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Distance and Decline: The Case of Petersburg, Virginia[*]

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Abstract

Petersburg, Virginia, prospered over two centuries as a center of production and trade. However, the city experienced economic difficulties beginning in the 1980s as a large number of layoffs at production plants in the area coincided with an erosion of retail trade in the city. Prolonged economic decline followed. In contrast, somewhat similar shocks in other moderate-sized cities in Virginia were followed by gradual economic recovery. We examine these differing outcomes and offer an explanation that hinges on the proximity of Petersburg to its larger neighbor, the greater Richmond area. We find evidence suggesting that after the job declines, higher-skilled residents in Petersburg initially commuted to jobs nearer to Richmond, later relocating from Petersburg toward Richmond–an option not readily available in the other Virginia cities considered. We suggest that, as a result, Petersburg suffered a sharp decline in tax revenues and that municipal costs could not be proportionately scaled down, leading to severe fiscal stress.

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Keywords: spatial equilibrium, urban decline

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1 Introduction

Cities and towns arise and some subsequently disappear for a wide variety of reasons. Those that arise may sit at an advantageous location or may be adjacent to resources. But some–such as mining towns– may disappear soon after the ore runs out and their initial advantage disappears. Others persist long after their initial advantage is lost (Bleakley and Lin (2012)). Petersburg, Virginia, falls into the second category. Situated at the fall line of the Appomattox River, Petersburg's location represented the farthest point inland that colonial-era ships could navigate. The fall line was also the shortest distance that relatively costly-to-transport goods produced in the interior had to travel to be shipped by vessel. This combination led to the importance of Petersburg as an early trading center.[1]

Because of its location, Petersburg rose to prominence as a colonial-era city and played a crucial role in the Civil War. After the war, it served as a transportation hub and a regional trade center for over a century. It remained a growing city until a few decades ago. In recent years, though, it has received national attention for its dire fiscal situation. The city had, for example, some of its fire equipment repossessed, and delayed maintenance led to the failure of its water system (Schneider (September 6, 2016)). But even deeper issues plagued the city. Newspapers reported that the city's finances were being investigated by the Department of Justice in late 2016 (Buettner (October 13, 2016)).

How did Petersburg fall so far in recent decades when other, somewhat similar, cities in Virginia generally have exhibited modest economic growth? One intriguing possibility is that technological advances in transportation resulted in Petersburg becoming effectively too "close" to its more economically vibrant neighbor Richmond to endure some of the negative economic shocks that other similar cities have seemingly weathered.[2] The role that effective distance may have played on the ability of Petersburg to recover from local economic shocks will be examined in this paper.[3]

To understand Petersburg's transition from economic prominence to its present fiscal difficulties, we will briefly review Petersburg's history and look at its economic structure in recent decades. Next, a simple model of two cities is proposed and following that, a similar model for a standalone or "isolated" city is proposed. The implications from these models are matched to Petersburg's economic features and demographics measures and similar measures in the control cities of Waynesboro and Lynchburg.

[1] Burnett et al. (2017) provides an extended description of the history of Petersburg, along with the challenges faced by the city in recent times.

[2] Throughout the paper we use the term "Richmond" loosely. Specifically, we refer to those localities within the greater Richmond area, neighboring or very close to Petersburg, that have been experiencing significant economic growth for the last fifty years, such as Chesterfield County and Henrico County, among others. Chesterfield County, just north of Petersburg, separated only by the Appomattox River, has seen an increase in population from approximately 77,000 in 1970 to 340,000 in 2010. The population in Henrico County has more than doubled during the same period.

[3] We use "effective" distance to denote the actual travel time between Petersburg and Richmond. Prior to I-95 (and later I-295), the cities were linked by Rt. 1 and Rt. 301. These highways passed through both dense residential and commercial areas between the cities. As such, traffic congestion as well as stop lights made travel slow. With I-95 and I-295, travel time went down considerably, lessening the "effective" commuting distance for residents.

2 A Brief History of Petersburg

Like many fall line cities and towns in Virginia, Petersburg continued to exist and prosper long after ships ceased being an important transportation mode. In part, the scale economies that developed early in its history made the city an attractive connecting point for later, more efficient modes of transportation, such as turnpikes, railroad lines, and eventually, interstate highways (Bleakley and Lin (2012)). All of these subsequent forms of transportation passed through Petersburg, with both railroads and highways intersecting there. Each new, more efficient mode of transportation enhanced Petersburg's connectivity with surrounding areas and added to the city's locational durability but, ironically, may have also ultimately contributed to Petersburg's decline.

Along with transportation connections, Petersburg's location along with its infrastructure and population size made the city an attractive location to process and manufacture regionally produced agricultural products. In the post-Civil War period, the city became a center of cigarette, furniture, and textile production. Those industries, along with chemicals, trade, and services sustained Petersburg's economy through the 1970s.[4]

It was early in that decade when the Petersburg City Council, perhaps encouraged by the new interstate highways intersecting there and the opening of retail malls in the city, made the decision to annex about fourteen square miles of adjoining territory from neighboring Dinwiddie and Prince George Counties. Following several court challenges, the annexation was approved and went into effect on December 31, 1971. Petersburg officials believed the area had great potential for future development and found the prospect for increased tax revenues attractive. While the city would provide infrastructure and services for the annexed area, the existing population there was relatively small, generating only modest tax revenues. The payoff to the city hinged on future substantial development in the incorporated area, but that development never fully materialized. That would ultimately have important local economic consequences, especially on the public finances of the city.[5]

By the mid-to-late 1970s, though, the traditional industries that had sustained Petersburg's economy for nearly a century were changing. A pivotal event was the 1982 announcement by tobacco producer Brown and Williamson that they would eliminate one-third of their 2800 employees in the city. By 1985, the firm would completely shutter their antiquated Petersburg operation. Adding to the city's woes, Southpark Mall was constructed in the late 1980s north of Petersburg in Colonial Heights. The new mall –located along I-95– could draw shoppers from the rapidly developing southern Richmond suburbs, as well as those in Petersburg and areas south. Storeowners in Petersburg saw the potential of the new mall and a number relocated there, leading to the closure of the city's Walnut Mall, which had opened in the 1960s, amid much optimism and anticipated

[4]Section D in the Appendix, shows a timeline of Petersburg's recent history.

[5]We leave for future research a complete assessment of institutional framework that regulates the decision by localities to annex, or, if the process fails, to "deannex" territory, and its economic implications. In fact, approximately thirty-six states have deannexation laws, but such a mechanism is rarely used in practice (see Moreo et al. (2015)).

sales tax revenues for Petersburg. Originally, city leaders viewed Walnut Mall as a facility that would serve a broad base of households throughout southside Virginia. However, Southpark Mall would ultimately fulfill that role, bypassing revenue generation for Petersburg.

In many ways, the events unfolding in Petersburg were not unique to the city, as other small cities in Virginia were exposed to the broader shifts in industry and retail taking place during the early 1980s. In Waynesboro, for example, large firms such as DuPont, General Electric, and Compton had been important local employers for many years. But the recession in the early 1980s combined with global shifts in production weakened sales at these firms. Weaker sales, in turn, translated into local layoffs numbering in the thousands from 1980 through 1983. By the middle of the decade, however, jobs in the city and the immediate surrounding areas were growing on balance, though DuPont continued to shed positions – many through early retirement.[6] Craddock Terry, a large shoe producer, was established in Lynchburg in 1888, and Lynchburg Foundry was founded eight years later. Both laid off substantial portions of their workforces in the 1980s, especially in the first half of the decade following the back-to-back economic recessions. In the first three months of 1982, for example, these companies, along with General Electric, Babcock and Wilcox, and other firms with a smaller local presence, laid off 6,740 workers. This was a severe blow to a town of 67,000 at the time.[7]

The negative shocks experienced by Petersburg, Waynesboro, and Lynchburg were typical of those that hit small specialized towns and cities across America in the 1980s and 1990s.[8] Cities that were specialized were vulnerable to sectoral or industrial shocks as advances in technology and globalization combined to alter both the form and location of production globally. But towns and cities differed in their post-shock experiences. Some eventually rebounded, if slowly, from the episodes, while others, such as Petersburg, did not. While a number of factors likely contributed to the differing outcomes, we focus on one particular explanation: the distance to a larger city may partly explain the extent to which small cities recover after experiencing a negative economic shock.

Our approach is to look at Petersburg, which lies about twenty miles south of Richmond, Virginia, the state capital, with a Metropolitan Statistical Area (MSA) population of about 1.3 million people. Petersburg lies within the Richmond MSA, though at the southern edge. We propose that a small city that lies close enough, defined as easily commutable, to the core larger city will face hurdles in its recovery from a negative economic shock that are stronger than those faced by a similar city that

[6]See, for example, Nardi (March 15, 1987).

[7]See, for example, Goodman (March 2, 1982).

[8]The present work focuses on the economic and social challenges faced by small cities whose economic growth has historically depended on a narrow set of economic activities (in other words, cities that have specialized in the production of one or two goods) and that have been hit with a substantial negative economic shock. In these specialized cities, employment is generally concentrated in a small number of relative large firms. Some research in urban economics has focused on the relationship between the degree of city specialization, city size, and city growth. For instance, Glaeser et al. (1992) found evidence that a diverse local productive structure (rather than a specialized) is associated with strong local growth. Duranton and Puga (2000) show that smaller urban areas tend to be less diverse in terms of their employment composition. However, the precise mechanism through which the local industry composition affects urban growth is more complicated and less clearly understood. For a thorough and complete discussion on this topic, see Henderson (2005) or Duranton and Puga (2014).

is isolated ("distant enough" from a larger city). Finally, we briefly explain how the local public finances may reinforce the negative effects of the adverse economic shock and highlight the fact that some decisions made by local officials, namely the annexation of a sizeable area by Petersburg in the early 1970s, could have imposed additional financial burdens on the city's finances.

The next section proposes a model of distance and fiscal impacts of a relatively small city that is subject to a negative economic shock. The first model allows for the city to be located near "enough" to a bigger city, a system of two cities. The second describes the spatial equilibrium when a city is isolated from the rest. The next section aligns the model's results, the outcomes expected both from the interaction between the small and large cities and the isolated city scenario. Section 4 compares data on the evolution of economic and demographic indicators in Petersburg, Waynesboro, and Lynchburg in recent decades. The objective of this section is to compare some stylized facts to determine if these are consistent with the predictions of the models. The last section concludes.

3 The model

We consider a closed, linear urban area that has unit width, represented by the interval $[0, \bar{x}]$. There are two employment centers or cities: R and P. The central business district of city R (CBD^R hereafter) is located at 0, while the CBD of city P (CBD^P) is located at the other end $\bar{x}$. Distance from CBD^R is denoted by x and distance from the CBD^P by $(\bar{x} - x)$. The distance $\bar{x}$ between the two employment centers is short enough so that it is feasible for residents at any location x in $[0, \bar{x}]$ to commute to work in either CBD^R or CBD^P.

Individuals receive labor income from working at either CBD^j with $j = R, P$. The population consists of two types of individuals characterized by their skill level: a group of high-skilled residents/workers, with population size N_h, and a group of low-skilled residents/wokers with population size N_ℓ. High-skilled individuals earn higher wages than low-skilled individuals at every location. Specifically, we assume that $w_h^R \geqslant w_h^P > w_\ell^R \geqslant w_\ell^P$.

Urban residents derive utility exclusively from the consumption of a composite nonland good, denoted z. In other words, the utility of an urban resident is simply z. The price of z is normalized to one. Individuals who commute from their residential location x to either CBD^R or CBD^P face a commuting cost of t dollars per mile of travel. Residents directly consume a fixed amount of land q_i, $i = h, \ell$. We assume that land consumption of high-skilled individuals q_h is fixed at one unit, and land consumption of low-skilled residents is $q_\ell = q < 1$. Moreover, we assume that $w_h^j / q_h > w_\ell^j / q_\ell$, which is consistent with a positive, but less than one, income elasticity of housing demand.[9]

Ultimately, individuals jointly decide their residential location and where to commute to work. Specifically, the utility of an individual of type i who resides at location x and commutes to CBD^j

[9] Empirical evidence seems to indicate that this elasticity is between 0.3 and 0.9.

is

$$u_i^j(x) \quad = \quad w_i^j - t\left[x\,\mathbb{1}\{CBD^R\} + (\bar{x}-x)\,\mathbb{1}\{CBD^P\}\right] - r_i^j q_i, \tag{1}$$

where $\mathbb{1}\{CBD^j\}$ is an indicator function that is equal to one when an individual who resides at location x commutes to CBD^j, and r_i^j is the rent per unit of land paid by a type-i individual who works at CBD^j. For simplicity, land rent is set equal to zero when land is devoted to nonurban purposes. We assume that urban area is large enough to accommodate the entire population, i.e., $\bar{x} = N_h q_h + N_\ell q_\ell = N_h + N_\ell q$.

3.1 Equilibrium: Definition

In an urban equilibrium model with two employment centers, individuals of each type must be indifferent across all residential locations $x \in [0, \bar{x}]$ and between commuting destinations or employment centers CBD^R and CBD^P. Specifically, for each type $i = h, \ell$, $u_i^j(x) = \bar{u}_i$, for $j = R, P$. Since we are considering a closed urban equilibrium model, the utilities $\bar{u}_i$ are endogenously determined. The highest land rent each individual of type i is willing to pay per unit of land at location x is

$$r_i^R(x) = \frac{w_i^R - tx - \bar{u}_i}{q_i} \quad \text{when commuting to } CBD^R, \tag{2}$$

$$r_i^P(x) = \frac{w_i^P - t(\bar{x}-x) - \bar{u}_i}{q_i} \quad \text{when commuting to } CBD^P. \tag{3}$$

Different types of spatial configurations may arise in equilibrium depending on the slopes and intercepts of the bid-rent functions. Among other things, the equilibrium spatial configurations depend on the slopes and intercepts of the bid-rent functions. First, note that the slopes of the bid-rent functions are, in absolute value, equal to $1/q_i$. Since $1/q_h < 1/q_\ell$, the bid-rent function of high-skilled individuals is always flatter than the respective slope of low-skilled individuals. Second, the intercepts of the curves, $(w_i^j - \bar{u}_i)/q_i$, determine whether they cross at a location $x \in (0, \bar{x})$ or whether one curve is always above the other. We initially focus on an equilibrium of the type illustrated in the top panel of Figure 1 in which type-ℓ individuals reside close to the respective CBDs (those at locations $x \in [0, \hat{x}^R]$ commute to CBD^R, and those at locations $x \in [\hat{x}^P, \bar{x}]$ commute to CBD^P), and type-h individuals tend to reside in the suburban areas (they reside at locations $x \in [\hat{x}^R, \hat{x}^P]$, where residents in $[\hat{x}^R, x^*]$ commute to CBD^R, and residents in $[\hat{x}^P, \bar{x}]$ commute to CBD^P).[10]

We formally define an equilibrium (as the one characterized in Figure 1) as a list of values $\{\hat{x}^R$, x^*, $\hat{x}^P$, $\bar{u}_h$, $\bar{u}_\ell\}$ that satisfies the following conditions:

1. $r_\ell^R(\hat{x}^R) = r_h^R(\hat{x}^R)$,

[10] So, for instance, an equilibrium in which individuals of type ℓ reside closer to the respective city centers, and individuals of type h reside in the suburbs of the cities would be characterized by $(w_\ell^j - \bar{u}_\ell)/q_\ell > (w_h^j - \bar{u}_h)/q_h$, in addition to the fact that the bid-rent curve of type-h individuals is flatter than the bid-rent curve of type-ℓ individuals. Since $w_h^j/q_h > w_\ell^j/q_\ell$, then, in equilibrium, the relative utilities satisfy $(\bar{u}_\ell/\bar{u}_h) < q_\ell/q_h = q$.

2. $r_h^R(x^*) = 0$,

3. $r_h^R(x^*) = r_h^P(x^*)$,

4. $r_h^P(\hat{x}^P) = r_\ell^P(\hat{x}^P)$, and

5. $\hat{x}^P - \hat{x}^R = N_h$.

The locations $\hat{x}^j$, which define the borders between high- and low-skilled individuals in the residential area surrounding CBD^j, are determined by the intersections of the bid-rent functions of high- and low-skilled individuals who commute to city R (condition (1)) or city P (condition (4)). Condition (5) states that there should be enough land for all type-h individuals residing in the area. Location $x = x^*$ separates high-skilled individuals who commute to CBD^R from high-skilled individuals who commute to CBD^P (defined by (3)). Moreover, at $x = x^*$, land rent, when land is used for residential purposes, should be that same as land rent in the alternative (agricultural) use, assumed to be zero (condition (2)). As mentioned earlier, we will focus on equilibria in which $0 \leq \hat{x}^R \leq x^* \leq \hat{x}^P \leq \bar{x}$. The market land rent at each location x is given by $r(x) = max[r_\ell^R(x), r_h^R(x), r_h^P(x), r_\ell^P(x)]$, where $r(x) \geq 0$ for all $x \in [0, \bar{x}]$ and $r(x^*) = 0$.

3.2 Characterization of the equilibrium

Solving (1) - (5), we obtain

$$\begin{aligned}
\hat{x}^R &= \frac{\bar{x} - N_h}{2} - \frac{q(w_h^R - w_h^P) - (w_\ell^R - w_\ell^P)}{2(1-q)t}, && (4)\\
\hat{x}^P &= \frac{\bar{x} + N_h}{2} - \frac{q(w_h^R - w_h^P) - (w_\ell^R - w_\ell^P)}{2(1-q)t}, && (5)\\
x^* &= \frac{\bar{x}}{2} + \frac{w_h^R - w_h^P}{2t}, && (6)\\
\bar{u}_h &= \frac{w_h^R + w_h^P}{2} - \frac{t\bar{x}}{2}, && (7)\\
\bar{u}_\ell &= \frac{w_\ell^R + w_\ell^P}{2} - \frac{t\left[\bar{x} - N_h(1-q)\right]}{2}. && (8)
\end{aligned}$$

Note that $\bar{x} - N_h(1-q) > 0$.[11] Consider, initially, an equilibrium in which $w_h^R = w_h^P = w_h$ and $w_\ell^R = w_\ell^P = w_\ell$. Then,

$$\hat{x}^R = \frac{\bar{x} - N_h}{2},\ \hat{x}^P = \frac{\bar{x} + N_h}{2},\ x^* = \frac{\bar{x}}{2},\ \bar{u}_h = w_h^R - \frac{t\bar{x}}{2},\ \bar{u}_\ell = w_\ell^R - \frac{t\left[\bar{x} - N_h(1-q)\right]}{2}. \quad (9)$$

We assume that this initial equilibrium, more precisely $x^* = \bar{x}/2$, determines the border between the “metropolitan statistical areas" (MSAs) that contain the respective employment centers CBD^j. With some abuse of notation, we denote these areas as MSA^j, so the interval $[0, x^*]$ defines the MSA^R and $(x^*, \bar{x}]$ defines MSA^P. Moreover, this border is assumed fixed hereafter.[12]

[11] Since $\bar{x} = N_h + N_\ell q$, then $\bar{x} - N_h(1-q) = q(N_h + N_\ell) > 0$.

[12] An initial symmetric equilibrium is chosen to simplify the exposition. The conclusions do not qualitatively change if w_i^R and w_i^P are initially different.

3.3 Negative productivity shock to CBD^P

Next, suppose that CBD^P is hit by a negative productivity shock that decreases wages of both types of workers in the same proportion, so all types of workers who commute to CBD^P receive $(1-\theta)w_i$, where $0 \le \theta < 1$.[13] The new solution becomes

$$\hat{x}^R = \frac{\bar{x} - N_h}{2} - \frac{\theta(qw_h - w_\ell)}{2(1-q)t}, \quad \hat{x}^P = \frac{\bar{x} + N_h}{2} - \frac{\theta(qw_h - w_\ell)}{2(1-q)t}, \quad x^* = \frac{\theta w_h}{2t} + \frac{\bar{x}}{2}, \tag{10}$$

$$\bar{u}_h = \frac{(2-\theta)}{2}w_h - \frac{t\bar{x}}{2}, \quad \bar{u}_\ell = \frac{(2-\theta)}{2}w_\ell - \frac{t\left[\bar{x} - N_h(1-q)\right]}{2}. \tag{11}$$

We now examine how the equilibrium changes with the magnitude of the negative shock.[14] Let L_i^j denote the number of type-i individuals who work at CBD^j, and $L^j = L_\ell^j + L_h^j$ the total number of workers at CBD^j. Then,

$$L^R = \underbrace{\hat{x}^R/q}_{L_\ell^R} + \underbrace{(x^* - \hat{x}^R)}_{L_h^R} \quad \text{and} \quad L^P = \underbrace{(\bar{x} - \hat{x}^P)/q}_{L_\ell^P} + \underbrace{(\hat{x}^P - x^*)}_{L_h^P}. \tag{12}$$

From the comparative static results

$$\frac{\partial \hat{x}^R}{\partial \theta} = \frac{\partial \hat{x}^P}{\partial \theta} = -\frac{(qw_h - w_\ell)}{2(1-q)t} < 0, \quad \frac{\partial x^*}{\partial \theta} = \frac{w_h}{2t} > 0, \quad \frac{\partial \bar{u}_i}{\partial \theta} = -\frac{w_i}{2} < 0, \tag{13}$$

we can conclude the following. First, $\partial L^R/\partial\theta = -\partial L^P/\partial\theta > 0$, so a shock that negatively affects CBD^P attracts more workers to CBD^R and fewer to CBD^P. Second, there is also a change in the composition of commuters to each location. Since $\partial L_h^R/\partial\theta > 0$ and $\partial L_\ell^R/\partial\theta < 0$, the share of high-skill workers increases and the share of low-skill workers decreases at CBD^R. The opposite effects take place at CBD^P. Third, the resulting relocation of type-h individuals from CBD^P to CBD^R displaces some type-ℓ workers who used to reside in MSA^R and commute to work to CBD^R before the shock. Fourth, if the negative shock in P becomes sufficiently large (in this case, if θ is equal to some critical value $\theta^c \equiv [N_h(1-q)t]/(w_h - w_\ell))$, then only type-$\ell$ workers will end up commuting to CBD^P, i.e., $x^*(\theta^c) = \hat{x}^R(\theta^c))$. And fifth, even though the shock initially affected CBD^P, the negative effect of the shock is propagated throughout the entire area, reflected in a decrease in the utility of all residents. Specifically, $\partial\bar{u}_i/\partial\theta = -w_i/2 < 0$.

The negative shock will also affect total production in each city and total land rents in the respective MSAs. Production in each CBD is given by

$$Y^R = w_\ell L_\ell^R + w_h L_h^R, \quad Y^P = (1-\theta)w_\ell^R L_\ell^P + (1-\theta)w_h L_h^P, \tag{14}$$

and total land rents in each MSA by

$$\mathcal{R}^R = \int_0^{x^*} \max\{r_\ell^R(x), r_h^R(x)\}, \quad \mathcal{R}^P = \int_{x^*}^{\bar{x}} \max\{r_\ell^P(x;\theta), r_h^P(x;\theta)\}, \tag{15}$$

where the land price gradients $r_i^R(x)$ and $r_i^P(x;\theta)$, defined in (2) and (3), respectively, are evaluated

[13] Note that this is a shock that affects all workers in the city in the same way.

[14] The exogenous variable of interest in the analysis is θ. In fact, the political boundary between the two MSAs is determined by $x^*(\theta)$ when $\theta = 0$.

at the equilibrium utilities $\bar{u}_h$ and $\bar{u}_\ell$.[15] Consider the impact of the shock on production:

$$\frac{\partial Y^R}{\partial \theta} = \frac{(qw_h - w_\ell)^2}{2q(1-q)t} + \frac{w_h^2}{2t} > 0, \tag{16}$$

$$\frac{\partial Y^P}{\partial \theta} = -\left[\frac{w_\ell N_\ell + w_h N_h}{2}\right] - (1-2\theta)\frac{\partial Y^R}{\partial \theta} < 0, \tag{17}$$

$$\frac{\partial (Y^R + Y^P)}{\partial \theta} = -\left[\frac{w_\ell N_\ell + w_h N_h}{2}\right] + 2\theta\frac{\partial Y^R}{\partial \theta}, \tag{18}$$

where the inequality in (17) holds for $\theta < 1/2$. Note that the effect on $Y^R + Y^P$ consists of two terms: the first one represents the immediate impact on production in CBD^P, which is negative, and the second one captures the positive effect that the relocation of workers has in CBD^R. As a result, the negative initial effect is, in the aggregate, partially compensated by the higher production taking place in CBD^R.

Graphically, the effects of the negative shock to CBD^P are illustrated in Figure 1. The figure depicts two spatial equilibria. The top panel presents the initial equilibrium, where the two cities are identical and $\theta = \theta_0 = 0$. As stated earlier, type-ℓ individuals reside closer to the respective $CBDs$ (at locations $x \in [0, \hat{x}^R]$ and $x \in [\hat{x}^P, \bar{x}]$), and type-$h$ individuals reside in the suburbs of the CBDs (at locations $x \in [\hat{x}^R, x^*]$ and $x \in [x^*, \hat{x}^P]$). The bottom panel of Figure 1 shows the new spatial equilibrium when a shock $\theta = \theta_1 > 0$ negatively affects CBD^P. As a result of the shock, individuals tend to relocate: type-h individuals move away from CBD^P toward CBD^R, displacing some of the type-ℓ individuals from locations closer to CBD^R to locations closer to CBD^P. The figure shows an extreme case in which the negative shock is so large (in this case, $\theta_1 = \theta^C$, as defined above) that only individuals of type ℓ end up commuting to the employment center in city CBD^P. In other words, high-skill employment at CBD^P has been entirely replaced by low-skill positions.

[15] The notation $r_i^P(x;\theta)$ means that income at CBD^P is $(1-\theta)w_i$. Also, note that total land rents before and after the shock are calculated over the fixed intervals $[0, x^*]$ and $[x^*, \bar{x}]$, since the MSAs are assumed to be defined by the initial situation, without the shock.

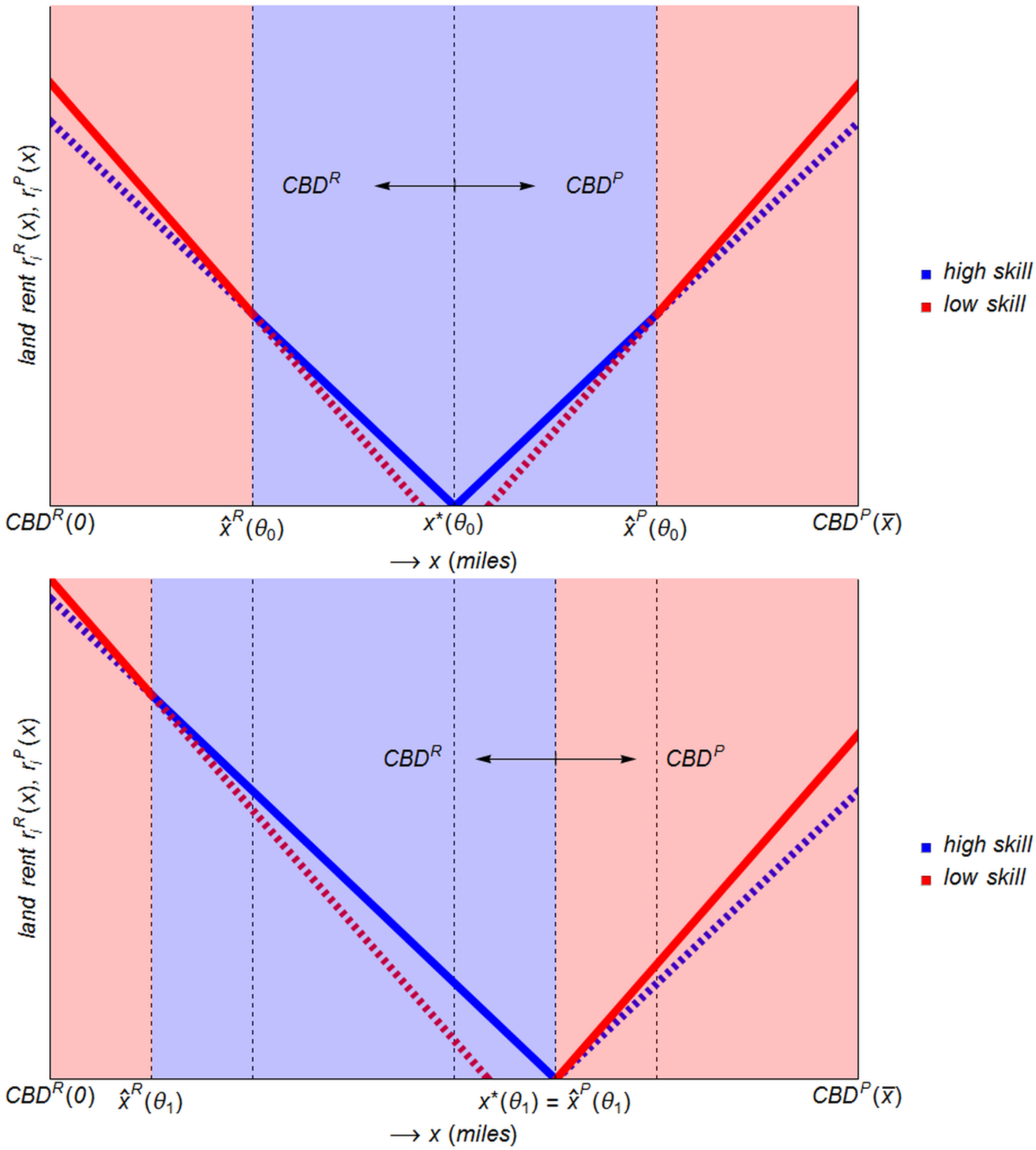

Figure 1: Urban equilibrium:
Before the shock, $\theta = 0.0$ (top panel), and after the shock, $\theta = 0.1$ (bottom panel)

To further characterize how the negative shock to CBD^P affects the spatial equilibrium, we construct a very simple numerical example based on Figure 1. Table 1 in Appendix A summarizes the results of the numerical exercise for different values of θ, including the two cases examined in the figures ($\theta_0 = 0.0$ and $\theta_1 = 0.1$), and other values of θ between them.[16] In addition to the equilibrium values of $\hat{x}^R$, x^*, and $\hat{x}^P$, the table also includes total land rents in each MSA, $\mathcal{R}^R$ and $\mathcal{R}^P$, the total amount produced at each CBD, Y^R and Y^P, and equilibrium utilities $\bar{u}_i$. First, total land rents in MSA^R increase, and total land rents in MSA^P decrease, but in absolute value, the former is substantially larger than the latter. Second, as expected, total production goes down in CBD^P and up in CBD^R. However, the negative shock in CBD^P has interesting qualitative effects. Consider the changes taking place when θ increases from 0.00 to 0.10, i.e., a 10% negative shock. Initially, production in each CBD is 2.70, so aggregate production $Y^R + Y^P$ is 5.40. The immediate effect of the shock (i.e., the short-run effect ignoring the spatial relocation of residents and labor) is to reduce production in CBD^P from 2.70 to 2.43 (10% reduction entirely due to the shock), and production in CBD^R is unaltered. Hence, aggregate output declines to 5.13 (5% decline). As residents and workers relocate and commuting patterns change, local production will be affected further. Specifically, Y^R increases to 3.60 (33% increase), and Y^P decreases to 1.62 (40% decline). At the end, overall production $Y^R + Y^P$ goes down to 5.22 (3.33% decline).

Finally, note that since we consider a closed system of cities, a negative shock to CBD^P adversely affects the utilities of all types of individuals residing in the area.[17] However, even though the initial negative productivity shock affects low- and high-skilled workers in CBD^P in the same proportion θ, low-skilled individuals end up experiencing a proportionally larger negative effect on utility. In the example, while $\bar{u}_h$ declines in 6.25%, $\bar{u}_\ell$ declines in 6.90%.

3.4 Implications of the analysis

The key underlying assumption in the model presented here is that when economic activity declines in one city, workers and residents in the area have the option to commute and eventually later move toward a nearby and more vibrant employment center. This movement is amplified if the costs of doing so are relatively low. Under these conditions then, what does our simple spatial equilibrium model predict will happen in the region? We consider below the changes that would take place following a negative shock at each employment center CBD^j and in the surrounding areas or MSAs.

According to the model, a negative shock in city P (i.e., a uniform shock that negatively affects the productivity of all types of workers, low- and high- skilled, in the same proportion) is expected to have the following effects:

1. Total employment at CBD^P declines, and total employment at CBD^R increases.

[16] The bottom panel of Figure 1 is consistent with a value of $\theta_1 = \theta^C = 0.1$.

[17] If nothing else happens in the region, then it is expected that in the long run some individuals will leave the area if alternative regions offer higher net-of-moving costs utilities. In a previous version of the present model, we consider a situation in which the overall productivity in city P declines, and the productivity of type-h jobs increases at CBD^R. In this case, the utility of type-h workers may actually increase if the latter dominates the former effect for this type of workers.

2. The composition of residents at each MSA and the composition of workers commuting to each city change as follows:

   - The proportion of high-skilled residents increases in MSA^R.
   - Similar changes are observed in the composition of workers commuting to each city: the proportion of high-skilled workers commuting to CBD^R increases, and the proportion of low-skilled workers commuting to CBD^P increases.
   - A larger proportion of high-skilled workers who still reside in MSA^P (recall that the model predicts they will locate in the suburbs of city P) will start commuting to the more economically vibrant employment center CBD^R. Eventually, if the negative shock in CBD^P is large enough (as shown in the bottom panel of Figure 1), then all type-h individuals who reside in MSA^P (represented in the graph by the segment $[\hat{x}^P(\theta_1) - x^*(\theta_0))$ will commute to CBD^R.

3. The negative shock on MSA^P reduces production in CBD^P and increases production in CBD^R. Some workers, in particular the most productive ones, are induced to relocate to CBD^R. As the workforce in CBD^P becomes increasingly low-skilled, the production in CBD^P declines further, amplifying the initial negative impact. Overall, at the regional level, the decline in production CBD^P is partially compensated by the higher production taking place in CBD^R.

4. Land prices will tend to rise at all locations in MSA^R and decline at most locations in MSA^P.[18] Low- and high- skilled residents in MSA^R face higher land prices, and low-skilled residents in MSA^P face lower land prices (this is also true, on average, for high-skilled residents who remain in MSA^P after the shock). Hence, low-skilled workers displaced from MSA^R to MSA^P end up paying lower land prices, but those who remain in MSA^R pay higher land prices after the negative shock in CBD^P.

5. Total land rents in MSA^P, $\mathcal{R}^P$, will tend to decline, and total land rents in MSA^R, $\mathcal{R}^R$, will tend to increase.

3.5 Negative shock to CBD^P and positive shock to type-h jobs at CBD^R

In the case of Richmond and Petersburg, not only has Petersburg been declining, but it has been doing so at the same time Richmond has been booming. We show in Appendix B how the equilibrium values of $\{\hat{x}^R, x^*, \hat{x}^P, \bar{u}_\ell, \bar{u}_h\}$ change when we consider at the same time both a negative productivity shock to CBD^P and a positive productivity shock to CBD^R. Specifically, we assume that wages for low- and high-skilled workers in CBD^P are $(1-\theta^P)w_i$ after the shock (the same as before), and wages in CBD^R increase to $(1+\theta^R)w_i$ after the shock, with $\theta^j > 0$.

[18] Specifically, the land rent function is lower after the shock at all locations $x \in [\hat{x}^P(\theta_1), \bar{x}]$ in MSA^P. Note that locations $x \in [x^*(\theta_0), \hat{x}^P(\theta_1)]$ are inhabited by high-skilled residents who live at the edge of MSA^P and commute to CBD^R.

The following conclusions can be drawn from this exercise. First, the positive shock to CBD^R has exactly the same effect on $\hat{x}^R$, x^*, and $\hat{x}^P$ as the negative shock to CBD^P. In other words, the equilibrium values of $\hat{x}^R$, x^*, and $\hat{x}^P$ are exactly the same when $\{\theta^P, \theta^R\} = \{\tilde{\theta}, 0\}$ and $\{\theta^P, \theta^R\} = \{0, \tilde{\theta}\}$. In fact, only changes in the sum of the two shocks $\bar{\theta} = \theta^P + \theta^R$ would affect the equilibrium values of these variables. Second, the equilibrium utilities $\bar{u}_\ell$ and $\bar{u}_h$ depend on the difference between the two shocks $(\theta^R - \theta^P)$. If the magnitude of the two shocks is the same, then equilibrium utilities would not be affected. And third, for a given θ^P, the effect of the positive of shock to CBD^R is to push even more high-skilled workers to CBD^R and MSA^R ($\hat{x}^R$ decreases, x^* increases, and $\hat{x}^P$ decreases).

3.6 Reinforcing effects

The model above captures only a portion part of the economic effects of the negative shock to CBD^P. It should be emphasized that, as all these events unfold, other factors simultaneously take place reinforcing and amplifying the initial negative effects of the shock. For instance, a decline in land prices and the shift toward a predominantly low-skill workforce may adversely affect the local public finances of city P. The resulting lower land prices and lower local production would translate into lower tax revenues and lead to a lower quality of local public goods, such as schools, parks, and other public infrastructure. The dimming economic prospects at MSA^P due to the deteriorating balance between taxes and local public goods would eventually induce additional residents to leave the area. Presumably, the first workers to leave the area are mostly high-skilled workers, further hampering the local economic situation. These feedback effects are not explicitly considered in the present model but undoubtedly contribute to explain the overall decline of the region containing city P.[19]

The recovery hurdles could by exacerbated by the existence of asymmetric fixed boundaries for the city, that is, it can grow but not shrink when structural economic conditions change. Fixed boundaries impose costs of operating the city that are "sticky" when population declines as a result of the negative shock. Petersburg, for instance, riding a wave of optimism in the early 1970s, annexed fourteen square miles of land from adjacent localities, envisioning an industrial park. Their vision, however, never materialized. In fact, the annexed parcel had a relatively small population for the large area, saddling the city with sizeable maintenance costs that were not balanced by increased tax revenues. Such decisions made the city particularly vulnerable to shocks to its local public finances.

3.7 Isolated city: Benchmark for comparison

How would the situation described above differ from that of a city that is also subject to a negative shock but is completely isolated from other cities? More precisely, suppose that the distance from

[19] In a different paper, we focus more precisely on the local public finance implications of urban decline.

any location in the MSA surrounding an isolated city, denoted by CBD^S, to the next closest employment center is sufficiently large so that commuting costs are prohibitively large. Moreover, if residents wanted to move out of MSA^S, they would need to incur sizable moving costs. We assume, hence, that the city is closed and examine the implications of a negative shock using the standard closed-city urban equilibrium model. The goal is to compare the impact of the shock to CBD^S and MSA^S to the respective effects on CBD^P and MSA^P analyzed earlier. We assume, for a more direct comparison, that CBD^S is located at $x = \bar{x}$.

In this case, the equilibrium is simply determined by

$$\hat{x}^S = x^* + N_h^S, \quad \bar{u}_h^S = w_h(1-\theta) - t(\bar{x} - x^*), \quad \bar{u}_\ell^S = w_\ell(1-\theta) - t[\bar{x} - x^* - N_h^S(1-q)], \tag{19}$$

where x^{*S} is the outer border of MSA^S, and location $\hat{x}^S$ separates the residential locations of the two types of workers (i.e., type-h workers reside at locations $x \in [x^*, \hat{x}^S]$ and type-h workers reside at locations $x \in [\hat{x}^S, \bar{x}]$). In order to compare the impact of the shock on MSA^S and MSA^P, we assume the initial conditions of the two cities are identical. In other words, we assume that wages w_i and commuting costs t are the same, and $N_i^S = N_i/2$, so that when $\theta = 0$, $x^* = \bar{x}/2$, $\hat{x}^S = \hat{x}^P$, and $\bar{u}_i^S = \bar{u}_i$.

Clearly, the only impact of the negative shock on CBD^S and MSA^S is to reduce the equilibrium utilities of both low- and high-skilled workers. However, total land rents are unaffected and the decline in production is substantially smaller when CBD^S experiences a negative shock of the same kind and magnitude as CBD^P.[20] In the case of the isolated city, the amplifying effects discussed earlier in the case of a negative shock to CBD^P (triggered basically by the fact that high-skilled workers would over time tend to disproportionately abandon the area) do not completely materialize to the same degree because the negative effects are partially contained within the geographic area. To some extent, by circumscribing the harmful effects of the negative productivity shock to the immediate surrounding area of CBD^S, it eventually becomes relatively easier for the city to recover in times of prosperity.

4 Some Stylized Facts

A number of the implications from the models can be matched to data from Petersburg and the greater Richmond area, in general. We also include, for comparison, a number of indicators of economic performance for Waynesboro and Lynchburg. These cities are in some ways comparable to Petersburg, but importantly, are not close to other economically vibrant MSAs, and we, thus, considered them to be isolated.[21]

[20] Since $Y^S = (1-\theta)w_\ell N_\ell^S + (1-\theta)w_h N_h^S$, then $\partial Y^S/\partial\theta = -\left(w_\ell N_\ell^S + w_h N_h^S\right)$, which essentially captures the direct effect of the shock on production discussed in the previous case. Moreover, note that, evaluated at the equilibrium utilities, the land rent functions are unchanged. It is straightforward to verify this by replacing $\bar{u}_i$ from (19) into the land-price gradient (3), substituting w_i^P for $(1-\theta)w_i$.

[21] Lynchburg, Virginia is fifty-six miles from Roanoke, Virginia, the nearest larger city. Waynesboro, Virginia is twenty-eight miles from Charlottesville, Virginia, also the nearest larger city. These distances are greater than those

Figure 2 shows that, in general, similar shocks hit all the three cities in the 1980s and 1990s. From 1990 to 2015, for example, unemployment rates in the cities typically moved together, rising around U.S. recessions and falling with expansions. Of the four cities, Petersburg posted a generally higher unemployment rate, particularly around recessions, but it tended to converge toward the unemployment rates of the other cities during expansions. Notably, the gap between Petersburg's unemployment rate and that of the other cities was wider following the Great Recession than after previous recessions. In addition, Figure 3 displays the job numbers in the Virginia cities considered in the present analysis. In the case of Petersburg, the figure shows a peak of employment in the early 1980s before its long steady decline. For Lynchburg and Waynesboro, the situation is somewhat different. Despite going through a period of decline (attributed to the shocks described earlier), employment in both cities not only recovered, but, by 2010, reached the highest levels since 1970.[22]

Differences are also apparent in the population trends of the cities as seen in Figure 4. Subsequent to the economic shocks of the 1980s and 1990s, Petersburg's population followed a downward trend that persisted throughout the thirty-five-year period shown. Specifically, the population in Petersburg declined from a peak of 41,000 in 1980 to 32,000 in 2015 (approximately a 22% decline in population). In contrast, the populations of Lynchburg and Waynesboro rebounded after a period of population decline. Lynchburg notably recovered from a small population loss observed during the 1980-2000 period, reaching 79,505 in the year 2015 (a 20% population increase compared to 1980). The population in Waynesboro importantly declined during the 1980s, but also rapidly recovered, surpassing by 2010 the population levels observed prior to 1980.

With declining population and higher unemployment plaguing the city, Petersburg was further hampered by a changing demographic composition.[23] On average, relative to the other cities examined, Petersburg residents were less likely to have a high school diploma (Figure 5), and more likely not to hold a Bachelor's degree or higher (Figure 6). This is consistent with the model's prediction that high-skill residents of the city would relocate outside of Petersburg (toward better job prospects), while those with lower skills were less likely to move (Duranton and Puga (2014)). One plausible explanation is that the lower educational attainment in Petersburg may result from higher-skill residents leaving the city. If higher-skill residents leave, they are more likely to be working age and their departure would have implications for Petersburg's residential age distribution. The proportion of Petersburg residents that were age 65 or older was the second lowest among the four cities in 1970, but second highest among the cities by 2010 (Figure 7). Note that an older population is consistent with a lower labor force participation rate in Petersburg compared to other

between Petersburg and Richmond, but both Roanoke and Charlottesville are substantially smaller and perhaps less diversified than Richmond, lessening the available job opportunities, and consequently the "pull", to residents from the smaller cities after a negative shock.

[22] For Waynesboro, the substantial layoffs in the early 1980s mentioned in Section 2 are not apparent in Figure 3 because that data are decennial, and jobs lost in Waynesboro after 1980 that were offset later in the decade do not show up at the 1990 level. As a result, the 1990 reading will appear similar to the 1980 level.

[23] While unemployment also tends to rise in Lynchburg and Waynesboro when economic conditions are weak, residents in those cities do not seem to respond to the negative shock by overwhelmingly leaving their respective areas, as opposed as to the activity seen in Petersburg.

Virginia cities and is likely a factor in the widening unemployment rate gap (as seen in Figure 2).

While these figures paint a picture of a city that has wider employment swings around business cycles, is experiencing an aging population, and has falling educational attainment, the spatial aspects of these changes remain unaddressed thus far. The following charts provide some evidence that the flows of people and economic activity in and around Petersburg have been moving toward its neighbor to the north, Richmond. Additionally, corresponding charts for Waynesboro and Lynchburg do not have a nearby city and the patterns of flows appear to differ in those jurisdictions.

Figure 8 shows that the locations of high-income residential concentrations lessened in Petersburg and tended to show up more prominently in areas north of the city (toward Richmond) over the period examined. Further, concentrations of higher home values also migrated in a similar fashion, mostly disappearing in Petersburg and arising north of the city –toward Richmond (Figures 9).[24] This movement is not surprising in light of the income migrations as local income levels are typically correlated with local housing prices.

The outmigration of higher-skilled workers left Petersburg with both a lower population and a lower-skilled workforce subsequent to the closing of tobacco firms in the 1990s. For decades, the city had relied on these firms for a major portion of the job base. Because these firms required workers with lower-tier skill sets, their departure may have disadvantaged Petersburg's ability to attract new firms, many of which likely required higher skill sets. Compounding the problems facing the city, potential workers with higher skills appear to have migrated toward Richmond, possibly leading relocating firms to always choose Richmond for that city's labor pool.

The data for both Lynchburg and Waynesboro suggest a different reaction to negative employment shocks, with less clear-cut changes in geographic patterns. For instance, Figures 10 and 12 show a less pronounced movement of high-skill departures, and Figures 11 and 13 reveal a muted change in housing values. Specifically, within the city borders, both household income and home values did not significantly change from 1980 to 2015.

Over time, the tax base of Petersburg faced downward pressures, even as the costs of running the city could not easily adjust down commensurately partly because of the large land area the city acquired in the 1971 annexation. Ultimately, facing mounting fiscal stress, Petersburg's infrastructure –including schools– declined, creating added headwinds to efforts aimed at reviving the city.

5 Conclusions

Following two centuries of general economic prosperity, Petersburg has experienced a prolonged period of decline. A fixed-boundary city combined with a shrinking population may have left the

[24]While generally the case, note that housing values also increased east of Petersburg, as seen in Figure 9. This increase likely occurs because that area contains I-95, which connects Petersburg with Richmond, and households located there are able to easily commute to Richmond, as are households located north of Petersburg. Though not explicitly modelled here, the "effective" distance to job centers, basically determined by the time it takes to reach the destination, is likely the relevant distance for households when they determine their residential locations.

city vulnerable to negative economic shocks as city officials faced “fixed" municipal costs in a context of declining tax revenues. When large layoffs occurred beginning in the 1980s, the city appears to have lost residents, especially higher-skilled residents, to the Richmond suburbs north of the city. Additionally, a new regional shopping center in neighboring Colonial Heights drained the city of retail tax revenues. These development led to a prolonged period of decline in the city.

But other Virginia cities also experienced substantial layoffs around the same time as Petersburg, yet they did not decline to the same degree. The question is why? We model two scenarios. The first incorporates two cities, one relatively economically vibrant and the other less so. We show that a negative productivity shock to the less vibrant city will lead to an outflow of high-skill workers to the more vibrant neighboring city along with higher-value homes. As tax revenues fall, the city experiences fiscal decline, which amplifies and reinforces its decline.

We also model an isolated city in which a negative shock does not result in as large of an outflow of high-skilled workers. In this setting, the city experiences a loss in aggregate utility for residents but is in a better position to weather the shock and eventually return to a path of economic growth.

Evidence from several Virginia cities is consistent with the implications of the models. In Petersburg, the period after the shocks saw high-income residents and higher home price areas decrease in the city and increase in areas closer to Richmond. As higher-skilled workers left, the population of Petersburg got older and less well-educated. In contrast, isolated cities that experienced somewhat similar shocks showed less pronounced effects. We conclude that Petersburg was a victim of being “too close" to Richmond, and as residents and the tax base left the city, an inability to scale down city municipal costs led to the severe fiscal difficulties seen today.

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A Numerical example: Negative productivity shock to CBD^P

θ	$\hat{x}^R$	$\hat{x}^*$	$\hat{x}^P$	$\mathcal{R}^R$	$\mathcal{R}^P$	Y^R	Y^P	$\bar{u}_h$	$\bar{u}_l$
0.0000	0.5000	1.0000	1.5000	0.3150	0.3150	2.7000	2.7000	2.4000	1.4500
0.0100	0.4750	1.0250	1.4750	0.3285	0.3019	2.7900	2.5840	2.3850	1.4400
0.0200	0.4500	1.0500	1.4500	0.3422	0.2897	2.8800	2.4700	2.3700	1.4300
0.0300	0.4250	1.0750	1.4250	0.3558	0.2782	2.9700	2.3570	2.3550	1.4200
0.0400	0.4000	1.1000	1.4000	0.3696	0.2676	3.0600	2.2460	2.3400	1.4100
0.0500	0.3750	1.1250	1.3750	0.3834	0.2578	3.1500	2.1370	2.3250	1.4000
0.0600	0.3500	1.1500	1.3500	0.3974	0.2489	3.2400	2.0300	2.3100	1.3900
0.0700	0.3250	1.1750	1.3250	0.4113	0.2407	3.3300	1.9250	2.2950	1.3800
0.0800	0.3000	1.2000	1.3000	0.4254	0.2334	3.4200	1.8220	2.2800	1.3700
0.0900	0.2750	1.2250	1.2750	0.4395	0.2269	3.5100	1.7200	2.2650	1.3600
0.1000	0.2500	1.2500	1.2500	0.4538	0.2213	3.6000	1.6200	2.2500	1.3500

Parameter values: $w_\ell = 2$, $w_h = 3$, $q = 5/6$, $t = 0.6$, $N_h = 1$, $N_\ell = 1/q$

B Negative productivity shock to CBD^P and positive productivity shock to CBD^R

Suppose that while CBD^P is hit by a negative productivity shock $\theta^P > 0$, CBD^R experiences at the same time a positive productivity shock $\theta^R > 0$. Specifically, suppose that wages in CBD^P are, as before, $(1-\theta^P)w_i$, and wages in CBD^R are $(1+\theta^R)w_i$, for $i = \ell, h$. The equilibrium values of $\{\hat{x}^R, x^*, \hat{x}^P, \bar{u}_\ell, \bar{u}_h\}$ are now given by

$$\hat{x}^R = \frac{\bar{x} - N_h}{2} - \frac{\bar{\theta}(qw_h - w_\ell)}{2(1-q)t}, \quad x^* = \frac{\bar{\theta}w_h}{2t} + \frac{\bar{x}}{2}, \quad \hat{x}^P = \frac{\bar{x} + N_h}{2} - \frac{\bar{\theta}(qw_h - w_\ell)}{2(1-q)t}, \tag{20}$$

$$\bar{u}_h = \frac{(2+\theta^R-\theta^P)}{2}w_h - \frac{t\bar{x}}{2}, \quad \bar{u}_\ell = \frac{(2+\theta^R-\theta^P)}{2}w_\ell - \frac{t\left[\bar{x} - N_h(1-q)\right]}{2}, \tag{21}$$

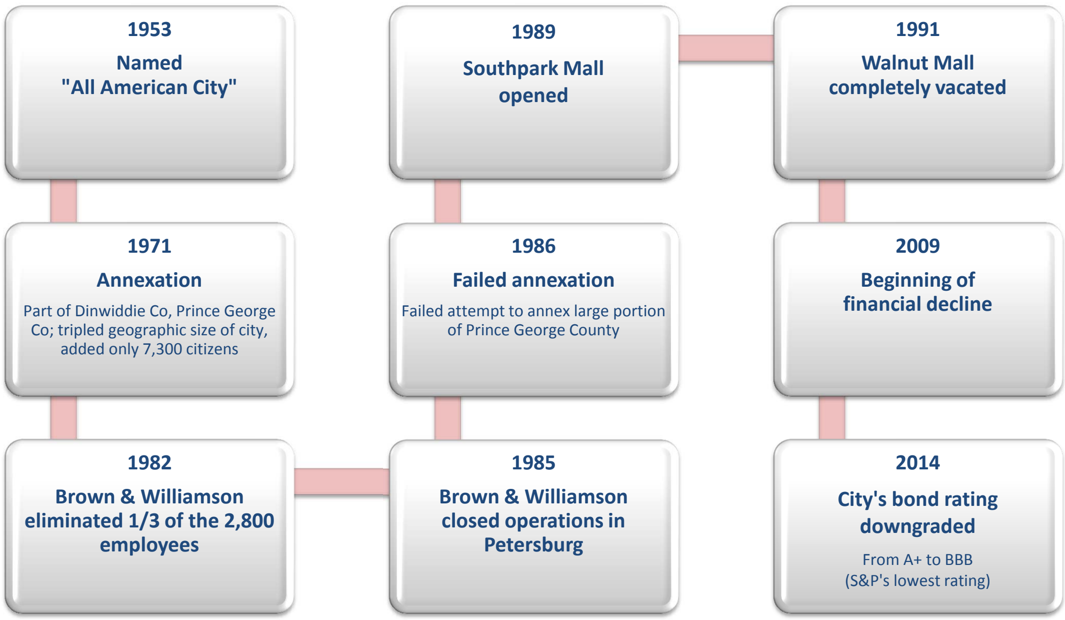
where $\bar{\theta} = \theta_0 + \theta_1$.

C Isolated city: Benchmark for comparison

θ	x^*	$\hat{x}^S$	$\bar{x}$	$\mathcal{R}^S$	Y^S	$\bar{u}_h$	$\bar{u}_l$
0.00	1.00	1.50	2.00	0.315	2.70	2.40	1.45
0.01	1.00	1.50	2.00	0.315	2.67	2.37	1.43
0.02	1.00	1.50	2.00	0.315	2.65	2.34	1.41
0.03	1.00	1.50	2.00	0.315	2.62	2.31	1.39
0.04	1.00	1.50	2.00	0.315	2.59	2.28	1.37
0.05	1.00	1.50	2.00	0.315	2.57	2.25	1.35
0.06	1.00	1.50	2.00	0.315	2.54	2.22	1.33
0.07	1.00	1.50	2.00	0.315	2.51	2.19	1.31
0.08	1.00	1.50	2.00	0.315	2.48	2.16	1.29
0.09	1.00	1.50	2.00	0.315	2.46	2.13	1.27
0.10	1.00	1.50	2.00	0.315	2.43	2.10	1.25

Parameter values: $w_\ell = 2$, $w_h = 3$, $q = 5/6$, $t = 0.6$, $N_h = 1/2$, $N_\ell = (1/q)/2$.

D Petersburg's recent history: Critical events



E Evolution of various economic variables for different cities

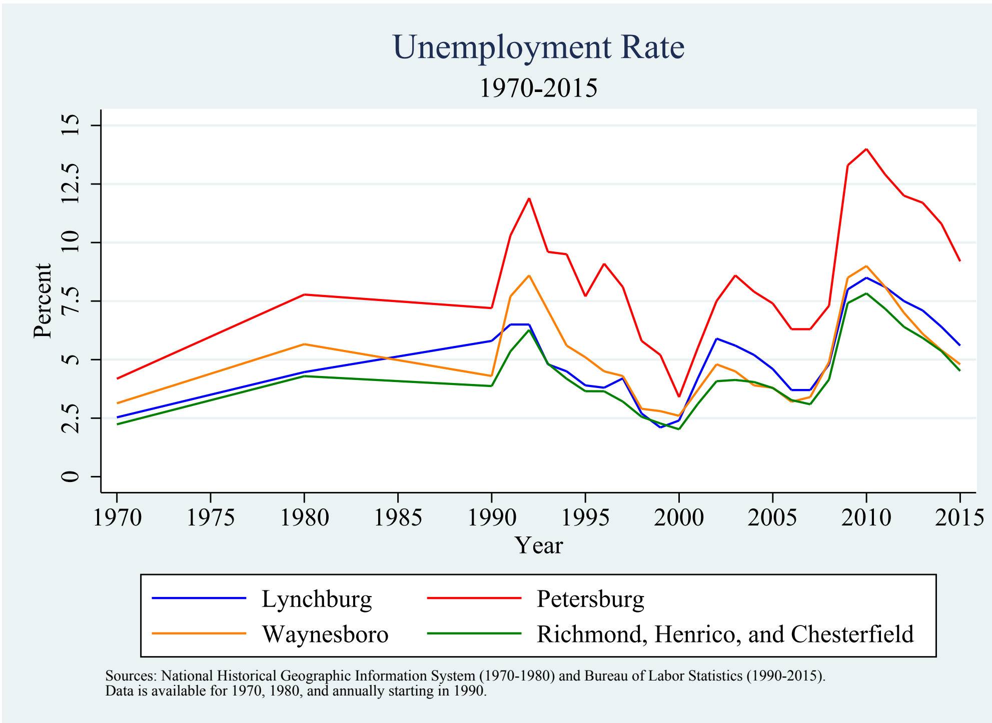


Figure 2

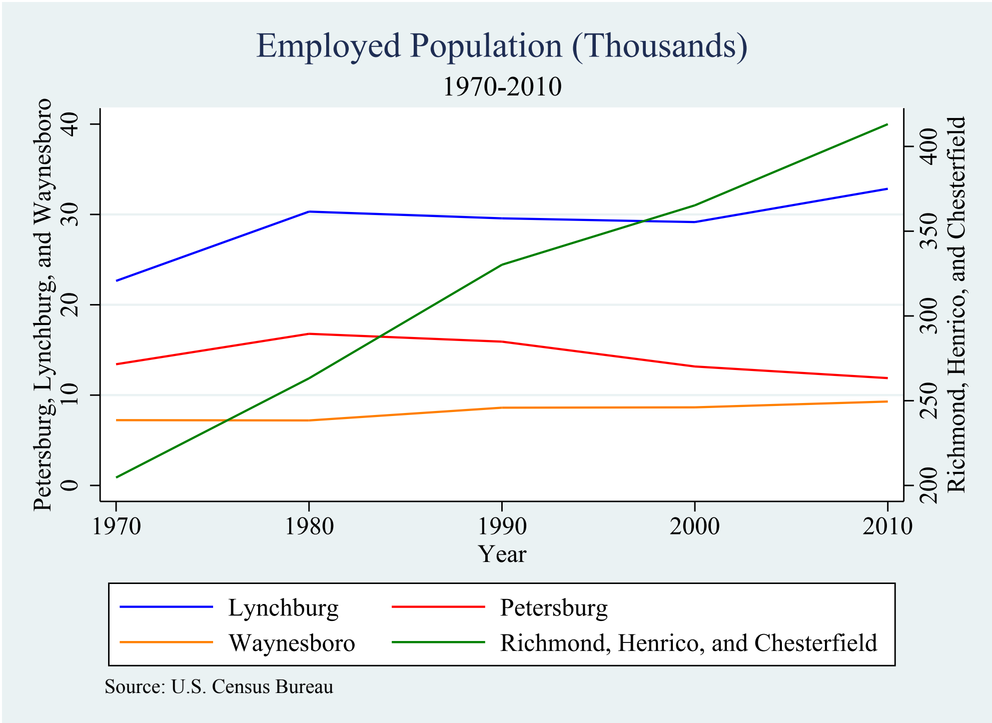


Figure 3

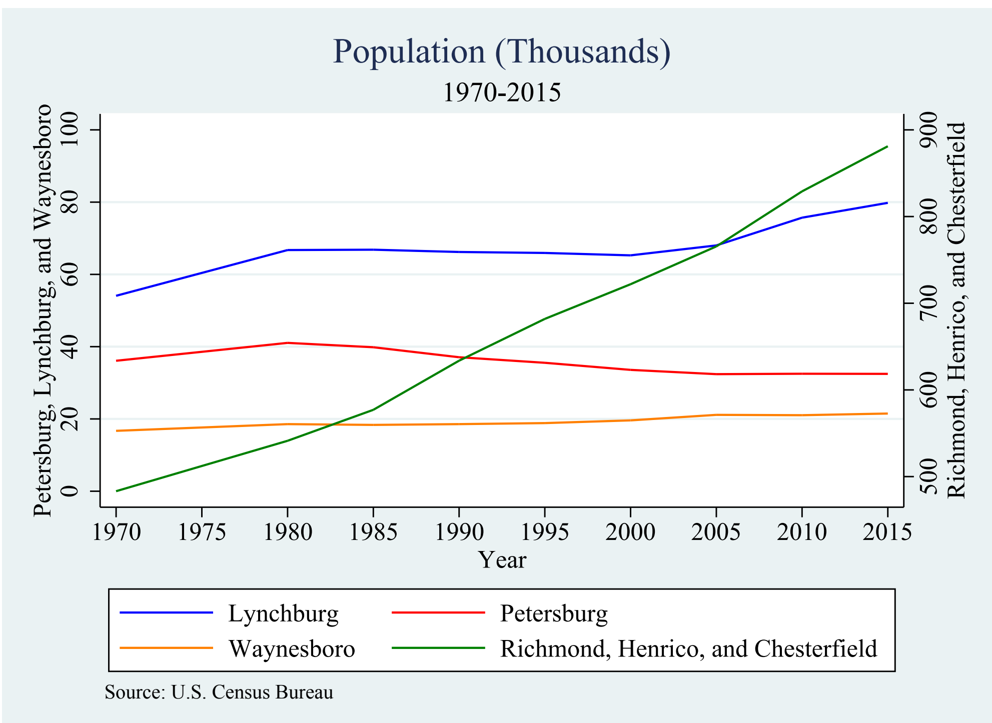


Figure 4

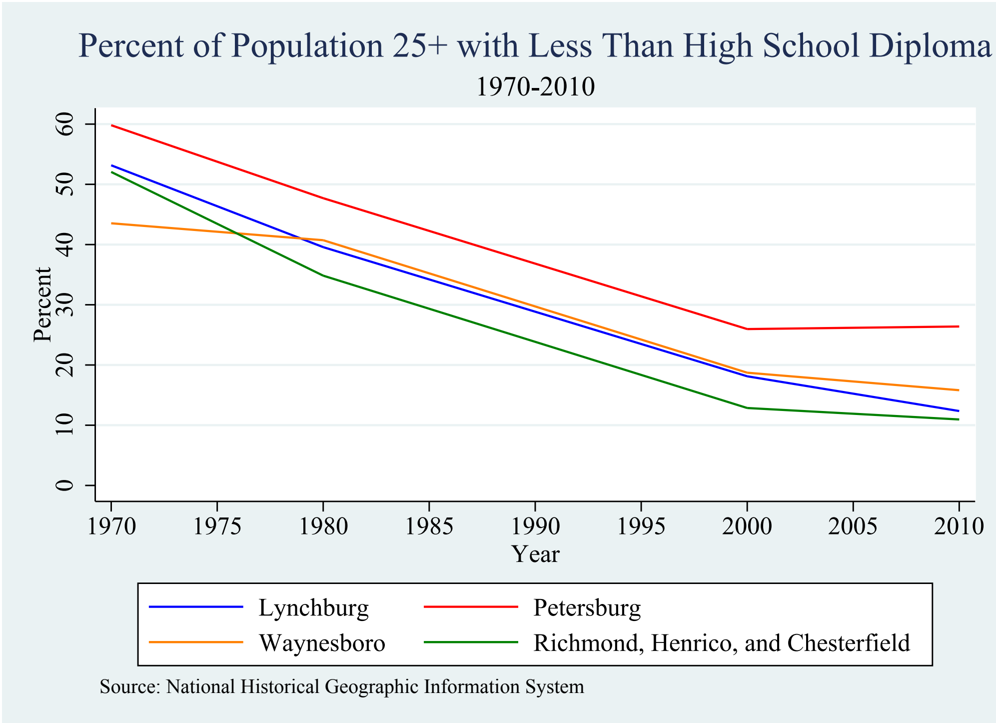


Figure 5

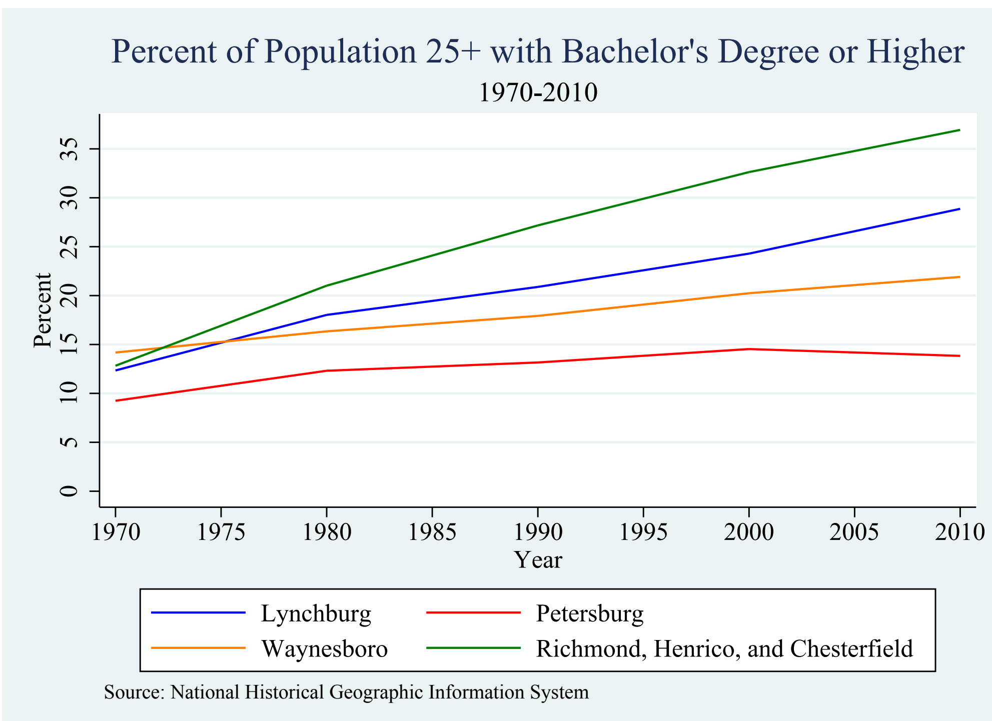
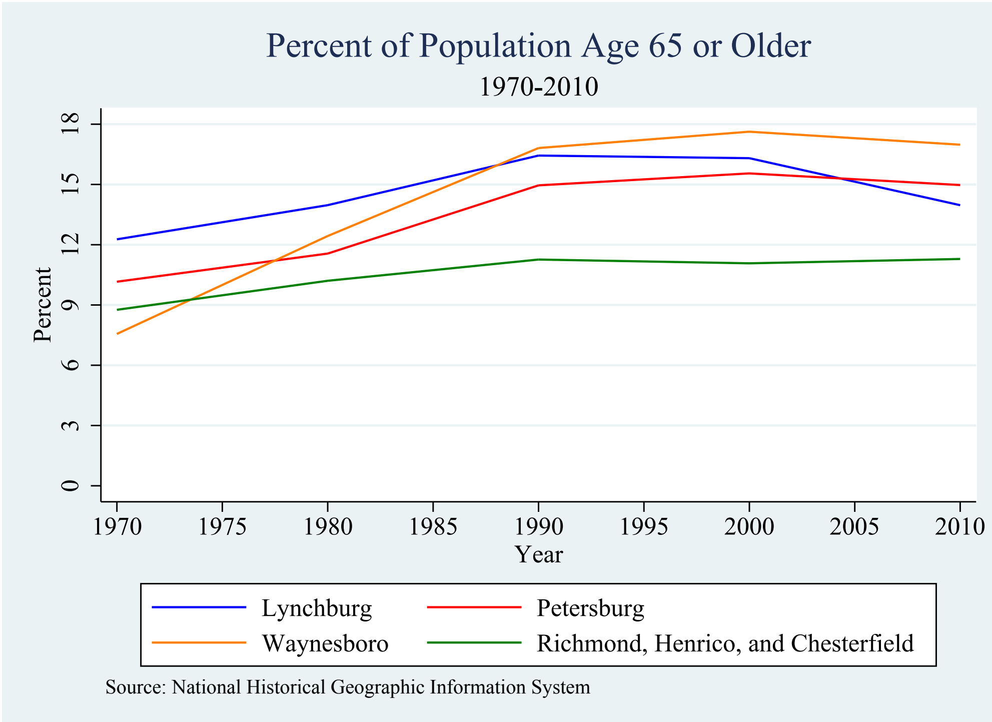


Figure 6

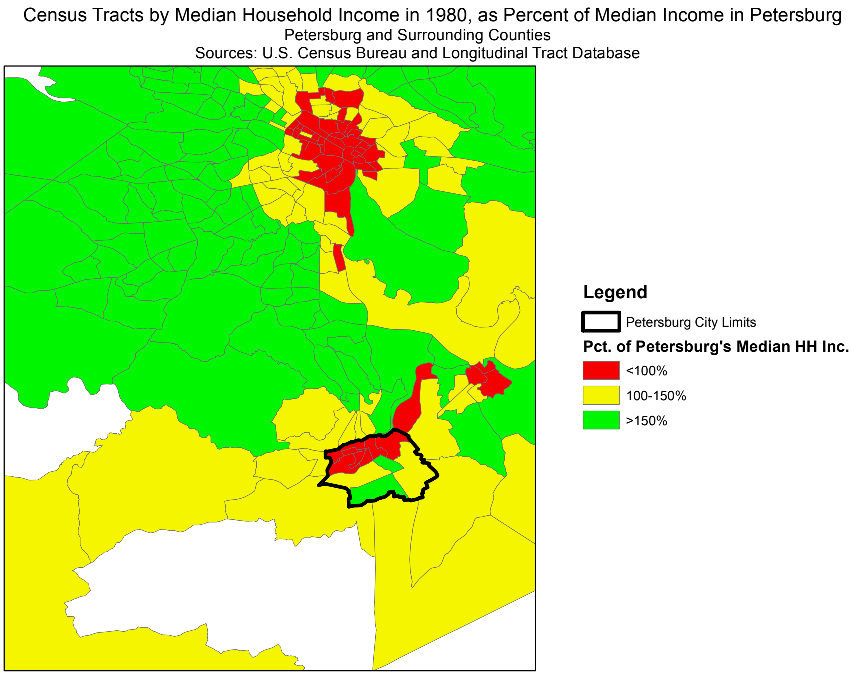


Percent of Population Age 65 or Older
1970-2010
Percent
0
3
6
9
12
15
18
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year
Lynchburg
Petersburg
Waynesboro
Richmond, Henrico, and Chesterfield
Source: National Historical Geographic Information System

Figure 7

E.1 Household income and housing prices

E.1.1 Petersburg



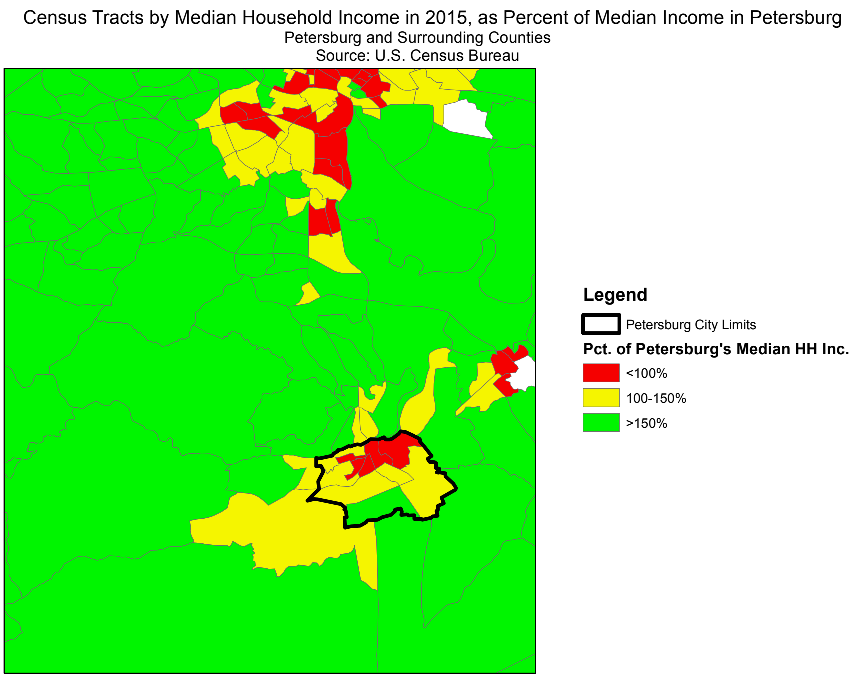
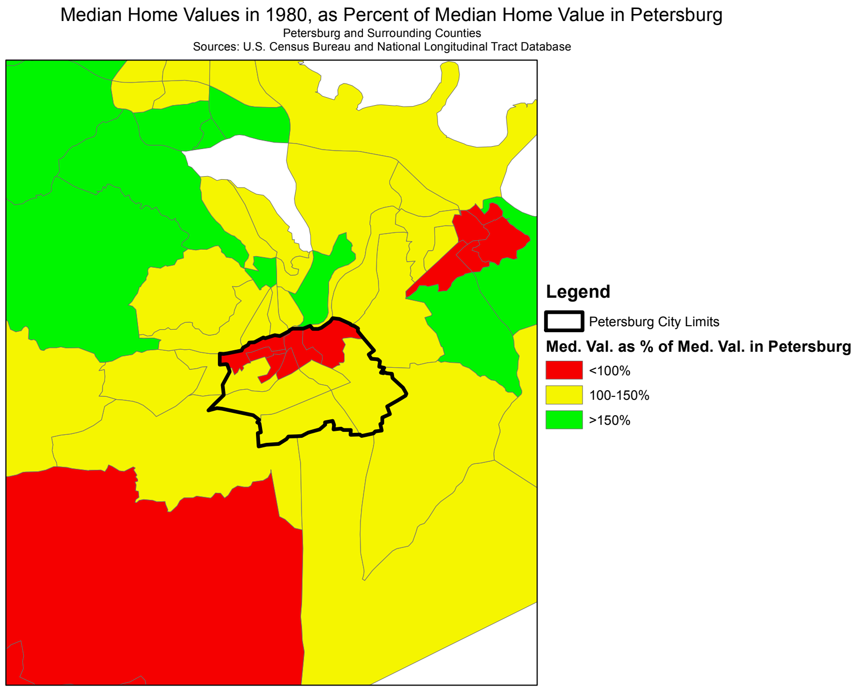


Figure 8: Petersburg: Household income



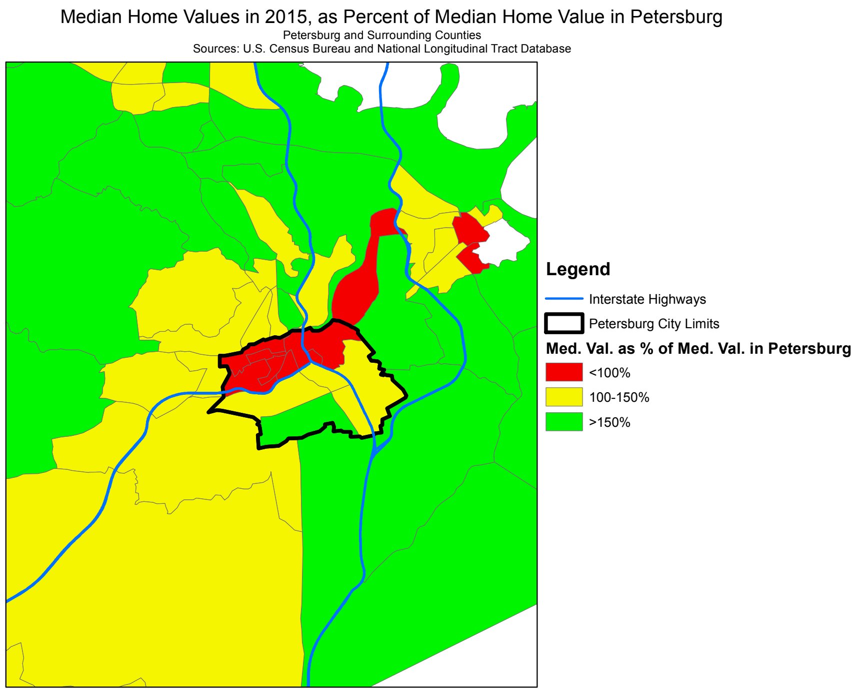
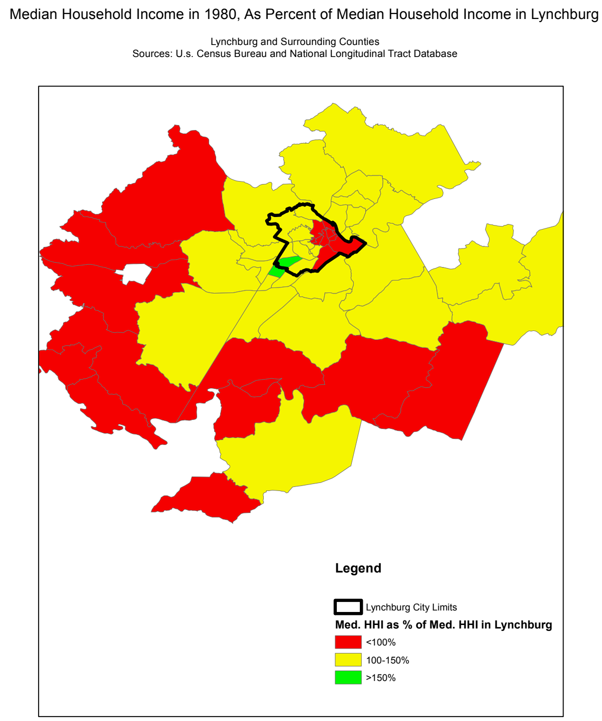


Figure 9: Petersburg: Home values

E.1.2 Lynchburg



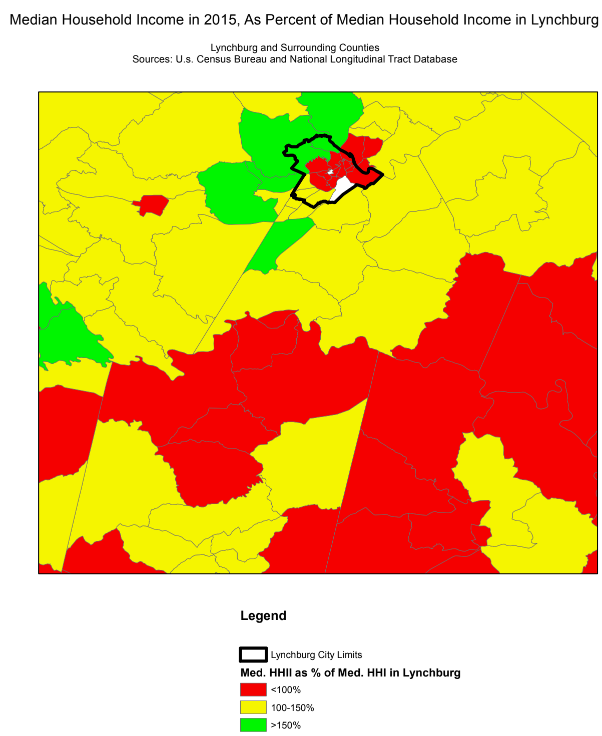
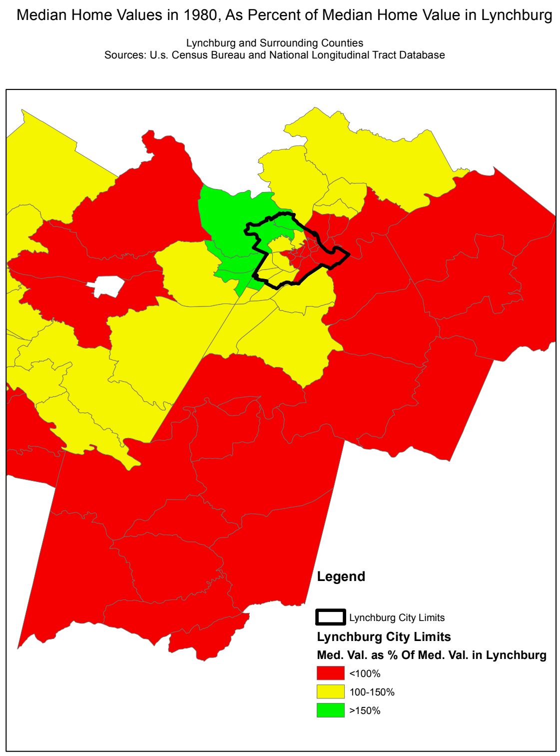


Figure 10: Lynchburg: Household income



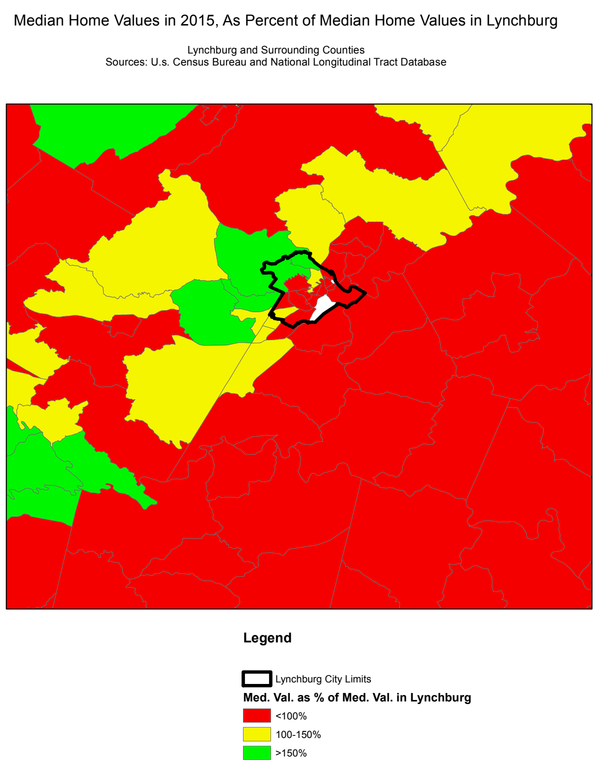
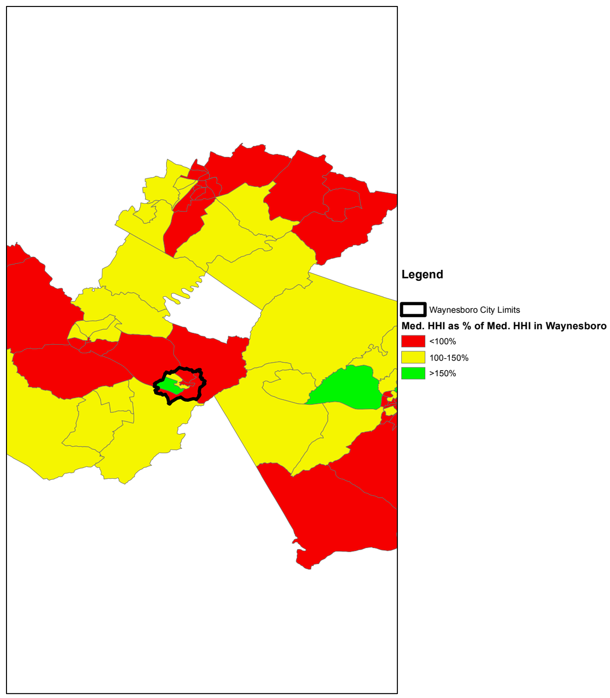


Figure 11: Lynchburg: Home values

E.1.3 Waynesboro

Median Household Income in 1980, as Percent of Median Household Income in Waynesboro

Waynesboro and Surrounding Counties
Sources: U.S. Census Bureau and National Longitudinal Tract Database



Median Household Income in 2015, as Percent of Median Household Income in Waynesboro

Waynesboro and Surrounding Counties
Sources: U.S. Census Bureau and National Longitudinal Tract Database

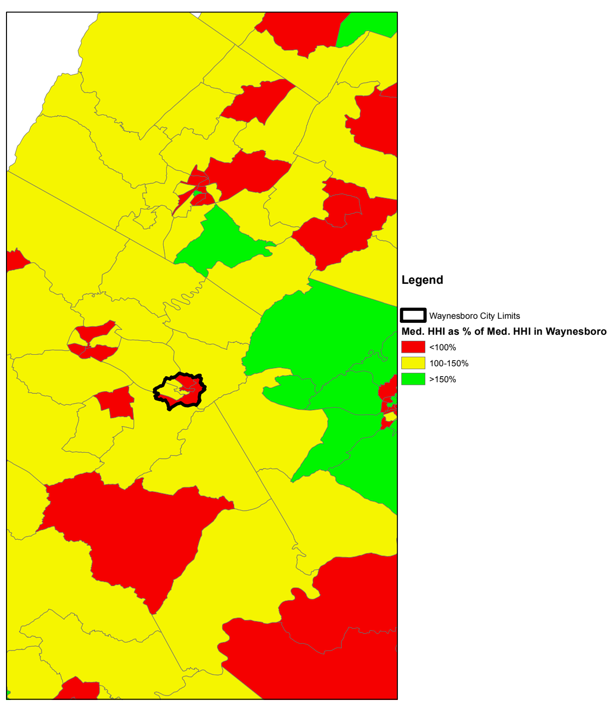
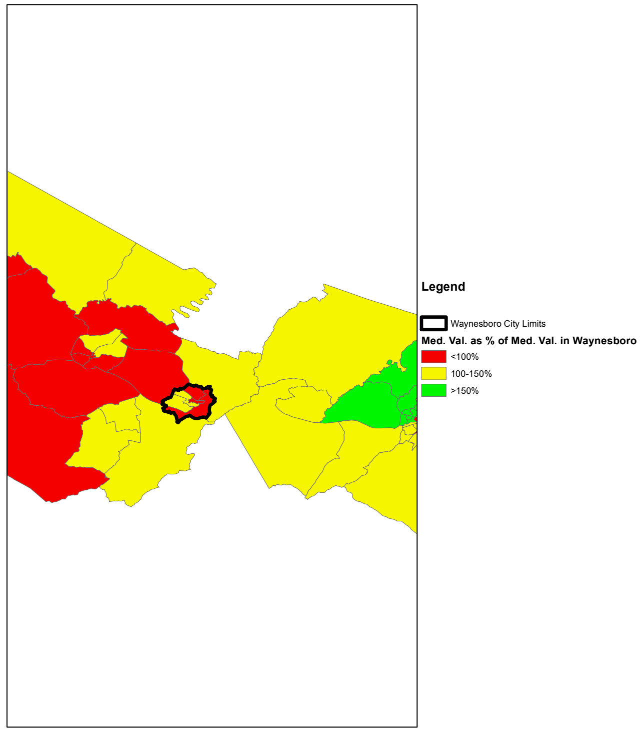


Figure 12: Waynesboro: Household income

Median Home Values in 1980, as Percent of Median Home Value in Waynesboro

Waynesboro and Surrounding Counties
Sources: U.S. Census Bureau and National Longitudinal Tract Database



Median Home Values in 2015, as Percent of Median Home Value in Waynesboro

Waynesboro and Surrounding Counties
Sources: U.S. Census Bureau and National Longitudinal Tract Database

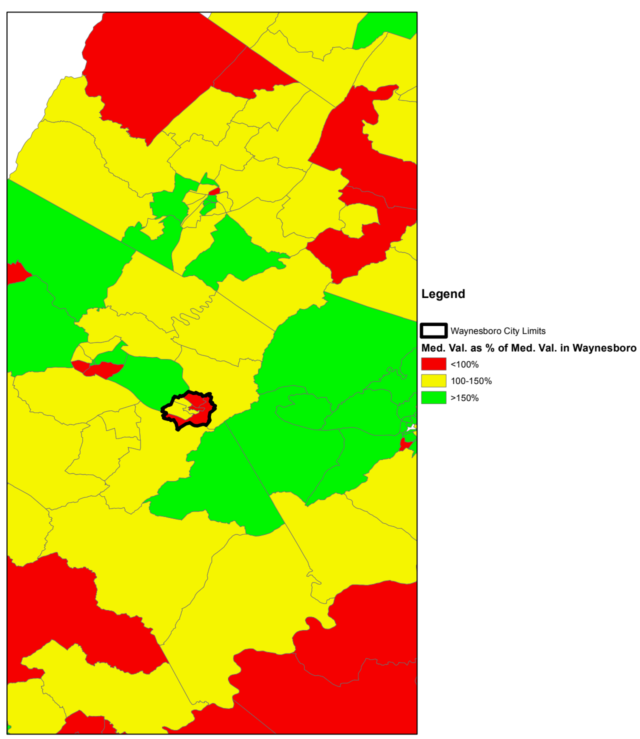


Figure 13: Waynesboro: Home values