The Unequal Geographic Burden of Federal Taxation

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In the United States, workers in cities offering above-average wages—cities with high productivity, low quality of life, or inefficient housing sectors—pay 27 percent more in federal taxes than otherwise identical workers in cities offering below-average wages. According to simulation results, taxes lower long-run employment levels in high-wage areas by 13 percent and land and housing prices by 21 and 5 percent, causing locational inefficiencies costing 0.23 percent of income, or $28 billion in 2008. Employment is shifted from north to south and from urban to rural areas. Tax deductions index taxes partially to local cost of living, improving locational efficiency.

I. Introduction

Wage and cost-of-living levels vary considerably across cities in the United States, yet the federal tax code does not take this variation into

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account. Since federal taxes are based on nominal incomes, workers with the same real income pay higher taxes in high-cost areas than in low-cost areas, without receiving additional benefits. Recognizing this, the Tax Foundation (Dubay 2006, 1) argues, “the nation is not only redistributing income from the prosperous to the poor, but from the middle-income residents of high-cost states to the middle-income residents of low-cost states.” While the Tax Foundation has suggested a flat tax to remedy this problem (Hoffman and Moody 2003), politicians from high-cost areas have proposed indexing federal taxes and benefits to local costs, arguing that workers with the same real incomes should pay the same nominal taxes.

For federal taxes to not distort the location choices of workers, the correct principle is that taxes should be independent of where workers live so that location-wise they are effectively lump sum. The current system taxes workers more for taking jobs in higher-paying cities, blunting the incentive to live in these cities, characterized by high firm productivity and low quality of life. For example, in the New York metropolitan area, wage levels are 21 percent above the national average, which, interacted with an effective marginal tax rate of 33 percent, creates a 7 percent federal surtax on labor income for locating there. Unlike local tax differences, federal tax differences of this kind are not compensated with higher levels of local spending and may therefore affect location choices substantially.

Because federal taxes are not indexed to local wage levels, workers are induced to leave cities with high wages and move to cities with low wages. As a result, unindexed federal taxes lower employment levels and property values in high-wage cities while having the opposite effect on low-wage cities. In equilibrium, these price changes compensate workers for federal tax differences across cities, but the resulting geographic distribution of employment is inefficient, reducing overall welfare.

The unequal distribution of federal taxes that results from wage differences across cities does not depend on the progressivity of taxes and cannot be eliminated with a flat tax. The view that workers with the same real incomes should pay the same nominal taxes holds true across cities that vary in the productivity of their firms, as nominal incomes merely track cost-of-living differences across these cities. However, this view is incorrect across cities that vary in quality of life, as nicer cities have a higher cost of living but lower nominal wage levels and hence a lower federal tax burden. Indexing the tax code to local costs would eliminate federal tax differences across cities that vary in productivity but exacerbate them across cities that vary in quality of life.

An empirical simulation for the United States, below, reveals that workers with the same skills pay up to 27 percent more in federal taxes in high-wage cities than in low-wage cities. The federal government effectively taxes workers for living in large cities while subsidizing them to live in rural areas. Taxes also fall more heavily on the Northeast, Pacific, and Great Lakes regions and less on the South. Controlling for socioeconomic disparities, approximately $270 billion each year are transferred horizontally from high-wage areas to low-wage areas. These findings partly confirm Senator Patrick Moynihan's (2000) claims in 24 years of reports, entitled *The Federal Budget and the States*, that the "federal balance of payments" across areas is highly unequal, although these reports do not control for socioeconomic differences across regions, nor do they consider the effects on local employment or prices.

Journalist Malcolm Gladwell (1996) writes that the inequality in the federal balance of payments "is according to urban experts and economists one of the best-kept secrets in American politics" and that "the decline of many northeastern American cities may be due not just to mismanagement—as is now popularly imagined—but to the emptying of their coffers by the federal government." Such a view is supported by the simulation: over the long run, federal taxes have lowered employment, housing prices, and land values in high-wage areas by 13, 5, and 21 percent, respectively, and done the opposite in low-wage areas. Overall, federal taxes have tilted the geographic distribution of employment away from the North toward the South and away from urban areas toward rural areas, creating a welfare loss estimated at 0.23 percent of income, or $28 billion in 2008. Without federal tax deductions for mortgage interest and local taxes, this loss would be even larger.

Previous research about how federal taxes interact with local prices contains some important findings but has been too narrow or informal to guide policy comprehensively. Wildasin (1980) finds that federal taxes on labor income cause mobile workers to locate inefficiently across cities offering different wages but focuses on conditions characterizing efficiency rather than the results of inefficiency. Without referring specifically to taxation, Glaeser (1998) argues that federal transfer levels should not be tied to local price levels, as this implicitly subsidizes recipients to live in expensive, high-quality-of-life cities. More generally, Kaplow (1995) and Knoll and Griffith (2003) also allow productivity differences to affect local wages and prices, leading them to consider the benefits of indexing taxes to local wages. Although insightful, their informal arguments leave open the exact consequences of failing to index the tax code, raising the need for more rigorous quantitative analysis.[1]

[1] Kaplow's (1995) analysis holds prices fixed and presents an index formula that does not equalize nominal tax payments across areas. Knoll and Griffith (2003) assume that a flat tax on income does not change prices or reallocate resources; this assumption, as shown below, does not hold in general equilibrium. Other work considers how tax deductions interact with local prices. Research by Gyourko and Sinai (2003, 2004) and Brady,

Section II introduces a model of mobile workers who live in cities with attributes that generate differences in costs of living, wages, and federal tax burdens. Section III describes the federal tax differences that arise in equilibrium and how they affect local prices. Section IV examines how taxes distort location decisions and how to calculate the resulting efficiency loss. Then, Section V considers the effect of indexing taxes to local wages or costs of living and demonstrates how tax deductions for locally produced goods, such as housing, produce a mild form of cost indexation. Section VI calibrates the model and simulates how differential taxes affect the distribution of local prices, employment, and welfare, taking into account differential federal spending patterns.

II. Theoretical Setup

To explain why prices and tax burdens differ across cities, I adapt the general-equilibrium model of Rosen (1979) and Roback (1980, 1982), incorporating federal taxes. The national economy is closed and contains many cities, indexed by j, which trade with each other and share a homogeneous population of mobile workers. These workers consume a numeraire traded good, x, and a nontraded "home" good, y, with local price p^j. Cities differ in three types of exogenous attributes. Quality of life, Q^j, may be affected by amenities such as weather or safety. Productivity in the traded-good sector, A_X^j (or "trade productivity"), may be due to natural advantages, such as a harbor, or to agglomeration economies, such as input sharing. Productivity in the home-good sector, A_Y^j (or "home productivity"), may be affected by natural advantages or regulations affecting residential housing. The average value of each attribute is set to one. Although some city attributes may indeed be endogenous, it is safe to consider them exogenous if federal taxes do not significantly affect their relative levels across cities.

Firms produce traded and home goods out of land, capital, and labor. Factors receive the same payment in either sector. Land, L, is fixed in supply in each city at L^j and is paid a city-specific price, r^j. Capital, K, is fully mobile and is paid the price $\bar{i}$ everywhere. The supply of capital in each city is denoted K^j, with the aggregate level of capital fixed at K^{TOT}; thus $\sum_j K^j = K^{\mathrm{TOT}}$. Labor, N, is also fully mobile, but because workers care about local prices and quality of life, wages, w^j, may vary across cities. Workers have identical tastes and endowments, and each

Cronin, and Houser (2003) tabulates how mortgage and local-tax deductions disproportionately benefit high-cost areas but neglects how these deductions may offset the unequal burden of federal taxes from wage differences. Surveys of the possible benefits of tax deductions for mortgage interest (e.g., Glaeser and Shapiro 2003) or local taxes (e.g., Kaplow 1996) do not consider their interurban locational effects.

supplies a single unit of labor. The total number of workers is fixed at N^{TOT}, so $\sum_j N^j = N^{\text{TOT}}$. Workers own identical diversified portfolios of land and capital, which pay an income $R = (1/N^{\text{TOT}}) \sum_j r^j L^j$ from land and $I = \bar{i}(K^{\text{TOT}}/N^{\text{TOT}})$ from capital. Total income $m^j \equiv R + I + w^j$ varies across cities only as wages vary. Out of this income, workers pay a federal income tax of $\tau(m^j)$. Deductions are introduced in Section V.[2]

Workers' preferences are modeled by a utility function, $U(x, y; Q)$, that is quasi-concave and homothetic over x and y and increasing in Q. The corresponding expenditure function is $e[p, u, \tau(m); Q] \equiv \min_{x,y}[x + py + \tau(m) \ : \ U(x, y; Q) \geq u]$; Q is assumed to enter neutrally into the utility function and is normalized so that $e[p, u, \tau(m); Q] = [e(p, u) + \tau(m)]/Q$, where $e(p, u) \equiv e(p, u, 0; 1)$. Since workers are fully mobile, their utility must be the same across all inhabited cities so that higher prices, lower quality of life, or higher taxes must be compensated with greater income:

$$[e(p^j, \bar{u}) + \tau(m^j)]/Q^j = m^j; \tag{1}$$

$\bar{u}$ is the level of utility attained by all workers, regardless of each worker's federal tax burden.[3]

Operating under perfect competition, firms produce traded and home goods according to the functions $X = A_X F_X(L_X, N_X, K_X)$ and $Y = A_Y F_Y(L_Y, N_Y, K_Y)$, where F_X and F_Y are concave and exhibit constant returns to scale.[4] Unit cost in the traded-good sector is $c_X(r, w, i)/A_X \equiv \min_{L,N,K}[rL + wN + iK : A_X F(L, N, K) = 1]$. A symmetric definition holds for unit cost in the home-good sector, c_Y. All factors are fully employed: $L^j_X + L^j_Y = L^j$, $N^j_X + N^j_Y = N^j$, and $K^j_X + K^j_Y = K^j$. As markets are competitive, firms make zero profits in equilibrium so that for given output prices, more productive cities pay higher rents and wages, and the following conditions hold in all cities j where production occurs:

$$c_X(r^j, w^j, \bar{i})/A^j_X = 1, \tag{2}$$

$$c_Y(r^j, w^j, \bar{i})/A^j_Y = p^j. \tag{3}$$

[2] Because markets are perfectly competitive, the economic incidence is unchanged if the nominal incidence of taxes is placed on firms' labor costs rather than on workers' wage incomes. Consumption taxes in this model are equivalent to income taxes; taxes on production are largely equivalent, except for the portion that falls on capital and land.

[3] The model generalizes to a case with workers that supplies different fixed amounts of labor if these workers are perfect substitutes in production, have identical homothetic preferences, and earn equal shares of income from labor. More general types of worker heterogeneity are considered in Albouy (2008*b*), including the case in which some workers are immobile or differ in their attachment to particular cities, simulating the effects of moving costs. This explains how federal tax changes can have redistributive effects across areas when tastes are heterogeneous or moving costs are substantial.

[4] Non-Hicks-neutral productivity differences have similar impacts on relative prices across cities but not on relative quantities.

This analysis models a single federal government that collects tax revenues, makes transfers, and uses the net balance to buy traded goods that are transformed into a federal public good, such as defense. This federal public good benefits workers everywhere equally, and its level is held fixed. Federal taxes are modeled net of federal transfers. Naturally, federal means-tested benefits increase the effective marginal tax rate for some workers.[5] In addition, it matters if federal tax payments are tied to federal transfers. In the United States, workers in high-wage areas pay more in payroll taxes and then receive higher social security benefits later in life. Thus, the marginal benefit of paying these taxes should be subtracted from the effective marginal income tax rate.

The local public sector does not need to be modeled explicitly. If local government provides goods efficiently, as in the Tiebout (1956) model, these goods can be treated as consumption goods. Furthermore, efficiency differences across local public sectors may be subsumed into differences in Q^j (Gyourko and Tracy 1989, 1991) or A^j_Y. Taxes levied at the subnational level can also be distributed unequally across areas when wages vary within a subnational jurisdiction, such as a state. State taxes are incorporated into the simulation below, in which their effects are small; for expositional ease, they are ignored here.

For workers, denote the expenditure shares of traded goods, home goods, and taxes as $s^j_x \equiv x^j/m^j$, $s^j_y \equiv p^j y^j/m^j$, and $s^j_T = \tau(m^j)/m^j$; denote the shares of income received from land, labor, and capital income as $s^j_R \equiv R/m^j$, $s^j_w \equiv w^j/m^j$, and $s^j_I \equiv I/m^j$. For firms, denote the cost shares of land, labor, and capital in the traded-good sector as $\theta^j_L \equiv r^j L^j_X/X^j$, $\theta^j_N \equiv w^j N^j_X/X^j$, and $\theta^j_K \equiv \bar{i} K^j_X/X^j$; denote similar cost shares in the home-good sector as ϕ^j_L, ϕ^j_N, and ϕ^j_K. Assume, as is likely, that home goods are more cost intensive in land relative to labor than traded goods, that is, $\phi^j_L/\phi^j_N > \theta^j_L/\theta^j_N$.

III. Price and Federal Tax Differences across Cities

Federal taxes on labor income affect how prices vary cross-sectionally across cities with different attributes. To analyze this, assume that there are enough cities varying in the three city attributes, Q, A_X, and A_Y, to treat these attributes as continuous variables. The equilibrium condi-

[5] This is complicated by eligibility requirements for programs that vary by state or county. Furthermore, some benefit levels are tied to local prices, such as housing programs, although these programs tend to be small. Inasmuch as they are valued, local goods provided by the federal government may be treated as transfers, as can intergovernmental transfers that increase the supply of local government goods. It should be noted that federal matching rates for many programs (e.g., Medicaid) decline with average state income. The complicated nature of these transfers makes it useful to consider some federal transfers separately from an overall tax schedule, as in Sec. VI.D.

tions (1), (2), and (3) implicitly define the prices w^j, r^j, and p^j—and the federal tax, $\tau(m^j)$, which depends on them—as a function of Q^j, A^j_X, and A^j_Y. These conditions may be log-linearized to express a particular city's price differentials in terms of its city-attribute differentials, each relative to the national average. These differentials are expressed in logarithms so that, for any variable z, $\hat{z}^j = \ln z^j - \ln \bar{z} \cong (z^j - \bar{z})/\bar{z}$ approximates the percentage difference in city j of z relative to the geometric average $\bar{z}$. Values in the presence of income taxes are not subscripted; counterfactual values under a uniform, utility-equivalent, lump-sum tax are subscripted by zero, for example, $\hat{z}^j_0$. The change in z due to income taxes is denoted with a d, so $dz^j = z^j - z^j_0$ and $d\hat{z}^j = \hat{z}^j - \hat{z}^j_0$. In an average city, $\hat{z}^j = \hat{z}^j_0 = d\hat{z}^j = 0$.

Log-linearized versions of (1), (2), and (3) describe how prices covary with city attributes:

$$s_w\hat{w}^j - s_y\hat{p}^j = \tau' s_w\hat{w}^j - \hat{Q}^j, \tag{4a}$$

$$\theta_L\hat{r}^j + \theta_N\hat{w}^j = \hat{A}^j_X, \tag{4b}$$

$$\phi_L\hat{r}^j + \phi_N\hat{w}^j - \hat{p}^j = \hat{A}^j_Y. \tag{4c}$$

These equations are first-order approximations around a nationally representative city, so the share values, without superscripts, are national averages. Equation (4a) states how before-tax real income, given by the nominal income difference, $s_w\hat{w}^j$, net of the cost-of-living difference, $s_y\hat{p}^j$, compensates for lower quality of life, $-\hat{Q}^j$, and higher federal taxes, $\tau' s_w\hat{w}^j$. This last term is the income tax differential as a fraction of total income, $\tau' s_w\hat{w}^j = \tau'\hat{m}^j \equiv d\tau^j/m$, due to the wage differential $\hat{w}^j$. For example, if a city offers 10 percent higher wages, the share of income from wages is 75 percent, and the marginal tax rate is 33 percent, then workers of the city pay additional taxes equal to 2.5 percent of income. The effects of a federal tax differential are similar to that of a head tax on workers for living in city j, except that the federal tax differential depends on an endogenous wage differential, $\hat{w}^j$, rather than being set exogenously. Equations (4b) and (4c) demonstrate how high productivity in each sector results in high factor prices relative to the output price in equilibrium.

The tax differentials depend on the wage differentials, which may be written

$$\hat{w}^j = \hat{w}^j_0 + \underbrace{\frac{\theta_L}{\theta_N}\frac{1}{s_R}\tau' s_w\hat{w}^j}_{d\hat{w}^j} = \frac{1}{1 - (\theta_L/\theta_N)(s_w/s_R)\tau'}\hat{w}^j_0, \tag{5}$$

where the wage differential under a neutral, utility-equivalent, lump-sum tax,

$$\hat{w}_0^j = \frac{1}{\theta_N s_R}(s_y \phi_L \hat{A}_X^j - \theta_L \hat{Q}^j - s_y \theta_L \hat{A}_Y^j), \tag{6}$$

relates how wages rise with trade productivity and fall with quality of life or home productivity. The first equality of (5) demonstrates that firms paying a positive wage differential without income taxes, $\hat{w}_0^j$, pay an additional wage differential, $d\hat{w}^j$, to help compensate for higher income taxes. The term multiplying $\hat{w}_0^j$ after the second equality exceeds one, meaning that income taxes increase wage differences across cities.[6]

Combining equations $d\tau^j/m = \tau' s_w \hat{w}^j$, (5), and (6), the tax differential in terms of city attributes is

$$\frac{d\tau^j}{m} = \tau' \frac{1}{1 - (\theta_L/\theta_N)(s_w/s_R)\tau'} \frac{s_w}{\theta_N s_R}\left(s_y \phi_L \hat{A}_X^j - \theta_L \hat{Q}^j - s_y \theta_L \hat{A}_Y^j\right). \tag{7}$$

As do wages, federal taxes rise with trade productivity and fall with quality of life or home productivity. Spatially, the income tax operates as if the federal government supplemented a uniform lump-sum tax with a revenue-neutral system of head taxes, which vary across cities according to equation (7).

Land rent and home-good price differentials can be decomposed similarly:

$$\hat{r}^j = \hat{r}_0^j - \underbrace{\frac{1}{s_R}\frac{d\tau^j}{m}}_{d\hat{r}^j}, \tag{8a}$$

$$\hat{p}^j = \hat{p}_0^j - \underbrace{\left(\phi_L - \frac{\theta_L}{\theta_N}\phi_N\right)\frac{1}{s_R}\frac{d\tau^j}{m}}_{d\hat{p}^j}, \tag{8b}$$

where the rent and price differentials under a utility-equivalent lump-sum tax are

$$\hat{r}_0^j = \frac{1}{s_R}\left(\hat{Q}^j + s_x \hat{A}_X^j + s_y \hat{A}_Y^j\right), \tag{9a}$$

[6] The solution requires the identities $s_R = (s_x + s_T)\theta_L + s_y \phi_L$ and $s_w = (s_x + s_T)\theta_N + s_y \phi_N$. Expressions for price differentials without taxation equivalent to (6), (9a), and (9b) are found in Roback (1980). Those expressions are not log-linearized and ignore nonlabor income and the accounting identities. Gyourko and Tracy (1989) develop expressions similar to (5) and (8a) for wage and rent changes in the presence of local income taxes in the simpler case where $\phi_L = 1$. Their expressions look very different, as they are not log-linearized or simplified in the same way. These analyses do not refer to federal taxes or deductions.

$$\hat{p}_0^j = \frac{1}{\theta_N s_R}\left[(\theta_N \phi_L - \theta_L)\phi_N \hat{Q}^j + \phi_L s_w \hat{A}_X^j - \theta_L s_w \hat{A}_Y^j\right]. \tag{9b}$$

Both land rents and home-good prices increase with quality of life and trade productivity, although land rents rise and home-good prices fall with home productivity. Equation (8a) reveals how additional federal taxes are fully capitalized into land rents as $s_R \cdot m \cdot d\hat{r}^j = -d\tau^j$, which implies $dr^j \cdot L^j = -N^j \cdot d\tau^j$.[7] Equation (8b) reveals how taxes are capitalized into the price of home goods, depending on their land intensity. Overall, taxes lower relative land and home-good prices in cities with higher trade productivity, lower quality of life, or lower home productivity.[8]

Workers are compensated for higher taxes through a combination of higher wages and lower home-good prices. Using the expression for $d\hat{w}^j$ in equation (5), it is possible to show that the fraction of taxes compensated through wages, $dw^j/d\tau^j$, equals λ_L/λ_N, denoting the ratio of the fraction of land in the traded goods sector, $\lambda_L \equiv (1 - s_y)\theta_L/s_R$, to the fraction of labor in the traded sector, $\lambda_N = (1 - s_y)\theta_N/s_w$. The less land is used in traded-good production, the less total costs fall when taxes cause land rents to fall, and thus the less wages increase and the more lower land rents are passed on to workers through lower home-good prices. This ratio also determines how much quality-of-life advantages are reflected in lower wages rather than higher prices.[9]

The effect of federal taxes on local prices can be shown graphically by assuming that home goods are just land ($\phi_L = 1, A_Y^j = 1$), so that $p = r$, and that, initially, workers everywhere pay a uniform lump-sum tax of T. Figure 1 illustrates the case of a highly trade-productive city, say Chicago (labeled C), and an average city, say Nashville, with pro-

[7] If land is not shared equally across the population, increases in the marginal (but not average) tax rate benefit land owners in low-wage cities and hurt those in high-wage cities. Utilities cease to be equal across workers, but this does not change the resulting equilibrium if preferences are homothetic. As home goods consist mainly of durable housing, supply of home goods could take time to adjust to this equilibrium in response to a tax change. In the short run, the housing supply is relatively fixed. A way to model this is to augment the definition of "land" to include the housing stock and to increase the effective cost shares ϕ_L and θ_L. In the short run, housing price changes are larger and employment changes smaller than in the long run.

[8] The effect of taxes on prices is sensitive to the assumption that attributes are exogenous. This is most conspicuous with respect to trade productivity, which increases with overall employment because of agglomeration. Higher federal taxes cause employment to fall, lowering trade productivity. This in turn lowers wages, home-good prices, and land rents, magnifying the effects for the latter two while dampening (or possibly reversing) the effect on wages. A simplified example is shown in Albouy (2008*b*). If quality of life falls (rises) with employment, then wage, rent, and price changes are dampened (magnified). If home productivity falls (rises) with employment, then wage and rent effects are dampened (magnified) while price effects are magnified (dampened).

[9] How attributes are capitalized into local prices is discussed in greater detail in Albouy (2009).

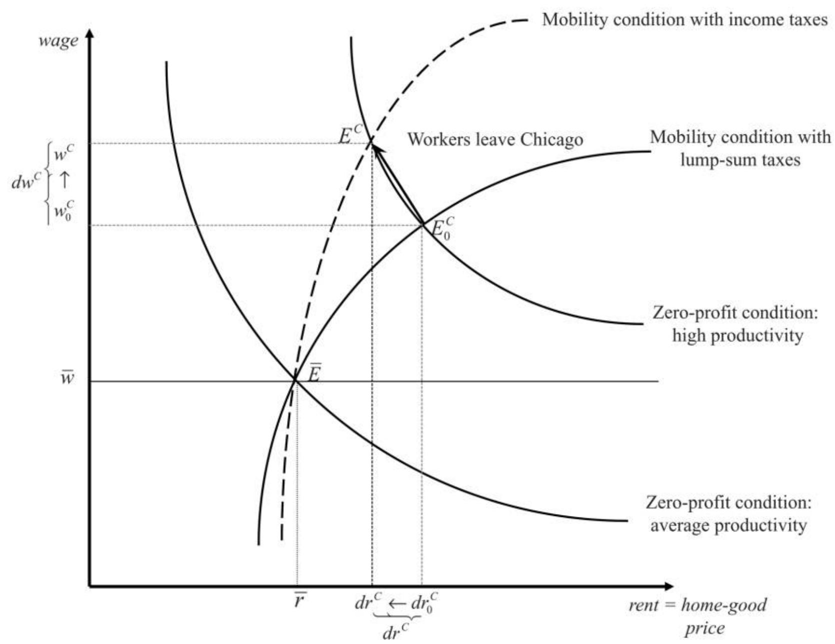

FIG. 1.—Effect of federal taxes on a high trade-productivity city. In a simplified model ($r^j = p^j$, $Q^j = A_Y^j = 1$ for all j), replacing a lump-sum tax, T, with a utility-equivalent federal income tax, τ, raises wages, w, and lowers rents, r, and employment in Chicago, labeled "C," a city with high trade productivity ($A_X^C > 1$), changing the equilibrium from E_0^C to E^C.

ductivities $A_X^C > 1$ and $\bar{A}_X = 1$. The zero-profit conditions slope downward, as wages must fall as rents rise to keep profits at zero. More productive firms in Chicago pay higher wages or rents, placing its zero-profit condition to the upper right of Nashville's. The worker-mobility condition slopes upward at a rate of y, as wages must rise with rents in order for workers to be indifferent between either city. In the tax-free equilibrium, shown at $\bar{E}$ and E_0^C, Chicago is more crowded than Nashville and pays workers a differential, $w_0^C - \bar{w}$, to compensate them for the higher cost of living reflected in $r_0^C - \bar{r}$.

Now replace the lump-sum tax with an income tax set so that workers with an average wage, $\bar{w}$, pay the same amount of taxes, $\tau(\bar{w} + R + I) = T$, leaving utility unchanged, although now these workers face a positive marginal tax rate, $\tau' > 0$. With this positive marginal tax rate, workers in costlier cities must be paid more before taxes to receive the same compensation after taxes, rotating the mobility condition counterclockwise around its intersection with the horizontal line at $\bar{w}$, to its slope of $y/(1 - \tau')$. Workers in Chicago at the old equilibrium, E_0^C, are

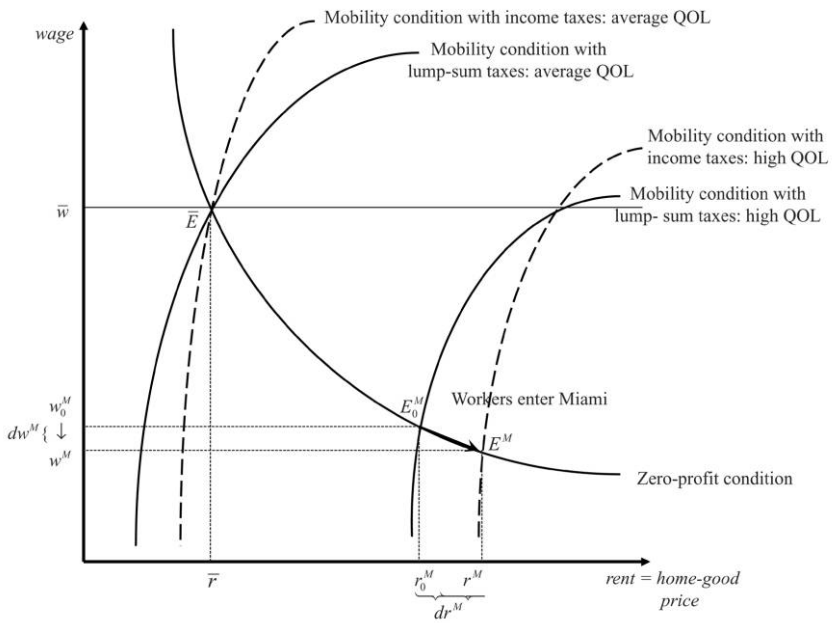

FIG. 2.—Effect of federal taxes on a high-quality-of-life city. In a simplified model ($r^j = p^j$, $A^j_X = A^j_Y = 1$ for all j), replacing a lump-sum tax, T, with a utility-equivalent federal income tax, τ, lowers wages, w, and raises rents, r, and employment in Miami, labeled "M," a city with high quality of life ($Q^M > 1$), changing the equilibrium from E^M_0 to E^M.

now worse off than in Nashville, as the old compensating differential does not make up for the higher costs and higher taxes. Workers will leave Chicago ($dN^C < 0$), lowering the demand for land in both production and consumption, causing rents to fall by dr^C and raising the labor-to-land ratio, causing wages to rise by dw^C. At the new equilibrium, E^C, workers are no worse off in Chicago. Firms are no better off, since their cost savings in land are passed off to workers in higher wages. By making Chicago relatively more expensive, the income tax discourages workers from working there, similar to how taxes discourage work by raising the cost of effort relative to leisure.

The case of a city offering a higher quality of life, say Miami, is illustrated in figure 2. Like Chicago, Miami is relatively crowded and has high rents, except that as compensation, workers receive a nicer environment rather than a higher wage. Because land is fixed in supply and used in production, local labor-demand curves are downward sloping; a larger supply of workers in the nicer city lowers the wage. This equilibrium is shown in figure 2, with Nashville and Miami (M) each having qualities of life $\bar{Q} = 1$ and $Q^M > 1$. Both cities have the same productivity and so share the same zero-profit condition. Yet, the mobility condition for workers in Miami is located to the lower right, as workers are willing to accept lower wages or pay higher rents to live there. In equilibrium, shown in E_0^M, workers in Miami pay the rent premium $r_0^M - \bar{r}$ and give up the wage differential $w_0^M - \bar{w}$.

Replacing the lump-sum tax with an income tax, workers in Miami pay less tax as they earn below-average wages. A worker is more willing to bid down her wage to live in Miami, as a \$1 reduction in income implies only a $\$(1 - \tau')$ reduction in consumption. With this effective tax rebate for quality of life, workers in Miami are made better off. Workers are then induced to move to Miami ($dN^M > 0$) until rents are driven up by dr^M and wages are driven down by dw^M to make Miami no more attractive than other cities. To the extent that higher quality of life is bought through lower pretax wages rather than higher posttax home-good prices, its tax treatment is similar to untaxed fringe benefits: firms located in a city by the beach share tax advantages similar to firms that offer a tax-deductible company car.

The case of a more home-productive city, say Dallas (D), may be illustrated simply by assuming $p = r/A_Y^D < r$, as $A_Y^D > \bar{A}_Y = 1$. Lower prices make Dallas workers better off for given wages and rents, shifting the mobility condition to the lower right, as in figure 2. In equilibrium, wages and home-good prices are lower than in Nashville, although rents are higher. Because Dallas workers are paid less, they have lower tax burdens, creating the same tax effects as in Miami.

Taxing labor income may have many advantages, but the burden of income tax is curiously distributed across cities with different attributes. By falling more heavily on cities offering higher wages, federal taxes act like an arbitrary head tax for deciding to live in a city with wage-improving attributes, whatever those attributes may be. The tax is distortionary because workers are artificially attracted to cities that are nicer to live in, more home productive, or less trade productive. At a minimum, it would be preferable to charge an equivalent tax directly on land according to its wage-improving attributes: this would affect land rents in the same way but would not distort location behavior or other prices.[10]

[10] If labor supply is elastic, the effect of federal tax differentials cannot be equated directly with head taxes. Real wages fall with quality of life, so if labor supply increases with real wages, labor supply is lower in nicer cities, assuming quality of life and leisure are not substitutes. Thus, in nicer cities, workers will work less and thus avoid taxes even more, increasing the tax advantage that nicer cities have.

IV. Employment Effects and Locational Efficiency

Federal taxes not only influence prices but also cause factors such as labor to move across cities. By making high-wage cities more expensive to live in—or, equivalently, more expensive to hire in—federal taxes induce workers to move away from high-wage areas toward low-wage areas, leading to an efficiency loss from misallocating workers across areas.

The employment effect of a differential tax can be written as

$$d\hat{N}^j = \varepsilon \cdot d\tau^j/m, \tag{10}$$

where ε is the elasticity of local employment with respect to a local, uncompensated tax, written as a percentage of total income. In principle, reduced-form estimates of this elasticity can be obtained. Furthermore, tax differentials can be obtained directly from data on wages and federal taxes. Thus, employment effects in equation (10) can be calculated without referring to a richer theoretical apparatus. Nevertheless, the theoretical model does imply a structural value for ε. This elasticity is the sum of three long terms, each dependent on a different elasticity of substitution, and is unambiguously negative if $\phi_L/\phi_N > \theta_L/\theta_N$.

Because workers locate in response to federal income taxes, the resulting spatial distribution of employment becomes inefficient, or "locationally inefficient" (Wildasin 1980). I derive the deadweight loss due to this inefficiency by calculating how much revenue the government loses when it replaces a neutral lump-sum tax with an income tax, holding the utility of workers constant. Consistent with Harberger (1964), this deadweight loss, expressed as a fraction of national income, is proportional to half the size of the tax differential times the induced change in migration, averaged across cities.

$$\frac{\text{DWL}}{mN^{\text{TOT}}} = \frac{1}{2}E\left[\frac{d\tau^j}{m}d\hat{N}^j\right].$$

Whatever the distribution of city attributes, this formula captures the entire efficiency loss from all of the distortions created by unequal geographic taxation, including the indirect distortion on the location of capital. This does assume that city attributes are unaffected by employment levels. Furthermore, as $d\hat{N}^j = \varepsilon \cdot d\tau^j/m$, the deadweight loss can be calculated using only data on ε and the variance of income tax differentials:

$$\frac{\mathrm{DWL}}{mN^{\mathrm{TOT}}} = \frac{1}{2}\mathrm{Var}\left(\frac{d\tau^j}{m}\right)\varepsilon. \tag{11}$$

Since $d\tau^j/m = \tau' s_w \hat{w}^j$, the deadweight loss increases with the variance of wage differences across cities.

V. Tax Indexation and Deductions

Since federal taxes make workers locate inefficiently, it is worth considering policies to remedy this problem. Taxes can be indexed to either local wages or local costs: the former is better in theory but arguably harder to implement, whereas the latter oversubsidizes life in nicer locations. If demand for home goods is inelastic, tax deductions for home-good expenditures effectively index taxes partially to local costs.

A. *Wage-Level and Cost-of-Living Indexation*

Income taxes may be indexed to wages by dividing taxable labor income by the "pay relative" $1 + \hat{w}^j = w^j/\bar{w}$, assuming those pay relatives can be correctly measured. With this indexation, a worker's federal taxes do not depend on where she lives, effectively turning the income tax into a neutral lump-sum tax.

Indexing taxes to local cost of living may be easier than indexing taxes to wages, as the prices of homogeneous goods across cities may be easier to measure than the prices of homogeneous units of labor. Presumably, taxes would be indexed to local costs by dividing income by an index $\kappa(p^j)$—one that ignores quality of life—resulting in taxes $\tau = \tau[m^j/\kappa(p^j)]$. An ideal cost-of-living index of this kind is defined in terms of gross expenditures: $\kappa(p^j) = [e(p^j,\bar{u}) + \bar{\tau}]/[e(\bar{p},\bar{u}) + \bar{\tau}]$, where $\bar{p}$ and $\bar{\tau}$ are the average home-good price and tax burden.

With cost indexation, the tax differential in a city increases with wages and decreases with home-good prices according to the formula $d\tau^j/m = \tau'(s_w\hat{w}^j - s_y\hat{p}^j)$. This changes the mobility condition (4a) to

$$s_y\hat{p}^j - s_w\hat{w}^j = \frac{\hat{Q}^j}{1-\tau'}. \tag{12}$$

With cost-indexed taxes, workers are willing to take a larger fall in pretax real income to improve their quality of life. Substituting equation (12) into $d\tau^j/m = \tau'(s_w\hat{w}^j - s_y\hat{p}^j)$ reveals that cost-indexed taxes depend only on local quality of life:

$$\frac{d\tau^j}{m} = -\frac{\tau'}{1-\tau'}\hat{Q}^j. \tag{13}$$

Relative to taxation without indexation, cost indexation eliminates tax differences across cities differing in either type of productivity (A_X or A_Y); across these cities, wages rise in step with costs. Thus, indexing with costs is equivalent to indexing with wages. The drawback to cost indexation is that in nicer cities, workers receive two tax advantages: they owe fewer taxes for paying higher prices and for receiving lower wages. The government then massively subsidizes life in nicer cities. While this may sound like a welfare-improving policy, it would actually reduce welfare, as nicer cities would become overcrowded.[11]

B. Tax Advantages for Housing and Local Taxes

Thus far, I ignored that the federal tax code confers a number of advantages to housing and goods provided by local government. Homeowners benefit from a number of tax advantages in housing consumption, as they are not taxed for the rent they implicitly "pay" themselves when living in their own home and as they can deduct mortgage interest from their income taxes (see Rosen 1985; Poterba 1992). Goods provided by local governments are also subsidized by the federal government, as local and state taxes can be deducted from federal taxes. Since housing and most locally provided government goods, such as education and public safety, are produced locally, these tax advantages may be thought to apply primarily to home goods. Together, these advantages may be modeled by allowing households to deduct a fraction $\delta \in [0,1]$ of home-good expenditures, py, from their federal income taxes so that taxes paid are $\tau(m^j - \delta p^j y)$; δ should be less than one, as these advantages do not apply to certain taxes (e.g., payroll) or to certain home goods, such as haircuts or restaurant meals. Nor are these advantages available to all workers: many renters and homeowners do not itemize deductions for mortgage interest or local taxes.

Incorporating the home-good deduction into the income tax, $\tau(m -$

[11] A handful of U.S. federal programs are indexed to local prices. Federal Housing Administration loan insurance is guaranteed up to the level of local median home prices. Department of Housing and Urban Development (HUD) public housing and rental vouchers programs use local metropolitan-area income levels to determine eligibility, in combination with a local index of "fair market rents" to determine benefits. U.S. members of Congress have proposed but not passed legislation to index taxes and transfers to regional cost of living repeatedly: the Tax Equity Act, to index taxes; the Poverty Data Correction Act, to index the poverty line; and the COLA Fairness Act, to index social security payments.

$\delta py)$, changes the expenditure function to $e[p, u, \tau(m - \delta py); Q] \equiv \min_{x,y}[x + py + \tau(m - \delta py) : U(x, y; Q) \geq u]$. Differentiating the mobility condition and using the envelope theorem yields the log-linearized mobility condition

$$\hat{Q}^j = (1 - \delta\tau')s_y\hat{p}^j - (1 - \tau')s_w\hat{w}^j, \tag{14}$$

which replaces (4a). Solving, the tax differential with the deduction also depends negatively on the home-good price differential, providing a level of cost indexation proportional to δ:

$$\begin{aligned} \frac{d\tau^j}{m} &= \tau'\left(s_w\hat{w}^j - \delta s_y\hat{p}^j\right) \\ &= \tau'\frac{s_w\hat{w}_0^j - \delta s_y\hat{p}_0^j}{1 - \tau'\left(\theta_L/\theta_N\right)\left(s_w/s_R\right) - \delta\tau'\left(s_y/s_R\right)\left[\phi_L - \phi_N\left(\theta_L/\theta_N\right)\right]}. \end{aligned} \tag{15}$$

The second equality relates the tax differential to the pretax differentials in (6) and (9b) and results from subtracting $\hat{Q}^j = s_y\hat{p}_0^j - s_w\hat{w}_0^j$ from (14), substituting in (5) and (8b), and rearranging. The denominator reflects two multiplier effects: heavily taxed cities see wages rise and home-good prices fall, raising taxes through both higher wages and smaller deductions.

When $\delta < 1$, workers in cities with high trade productivity or low home productivity still pay higher taxes because the primary wage-tax effect is larger than the cost-indexation effect from the deduction. Taxes fall more precipitously with quality-of-life advantages, as the higher cost of living from quality of life is partly offset through the deduction.[12]

C. *Including State Tax Differences*

Differences in within-state tax burdens are worth considering, as wages and prices often vary significantly within a state, whereas state services largely do not. State tax differentials are computed by multiplying state tax and deduction rates by the wage and price differentials within state,

$$\frac{d\tau_S^j}{m} = \tau_S'\left[s_w(\hat{w}^j - \hat{w}^S) - \delta_S s_y(\hat{p}^j - \hat{p}^S)\right], \tag{16}$$

where τ_S' and δ_S are marginal tax and deduction rates at the state level,

[12] This can be seen by substituting (6) and (9b) into

$$d\tau^j/m = \tau'\{(1 - \delta)s_y s_w(s_w\hat{A}_X^j - s_w\hat{A}_Y^j) - [\delta s_y(\phi_L\theta_N - \phi_N\theta_L) + \theta_L s_w]\hat{Q}^j\}/$$
$$[\theta_N s_R - \tau'\theta_L s_w - \delta\tau' s_y(\phi_L\theta_N - \phi_N\theta_L)].$$

The effect of federal taxes on prices or employment with cost indexation or deductions is determined by substituting $d\tau^j/m$ from (13) or (15) into eqq. (5), (8a), (8b), and (10).

net of federal deductions, and $\hat{w}^S$ and $\hat{p}^S$ are the differentials for state S as a whole, relative to the entire country. These state tax rates should incorporate sales as well as income taxes, since sales taxes reduce the buying power of labor income. The total tax differential for a city is the sum of the federal tax differential and the state tax differential.

VI. Simulation of Tax Differences across the United States

The theoretical model above may be used to simulate the effects of differential federal taxation on prices, employment, and welfare across the United States. This requires calibrating the economic parameters of the model and estimating wage, housing cost, federal spending, and quality-of-life differentials across metropolitan areas.

A. *Calibrating the Model*

An overview of the calibration is presented here. Alternative calibrations are considered in several sensitivity checks. Given that parameters are known with limited certainty, I use round fractions for ease.

Looking first at income shares, labor, s_w, receives 75 percent of income; capital, s_I, 15 percent; and land, s_R, 10 percent. Housing cost differences are used to measure home-good price differences. Using this measure requires that the expenditure share for home goods equals the expenditure share on housing of 22 percent plus the estimated expenditure share on nonhousing home goods of 14 percent, to produce $s_y = 0.36$; see Albouy (2008*a*) for details. From national accounts, the government expenditure share, s_T, is 15 percent. The cost shares depend on a number of sources. For traded goods, the cost share of land, θ_L, is 2.5 percent; the cost share of capital, θ_K, is 15 percent; and the cost share of labor, θ_N, is 82.5 percent. For home goods, the cost share of land, ϕ_L, is 23 percent; the cost share of capital, ϕ_K, is 15 percent; and the cost share of labor, ϕ_N, is 62 percent. The cost and expenditure shares are consistent with the income shares and imply that the ratio λ_L/λ_N, which determines the fraction of taxes capitalized into wages, is equal to 23 percent.

The elasticity of employment with respect to local taxes, ε, is taken at -6.0 based on two methods, each yielding similar estimates. The first is to use direct reduced-form estimates of ε from Bartik's (1991) meta-analysis of the effect of local taxes on local levels of output and employment, controlling for local public spending. The second is to infer ε by directly calibrating a derived theoretical equation for employment changes using the above parameters as well as elasticities of substitution taken from the literature.

The marginal federal income tax rate on gross wages, τ', of 33.3

percent is equal to the average marginal tax rate from TAXSIM (Feenberg and Coutts 1993) of 25.1 percent plus the marginal payroll tax rate on both the employer and employee sides, net of additional social security benefits (Boskin et al. 1987) of 8.2 percent. The federal deduction level, δ, is set at 0.257, which is far less than one because of renters, nonitemizing owners, nonhousing home goods, and the inability to deduct from payroll taxes.[13]

At the state level, the effective marginal tax rate on wages is 6.2 percentage points on average, from 0 points in Alaska to 8.8 percent in Minnesota. Wage differences within state are only 44 percent as large, on average, as wage differences within the entire country. Thus, total tax differences may be approximated by increasing the federal marginal tax rate by $6.2 \times 0.44 = 2.7$ points to 36 percent, although state tax differentials below are calculated exactly using equation (16).

B. Estimates of Wage, Price, and Spending Differentials

Wage and home-good price differentials are estimated using 5 percent samples of census data from the 2000 Integrated Public Use Microdata Series (IPUMS). Home-good price differentials are based on housing costs, as they are a prime determinant and predictor of cost-of-living differences. Cities are defined at the metropolitan statistical area (MSA) level using 1999 Office of Management and Budget (OMB) definitions. Consolidated MSAs are treated as a single city (e.g., San Francisco includes Oakland and San Jose), as are the nonmetropolitan areas of each state. This classification produces a total of 241 cities and 49 state-level collections of nonmetropolitan areas.

Interurban wage differentials, $\hat{w}^j$, are calculated from the logarithm of hourly wages for full-time workers, ages 25–55. These differentials control for skill differences across workers to provide an analogue to the representative worker in the model. Thus, log wages are regressed on city indicators, μ_j^w, and on extensive controls, X_{ij}^w—each fully interacted with gender—for education, experience, race, occupation, industry, and veteran, marital, and immigrant status, in an equation of the form $\ln w_{ij} = X_{ij}^w \beta^w + \mu_j^w + \varepsilon_{ij}^w$. The estimates of μ_j^w are used as the wage differential for city j and are interpreted as the causal effect of city j's attributes on a worker's wage. Identifying these differentials requires that workers do not sort across cities according to their unobserved skills. This assumption may not hold: Glaeser and Maré (2001)

[13] Effects of a progressive tax system were also explored. A progressive tax schedule increases the variance of tax differentials, increasing the associated deadweight loss in (11). Because wage differentials are small relative to the tax schedule, they lead to only moderate changes in tax rates. A generous calculation produced at most a 5 percent increase in the deadweight burden calculation.

argue that up to one-third of the urban-rural wage gap could be due to selection, suggesting that at least two-thirds of wage differentials are valid, although this issue deserves greater investigation. At the same time, it is possible that the estimates could be too small, as some control variables, such as occupation or industry, could depend on where the worker locates.[14]

Housing values and gross rents reported in the census are used to calculate home-good price differentials, $\hat{p}^j$. To reduce measurement error from imperfect recall or rent control, the sample includes only units that were acquired in the last 10 years. Price differentials are calculated in a manner similar to wage differentials, using a regression of rents and values on flexible controls—interacted with tenure—for size, rooms, acreage, commercial use, kitchen and plumbing facilities, type and age of building, and the number of residents per room. Proper identification of housing-cost differences requires that average unobserved housing quality does not vary systematically across cities.[15]

Table 1 presents wage and housing-cost differentials in 2000 for selected metro areas and by census division and metropolitan size. Figure 3 graphs wage differentials against housing-cost differentials for all metro and nonmetro areas. Most large cities have above-average wages and housing costs; across cities of the same size, wages and costs tend to be higher in the Northeast and the Pacific. Overall, wages and housing costs are positively correlated, as reflected in the regression line.

Figure 3 plots a log-linearized mobility condition for cities with average quality of life, $\hat{Q}^j = 0$, and a log-linearized zero-profit condition for cities with average productivity in both sectors, $\hat{A}^j_X = \hat{A}^j_Y = 0$. Quality of life in a particular city is seen from how far its marker is to the right of this condition. Cities above the zero-profit condition have either high trade productivity or low home productivity, although without data on land rents, trade and home-productivity differences are not separately identified—nor do they need to be for this simulation. Quality-of-life and

[14] Obviously, workers do not all have the same endowments and tastes or pay the same marginal tax rate, nor are they equally sensitive to productivity differences. However, as shown in Albouy (2008*b*), workers with different tastes and endowments can be aggregated without serious complications, as long as each is weighted by his or her share of income (which is done, although it has little impact on the estimates). Furthermore, many workers report receiving little income other than labor income. Yet, given the static nature of the model, a worker's choices should be modeled to account for a worker's permanent income, which includes a large nonlabor component, particularly if implicit rental earnings from one's own home are included.

[15] Malpezzi, Chun, and Green (1998) determine that similar housing-cost indices derived from the census perform as well as or better than most other indices. Because home-good prices have only a minor effect on tax differentials, and as rent and housing-price differentials are highly correlated, the simulation is not very sensitive to how housing-cost differentials are estimated.

TABLE 1
Adjusted Wage, Housing-Cost, and Federal-Spending Differences across Areas, 2000

	Population (1)	Wage (2)	Housing Cost (3)	Federal Spending (4)
Metro area:				
San Francisco, CA	7,039,362	.26	.75	.011
New York, NY	21,199,865	.21	.42	−.003
Detroit, MI	5,456,428	.13	.09	−.009
Hartford, CT	1,183,110	.15	.15	.003
Chicago, IL	9,157,540	.14	.22	.001
Washington, DC	7,608,070	.13	.17	.006
Philadelphia, PA	6,188,463	.12	.07	.003
Boston, MA	5,819,100	.14	.35	.000
Minneapolis, MN	2,968,806	.09	.06	−.019
Los Angeles, CA	16,373,645	.13	.40	−.003
Jacksonville, FL	1,100,491	−.07	−.09	.006
Oklahoma City, OK	1,083,346	−.12	−.21	−.006
Norfolk, VA	1,569,541	−.11	−.07	−.013
Tucson, AZ	843,746	−.11	.00	.007
Killeen, TX	312,952	−.23	−.23	.025
Census division:				
Middle Atlantic	39,668,438	.08	.11	.000
Pacific	45,042,272	.10	.36	.001
New England	13,928,540	.07	.18	−.002
East North Central	45,145,135	.00	−.09	−.003
South Atlantic	51,778,682	−.03	−.06	−.001
West South Central	31,440,101	−.07	−.21	.001
Mountain	18,174,904	−.05	.02	.002
East South Central	17,019,738	−.12	−.30	.000
West North Central	19,224,096	−.11	−.25	.006
Metro population:				
Population >5 million	81,606,427	.16	.32	.000
Population 1.5–4.9 million	55,543,090	.03	.05	−.005
Population .5–1.4 million	40,499,870	−.03	−.07	.000
Population <.5 million	36,417,747	−.09	−.15	−.002
Nonmetro areas	67,354,772	−.14	−.28	.005
U.S. standard deviation		.13	.29	.011
U.S. mean absolute deviation		.11	.24	.008

Note.—Consolidated Metropolitan Statistical Areas (CMSA) used to define the largest metro areas. Wage, housing cost, and federal spending differentials are adjusted to control for observable characteristics.

productivity estimates across U.S. cities are reported and explained in Albouy (2008*a*, 2009).[16]

To investigate federal spending differentials, data are taken from the Consolidated Federal Funds Report (CFFR), available from the U.S. Census of Governments. Spending is divided into three categories: (i) government wages and contracts, (ii) benefits to nonworkers, and (iii)

[16] Ignoring state taxes, the slope of the mobility condition is $s_y(1-\delta\tau')/[s_w(1-\tau')]$, and the slope of the zero-profit condition is $-\theta_L/(\theta_N\phi_L-\theta_L\phi_N)$. The capitalization of a quality-of-life improvement or a federal tax reduction (modeled as a head tax) on wages and housing prices is illustrated by shifting the mobility condition to the right. The capitalization of an increase in firm productivity or a decrease in home productivity is modeled by shifting the zero-profit condition to the right.

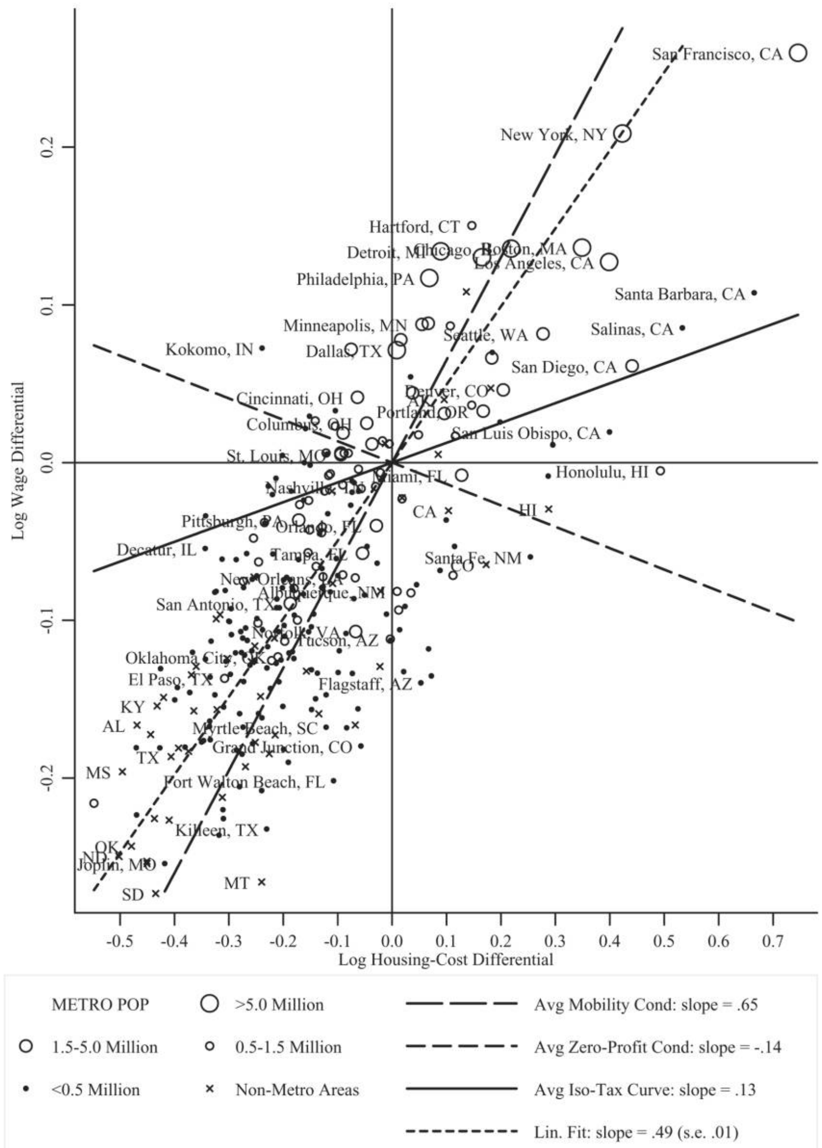

Fig. 3.—Wage levels and housing costs across areas, 2000

other spending. The first category consists of federal government purchases of goods and labor services; if these purchases are made at cost, they should not be considered transfers.[17] The second category includes spending that benefits individuals who are typically inactive in the labor market, such as retirees and full-time students, including social security and Medicare. The remaining category of other spending is more likely to benefit workers according to their location: it includes most government grants, such as for welfare, Medicaid, infrastructure, and housing subsidies. Spending differentials are adjusted to control for a limited set of population characteristics in a city, such as average age and percent minority, to provide a spending differential applicable to a representative worker. The adjusted differentials for other spending are reported as a fraction of household income in table 1.

C. *Tax Differences and Their Effects*

Using the base calibration and estimates of $\hat{w}^j$ and $\hat{p}^j$ for 2000, table 2 reports estimates of tax differentials and their effects across selected cities, and by census division and metropolitan size.[18] The wage and deduction components of the federal tax differential in (15) are in columns 1 and 2, with the sum in column 3. State tax differentials are in column 4, and the total combined tax differential is in column 5. A kernel density estimate of these total tax differentials is drawn in figure 4.

The unequal distribution of taxes is substantial: the mean absolute deviation of federal tax differentials equals 2.2 percent of income, and with state taxes this rises to 2.4 percent. Starting at an average federal tax rate of 17 percent, a worker moving from a typical low-wage city to a typical high-wage city sees her average tax rate rise from 14.8 percent to 19.2 percent, paying 27 percent more in federal taxes. Although tax differences are compensated for in local prices, this represents a horizontal transfer of \$269 billion (in 2008) from workers in high-wage areas to similarly skilled workers in low-wage areas.[19]

According to the simulation, the tax differential from equation (15) is given numerically by $d\tau^j/m = 0.271\hat{w}^j - 0.035\hat{p}^j$. Tax differences are driven largely by wage differences, although price differences have some effect. This phenomenon is illustrated in figure 3 by the upward-sloping

[17] Weingast, Shepsle, and Johnsen (1981) explain when localized spending should be treated as a transfer.

[18] A full list is provided in Albouy (2008*b*).

[19] The average federal tax rate of 17 percent includes federal income taxes and payroll taxes, appropriately adjusted (Congressional Budget Office 2003). Multiplying the mean absolute deviation of federal tax differentials, 0.221, by personal income in 2008 of \$12.11 trillion produces a figure of \$269 billion. Using GDP produces \$317 billion, or adjusted gross income of roughly \$189 billion.

average iso-tax line: a city's federal tax differential is proportional to the vertical distance of the city marker above this line. Empirically, the deductions tend to reduce tax differences across areas, as wages and housing costs are positively related. Figure 4 shows how eliminating the deduction would change the distribution of federal taxes across cities, increasing the tax differential gradient by 34.5 percent. Thus, without the deduction, the average tax differential would be 3.2 percent, making the distribution of federal taxes even more unequal.[20]

Each city's tax differential depends on its attributes, according to the numeric analogue of equation (7): $d\tau^j/m = -0.185\hat{Q}^j + 0.228\hat{A}^j_X - 0.025\hat{A}^j_Y$, which adjusts for deductions and state taxes. Thus, federal taxes depend quite positively on a city's trade productivity and negatively on quality of life and, to a lesser extent, home productivity. The mean absolute deviation of $\hat{Q}^j$ is 0.037, whereas the corresponding figure for $\hat{A}^j_X$, assuming $\hat{A}^j_Y = 0$ for all j, is 0.111. Accordingly, the average tax differential from quality-of-life differences alone is only 0.7 percent, whereas the same from productivity differences alone would be 2.6 percent. Thus, tax differences appear to be caused more by productivity differences than by quality-of-life differences. As a result, tax burdens are highest in large, productive cities in the Northeast, Midwest, and Pacific, whereas small, less productive towns and nonmetropolitan areas, particularly in the South, receive a large tax break.

The total tax differentials are considerable relative to typical differences in local taxes. Any local official would consider a permanent 3 percent tax on local residents without any compensating services to be a fiscal calamity. Yet, central governments are imposing this situation on cities such as Chicago, New York, and San Francisco. However, an unconditional grant of 3 percent of income in perpetuity dwarfs almost any pork-barrel project. Relative to the national average, this is what workers in cities such as Norfolk and Tucson, as well as most nonmetropolitan areas, effectively receive from the federal government.

These large tax differentials have considerable effects on prices and employment, seen in the last four columns of table 2. For example, the additional taxes paid to Washington and Albany by New York City raise wages by 1.3 percent, lower long-run housing costs by 9 percent, and lower land values by 35 percent. The employment effect is especially striking, stating that employment is 23 percent lower than in an undistorted equilibrium. This effect may seem too large, but it may be reasonable in the long run, as sizable federal taxes first affected average workers in World War II. The rise of the income tax is certainly consistent

[20] Since the existing tax system has a deduction, the tax differentials with no deduction in fig. 4 and col. 6 of table 3 are based on the counterfactual wage without a deduction. Counterfactual wages are simply $\hat{w}^j_0 = \hat{w}^j - d\hat{w}^j$. The tax differentials with no deduction are similar to the ones for which the deduction is just ignored and $\hat{w}^j$ is used.

TABLE 2
Tax Differentials and Their Effects on Prices and Employment, 2000

	Tax Payment Rank	Federal Tax Differential: From Wage (1)	Federal Tax Differential: From Deduct (2)	Federal Tax Differential: Total Federal (3)	State Tax Differential (4)	Total Tax Differential (5)	Total Tax Differential Effects: Wage (6)	Total Tax Differential Effects: Housing Cost (7)	Total Tax Differential Effects: Land Rent (8)	Total Tax Differential Effects: Employment (9)
Metro area:										
San Francisco, CA	1	.068	−.023	.045	.004	.048	.015	−.103	−.480	−.288
New York, NY	2	.054	−.013	.041	.002	.043	.013	−.093	−.434	−.261
Detroit, MI	3	.035	−.003	.032	.004	.036	.011	−.076	−.355	−.213
Hartford, CT	4	.039	−.005	.035	.001	.035	.011	−.076	−.352	−.211
Chicago, IL	6	.035	−.007	.029	.003	.031	.009	−.067	−.310	−.186
Washington, DC	7	.034	−.005	.029	.002	.031	.009	−.066	−.306	−.183
Philadelphia, PA	8	.030	−.002	.028	.002	.030	.009	−.065	−.303	−.182
Boston, MA	9	.035	−.011	.025	.001	.026	.008	−.056	−.259	−.155
Minneapolis, MN	10	.023	−.002	.021	.005	.026	.008	−.055	−.256	−.154
Los Angeles, CA	15	.033	−.012	.021	.000	.021	.006	−.045	−.209	−.126
Jacksonville, FL	114	−.019	.003	−.016	.000	−.015	−.005	.033	.153	.092
Oklahoma City, OK	160	−.032	.006	−.026	.002	−.024	−.007	.051	.239	.143
Norfolk, VA	188	−.028	.002	−.026	−.004	−.030	−.009	.064	.300	.180
Tucson, AZ	195	−.029	.000	−.029	−.003	−.032	−.010	.069	.322	.193
Killeen, TX	241	−.060	.007	−.053	−.005	−.058	−.018	.125	.582	.349

Census division:										
Middle Atlantic	1	.021	−.003	.017	.000	.017	.005	−.037	−.172	−.103
Pacific	2	.026	−.011	.015	.000	.015	.004	−.031	−.145	−.087
New England	3	.017	−.006	.012	.000	.012	.004	−.025	−.117	−.070
East North Central	4	.001	.003	.003	.000	.003	.001	−.007	−.033	−.020
South Atlantic	5	−.008	.002	−.006	.000	−.006	−.002	.013	.062	.037
West South Central	6	−.019	.006	−.012	.000	−.012	−.004	.026	.123	.074
Mountain	7	−.013	−.001	−.013	.000	−.013	−.004	.029	.135	.081
East South Central	8	−.030	.009	−.021	.000	−.021	−.006	.044	.207	.124
West North Central	9	−.029	.008	−.021	.000	−.021	−.006	.046	.213	.128
Metro population:										
Population >5 million	1	.041	−.010	.031	.002	.033	.010	−.071	−.330	−.198
Population 1.5–4.9 million	2	.007	−.001	.006	.001	.007	.002	−.015	−.071	−.043
Population .5–1.4 million	3	−.008	.002	−.006	.000	−.005	−.002	.011	.053	.032
Population <.5 million	4	−.022	.005	−.018	−.002	−.019	−.006	.041	.193	.116
Nonmetro areas	5	−.036	.009	−.027	−.002	−.030	−.009	.064	.296	.178
U.S. standard deviation		.034	.009	.026	.003	.028	.008	.060	.278	.167
U.S. mean absolute deviation		.029	.007	.022	.002	.024	.007	.051	.239	.143

Note.—The federal tax differentials are calculated from eq. (15), and the state tax differentials from eq. (16). Total tax differential effects are based on the main calibration presented in col. 1 of table 3.

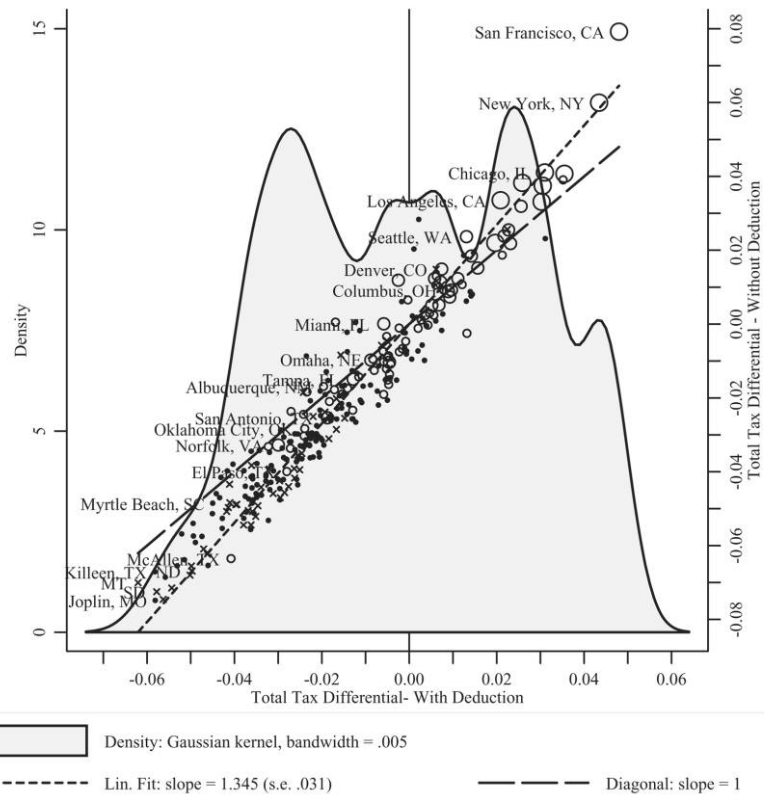

FIG. 4.—Differential tax burdens with and without deduction

with the migration of people and jobs over the last 60 years from the high-wage "rust belt" to the low-wage "sun belt" (Kim and Margo 2004).

The nationwide effects on prices, employment, and welfare for a number of different calibrations are given in table 3. The economic and tax parameters of these calibrations are displayed in the first panel, followed by the mean absolute deviations in outcomes and the deadweight loss of taxation throughout the economy. All effects are averaged using the total population size of each area as weights.

The benchmark case, shown in column 1, reveals the overall significance of differential federal taxation nationwide. In a typical high-wage city, workers pay 2.4 percent more of their income in taxes, which causes land values to be 21 percent lower. Workers are compensated for the tax differential through a 0.7 percent increase in wages, increasing their pretax incomes by slightly over 0.5 percent, and a 5.0 percent reduction

TABLE 3

SIMULATED EFFECTS OF TAX DIFFERENTIALS ACROSS ALL AREAS FOR ALTERNATE CALIBRATIONS

	Benchmark Case (1)	All Land in Home Goods (2)	Smaller Land Share (3)	Larger Employment Response: Cobb-Douglas (4)	Wage Differentials Two-Thirds Estimated Size (5)	Housing Deductions Eliminated (6)	Federal Taxes Only, No State Taxes (7)	Adding Federal Spending Differences (8)
Economic parameters:								
Home-goods share, s_y	.360	.360	.360	.360	.360	.360	.360	.360
Traded-good land share, θ_L	.025	.000	.013	.025	.025	.025	.025	.025
Traded-good labor share, θ_N	.825	.850	.825	.825	.825	.825	.825	.825
Home-good land share, ϕ_L	.233	.278	.117	.233	.233	.233	.233	.233
Home-good labor share, ϕ_N	.617	.572	.617	.617	.617	.617	.617	.617
Elasticity of employment to tax/income, ε	−6.000	−6.000	−6.000	−9.370	−6.000	−6.000	−6.000	−6.000
Implied share of income to land, s_R	.100	.100	.050	.100	.100	.100	.100	.100
Tax parameters:								
Marginal tax rate, τ'	.361	.361	.361	.361	.361	.361	.333	.361
Deduction level, δ	.291	.291	.291	.291	.291	.000	.257	.291
Average percent effects (mean abs. dev.):								
Tax differential, $E\|d\tau^j\|$	.024	.024	.024	.024	.014	.032	.022	.027
Wage effect, $E\|d\hat{w}^j\|$	.007	.000	.007	.007	.004	.010	.007	.008
Home-good price effect, $E\|d\hat{p}^j\|$	.051	.066	.051	.051	.029	.069	.048	.059
Land rent effect, $E\|d\hat{r}^j\|$	.239	.239	.478	.239	.136	.323	.222	.274
Employment effect, $E\|d\hat{N}^j\|$	.143	.143	.143	.224	.082	.194	.133	.164
Deadweight loss from locational inefficiency:								
As a percent of income, DWL/(mN^{TOT})	.23%	.23%	.23%	.36%	.07%	.43%	.20%	.31%
Total, billions per year, 2008 dollars	28	28	28	44	9	52	24	37
Per capita per year, 2008 dollars	93	93	93	146	30	174	82	124

NOTE.—Wage, land rent, home-good price, and employment effects are calculated from eqq. (5), (8a), (8b), and (10). Deadweight loss is determined from eq. (11), and the dollar values are based on a personal income measure of $12.11 billion. The Cobb-Douglas elasticity of employment is derived in online Apps. A and B. See text for further detail.

in the housing prices, reflecting a cost-of-living reduction of 1.8 percent. Thus, workers are compensated for higher taxes more through lower costs than through higher wages.

The negative employment effect on a typical high-wage city is 14 percent. Taken together, the employment effects create a substantial deadweight loss of about 0.23 percent of income a year, or $28 billion in 2008. As these numbers are based on a calibrated model, they should not be taken as absolute truth, but they do provide a sense of the magnitude of the impacts and costs caused by the unequal distribution of federal taxes.[21]

Alternative calibrations in table 3 are shown in columns to the right. In column 2, all land is devoted to home-good production, keeping the total share of income to land constant: in this case, wage differentials are unaffected by taxes, whereas home-good price differentials are affected more. In column 3, the cost shares of land in both sectors are reduced by one-half, with mobile capital taking up the remaining costs; this doubles the impact on land rents without changing any of the other quantities.

Column 4 shows that if ε is -9.37, which corresponds to when production and preferences are Cobb-Douglas, the employment effects and deadweight loss are increased proportionally. Column 5 cuts wage differentials down to two-thirds their original size, in case unobserved selection makes the estimated differentials too large: this lowers the differential taxes and price and employment effects by 41 percent and reduces the deadweight loss to only 0.07 percent of income. Column 6 reveals that if the deduction is eliminated but tax rates on labor are held constant, then the tax effects would become 35 percent larger and the deadweight loss would increase to 0.43 percent of income. Finally, column 7 looks at the effect of federal taxes only, ignoring state taxes. Since federal taxes account for 92 percent of tax differences, the effects are only slightly smaller.

D. *The Distribution of Federal Spending*

The unequal burden of federal taxation would be much less of an issue if it was compensated for by federal spending differences. To explore this possibility, table 4 reports coefficients from regressions of spending differentials, both raw and adjusted, on tax differentials in 2000. In the raw differentials, there is a positive correlation with federal purchases

[21] In the base calibration, agglomeration effects could dampen the positive effect of taxes on wages. According to Rosenthal and Strange (2004), the elasticity of wages with respect to population size due to agglomeration is close to 4 percent. At this level, a 17 percent reduction in employment from taxes reduces wages by 0.7 percent, which would offset the 0.7 percent predicted increase in wages due to higher land-to-labor ratios.

TABLE 4
DIFFERENTIAL FEDERAL SPENDING PATTERNS RELATIVE TO DIFFERENTIAL TAXATION PATTERNS, 2000

Type of Federal Spending	All Spending (1)	Wages and Contracts (2)	Nonworker Benefits (3)	All Other Spending (4)
A. Raw spending differentials:				
federal tax differential	−.134	.305	−.261	−.025
	(.212)	(.158)	(.092)	(.070)
B. Adjusted spending differentials:				
federal tax differential	−.246	−.094	−.032	−.098
	(.157)	(.095)	(.025)	(.037)

NOTE.—Each entry corresponds to a separate regression, reporting the coefficient on the federal tax differential variable using alternate measures of federal spending as the dependent variable. Regressions weighted by population for all 290 observations. Robust standard are errors reported in parentheses. Adjusted spending differentials control for socioeconomic disparities as described in online App. C.

(wages and contracts), a negative correlation with nonworker benefits, and no correlation with other spending, the category closest to a locational transfer. Once population characteristics are controlled for, correlations for wages and contracts and nonworker benefits become negative and insignificant, while other spending, as well as aggregate spending, becomes negatively correlated with federal tax differentials. Although the federal government makes greater purchases in areas with higher wages, this arises from its need to purchase skilled labor.

Figure 5, which graphs "other spending" differentials against tax differentials, makes it clear that federal spending does not offset differences in federal taxation and may in fact do the opposite. Column 8 of table 3 simulates the effects of tax differentials net of other spending: these differentials have slightly larger variance, increasing the tax effects and deadweight loss by a small amount.

VII. Conclusion

Any tax on labor income creates an incentive for workers to leave high-wage areas in favor of low-wage areas. Although mobile workers should be compensated for the resulting tax differences through adjustments in local prices and wages, the resulting geographic distribution of employment will be distorted, causing a substantial welfare loss.

The simulated effects of federal taxes on prices, employment, and welfare are based on the assumption that city attributes are unaffected by population movements. When city attributes are affected by population size, these effects could be smaller or larger than predicted. Furthermore, the distribution of city sizes may no longer be optimal even in the absence of federal taxes, which could ameliorate or aggravate preexisting distortions. Given the complexities of dealing with endog-

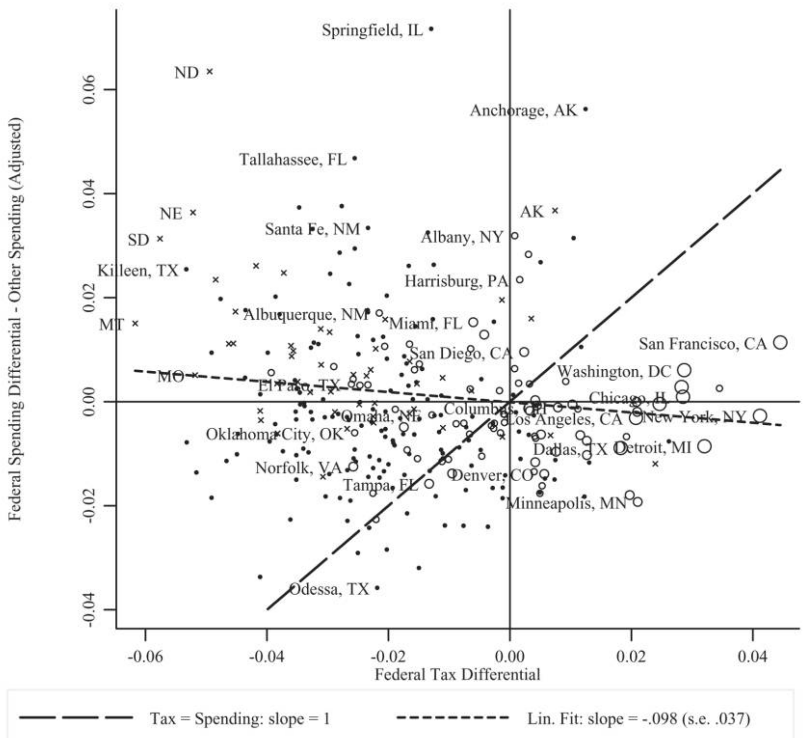

FIG. 5.—Federal spending and tax differentials across areas

enous attributes, these issues are left for further work (see Albouy and Seegert 2009).

Politicians who represent high-wage areas may legitimately complain that their districts pay a disproportionate share of federal taxes. However, in most countries, reforms to equalize the federal tax burden across areas would likely meet fierce political opposition. In the United States, highly taxed areas tend to be in large cities inside of populous states, which have low congressional representation per capita, making the prospect of reform daunting. In other countries, such as Canada, rural areas also receive disproportionate representation in national legislatures. Nevertheless, when considering federal tax reforms, policy makers should be aware of their spatial consequences on local prices, employment, and welfare.

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