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BY

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GRADUATE SCHOOL OF BUSINESS ADMINISTRATION

CENTER FOR REAL ESTATE AND URBAN ECONOMICS
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October, 1984

I. Introduction

Municipal income or payroll taxes are an increasingly popular source of revenue for U.S. cities. In general, cities enact such taxes during times of financial crisis, as a supplement to traditional local revenue sources such as property taxes and transfers from higher levels of government.

A city contemplating imposing such a tax might want to know its expected effects on the quantity and character of employment and wage levels in the city. At present little literature deals with these issues, and that which exists fails to provide conclusive evidence on the subject. This paper presents theoretical evidence on this question, focussing on the San Francisco case.

Existing U.S. municipal income tax structures vary widely. Some local governments tax earned and unearned income of residents, some tax all income generated within the jurisdiction, and others tax personal income of both residents and non-resident workers. Most of these localities tax non-residents at a lower rate than residents. Still others tax corporate income generated in the city in addition to personal income of residents and non-resident workers.

Nevertheless, some generalizations about tax structures are possible. The taxes are usually levied at a flat rate which ranges from .5% to 3% [1]. Most localities allow few adjustments to income, although the Indiana counties use IRS exemptions, and Washington and New York have developed their own complex sets of exemptions, deductions, and adjustments. When cities near each other tax both residents and non-resident workers, they create special provisions to avoid double taxation.

Despite some idiosyncracies [2], San Francisco's payroll tax provides a relatively simple example of a local income based tax. San Francisco levies a flat 1.5% tax [3] on all earned income generated within the city. Since San Francisco is the only city in the region which levies an income based tax, the effects of the tax on firm location are conceptually

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1. There are exceptions. Philadelphia's tax rate is currently 9% for residents, and New York and Washington have progressive taxes with rates as high as 7% and 11%, respectively.

2. Two idiosyncracies stand out. First, San Francisco levies two taxes, one on payrolls and the other on gross receipts. Each firm must calculate its liability under both taxes and pay the higher of the two. Rates are structured so the vast majority of revenue comes from the payroll tax, although many smaller firms do pay the gross receipts tax. The second idiosyncracy is that since 1977 there has been a small business exemption ($500 through 1982, and $2500 since then). Again, this affects many small firms, but the vast majority of San Francisco workers remain covered by the tax.

3. The city recently approved a reduction in the payroll tax rate to 1.4%, which will take effect in January 1985 if the latest California tax limitation initiative (Proposition 36) does not pass on November 6, 1984.

straightforward. Due to its relatively simple structure, this study will focus particular attention on the San Francisco tax.

The rest of this paper is organized as follows. Section II briefly reviews the literature on local income taxes. Section III presents a model of payroll tax incidence, and uses it to explore expected tax effects on employment and wages. Section IV draws overall conclusions about payroll tax effects from the model and compares these conclusions with those of other authors.

II. Review of Local Income Tax Literature

Little literature exists on local income taxes. While several comprehensive, though outdated, summaries of local income tax institutions exist [4], there are no recent surveys. The theoretical literature provides few contributions.

Smith [5] analyzed the progressivity and locational incentives of a local income tax, compared to the property tax. He

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4. See, for example, Robert Sigafoos, The Municipal Income Tax: Its History and Problems, Chicago 1955; Louis H. Masotti and Jerry E. Kugelman, "The Municipal Income Tax as an Approach to the Fiscal Crisis", Journal of Urban Law, 1967; Joe Davis and Arthur Ransom, "Evaluation of Municipal Income Taxation", Vanderbilt Law Review, 1969; Milton C. Taylor, "Local Income Taxes After 21 Years", National Tax Journal, 1962.

5. R. Stafford Smith, Local Income Taxes: Economic Effects and Equity, Berkeley, Institute of Governmental Studies, 1972.

discussed various types of income taxes, and concluded that the real burden rests primarily on those who bear the nominal burden of the tax (workers and/or capital owners, depending on the structure of the tax). The progressivity of the income tax relative to that of the property tax thus depends on assumptions about property tax incidence among various groups.

Gadsden and Schmenner [6] also compared various local income taxes with the property tax. They pointed out that a tax covering only earned income is regressive because unearned income constitutes a larger share of income for richer taxpayers. Again, comparisons with the property tax require further assumptions about property tax effects [7]. A tax which covers both earned and unearned income creates fewer distortions than the property tax since it taxes all factors of production. However, they reasoned that an income tax probably creates greater adverse locational incentives, since the property tax is more easily shifted to consumers or to other factors [8].

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6. Christopher Gadsden and Roger Schmenner, "Municipal Income Taxation" in John Quigley and John Meyer, Eds., Local Public Finance and the Fiscal Squeeze, Cambridge, Mass., Ballinger 1977.

7. Gadsden and Schmenner also thought that the income tax would be horizontally more equitable because it is easy to assess.

8. This would be true if, for example, the property tax falls primarily on housing, in which immobility gives the locality market power, while the income tax falls primarily on products which are sold in more national, and hence more competitive, markets.

Grieson [9] studied the Philadelphia income tax by running a series of regressions to estimate Philadelphia's share of Pennsylvania employment in a given industry using income tax rate and time trend as explanatory variables. He used an eleven year time series, from 1965 to 1975, to run separate regressions for each of six industry categories. Despite sample size and omitted variables problems, Grieson interpreted his results as indicating that the elasticity of employment with respect to the tax rate was about -0.4, meaning that raising the tax rate by 25%, from 4% to 5% for example, would result in about a 10% employment decline. Using these estimates, he then calculated the elasticity of tax revenues with respect to the tax rate, and found that it was close to one. This implies that the city was already maximizing tax revenues, and increasing tax rates further could only reduce revenues.

Haurin [10] took a different approach to the problem. He developed a spatial model with two jurisdictions, a city and a suburb; three goods, housing, a composite consumption good, and public services; two inputs to housing, land and capital, both of which can vary; and two inputs to the composite consumption good, less skilled labor and more skilled labor. He assumed both types

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9. Ronald Grieson, "Theoretical Analysis and Empirical Measurement of the Effects of the Philadelphia Income Tax", Journal of Urban Economics, July 1980.

10. Donald R. Haurin, "Local Income Taxation in an Urban Area", Journal of Urban Economics, November 1981.

of labor are perfectly mobile, so utility of metropolitan area residents is identical to that of similarly skilled workers elsewhere. Each worker provides a fixed quantity of labor services, so the two skill levels result in two income groups. Adding the conditions under which high-income households live further from the central business district than low-income households [11] makes the central city heterogeneous in income while only high income households live in the suburb. Each jurisdiction uses all of its tax revenues to provide a public good uniformly to all of its residents. Both city and suburb impose an ad valorem tax on labor income.

When both jurisdictions impose the tax, both types of workers move. High-skilled workers migrate from the city to the suburb, in response to their reduced fiscal surplus in the city. Low-skilled workers migrate to the city from outside the urban area, since their fiscal surplus increases. The migration reduces land prices in the city, due to lower average incomes, and increases land prices in the suburbs due to greater demand there.

At the new equilibrium, real wage (utility level) remains at its pretax level for each skill group, because the urban area is

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11. The condition is that the marginal utility of leisure relative to that of housing rises with falling income. See, for example, J. Vernon Henderson, Economic Theory and the Cities, New York, Academic Press, 1977.

a utility-taker on the national labor market. Haurin's numerical example suggests that an increase in the income tax from 0 to 2% will result in a 2.4% decrease in central city population [12]. His article does not present resulting changes in metropolitan population (employment).

This model does better at its stated goal of describing the flight to the suburbs than it does in determining the economic effects of the local income tax, for at least two reasons. First, the consumption good requires only labor inputs and housing requires no labor, so substitution away from the taxed factor within a given sector is impossible. Second, both jurisdictions levy the tax, so the situation of an income tax in the city but not in the suburb is not analyzed. Even as a description of flight to the suburbs, the model suffers from its exclusion of capital and land inputs to consumption good production and competition for land between the two production sectors.

Only Grieson's paper directly asks what effects a local income tax has on the character and vitality of the city's economy, and his conclusions go beyond what the data warrant. In contrast,

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12. Haurin's estimate of the effect on employment appears to be smaller than Grieson's. This could result from Grieson's econometric method, which may lead to overestimates, or from Haurin's model, which allows costless adjustments in land prices, city size, and wage rates, all of which are likely to be sticky in the real world.

the property tax literature provides a basis for modelling the payroll tax.

III. Modelling a City's Payroll Tax

Now we turn to modelling a payroll tax for a city such as San Francisco. The model presented here applies to payroll tax incidence many features of two important contributions to the property tax literature [13]. In addition, this model explores two different labor supply assumptions and considers the possibility of imperfect competition in the export market, while allowing differential tax incidence analysis which compares the payroll tax with a property tax.

A. Assumptions of the Model

In the following respects, the approach developed here follows both the Mieszkowski model and the Polinsky and Rubinfeld model. Only the jurisdiction which imposes the tax is explicitly modeled. The economy has three factors, land, labor, and capital. The city is sufficiently small, and the model sufficiently long-run, that capital supply is infinitely

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13. Peter Mieszkowski, "The Property Tax: An Excise or a Profits Tax?", Journal of Public Economics, 1972; and A. Mitchell Polinsky and Daniel L. Rubinfeld, "The Long-Run Effects of a Residential Property Tax and Local Public Services", Journal of Urban Economics, 1980.

elastic. Therefore, capital price is exogenous to the city.

As in Mieszkowski's work, land is modeled as homogeneous and in fixed supply to the taxing jurisdiction. This means that, within the taxing jurisdiction, there are no locational advantages to particular sites which can be reflected in land price differences, and that city boundaries are fixed.

Polinsky and Rubinfeld's article suggests several features. The model includes two production sectors; the export sector uses all three inputs in its production, while the home good (housing) uses capital and land only. It would be ideal to include all three factors in both production processes, but doing so hampers interpretation of the model. Because labor is relatively unimportant in housing production, its omission makes sense. Indeed, virtually all of the property tax models, including the work by Polinsky and Rubinfeld and by Mieszkowski, exclude labor inputs to housing production.

Again following Polinsky and Rubinfeld, each worker is assumed to provide the same quantity and quality of labor services, and all land and capital is owned by nonresidents. Therefore, all residents have identical incomes. The property tax is modelled as an ad valorem tax on both land and capital.

Polinsky and Rubinfeld set up their model to allow balanced budget analysis by modelling benefits as well as property taxes. In general, the payroll tax is implemented by cities seeking to maintain existing service levels in the face of limited revenue options, and is rarely used to expand government services. Therefore, it is appropriately compared to the most likely alternative revenue source, the property tax. This model is set up to allow differential tax analysis of both taxes, as well as separate analyses of each.

Demand for housing is determined within the model by the price of housing, nominal income of city residents, and the size of the city's population. The elasticity of demand for housing with respect to export price is assumed to be zero, which implies that the city's export good is an insignificant fraction of residents' purchases. This is similar, but not identical, to the framework used by Polinsky and Rubinfeld.

The present model departs from its predecessors in its treatment of export demand and labor supply. Here, demand for the export good depends on assumptions about the market structure in the export industry. Two cases are considered. The first, and more traditional, assumes a competitive export market. Thus the price elasticity of export demand is infinite and export price is exogenous to the city. Since the city is small as a consumer of its export good, its income level, population, and housing price are all irrelevant in determining the quantity of export good produced.

The second case considers a city with some market power, so demand elasticity is finite and the export price can vary with conditions in the city. This would occur if the city is a regional center for a particular product or service, or if different cities specialize in producing different goods. Even when export price can vary, most of the city's export is consumed elsewhere, so city residents are unimportant as consumers of the export good. Therefore, the elasticities of export demand with respect to resident income, population, and housing price are all zero.

Two labor supply assumptions are considered. Under the first, real wages remain constant. In addition to the small city assumption made earlier, this implies either that labor is perfectly mobile, even in the short run, or that the model is sufficiently long run to allow population adjustments to changing economic conditions. In this model, constant real wages are defined by a Laspeyres price index.

Under the alternative, labor supply is assumed fixed. This implies that labor is perfectly immobile, or that the time frame is too short for migration to occur. While labor supply is more likely perfectly elastic than fixed, the latter assumption provides a polar case which adds to the information provided by the model without making it algebraically intractable.

All net-of-tax prices are normalized to starting values of one. This simplifies the notation later, and also makes a tax on prices approximately equivalent to a tax on quantities [14]. Here the tax is modelled as a tax on quantities.

B. Structure of the Model

The basic structure is therefore as follows:

(1) $X = X[K_x, L_x, R_x]$

(2) $H = H[K_h, R_h]$

(3) $K_x = K_x[k+t, w+T, r+t, X]$

(4) $L_x = L_x[k+t, w+T, r+t, X]$

(5) $R_x = R_x[k+t, w+T, r+t, X]$

(6) $K_h = K_h[k+t, r+t, H]$

(7) $R_h = R_h[k+t, r+t, H]$

(8) $R_x + R_h = R_f$

(9) $H = H[w, h, L_x]$

(10) $X = X[p]$

(11) $pX = (k+t)K_x + (w+T)L_x + (r+t)R_x$

(12) $hH = (k+t)K_h + (r+t)R_h$

where subscripts indicate the relevant industries, and:

X = quantity of export good produced per unit of time

H = quantity of housing services produced per unit of time

K = capital services per unit of time

L = labor services per unit of time

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14. A tax on prices is exactly equivalent to a tax on quantities only when the tax is initially zero and the price is initially one.

R = land services per unit of time

p = price per unit of export good

h = price per unit of housing services

k = price per unit of capital services

w = price per unit of labor services

r = price per unit of land services

t = tax rate on capital and land services (property tax)

T = tax rate on labor services (payroll tax)

R_f = fixed land supply

Equations (1) and (2) are constant returns to scale production functions, (3) - (7) are factor demand schedules derived from the production functions, (8) is the land supply constraint, (9) is housing demand, (10) is export demand, and (11) and (12) are price relationships which follow from the assumption of constant returns to scale and Euler's theorem. Adding an equal-revenue constraint allows differential tax analysis.

Note that all quantities are expressed in terms of service flows rather than stocks. Therefore the prices of housing, land, and capital services are rental rates, rather than market values of housing, land, and capital stocks.

The equation system can be totally differentiated to express the relationships in terms of relative changes rather than absolute magnitudes [15]. Doing so yields the following structural system:

$$(1')\quad X^* = f_{kx}K_x^* + f_{1x}L_x^* + f_{rx}R_x^*$$

$$(2')\quad H^* = f_{kh}K_h^* + f_{rh}R_h^*$$

$$(3')\quad K_x^* = a_{kkx}gdt + a_{k1x}G(dw+dT) + a_{krx}g(dr+dt) + X^*$$

$$(4')\quad L_x^* = a_{1kx}gdt + a_{11x}G(dw+dT) + a_{1rx}g(dr+dt) + X^*$$

$$(5')\quad R_x^* = a_{rkx}gdt + a_{r1x}G(dw+dT) + a_{rrx}g(dr+dt) + X^*$$

$$(6')\quad K_h^* = a_{krh}gdr + H^*$$

$$(7')\quad R_h^* = a_{rrh}gdr + H^*$$

$$(8')\quad 0 = c_{rx}R_x^* + c_{rh}R_h^*$$

$$(9')\quad H^* = E_h dh + E_w dw + E_L L_x^*$$

$$(10')\quad X^* = E_x dp$$

$$(11')\quad dp = f_{kx}gdt + f_{1x}G(dw+dT) + f_{rx}g(dr+dt)$$

$$(12')\quad dh = gdt + f_{rh}gdr$$

where asterisks indicate logarithmic derivatives, f's are factor shares, and a's are partial factor demand elasticities in the indicated industries. For instance, a_{1kx} is the relative change in demand for labor in the export industry which results from a relative change in the gross of tax price of capital, holding everything else, including output, constant. In addition:

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15. If we had not assumed that all prices were initially zero, price changes would equal relative changes (dw would become w*). Tax changes would equal changes in the tax rate on quantities, relative to the relevant factor price (dT would become dT/w).

addition:

E_h = price elasticity of housing demand

E_x = price elasticity of export demand

E_w = wage (income) elasticity of housing demand

E_L = employment elasticity of housing demand

$c_{rx} = R_x/R_f$

$c_{rh} = R_h/R_f$

$g = 1/(1+t)$

$G = 1/(1+T)$

One problem with this method of analysis is that derivatives are technically accurate only for infinitesimal changes, while actual tax changes are discrete. An alternative, but less general, approach to this problem would be to impose a particular functional form on the undifferentiated version of the model, and to solve that system under various tax regimes.

Now, we have twelve equations, of which ten are independent. Equations (1'), (3'), (4') and (5') are linearly dependent, as are (2'), (6') and (7'). Thus, in solving the system we can eliminate equations (1') and (2'). If we set the change in property tax rate (dt) and change in payroll tax rate (dT) as policy parameters, there are then eleven unknowns: changes in wages (dw), land rents (dr), housing rents (dh), export price (dp), output of housing (H*) and the export good (X*), employment (L_x*), and land and capital use in each industry (R_x*, R_h*, K_x*,

K_h*). By imposing constraints of constant real wages ($dw = s_h dh$) or fixed labor supply ($dL_x = 0$) we reduce the number of unknowns to ten so the system can be solved.

If the export good is sold on a competitive market, then equation (10') must be dropped from the system and the constraint dp=0 imposed, since the system cannot be solved with the export demand elasticity set equal to infinity. This reduces the system to nine equations with nine unknowns.

C. Analytical Results

To analyze the implications of the model, we first make some preliminary observations about signs of parameters. The factor shares (f), industry shares in total factor use (c), and product shares in consumption (s) are all positive. In addition, the price elasticities of housing and export demand (E_h and E_x) are negative, the income elasticity of housing demand (E_w) is positive, and the employment elasticity of housing demand (E_L) is between zero and one. The own-price factor demand elasticities are assumed to be negative, while cross price factor demand elasticities are positive. This implies that all pairs of factors are substitutes.

An equal revenue constraint can be imposed to determine the differential incidence of the two taxes. The equal revenue constraint is:

(13) Total Revenue = $T(wL) + t(rR+kK)$

which, when totally differentiated, becomes:

(13') $0 = f_{1x}GdT + (f_{rx}+(s_h/s_x)+f_{kx})gdt$

The algebraic solution of the model leaves many unanswered questions about the expected effects of the tax, as Table 1 indicates.

Table 1

Directions of Change in Economic Variables Predicted Algebraically

	L_x* Constant Real Wages			dw Fixed Labor Supply		
	$dT > 0$, $dt = 0$	$dT = 0$, $dt < 0$	$dT > 0$, $dt < 0$	$dT > 0$, $dt = 0$	$dT = 0$, $dt < 0$	$dT > 0$, $dt < 0$
X*	?	?	?	?	?	?
H*	?	?	?	?	?	?
K_x*	?	?	?	?	?	?
K_h*	?	?	?	?	?	?
L_x*	?	?	?	0	0	0
R_x*	?	?	?	?	?	?
R_h*	?	?	?	?	?	?
dw	-	?	?	-	+	?
dr	-	+	?	-	+	?
dh	-	?	?	-	-	-
dp	?	?	?	?	?	?

D. Cobb-Douglas Numerical Examples

Nevertheless, using plausible parameter values it is possible to place some restrictions on expected results. To make the results more understandable, we start with Cobb-Douglas production functions, thereby setting all substitution elasticities equal to one.

1. Base Case Parameter Values: Table 2 lists base case parameter values used in numerical examples of economic effects [16]. Values for factor shares in housing, goods shares in household expenditures, and income and price elasticities of housing demand are consistent with Muth's results [17]. Labor share for the export good was calculated from aggregate 1980 data in Survey of Current Business. The employment elasticity of housing demand is based on the observation that in 1980 the number of people employed in San Francisco was roughly twice the

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16. factor demand elasticities were calculated from these parameters as follows:

$a_{ijg} = f_{jg}\sigma_g$ for all goods g and all factors $i \neq j$

$a_{kkg} = -a_{kig} - a_{kjg}$ for all goods g and all factors $i \neq j \neq k$

17. See Richard F. Muth, "The Demand for Non-Farm Housing", in Arnold C. Harberger, ed., The Demand for Durable Goods, Chicago, University of Chicago Press, 1960; "Household Production and Consumption Demand Functions", Econometrica, 1966; Cities and Housing, Chicago, University of Chicago Press, 1969; and "The Derived Demand for Urban Residential Land", Urban Studies, 1971.

18. U.S. Census Bureau, Census of Population and Housing, 1980.

number of San Francisco residents who held jobs [18]. Based on this we assume that increasing San Francisco employment by 10% would increase the number of San Francisco residents by about 5%. Housing and export shares of land are rough estimates based on maps of San Francisco land use in 1970 [19].

Table 2

Cobb-Douglas Base Case Parameter Values

Name	Parameter	Value
Capital share in export production	f_{kx}	0.20
Labor share in export production	f_{lx}	0.75
Land share in export production	f_{rx}	0.05
Capital share in housing services	f_{kh}	0.80
Land share in housing services	f_{rh}	0.20
Factor substitution elasticity in exports	σ_x	1.00
Factor substitution elasticity in housing	σ_h	1.00
Export share of city's land supply	c_{rx}	0.25
Housing share of city's land supply	c_{rh}	0.75
Housing share in household expenditures	s_h	0.20
Traded good share in household expenditures	s_y	0.80
Price elasticity of housing demand	E_h	-1.00
Wage (income) elasticity of housing demand	E_w	1.00
Employment elasticity of housing demand	E_L	0.50
Price elasticity of export demand	E_x	∞

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19. San Francisco City Planning Department, Land Use, 1980.

The results for base case values of the parameters confirm the analytical results and provide estimates of expected magnitudes. Table 3 lists changes in economic variables resulting from base-case parameter values, where the payroll tax change, dT, is +1%. The property tax change, dt, derived from dT and the equal-revenue constraint (13'), is -1.8%.

Table 3

Changes in Economic Variables From Base Case Parameter Values

	L_x^* Constant Real Wages			$dw-s_h$ Fixed Labor Supply		
	Payroll Tax	Property Tax	Both	Payroll Tax	Property Tax	Both
dt	0.0000	-0.0180	-0.0180	0.0000	-0.0180	-0.0180
dT	0.0100	0.0000	0.0100	0.0100	0.0000	0.0100
X*	-0.1417	0.0960	-0.0457	0.0005	0.0037	0.0042
H*	-0.0590	0.0480	-0.0110	-0.0081	0.0150	0.0069
K_x^*	-0.1417	0.1110	-0.0307	0.0005	0.0187	0.0192
K_h^*	-0.0777	0.0630	-0.0147	-0.0095	0.0187	0.0092
L_x^*	-0.1480	0.0960	-0.0520	0.0000	0.0000	0.0000
R_x^*	0.0480	0.0360	0.0120	0.0075	-0.0000	0.0075
R_h^*	-0.0160	-0.0120	-0.0040	-0.0025	0.0000	-0.0025
dw	-0.0038	0.0000	-0.0038	-0.0095	0.0037	-0.0058
dr	-0.1125	0.0900	-0.0225	-0.0084	0.0225	0.0141
dh	-0.0187	0.0000	-0.0187	-0.0014	-0.0112	-0.0127
$dw-s_h dh$	0.0000	0.0000	0.0000	-0.0092	0.0060	-0.0033

Table 3 shows that if real wages are constant, employment falls by 15%. In contrast, if labor supply is fixed, real wages fall by 0.9%. Therefore, if labor is in fact imperfectly mobile, both real wages and employment would be expected to fall, but by smaller amounts. These figures raise the question of why employment changes so much more than wages. We turn now to answering that question.

For the case of fixed real wages, the size of the employment change is determined primarily by the magnitude of the output reduction caused by the tax. This can be seen in Figures 1a and 1b.

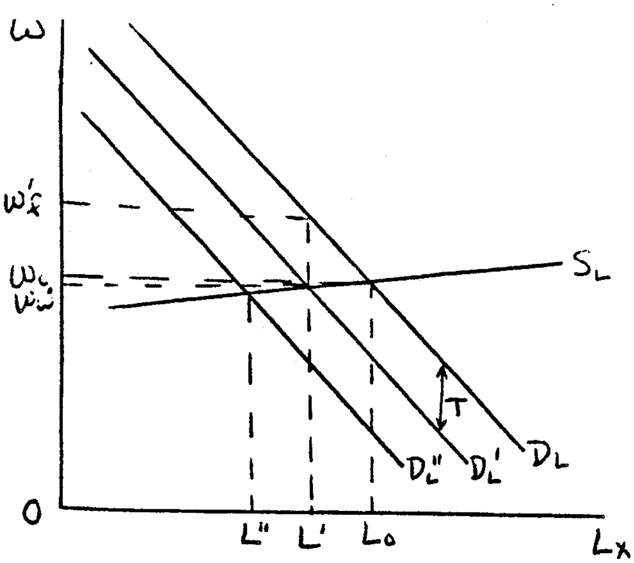

Figure 1a

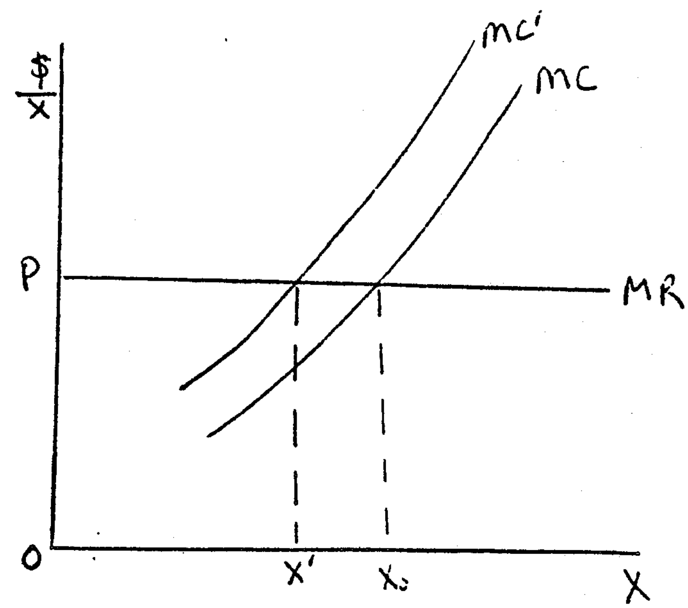

Figure 1b

Demand for labor, as described in equation 4', is a function of nominal wage rates, property and payroll tax rates, land rents, and output. The demand for labor curve, D_L, in Figure 1a shows labor demand as a function of wages, holding land rent, tax rates, and output constant. The supply of labor, S_L, is determined by the constant real wages condition, $dw = s_h dh$. It slopes up because if nominal wages fall, house rents must also fall to maintain constant real wages.

Figure 1b shows the export firm's profit-maximizing output decision. MR represents marginal revenues under the good's competitive market structure. Marginal costs (MC) are increasing in the relevant region, and the firm initially produces output X_o, where MR=MC.

Now we impose a payroll tax. This shifts net-of-tax labor demand down by the amount of the tax, T, to D_L' in Figure 1a. Workers earn lower nominal wages, w_w', and firms pay a higher wage rate, $w_f'=w_w'+T$. This in turn increases the firm's marginal costs, to MC' in Figure 1b, so output falls to X'. This output reduction shifts the demand for labor curve further down, to D_L'', reducing both employment and nominal wages.

The resulting lower wages, together with reduced land rents which also result from the tax, shift marginal costs below MC', which in turn shifts labor demand above D_L''. This sequence converges with employment between L' and L", and output between X_o and X'.

Figures 2a and 2b illustrate the fixed labor supply case. Here the labor supply curve, S_L, is vertical since labor supply is fixed. We start out with wage w_o, employment L_o, and output X_o, as before. When the payroll tax is imposed, the demand for labor shifts down to D_L', where firms still pay w_o but workers get only w_w'. Marginal cost to the firm has not changed, so output remains constant. The only thing that prevents this from being the long run solution is that lower wages to workers reduce demand for housing, which lowers land rents. This causes a slight reduction in marginal costs, increasing output and shifting D_L' slightly to the right.

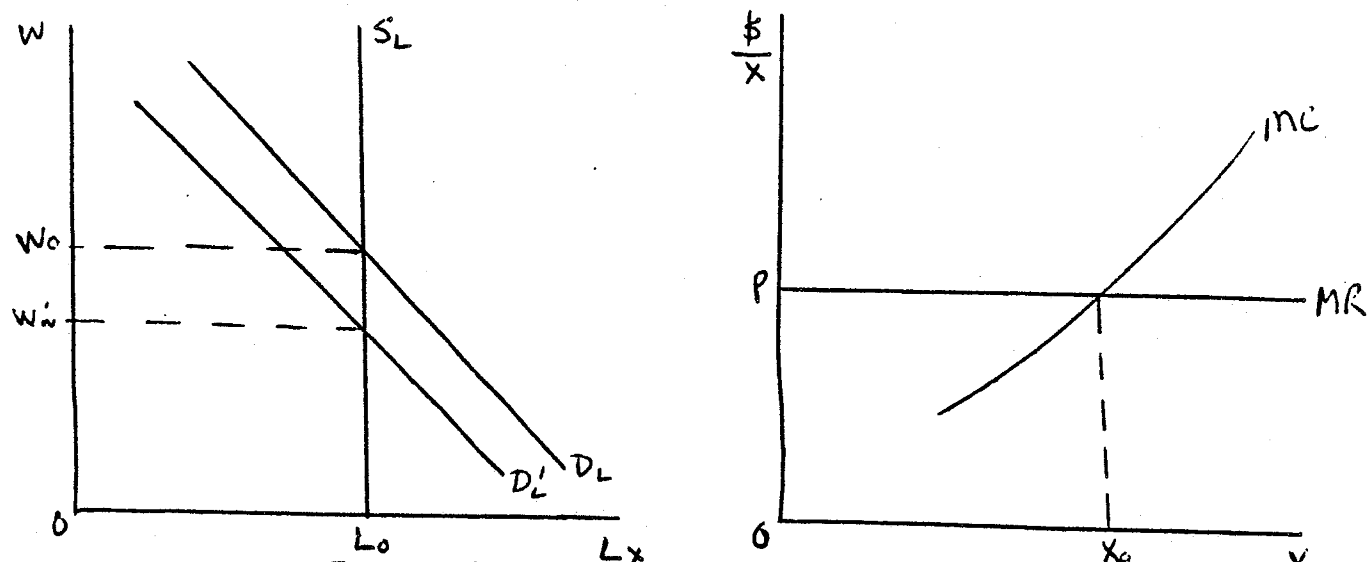

Figure 2a Figure 2b

2. Changing Parameters in Cobb-Douglas Examples: The magnitudes of employment and wage effects depend on several key parameter values. To analyze how the parameters change these economic effects, we allow five parameters (labor share, price elasticities of product demand, and income and employment elasticities of housing demand) to vary.

For the case of constant real wages, the parameter values determine (1) how large the output effect is, and hence how large the shift from D_L' to D_L'' is, and (2) how large the land price change, and hence the shift from D_L'' toward D_L', is. Together, these two factors determine the magnitude of the employment effect.

The single parameter which has the greatest impact on the magnitude of the employment effect is the price elasticity of demand for the export good. For example, infinitely elastic export demand leads to a 14.8% drop in employment, but the decrease in employment is only 1.7% when E_x=-2, and 1.0% when E_x=-1. As export producers can pass more of the tax on to their consumers, they reduce their output by less, which leads to a smaller employment reduction. In terms of Figure 1, a smaller demand elasticity implies a steeper marginal revenue curve. Therefore, output declines by less than in the competitive case, so the shift from D_L' to D_L'' is smaller.

With infinitely elastic export demand, changes in other parameters cause less significant changes in the employment effect. With all parameters at their base case values, employment falls by 14.8%. When labor share increases from .75 to .85, the drop in employment increases to 20.8%. As labor becomes more important to a firm, an increase in the payroll tax becomes more burdensome and the firm releases more employees, <u>ceteris</u>

paribus. In terms of Figure 1, the initial shift in marginal cost from MC to MC' is larger, so output and hence labor demand falls by more.

The employment loss increases to 17.1% when the price elasticity of housing demand is set equal to -2. When the demand elasticity for housing increases, housing prices fall by less, so land prices fall by less. This causes a smaller shift from D_L" to a higher labor demand curve, so the employment loss is greater.

If the employment elasticity of housing demand increases from .5 to 1, the employment loss is only 9.3%. The reasoning is similar to that for the price elasticity of housing demand. Outmigration of laid off workers causes a larger reduction in housing demand. Therefore, demand for housing land falls by more, so its price falls by more and demand for labor rises by more after falling to D_L".

As the income elasticity of housing demand rises from 1 to 2, the reduction in employment falls to 14.4%. When the tax is imposed, initially nominal wages fall. With a higher income elasticity, this leads to a larger decrease in housing demand, so housing price falls by more. Thus, the same nominal wage reduction causes a smaller reduction in real wages with a higher income elasticity. This in turn means that it takes less outmigration to equilibrate the labor market, so employment falls by less. In Figure 1, the supply of labor curve is steeper when income elasticity of housing demand is greater.

So far, we have only discussed the sensitivity of employment changes to various parameter values when export demand is infinitely elastic. When demand elasticity is lower, say -1, the altered employment effects caused by these parameter changes work in the same directions but are far smaller, due to the smaller base case magnitude of employment changes.

Turning to the effect on real wages in the fixed labor supply model, all parameter values lead to a reduction in real wages of between .84% and .96%. These correspond to nominal wage reductions between 0.91% and 1.00%. This makes sense, since when a lump sum tax of 1% is imposed the only mechanisms preventing wages from falling by the full amount of the tax are the income effect on housing demand and the potential for passing some of the tax on to export consumers in the form of higher prices.

E. CES Numerical Examples

The next step in analyzing the model is to allow for variations in factor substitutability. The simplest way to do this is to use a CES production function in the critical export sector, while retaining Cobb-Douglas production in housing [20].

We can do this in a way which allows us to consider how different industries are likely to respond to the tax, by hypothesizing three sets of parameters to correspond to three distinct industry structures. Here, we consider manufacturing, retail sales, and business services. Parameters used to represent each industry are presented in Table 4.

Table 4

Parameter Values Used in CES Numerical Examples

	Manufacturing	Retail Sales	Business Services
f_{lx}	0.80	0.85	0.70
f_{kx}	0.16	0.12	0.28
f_{rx}	0.04	0.03	0.02
σ	1.50	1.00	0.70
E_x	∞	-3.00	-1.00

Thus, manufacturing is more able to substitute one factor for

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20. Empirical work on housing production suggests that this may well be the appropriate assumption to make. See John M. Clapp, "The Elasticity of Substitution for Land: The Effects of Measurement Errors", Journal of Urban Economics, 1980, pp. 255-263; and John F. McDonald, "Capital-Land Substitution in Urban Housing: A Survey of Empirical Estimates", Journal of Urban Economics, 1981, pp. 190-211.

another in response to changing economic conditions than are business services, in which there is no substitute for the highly skilled labor provided by a quality attorney or investment counselor. Substitutability in retail sales falls between these two extremes.

Labor shares were computed using Survey of Current Business data for 1980 for manufacturing, retail sales, and miscellaneous professional services. The land share is smaller relative to capital in business services because these firms tend to locate in high rise office buildings.

Relative demand elasticities follow from market structure. Manufactured products are relatively homogeneous and easy to transport. Since textiles made in one city are no different to a consumer from textiles made somewhere else, and since San Francisco textile manufacturers comprise a small fraction of all textile manufacturers, the city's textile manufacturers are price takers on their market. In contrast, business services is a regional industry; a large city such as Sn Francisco is the only regional center for major investment and law firms, and hence the city faces a market demand curve for business services. Retail establishments in a city can attract business from elsewhere, if for example product selection is greater. Therefore the city is not a price taker in retail sales, but can be thought of as one of a few suppliers of retail products. Thus, as with an oligopoly, the demand elasticity is greater than it would be for a monopolist but less than in the perfectly competitive case.

In these examples, base case values for other (non-export) parameters, listed previously in Table 2, are used for all three industries. Note in addition that the substitution elasticity is assumed to be the same between any pair of factors in export production. This simplifies the procedure in the three-factor CES case but is not necessary.

Table 5

Results of CES Numerical Examples

Changes Resulting from Imposition of 1% Payroll Tax

	Manufacturing	Retail Sales	Business Services
L_x*	-19.80%	-2.47%	-0.89%
dw	-0.97%	-0.98%	-0.99%
dw - $s_h$dh	-0.94%	-0.95%	-0.96%

As Table 5 shows, substantial differences exist across industry structure groups for employment effects, with smaller differences for both nominal and real wages. The greatest employment effects occur in manufacturing, followed by retail and business services, in that order. This is consistent with differences in demand elasticities. However, it contradicts what the differences in production parameters lead us to expect about relative magnitudes of employment losses in manufacturing and retail trade. This confirms the conclusion drawn from varying parameters in the Cobb-Douglas case, that with constant real wages the effect of demand elasticity changes dominates changes in other parameters.

In contrast, both nominal and real wage changes are larger for retail and business services than they are for manufacturing. This is consistent with expectations based on production parameters, but contradicts those based on the demand elasticity. Again, this confirms the Cobb-Douglas example, in which changes in the firm's marginal costs were small. Therefore, reduced output in the export sector, and hence the effect of demand elasticity, was insignificant.

In the real world, where labor is imperfectly mobile, wages would fall by somewhat less than the amount of the tax. Thus, for example, if a 1% payroll tax were imposed, wages might fall by about .5%. The decrease in employment is would probably be larger, depending on the industry mix in the taxing city. In a city which exports only manufactured products, employment might fall by about 10% due to imposition of a 1% payroll tax. A city whose sole export is business services, however, would probably not suffer employment reductions in excess of .5%. In San Francisco, where business services are more important than manufacturing industries, employment is unlikely to fall by more than 6% following imposition of a 1% tax.

F. Offsetting Changes

Another way of seeing how the model works is to consider economic changes which would compensate for the imposition of the payroll tax. Using equations 4', 10', and 11' we can calculate the exogenous changes which would maintain either constant real wages or constant employment. This particular structure accounts for changes in export demand but does not consider the role of the housing market.

1. Constant Real Wages: First, consider the changes in land rents, property tax rates, and employment which maintain constant real wages. Here we add equation 12' to account for the price relationship in housing production. The results, using parameter values from Tables 2 and 4, are listed in Table 6.

Table 6

Changes to Offset a 1% Payroll Tax Increase
Constant Real Wages

(No Interaction With Housing Demand)

	dr	dt	L_x*
Cobb-Douglas	-2.6%	-2.3%	+75.3%
CES			
Manufacturing	-4.0%	-2.7%	+80.3%
Retail Sales	-4.5%	-3.2%	+2.7%
Business Services	-4.8%	-3.3%	+0.9%

If wages and property tax rates remain constant, land rents must fall to offset the payroll tax. When the payroll tax rises, labor demand falls both because output falls, and because the firm substitutes away from labor. Thus labor demand falls more with higher labor share, demand elasticity, and substitution elasticity. When land rents fall, labor demand rises due to higher output, but this is tempered by substitution toward land. The increase in labor demand due to lower land rent is greater with higher land share and demand elasticity, and lower substitution elasticity. For these examples, the ratio of labor to land share has sufficient impact to dominate changes in substitution and demand elasticities. This explains the variations in land rent changes as parameter values change.

For similar reasons, property tax rates must fall to maintain labor demand in the face of the payroll tax if land rents and wages are held constant. When property tax rates fall, the firm's labor demand rises because output rises, but substitution toward capital and land tempers this effect. The impact of property tax rates on labor demand increases with higher non-labor share and demand elasticity, and higher substitution elasticity. For most parameter values, results are analagous to the land rents case, and the ratio between labor and non-labor share is the most important determinant of relative magnitudes of property tax changes required to offset the payroll tax. However, business services require greater compensation than the other three categories even though their ratio of labor to non-labor share is the smallest of this group. This happens because the demand elasticity for the export good is so small relative to substitution elasticity. When the property tax rate falls, the increase in labor demand due to higher increase is smaller relative to the decrease in labor demand due to substitution away from labor. Therefore, it takes a larger property tax reduction to compensate for the same payroll tax increase.

Exogenous employment increases required to offset the tax work somewhat differently. The payroll tax initially increases the firm's marginal costs by the amount of the tax. The firm responds by cutting output and by substituting away from labor, which causes employment to fall. An exogenous increase in labor demand is required to increase employment to its initial level. The magnitude of this labor demand increase depends on the initial responsiveness of labor demand to the tax. As the numerical examples showed, labor demand is extremely sensitive to the price elasticity of export demand. The relative magnitudes of employment changes required to offset the tax confirm that price elasticity is a key determinant of the tax's effects. Manufacturing is somewhat more sensitive than the Cobb-Douglas case because (1) labor share is greater, so a change in output leads to a larger change in employment, and (2) substitution elasticity is greater, so higher labor costs lead to more substitution away from labor.

2. Constant Employment: Next, consider changes in nominal wages, land rents, or property tax rates which would maintain the previous level of employment. Again, we use equations 4', 10', and 11', but omit 12' from this exercise. Table 7 presents the results.

Table 7

Changes to Offset a 1% Payroll Tax Increase
Constant Employment

(No Interaction with Housing Market)

	dw	dr	dt
Cobb-Douglas	-1.00%	-18.24%	-3.65%
CES			
manufacturing	-1.00%	-24.46%	-4.89%
retail sales	-1.00%	-54.00%	-10.80%
business services	-1.00%	-182.01%	-12.13%

If wages fall by 1% following imposition of the 1% payroll tax, labor demand remains unaffected.

As in the constant real wages example, reductions in land rents and property taxes required to offset the payroll tax increase as entries get lower on the table. In general, the ratio of labor share to land or non-labor share determines the relative magnitudes of change required to offset the 1% payroll tax.

The changes required are larger than in the constant real wages case because here labor demand is far less sensitive to prices of other factors. In the constant real wages case, lower land rents caused lower housing rents, so nominal wages had to fall to maintain equilibrium in the labor market. Thus lower land rents shifted the supply for labor curve down. This in turn caused a shift along the labor demand curve to a higher employment level. This shift along the labor demand curve makes employment more sensitive to land rents in the constant real wages case, since this is added to the shift of the labor demand curve which occurs in both cases. Therefore, the land rent change required to offset the payroll tax is smaller.

The same reasoning applies to property tax rate effects, but differences are less dramatic because non-labor share is greater than the land share in export production. Therefore, output is more sensitive to property tax rates than to land rents, so labor demand is also more sensitive. Thus the labor demand curve shifts so much more than the labor supply curve that the supply curve shift is insignificant.

These two examples show that even a relatively small change in taxes can significantly affect specific economic variables if other variables are resistant to change. For example, sticky wages could cause substantial capital losses to land owners.

IV. Conclusion

Information provided by the model can be used to predict responses to payroll tax changes. The magnitudes of these responses likely vary across industries with different production parameters and market conditions. In addition, constraints in some parts of the city's economy could magnify effects in other parts of the city's economy.

Under reasonable assumptions it is unlikely that any industry will suffer employment reductions of more than 10% in response to the imposition of a 1% payroll tax. Employment in manufacturing is likely to be most sensitive to payroll taxes if manufacturers sell their products in a more competitive market and therefore are less able to pass the tax on to consumers [21]. Industries in which the city has a local monopoly, such as business services, are unlikely to show significant employment reductions. Industries whose product markets fall between these two extremes may experience moderate losses of employment [22].

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21. A city such as Detroit or Pittsburgh would have been able to shift part of a local income tax onto consumers of cars or steel when these industries had more market power in the U.S. It is not the type of product as much as the market faced by the city's producers which determines the demand elasticity.

22. Regressions using County Business Patterns data also suggest that manufacturing industries in San Francisco lose more employment than business services due to a payroll tax increase.

Overall employment losses will depend on the city's industry mix and the specific structure of the city's tax. In San Francisco, where manufacturing provides relatively few jobs, total employment probably falls by a smaller amount than it would in a city with a more industrial economic base. The structure of San Francisco's tax also limits the tax's effects on employment. The small business exemption, together with the joint administration of the payroll and gross receipts taxes, makes small business employment relatively insensitive to the payroll tax. Nevertheless, since larger employers provide most jobs, employment lost due to the tax should not differ greatly from estimates based on the assumption tht all sizes of firms are equally affected. These two factors suggest that total San Francisco employment would be unlikely to fall by more than 4 or 5% in reponse to imposition of a 1% tax.

Substantial wage reductions, approaching 1% for a 1% payroll tax, will occur in all industry categories if labor mobility prohibits workers from seeking higher wages elsewhere. On the other hand, if workers are highly mobile, they are unlikely to experience wage losses at all. If the city imposing the tax is part of a larger metropolitan area, workers can easily seek employment in other cities within the urban area if there are wage advantages to doing so. Thus, labor supply to an individual city is likely to be highly elastic, and the tax will have little effect on wages.

The only other theoretical examination of a city tax on labor was by Haurin, whose numerical example suggested that central city population would fall by 2.4% with a 2% increase in the tax for the entire urban area. If this translates to a 1.2% decrease for a 1% increase in the tax, then Haurin's model suggests a smaller employment effect than the present model does. Since in his model employment falls by more than central city population does, his estimate is not entirely inconsistent with those of the current model.

Both Haurin's model and the present one suggest smaller employment effects than Grieson's empirical study, which suggested an aggregate decrease in employment of 10% in response to a 1% income tax increase. At first glance, Grieson's estimate appears consistent with those from the present model, since Philadelphia employment is more manufacturing oriented than San Francisco's. However, Grieson's smaller estimated effect for manufacturing than for finance raises additional questions. His paper presented no reason for the relative magnitudes of effects in different industries, so it is hard to know how much to make of this discrepancy.

Several conclusions follow from the work presented here. First, the 1.5% payroll tax probably reduces employment in San Francisco. Second, the employment reductions are probably greatest in manufacturing, and smallest in industries such as business services, with retail and wholesale sales and personal services showing intermediate effects. Finally, overall employment losses depend on the city's industry mix. In San Francisco, which has relatively little manufacturing employment, it is unlikely that the 1.5% payroll tax has caused more than a 7% overall reduction in employment.

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