Preliminary draft

Impact of U.S. State and Local Taxes and Expenditures on Wage Rates

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What is the incidence of taxes and expenditures in small open economies, such as U.S. states and localities? Both individuals and firms can easily move across state and local jurisdictions in response to any changes in government policies. Since these jurisdictions are small relative to the (inter)national market, the natural starting point is that these jurisdictions are price takers in the market for individuals and firms. Individuals will locate in a jurisdiction only if they receive at least the same utility they can receive elsewhere, taking into account government expenditures as well as taxes. Similarly, firms locate in a jurisdiction only if they receive at least the same profits they can receive elsewhere. If both are true, neither mobile individuals nor mobile firms end up bearing any of the incidence of state and local fiscal policies.

Use of one or both of these stylized assumptions is common in the academic literature. Hassett and Mathur (2006), for example, follow a long tradition of presuming that firms are costlessly mobile internationally (while individuals are not mobile), and find supporting evidence that differences in corporate tax rates across countries are borne almost entirely by workers through adjustments to their wage rates. In contrast, Feldstein and Wrobel (1998) presume that individuals and firms are costlessly mobile across states, and find support empirically that relative net-of-tax wage rates are little affected by changes in the progressivity state tax schedules.

The Tiebout model assumes that both firms and individuals are costlessly mobile. Ignoring land, the only equilibrium involves benefit taxation, whereby each individual or firm gets back in public services enough to fully offset any taxes they pay. With land, any difference between taxes and benefits are capitalized into the value of land in the jurisdiction.

The Tiebout model, though, focuses on a head tax and homogeneous communities. Property values can then adjust to neutralize any net tax or transfer simultaneously for all potential residents. Haughwout (1996) considers differential taxes on individuals and firms and solves for the resulting equilibrium. If firms as well as households demand land, then both land prices and wage rates adjust in response to fiscal changes -- two prices are needed to ensure that both firms and households are left unaffected on net by state fiscal changes. If firms use no land, though, this type of model implies that taxes on firms must be offset entirely by changes in wage rates to leave the net cost of labor to firms unaffected. Similarly, taxes on individuals should not in equilibrium change the net cost of labor to firms, though they may well affect relative wage rates as well as land prices.

The objective of this paper is to examine the incidence of state and local tax and expenditure changes, focusing in particular on their impact on wage rates. Our first focus will be on taxes on firms. We begin in section 1 with a theoretical analysis, building on the assumption that firms but not individuals are fully mobile and that firms do not use land. Key to the analysis is the use of the resulting tax revenue. If this revenue is used to provide benefits to residents in proportion to their labor income, then the equilibrium involves a proportional fall in wage rates by enough to leave both firms and individuals unaffected on net. When the revenue is allocated non-proportionately, however, then relative wage rates can change, with the extent of the changes depending on both the degree of substitutability of different skill levels in production and on the degree of mobility of individuals of different skill levels. In particular, if all workers are perfect substitutes in production, then relative wage rates are left entirely unchanged: migration occurs, but with no effect on wage rates. If different skill levels are not perfect substitutes, though, then these changes in the relative supply of workers of different skill levels will change relative wage rates.

Section 2 examines the possible impact of state personal income taxes, sales taxes, and local property taxes on wage rates. With any change in net fiscal transfers between types of households, e.g. skilled vs. unskilled, those making more payments will find the state less attractive, and conversely. As with the analysis in section 1, the out-migration of those facing a net fiscal loss and the in-migration of those receiving a net fiscal benefit will change the relative supplies of workers of different skill levels. Relative wage rates then adjust to the degree that workers are not perfect substitutes in production.

Section 3 explores a variety of additional complications when analyzing the impact of fiscal decisions on wage rates. For one, wages and salaries are only one form of compensation, and the form of compensation can be affected by the relative tax rates faced by firms and their employees, as argued in Gordon and Slemrod (2000). We describe how results change when firms are not fully mobile, as would occur when there are agglomeration economies, and when land is added to the model. Finally, we consider the implications of changes in state business taxes for Federal tax liabilities of state residents. In particular, if wage rates fall in response to these taxes, then Federal tax liabilities faced by state residents fall, even if their utility has been left unaffected by the tax changes.

In section 4, we then examine empirically the impact of past changes in state tax and expenditure decisions on wage rates of different skill groups, using data from the PSID. Here, we examine variation in an individual's hourly wage rate as a function of variation in the net taxes paid and benefits received by firms and by households with different characteristics.

1. Business taxes: initial model

Consider first the impact of state and local taxes on the firm's capital stock, or on the firm's income from capital. Examples would be a property tax on firms or the state corporate income tax.

Under the assumptions of constant returns to scale and competitive markets, firms selling in the national market break even by locating in jurisdiction j if $q = c(w_j, r + t_j; S_j)$.[1] Here, q represents the output price the firm faces on the national market, $c(.,.)$ represents the unit cost of production as a function of the prices for labor and capital, w_j is the representative local wage rate for workers, r is the rate of return on capital required in the international capital market, while t_j represents the effective tax rate per unit of capital. The level of publicly provided services (and quality of infrastructure), S_j, enters as a control variable, reflecting any benefits the firm receives from local public services.

The representative wage rate is itself a function of the distribution of wage rates for different skill groups: $w_j \equiv W(\{w_{sj}\})$, where $\{w_{sj}\}$ represents the vector of wage rates for each skill group s and $W(.)$ measures the minimum cost of providing a "unit" of labor, given this vector of wage rates, where this function is homogenous of degree one. Denote the cost-minimizing fraction of the labor force in each skill group s by α_s.[2]

In order to keep firms in the jurisdiction, in spite of any taxes, it must be that $\partial c / \partial t_j = 0$. We then infer that

$$L_j \frac{\partial w_j}{\partial t_j} = \sum_s L_j \alpha_s \frac{\partial w_{sj}}{\partial t_j} = -K_j - \frac{\partial c}{\partial S_j} \frac{\partial S_j}{\partial t_j}, \tag{1}$$

where L_j is the firms' labor force while K_j is the capital stock. In general, w_j changes to fully offset any *net* tax paid by the firm beyond the value of services it gets back in exchange.

To the extent that not all of the tax revenue is spent providing services to firms, then households can make use of the remaining tax revenue, either to finance extra public services or to reduce other taxes they face. A household in skill group s would be just willing to locate in this jurisdiction if

$$V(w_{sj}(1-\tau_j), G_{sj}, \gamma_s^*) = \bar{V}_s. \tag{2}$$

[1] A simplifying assumption here is that firms do not use land as an input. See section 3 for further discussion.

[2] Our simplifying assumption of weak separability between the vector of wage rates and non-labor inputs to production implies that the taxation of capital does not per se affect the equilibrium skill composition of a firm's workers. Given the observed skill-biased technical change, there is in fact a natural presumption that capital is a complement to skilled labor. When capital is taxed, we then expect a fall in demand for skilled labor, and everything else equal a resulting drop in the skilled wage rate.

Here, G_{sj} measures expenditures on publicly provided services available to households of this skill group in this jurisdiction, τ_j measures the labor income tax rate in this jurisdiction, $\overline{V}_s$ represents a standardized utility available elsewhere, while $\tilde{\gamma}$ represents the non-fiscal benefits measured in dollar equivalents that any given household receives from living in this jurisdiction. This taste parameter is randomly drawn from some distribution $\Phi(\gamma)$. Households with $\tilde{\gamma} > \gamma_s^*$ will choose to locate in this community. The resulting population of this skill group in state *j* is denoted by $N_{sj} \equiv \mathrm{P}_{sj}(w_{sj}(1-\tau_j), G_{sj})$. Denote the labor supply per worker in this skill group by H_{sj}.

The government budget constraint requires that

$$K_j = \frac{\partial S_j}{\partial t_j} + \sum_s N_{sj}\left(\frac{\partial G_{sj}}{\partial t_j} - \tau_j H_{sj}\frac{\partial w_{sj}}{\partial t_j} - w_{sj}H_{sj}\frac{\partial \tau_j}{\partial t_j}\right) - \frac{\partial E}{\partial t_j} \tag{3}$$

Here, $\partial E / \partial t_j$ captures the revenue effects of all changes in behavior by firms or individuals induced by the tax change, including firms' choice of their capital stock and individuals' choice of both labor supply and location.[3]

In equilibrium, equation (1) must be satisfied, so that firms continue to break even. In addition, the firms' desired labor input from each skill group must equal the number of workers in that skill group that choose to locate in the jurisdiction times labor supply per individual:[4] $\alpha_s L_j = H_{sj} P_{sj}(w_{sj}(1-\tau_j), G_{sj})$. Relative wage rates need to adjust to assure that the distribution of labor supply in each skill group matches the distribution desired by firms. The level of wage rates adjusts so that firms break even.

In general, the resulting equilibrium wage rates and population in the community depend on how the resulting tax revenue is spent, on the degree of substitutability in production of workers with different skill levels, and on the distribution of tastes for this location.

To make clear the characteristics of this equilibrium, it is helpful to examine some special cases. If all workers are perfect substitutes, with skilled workers simply providing more labor than less skilled workers, relative wage rates are unaffected by the choice whether or not to redistribute among households. We would then expect to see some out-migration of those who face a net increase in taxes and an in-migration of households who are net beneficiaries, but no change in relative wage rates.

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[3] To simplify much of the following discussion, we ignore this efficiency effect of taxes. The ignored loss in tax revenue implies a smaller state population, but with unclear effects on market wage rates.

[4] This assumption of a separate labor market within each jurisdiction is more appropriate for an analysis of state fiscal policies than those of local governments. At the local level, changes in the local supply of workers can still affect local relative wage rates, but the effects would be more muted since workers from the jurisdiction are only a fraction of the labor supply within the relevant market.

Even if workers are not perfect substitutes, wage rates for all skill groups would be expected to fall proportionately if the revenue (net of extra services provided to firms) is distributed to residents through a cut in income taxes on labor income. In this case, equations (1) through equation (3) are all satisfied when there is a proportional drop in wage rates *if* capital stocks are unaffected by the tax change.

A natural third example has the wage rates in each skill group adjust to fully offset the changes in taxes vs. benefits available to this skill group.[5] Individual utilities and labor supplies will then both be left unaffected by the policy change. For the labor market to continue to clear, firm demands for workers in different skill groups must not change either, in spite of the changes in relative wage rates. Production must therefore require fixed proportions of each skill group and of capital. In addition, patterns of government expenditures must have been chosen efficiently, so that the aggregate dollar benefits equal the aggregate dollar costs. In particular, N_s remains fixed if

$$H_{sj}\frac{\partial w_{sj}}{\partial t_j}(1-\tau_j) = w_{sj}H_{sj}\frac{\partial \tau_j}{\partial t_j} - M_{sj}\frac{\partial G_{sj}}{\partial t_j}. \tag{4}$$

Here, M_{sj} denotes the dollar value to a household in skill group *s* of an extra dollar of spending on G_{sj}. Summing these across income groups, we find that equations (3) and equation (2) will together be satisfied if H_s remains unchanged and if $\sum_s N_{sj}\partial G_{sj}/\partial t_j = \sum_s M_{sj}N_{sj}\partial G_{sj}/\partial t_j$, so that aggregate marginal benefits from extra spending equals aggregate dollar costs.

Additional assumptions are needed for H_s to remain unchanged. The implicit wage rate faced by workers in skill group *s* equals

$$w_{sj}(1-\tau_j) + M_{sj}\frac{\partial G_{sj}}{\partial H_{sj}} \tag{5}$$

Labor supply remains unchanged if labor supply depends solely on this implicit wage rate, and if this implicit wage rate itself is unaffected by the change in t_j. Equation (4) ensures that the implicit wage rate is unaffected by t_j if $G_{sj} = H_{sj}\partial G_{sj}/\partial H_{sj}$, so that benefits are proportional to labor supply.

In general, workers of different skill levels are imperfect substitutes in production. In this case, we expect that changes in (taxes - benefits) for any skill group will be only partially offset by adjustments to their wage rate. By how much is an empirical question.

[5] This is the outcome presumed in Feldstein and Wrobel (1998).

2. Sales taxes, property taxes, and personal income taxes

In this section, we consider the implications of household taxation on equilibrium wage rates within the jurisdiction.

Consider first a change in taxes and expenditures that is distributionally neutral, so that any extra tax payments for some skill group just equals the value of the extra services they receive, implying no change in utility for existing residents. To what degree does such a change affect labor supply per household and the population within the state of each skill group? The individual's net wage rate is measured by equation (5). The change in this wage rate as the income tax rate increases can be measured by

$$(6) \qquad -w_{sj} + M_{sj}\frac{\partial^2 G_{sj}}{\partial H_s \partial \tau_s}$$

If the tax is distributionally neutral, then $M_{sj}\partial G_{sj}/\partial \tau_s = H_{sj}w_{sj}$. We then infer that expression (6) equals zero, so that the net wage rates do not change. Hours of work then do not change if leisure is equally complementary with private consumption and public services.

What about N_s? The above model assumes homogeneous tastes for public goods within each skill group, implying that the utility offered in this jurisdiction does not change, and there should be no migration. If instead, marginal rates of substitution, M_{sj}, vary by household, then there would be a resorting by tastes across jurisdictions in response to any change in taxes and spending. Whether there is net out migration or net in migration depends on the shape of the joint distribution for M_{sj} and γ_s^*. Change is possible, though the direction of change is unclear in general. Such a change in the supply of workers in each skill group would then affect relative wage rates to the degree that workers are not perfect substitutes.

If the state redistributes between skill groups, then there will be an out-migration of those who are net losers and an in-migration of those who are net recipients. To the degree that workers of different skill levels are not perfect substitutes in production, then there will be a net rise in the wage rate of those facing net fiscal losses, and a net fall in the wage rate for net recipients.

The question is then how to measure the degree of redistribution resulting from possible changes in state fiscal policies. A key issue we focus on is how the dollar value of extra spending for workers in any given skill group varies across types of government spending.

With Tiebout sorting across jurisdictions, we expect that households face an implicit price for any given public service equal to the marginal cost of production. In particular, if they would like more of the service, they can move to a community offering the desired level of services, paying taxes equivalent to a user fee for these services. In this case, $M_{sj} = 1$ -- services are valued dollar for dollar. This will be our prior in the empirical work when examining the valuation of services provided by local governments.

The same valuation would be appropriate for intergovernmental transfers from state or Federal governments to local governments, as long as the local government chooses to supplement these funds with some locally raised funds. Then the marginal value of an extra dollar of spending remains a dollar.[6]

An important expenditure of state governments is transfer payments. Ex post, these should be valued at dollar for dollar.[7] Our prior in the empirical work will be based on this ex post assessment. Ex ante, however, individuals would instead be assessing the value of additional social insurance. Ex ante, many people could gain even if ex post they do not.[8]

For other state spending, e.g. parks or roads, the marginal valuation of each household is not so clear. When services are available only through the government, the value individuals assign to these services can vary by household. For example, if a household has a utility function $U = AC^{\alpha}G^{1-\alpha}$, then the marginal utility of G measured in dollar terms by dividing by the marginal utility of C equals $((1-\alpha)/\alpha)(C/G)$. If G is the same for all households, then the marginal dollar value of further expenditures is proportional to *C*. This will be our initial prior for state spending other than transfer payments.

Note that under this assumption, an increase in the state sales tax used to finance increased state spending should be roughly distributionally neutral. In contrast, an increase in the income tax to finance increased state spending would not be distributionally neutral, due to life-cycle differences between current income and current consumption. Those with current income above their permanent income would end up being net payers, and conversely for those with current income below their permanent income.

One remaining question is the degree of substitutability of workers from different skill groups in production. So far, we have assumed one production technology, so the question is the characteristics of this production technology. What if there are multiple industries, each with their own technology? In this case, industries will sort across

[6] With matching grants, though, the marginal valuation would be lower, and equal to the fraction of an extra dollar of spending that must be funded locally.
[7] For services provided in kind, though, this assumption is clear only if individuals choose to supplement the state-provided transfer with some self-financed additional spending.
[8] See Hoynes and Luttmer (this volume) for an analysis of the valuation of social insurance by state residents.

jurisdictions, with the most capital intensive industries locating in the jurisdictions with the lowest cost of capital, and conversely.[9] Each jurisdiction will then specialize in some type of industry.

What happens then when the distribution of skill types changes in response to shifts in tax and expenditure programs faced by individuals? If firms with the same capital labor ratio vary in the skill composition of their labor force, then there would be a further sorting based on this skill composition, with industries demanding more high skilled workers locating in jurisdictions that treat high skilled workers more favorably.

As long as the existing skill composition equals some weighted average of the optimal skill composition among the industries with the appropriate capital/labor ratio, then the changes in skill composition will have no long-run effect on relative wage rates. Short run effects are still possible.

3. Omitted complications

The above analysis omitted a variety of complications that merit further discussion. We focus on each in turn.

a. Other types of firms

The above analysis focused on firms that operate only in the particular jurisdiction, but sell in the national market. As long as the jurisdiction continues to attract at least some firms of this type, then the above analysis of equilibrium wage rates remains appropriate, regardless of the presence of other types of firms.

When there are firms with other characteristics, then in general the change in wage rates will not leave their profits unaffected. Equilibrium will require some other adjustment.

For example, the jurisdiction can contain firms that do not face competition from firms located in other jurisdictions, e.g. the service or retail sector. Here, local prices can adjust so that these firms continue to break even. Profits of these firms fall, requiring a price increase, if the increase in the cost of capital gets more weight for them than the fall in wage rates (they have a higher capital/labor ratio), and conversely.

The jurisdiction may also have activity in mining or agriculture, where output prices are set on national markets but land is an important input. Here, land prices can adjust so that these firms continue to break even.

A third example is multi-state firms. For firms that operate in multiple states, corporate tax liabilities are based on a fraction of national profits as measured through formula apportionment. The wage rates adjustment that allows local firms to continue to break even, will not in general leave profits of multi-state firms unaffected. If these multi-state

[9] See Kopczuk (this volume) for evidence on firm sorting in response to differential tax rates.

firms have decreasing returns to scale at each location, however, then their scale of operation will adjust to the degree that the combined wage and tax changes affect their profitability.

b. Nonwage compensation

Another complication ignored so far is that firms can compensate employees not only with wage payments but also with other forms of payment that largely avoid personal income taxes. One example for a publicly traded company is incentive stock options. These options never generate a deduction for the firm that grants them. The workers who receive them owe no taxes either at the grant date or at the exercise date, owing taxes on the income received only at the long-term capital gains rate and paid when the acquired shares are ultimately sold. For a closely-held firm, compensation can instead take the form of shares. While the value of these shares in principle is taxable income for the employee and a deductible expense for the firm, there is commonly no "market" value for these shares, leaving the firm great discretion in assigning a value to these shares. When the firm's tax rate is below that of the employees, they together have an incentive to assign a low "par" value to these shares.

Use of these alternative forms of compensation is typically associated with the desire for improved incentives, through tying compensation to firm performance. This can be done alternatively, however, through non-incentive stock options or bonuses: both can be linked to firm performance, yet are taxed as wage and salary income. The key consideration in the choice of form of compensation is therefore any differences between corporate tax savings compared with the personal income tax liabilities when payments are reported as wages and salaries. When the corporate rate is higher than the personal tax rate, wage compensation is preferred, but stock compensation or incentive stock options would be preferred when the corporate tax rate is below the personal tax rate. When the corporate tax rate increases above any given bracket under the personal income tax, the tax-minimizing form of compensation for workers in that tax bracket will change. Gordon and Slemrod (2000), however, find strong empirical evidence for such income shifting, particularly in personal tax brackets above the typical corporate tax rate.

A rise in the corporate rate should therefore lead to an increase in wage compensation (and an offsetting drop in other forms of compensation) for workers in tax brackets about the corporate tax rate. This effect offsets the forecasted drop in wage payments that we derived above.

c. Agglomeration economies

The above analysis assumed that enough firms were costlessly mobile that wage rates need to adjust to ensure that at least some of these mobile firms located in the state. What if firms, like individuals, have preferences for a particular location, as would occur when there are varying degrees of agglomeration economies across states? To achieve an equilibrium, firms would also need to have decreasing returns to scale, as would occur due to increasing transport costs to more distant markets as a firm expands.

Demand for labor is now less elastic. Some of the tax will end up being absorbed through a loss in profits among firms that remain in the state, and less will be passed on to workers through a lower wage rate.

d. Land as a source of utility and as a factor of production

Consider first adding a household demand for land, with land in fixed supply. Our solution for the drop in wage rates required to offset any increase in business taxes remains unaffected. All that can possibly change is the relative changes in wage rates for those receiving an increase or a decrease in net fiscal transfers. The direction of change in the net demand for land, however, is unclear, given offsetting migration patterns. If there is a net change in demand for land, then the resulting price change can either ease or reinforce the migration that is induced by the fiscal redistribution. While changing any quantitative forecasts, the qualitative forecasts remain unchanged.

If firms use land in production, the income earned from land as an input would normally be part of the business tax base. An increase in the business tax rate then leads to a fall in business demand for land. Without any redistribution across households, there is an overall fall in the demand for land. With land now cheaper, there is less need for a fall in wage rates so as to leave firms indifferent to locating in the state. Since firms use a small fraction of land in the state, though, this feedback effect should be modest.

e. Implications of wage changes for Federal tax liabilities

Any drop in market wage rates has important benefits for state residents since the Federal government imposes taxes based on these market wage rates. Federal income and payroll taxes both depend on reported labor income. For individuals who do not itemize deductions, Federal taxes change by $(\tau_F + p(2-\tau_F))\partial w_j / \partial t_j$, where t_F is the Federal marginal personal income tax rate while *p* is the payroll tax rate faced by both households and firms to finance Social Security and Medicare.[10] For those who itemize and are not constrained by the AMT, the change in Federal tax liabilities equals $\tau_F \partial(w_j(1-\tau_j))/\partial t_j + p(2-\tau_F)\partial w_j / \partial t_j$.

With *p* currently equal to 7.65% and τ_F currently ranging from 0% to 35%, the overall tax saving for those who do not itemize ranges from 15.3% to 44.9% of any change in market wage rates. Assuming that net wage rates remain unchanged, the benefits for those who itemize from savings in Federal taxes are much smaller, though, dropping to 9.9% for those in the top tax bracket.

Another implication of Federal deductibility is that the implicit subsidy to expenditures on G_j financed with business taxes becomes much larger. When expenditures are

[10] Since the payroll tax rate on the firm lowers taxable wage rates, it is implicitly deductible from the personal income tax.

financed with taxes on households, the expenditures are deductible under the income tax only for those who itemize. When business taxes are used instead, we find that expenditures are deductible under both the income tax and the payroll tax for all tax payers.

In spite of these gains to residents, the overall required drop in wage rates needed to keep firms willing to locate in the state remains unchanged. However, groups that gain more from the savings in Federal tax liabilities would be differentially attracted to the state. If skill groups are imperfect substitutes in production, then net gainers should suffer some drop in market wage rate due to expansion of the population in those skill groups.

The population of the state would be expected to expand, though, due to a shift from state personal income taxes to state taxes on businesses, so ironically business taxes attract new firms to the state.

4. Empirical estimates of fiscal impacts on state wage rates

As seen above, the forecasted effects of state and local tax and expenditure policies on wage rates depend on the characteristics of firm production functions and individual tastes, which are both unobserved directly. We therefore turn to the data to learn more.

Here, we employ data from the PSID on all men between the ages of twenty-five and fifty-four, covering the years 1977 - 2005. Our base model for wage rates is:

$$Ln(w_{ijt}) = \theta_i + \phi_j + \mu_t + \gamma_0 A_i - \gamma_1 A_i^2 + \psi U_j + X_{ijt}\beta + \varepsilon_{ijt} \tag{9}$$

Here, w_{ijt} represents the hourly wage rate for individual i living in state j in year t. We include fixed effects for each individual, each state, and each year. Individuals also have a life-cycle for their wage rate, captured by a function of age and age squared. Also, the state unemployment rate, U_j, is included in an attempt to capture state business cycles that differ from national patterns. The vector X_{ijt} is a list of variables capturing how state and local tax and expenditure programs affect market clearing wage rates.

Consider first the measurement of the effects of business taxes. The forecasts from the theory are captured by equation (1). According to this equation,

$$\frac{1}{w_{jt}}\frac{\partial w_{jt}}{\partial t_j} = -\frac{K_{jt}}{w_{jt}L_{jt}} \tag{1a}$$

The coefficient on a variable t_{jt} would then equal $-K_{jt}/w_{jt}L_{jt}$. Instead we define the variable to be (business taxes)/payroll, and have an expected coefficient equal to –1.

One important concern here is that business taxes may serve as a proxy for the state of the local economy, which independently affects wage rates. We use the state corporate income tax rates as an instrument for this expression.

Taxes on individuals and government expenditures on individuals will have no direct effect on equilibrium wage rates. In particular, according to equation (1), the weighted average wage rate should not change. However they can affect relative wage rates indirectly, by affecting the relative number of workers in each skill group in the jurisdiction.

Since the effects of these policies are intermediated by their impact on the skill composition of the labor force, we start by including in the vector *X* measures of the fraction of the population in each skill group, defined to equal the fraction of the relevant population that falls in each decile of the national distribution of expected labor incomes, as measured by the $\hat{\theta}_i$. In order to keep the number of added parameters reasonably small, we simply include the fraction of the population in jurisdiction *j* in that individual's decile of the national distribution, under the simplifying assumption that all other deciles are equally complements for any given decile.

Of course, these population figures both affect and are affected by relative wage rates, so are endogenous. We therefore rely again on the state and local fiscal structure in order to derive instruments for these population figures when estimating equation (9).[11]

To judge the effects of other taxes and expenditures on individual location decisions, we take a first-order approximation of the impact of the fiscal structure on individual utility:[12]

(10)

$$V(w_{ijt}(1-\tau_{ijt}),1+s_{jt},1+p_{ijt},G_{ijt};\gamma_{ijt}) \approx \overline{V} +$$

$$V_Y C_{it}\left(-(\tau_{ijt}-\bar{\tau}_{it})\frac{w_{it}H_{ijt}}{C_{it}}(1-\tau_{Fit})-(s_{jt}-\bar{s}_t)-\alpha(p_{ijt}-\bar{p}_{it})(1-\tau_{Fit})+M_{it}\frac{G_{ijt}-\overline{G}_{jt}}{C_{it}}+\gamma_{ijt}\right)$$

Several elements of this expression deserve comment. First, we take into account that state income taxes and state property taxes are deductible expenses under the Federal tax law for those who itemize and are not subject to the AMT. The resulting effective Federal tax rate is measured by τ_{Fit}. Second, we have added housing as an additional

[11] If businesses are fully mobile, as assumed in the above theory, then the weighted sum of these effects of the population structure on relative wage rates should add to zero. To the degree that firms are not fully mobile, though, then weighted average wage rates can change, providing a test of our initial presumption of full mobility.

[12] We do not include differences in wage rates in this expression. Instead, we treat both population shares and relative wage rates as joint outcomes of these fiscal pressures. We start with a reduced form forecasting population shares, and then examine a structural model forecasting wage rates in part as a function of these population shares.

consumption good to utility, where the user cost of housing depends on the property tax rate, p_{ijt}. Here, α measures housing as a fraction of overall consumption. We also assume that γ_{ijt} measures the fraction of consumption the individual would be willing to give up to live in this jurisdiction. We also include separate time trends for each state, to control for other general trends in the skill composition within each state.

Individuals then move to the state that provides them the highest utility. If γ has an extremum distribution, then the expected fraction of the population locating in the jurisdiction will be based on a logistic function of the observable variables inside the parentheses in equation (10), measured for each jurisdiction.[13] We estimate this relationship using data from the PSID aggregated to the state/year/skill decile level, forecasting the fraction of the state's adult population in each decile of the skill distribution in the national population. We include fixed effects for each jurisdiction/skill group as a proxy for time invariant differences in the skill composition across regions, due for example to technological reasons why some industry has a comparative advantage in a particular jurisdiction.

One other factor affecting the attractiveness of a jurisdiction is the use of business vs. non-business taxes. The use of business taxes implies a fall in Federal tax liabilities, due to the resulting fall in reported labor income. We then expect that the number in each skill group will expand based on the resulting tax savings (as a fraction of consumption) for this group. The change in wage rates will then depend on the fraction of consumption saved in taxes for this group compared with the weighted average fraction for the population as a whole. We therefore plan on including this difference as well as an added control variable.

In order to implement this, we need to come up with feasible measures for each of the variables in expression (10). We measure the variable $\tau_{ijt} w_{ijt} H_{ijt}$ based on the forecasts from NBER's Taxsim program for how much an individual would pay in income taxes in each state, taking as given their observed pre-tax labor income. Their consumption we construct by relating food and housing consumption to total consumption. The sales tax rate we set equal to sales tax revenue divided by aggregate consumption in the state, as measured in the National Income and Product Accounts.

For homeowners, the local property tax rate is measured based on the ratio of reported property tax payments to the reported value of the house. For renters, we use the average tax rate for owners in their jurisdiction. If the individual were to live instead in a different jurisdiction, we presume he would pay the average property tax rate faced by local residents who have the same labor income.

We consider separately four different categories of the government expenditures received by a household. For local expenditures, we presume the value in dollar terms simply equals the dollars spent per capita for local expenditures, so that $M_{it} = 1$. If the

[13] Note that the base values will cancel out in this expression.

individual moved to a different jurisdiction, they would receive the average dollar spending faced by local residents there who have the same labor income.

A second category of public expenditures is transfer payments. The individual is assumed to value these receipts at a dollar per dollar. We observe the amount received in the local jurisdiction, and presume they would receive the average observed payment received by local residents in other jurisdictions with the same labor income.

The third category of expenditures we consider is non-transfer state expenditures. Here, we make use of our prior argument that $M_{it} \propto C_{it} / \overline{G}_{it}$. We then measure $\overline{G}_{it}$ by the weighted average state non-transfer spending per capita, weighting by the number of individuals in that skill group in each state.

The fourth category is expenditures benefiting firms, e.g. infrastructure. Here, the forecasted increase in wage rates should depend on the dollars spent relative to payrolls. However, we cannot easily divide state spending into categories benefiting firms vs. households. We therefore enter non-transfer government spending twice, once in its role of benefiting households and the second in its role of benefiting firms. The data will then judge the relative importance of these two roles.

One further consideration when forecasting wage rates is income shifting, in response to any difference between statutory personal and corporate tax rates. We then add as an additional control variable the difference between the statutory corporate tax rate and the statutory personal tax rate faced by this individual in the observed jurisdiction.

One key remaining problem before attempting this estimation is that the construction of state and Federal income tax rates and of transfer payments builds in a correlation with the dependent variable, since the individual's current labor income is used in the construction of these variables, and labor income varies across observations largely due to variation in current wage rates. In order to address this, we construct an estimate of the individual's labor income from variables independent of the residual, and then reconstruct each of the tax rates based on these estimates for each individual's labor income.

One further issue is that the readjustment of the labor market to a change in fiscal policies would not be expected to be immediate. Kline (2007), for example, finds that the adjustment process for wage rates in response to an unexpected shock to labor demand plays out over about a three year period. To begin with, we include the fiscal variables in the current and the previous two calendar years in the specification, on the expectation that the current variables will have weaker effects since the adjustment process has barely started.

References

Besley, Timothy and Harvey S. Rosen. 1999. "Sales Taxes and Prices: An Empirical Analysis," *National Tax Journal* 52, pp. 157-78.

Feldstein, Martin S. and Marian Vaillant Wrobel. 1998. "Can State Taxes Redistribute Income?," *Journal of Public Economics* 68, pp. 369-96.

Gordon, Roger H. and Joel B. Slemrod. 2000. "Are 'Real' Responses to Taxes Simply Income Shifting between Corporate and Personal Tax Bases?" In Joel Slemrod, ed., *Does Atlas Shrug? The Economic Consequences of Taxing the Rich.* Cambridge: Harvard University Press, pp. 240-80.

Gordon, Roger H. and John D. Wilson. 1986. "An Examination of Multijurisdictional Corporate Income Taxation under Formula Apportionment," *Econometrica* 54, pp. 1357-73.

Hassett, Kevin A. and Aparma Mathur. 2006. "Taxes and Wages," AEI Working Paper No. 128.

Haughwout, Andrew F. 1996. "Infrastructure, Wages, and Land Prices." In David F. Batten and Charlie Karlsson, eds., *Infrastructure and the Complexity of Economic Development.* New York: Springer, pp. 75-95.

Kline, Patrick. 2007. "Understanding Sectoral Labor Market Dynamics: An Equilibrium Analysis of the U.S. Oil and Gas Field Service Industry." Mimeo.

McLure, Charles E., Jr. 1981. "The Elusive Incidence of the Corporate Income Tax: The State Case," *Public Finance Quarterly* 9, pp. 395-413.

Poterba, James M. 1996. "Retail Price Reactions to Changes in State and Local Sales Taxes," *National Tax Journal* 49, pp. 165-76.