Journal of Urban Economics, 17, 108-124.

Peterson, G. and Kaganova, O. (2010) Integrating Land Financing into Subnational Fiscal Management, Policy Research Working Paper, WPS5409, The World Bank.

Quigley, John., and Van Order, Robert. (1991). Defaults on mortgage obligations and capital requirements for U.S. savings institutions: a policy perspective. Journal of Public Economics 44(3): 353-370.

Reichert, Alan. (1990). The impact of interest rates, income, and employment upon regional housing prices. Journal of Real Estate Finance and Economics 3, 373-91.

Riddiough, Timothy. (1991). Equilibrium mortgage default pricing with non-optimal borrower behavior. Ph.D. dissertation, University of Wisconsin.

Rosenthal, S., & Strange, W. (2003). Geography, industrial organization, and agglomeration. The Review of Economics and Statistics, 85(2), 377-393.

Rosenthal, S., & Strange, W. (2004). Evidence on the nature and sources of agglomeration economies. Handbook of Urban and Regional Economics, volume 4.

Rosenthal, S., & Strange, W. (2005). The geography of entrepreneurship in the New York metropolitan area. Economic Policy Review, Dec, 29-53.

Rosenthal, S., & Strange, W. (2010). Small establishments/big effects: Agglomeration, industrial Organization, and entrepreneurship. In E. Glaeser (Eds.), Agglomeration Economics (pp. 277-302).National Bureau of Economic Research, Inc.

Saks, Raven. (2008). Job creation and housing construction: Constraints on metropolitan area employment growth. Journal of Urban Economics 64, 178-95.

Selma, Lewis. (2011). Spatial exploration of foreclosures in Maryland. PhD dissertation, University of Maryland.

Shelton, C. (2007) The size and composition of government expenditure. Journal of Public Economics, 91 (11), 2230-2260.

Sherlund, Shane. (2008). The past, present, and future of subprime mortgages. Working Paper.

Shick, A. (2007) Off-budget Expenditure: An Economic and Political Framework, OECD Journal on Budgeting, 7(3), 1-32.

Small, K., & Song, S. (1994). Population and employment densities: Structure and change. Journal of Urban Economics, 36, 292-313.

Sveikauskas, L. (1975). The productivity of cities. Quarterly Journal of Economics, 89(3), 393-413.

Tabuchi, T. (1986). Urban agglomeration, capital augmenting technology, and labor market equilibrium. Journal of Urban Economics, 20, 211-228.

Tatom, John. (2010). Crises and the recent recession. Unpublished paper.

Thomas, V. (2006). From inside Brazil: Development of a land contrasts, the World Bank, Washington D.C.

Tielemans, Erik., Kupper, Lawrence., Kromhout, Hans., Heederik, Dick., and Houba, Remko. 1998. Individual-based and group-based occupational exposure assessment: Some equations to evaluate different strategies. The Annals of Occupational Hygience 42(2): 115-119.

Towe, Charles., and Lawley, Chad. (2010). The contagion effect of neighboring foreclosures on own foreclosures. Working Paper.

Vandell, Kerry. (1992). Predicting commercial mortgage foreclosure experience. Real Estate Economics 20(1): 55-88.

Webb, Bruce. (1982). Borrower risk under alternative mortgage instruments. The Journal of Finance 37(1): 169-183.

Whitehead, Christine. (1999). Urban housing markets: Theory and policy. Handbook of Urban and Regional Economics, volume 3: 1559-1594.

Wooldridge, J. (2002). Econometric analysis of cross section and panel data. Cambridge, MA: MIT Press.

Zagler, M. and Dürnecker, G. (2003) Fiscal Policy and Economic Growth, Journal of Economic Surveys, 17(3), 397-418.

Zhan, J. (2011) Explaining Central Intervention in Local Extra-Budgetary Practices in China, Asian Survey, 51(3), 497-519.

Zhang, T. and Zou, H. (1998) Fiscal decentralization, public spending, and economic growth in China. Journal of Public Economics, 67 (2), 221-240.