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Do States Tax Wireless Services Inefficiently? Evidence on the Price Elasticity of Demand

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DO STATES TAX WIRELESS SERVICES INEFFICIENTLY? EVIDENCE ON THE PRICE ELASTICITY OF DEMAND

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I. INTRODUCTION

The taxation of goods and services by a state is considered efficient when consumer welfare is maximized subject to the condition that the local government raises a specified amount of revenues. According to the general principles of optimal taxation of commodities, an efficient commodity tax induces little change in consumer behavior and does not fall on a good that is relatively important in the budgets of the poor. Both propositions are fairly

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straightforward, but as these goals are often in conflict, optimal taxation involves a trade-off between efficiency and equity.[1]

A tax policy that ignores the principles of optimal taxation can introduce inefficiencies into the market. Because the market is a mechanism for allocating society's scarce resources, a misalignment in production from that which is efficient causes society to misuse its assets. Consequently, a commodity tax that causes consumers to buy substitute products is inefficient.[2] Therefore, the optimal commodity tax is one that consumers cannot easily avoid, a characteristic that leads to the conclusion that the efficiency of a tax increases with the insensitivity of consumer demand to the price of the taxed good.[3] In keeping with the principle that a tax should distort consumer behavior as little as possible, the full array of commodity taxes should reduce the demand for all products proportionally.[4] That is to say, it is essential to consider the effect of a commodity tax on those products that are substitutes for and complements to the taxed good, so as to minimize distortions to consumer purchasing decisions.[5]

States are increasingly relying on the taxation of wireless services

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[1] *See, e.g.*, F.P. Ramsey, *A Contribution to the Theory of Taxation*, 37 ECON. J. 47 (1927) (deriving the optimal tax structure in an economy with many commodities); *see also* N.H. Stern, *Optimal Taxation*, *in* 3 THE NEW PALGRAVE: A DICTIONARY OF ECONOMICS 734, 734 (John Eatwell et al. eds., 1991).

[2] *Cf.* RICHARD A. POSNER, ANTITRUST LAW 12 (2d ed. 2001) (explaining the societal cost of inefficient pricing in the context of monopoly-created market distortion).

[3] *See* Stern, *supra* note 1, at 735.

[4] To be precise, this rule, known as the Ramsey Rule of optimal taxation, states that *compensated* demands should be reduced proportionally as a result of the optimal tax structure. *See* Ramsey, *supra* note 1, at 57–59; Stern, *supra* note 1, at 735. Compensated demands differ from the concept of consumer demand taught in an introductory economics course. The basic demand curve, that of the *ordinary* demand curve, is derived from the economic problem in which a consumer maximizes welfare subject to a budget constraint. *See, e.g.*, ANDREU MAS-COLELL ET AL., MICROECONOMIC THEORY 50–51 (1995). The compensated demand curve graphs a relationship between price and quantity that occurs when a consumer minimizes total expenditures subject to the condition that he achieve a specified level of economic welfare. *See, e.g.*, MAS-COLELL, *supra* at 58–63. This distinction is technical in nature, and it does not affect the interpretation of the Ramsey Rule — that is, an optimal tax structure does not cause large distortions to the consumption of one good while leaving the consumption of another good unchanged.

[5] For example, a tax on peanut butter will lower the consumption of jelly as well as peanut butter because the two products are complements, whereas a tax on orange juice will increase the consumption of apple juice because the two products are substitutes.

as a source of revenue. For example, since 1991, New York has spent some 93% of the revenues from a special wireless tax to fund projects other than the enhanced 911 emergency services for which the tax was created.[6] The average wireless consumer in New York pays a sixteen percent state and local tax on his wireless bill,[7] which is nearly double that of the average business tax in New York.[8] In fact, the average state tax rate on wireless services exceeds the average state tax on general business services by 2.46 percentage points.[9] States have not, however, analyzed consumer demand for wireless services to determine whether it is efficient to tax wireless services with such intensity.

Economic research by Jerry Hausman found that state taxation of wireless services was inefficient. Hausman found that raising an additional dollar of revenue from the taxation of wireless services caused economic welfare to decrease by $0.72 in most states.[10] In states that taxed wireless services most aggressively, Hausman found the efficiency loss from an additional dollar of revenue raised to be $0.93.[11] Because less distortionary forms of taxation exist, Hausman concluded that wireless taxes were too high. His estimates of the efficiency loss from wireless taxes were based on demand estimates from wireless consumption in 1993. Since 1993, the price of wireless service has fallen dramatically. Consequently, the wireless market has attracted more consumers, and the average wireless consumer has begun using more wireless minutes per month. Therefore, consumers are likely to be more sensitive to the price of wireless services than they were in 1993, and that condition should lead to an even greater efficiency loss from the taxation of wireless services than Hausman estimated.

If the own-price elasticity of demand for wireless services has

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[6] *See* Edward Wyatt, *Cellphone Tax Produces Little for Cellphones*, N.Y. TIMES, May 10, 2004, at B1.

[7] Scott Mackey, *The Excessive State and Local Tax Burden on Wireless Telecommunications Service*, at *http://www.kse50.com/pdf/wireless_tax.pdf* (last visited October 20, 2004). *See* Table 6, *infra*. Unless otherwise noted, all tax rates discussed here are 2003 numbers provided in a November 2002 update of the Commission's report by Verizon Wireless.

[8] COMM. ON STATE TAXATION, 50-STATE STUDY AND REPORT ON TELECOMMUNICATIONS TAXATION app. A (2000). According to the study, the average tax on businesses in New York is 8.13 percent.

[9] *Id.*

[10] Jerry Hausman, *Efficiency Effects on the U.S. Economy from Wireless Taxation*, 53 NAT'L TAX J. 733, 739 (2000).

[11] *Id.*

increased over time, then the efficiency loss from the taxation of wireless services may have increased as well. In this paper, we estimate the own-price elasticity of demand for wireless services using an updated survey data set of wireless consumption. Using data on wireless consumption between 1999 and 2001, we find that the own-price elasticity of demand for wireless services is between –1.12 and –1.29. With these elasticity estimates, we find that reducing the taxation of wireless services by one dollar would improve economic welfare by between $1.23 and $1.95. This empirical finding calls into question the wisdom of the high taxes that many states impose on wireless services.

II. THE DEMAND FOR WIRELESS SERVICES

To calculate the efficiency loss from the taxation of wireless services, we must first estimate the own-price elasticity of demand for wireless services. We formulate a standard consumption model, controlling for consumer demographics and allowing for substitution between wireless service and long-distance service via landline telephony. Equation (1) defines consumer *i*'s demand for wireless services:

$$(1)\quad q_{wireless_i} = \alpha_0 + \alpha_1 p_{wireless_i} + \alpha_2 p_{long-distance_i} + \alpha_3 t_i + \sum_{j=4}^{M} \alpha_j X_j + e_i ,$$

where $q_{wireless}$ is the natural logarithm of wireless minutes, $p_{wireless}$ is the natural logarithm of the price per minute of wireless service, and $p_{long-distance}$ is the natural logarithm of the price per minute of wireline long-distance service. We included the variable $p_{long-distance}$ because most wireless service plans in the United States now offer free long-distance when the customer purchases a pre-specified number of monthly minutes. Purchasing such a wireless "bucket" plan reduces the marginal cost to the consumer of placing a long-distance call on her wireless phone to zero, so long as the consumer does not exceed the monthly allotment of minutes. In contrast, the marginal minute of long-distance wireline service incurs additional charges. Therefore, all other things being equal, a wireless customer would prefer to use pre-paid wireless minutes rather than incur additional long-distance charges on a wireline phone. As a result, at the retail level wireless services should serve as a substitute for wireline long-distance service.

Given the empirical specification in equation (1), the coefficient α_1 is the own-price elasticity of demand for wireless services. That is, when the price of wireless services increases by 1 percent, the quantity of wireless minutes consumed will rise by α_1 percent. (There can be a negative value for α_1, of course.) Similarly, α_2 is the cross-price elasticity of demand for wireless services with respect to long-distance wireline telephony. The term $\sum_{j=4}^{M} \alpha_j X_j$ is the summation of a series of demographic variables, as indicated in Table 1, that may affect the consumption of wireless services.

TABLE 1. DEMOGRAPHIC VARIABLES

X_j	**Description**
single	1 if survey respondent is single and has never married, 0 otherwise
married	1 if survey respondent is married, 0 otherwise
white collar	1 if any occupation of head of household is "professional," "proprietor, manager, or official", or "salesperson"; 0 otherwise
income	log of income
age	age of survey respondent
hhsize	number of persons in household, ranging from 1 to 5
teenagers	1 if any household member is age 13–17, 0 otherwise

Finally, the term *e* is a random error term with zero mean and constant variance. Table 2 lists these variables.

TABLE 2. VARIABLES USED IN ECONOMETRIC ANALYSIS

Variable	**Description**
$q_{wireless}$	log of minutes of wireless usage
$p_{wireless}$	log of wireless price per minute
$p_{long\text{-}distance}$	log of long-distance price per minute
t	time trend ($t = 1$ if 1999Q3; $t = 2$ if 1999Q4; $t = 3$ if 2000Q1; . . .)

Regression "instruments" and the regression procedure known as two-stage least-squares are typically used to estimate a demand equation.[12] Instruments are variables that are used to predict an endogenous variable on the right-hand side of the regression equation.[13] In particular, one instrument is a supply equation for wireless services that, along with equation (1), determines the

[12] *See, e.g.*, WILLIAM H. GREENE, ECONOMETRIC ANALYSIS 708–11, 740–41 (3d ed. 1997) (explaining construction of the two-stage least squares estimator and its properties when sample size becomes large); DAMODAR N. GUJARATI, BASIC ECONOMETRICS 686–93 (3d ed. 1995) (describing two-stage least-squares estimation process).

[13] *See, e.g.*, GUJARATI, *supra* note 12, at 687.

equilibrium price and quantity of wireless minutes in the market.[14] If one were to ignore the supply equation, then one would arbitrarily attribute all changes in price and quantity to demand conditions alone.[15] However, a change in production costs causes the supply curve for wireless minutes to shift, which in turn affects the price and quantity of wireless minutes consumed.[16] By first predicting the price of wireless minutes using the supply equation, one can obtain a superior estimate of the demand equation.[17] Table 3 lists the instruments used here to predict the wireless price in the two-stage least squares regression.

TABLE 3. INSTRUMENTAL VARIABLES USED TO PREDICT WIRELESS PRICES IN THE FIRST-STAGE REGRESSION

Variable	**Description**
metropop	percentage of state population living in metropolitan area
popdensity	population density for zip code area (thousand persons per square kilometer)
population	population of survey respondent's state (millions)
Mid Atlantic	1 if Middle Atlantic (NJ, NY, and PA), 0 otherwise
East North Central	1 if East North Central (IL, IN, MI, OH, and WI), 0 otherwise
West North Central	1 if West North Central (IA, KA, MN, MO, NE, ND, and SD), 0 otherwise
South Atlantic	1 if South Atlantic (DE, DC, FL, GA, MD, NC, SC, VA, and WV), 0 otherwise
East South Central	1 if East South Central (AL, KY, MS, and TN), 0 otherwise
West South Central	1 if West South Central (AR, LA, OK, and TX), 0 otherwise
Mountain	1 if Mountain (AZ, CO, ID, MT, NV, NM, UT, and WY), 0 otherwise
Pacific	1 if Pacific (CA, OR, and WA), 0 otherwise

Note: To avoid the singularity problem associated with indicator variables, the New England region, which includes Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont, was excluded from the first-stage regression.

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[14] *See, e.g.*, ROBERT S. PINDYCK & DANIEL L. RUBINFELD, MICROECONOMICS 20 (5th ed. 2001).

[15] *See, e.g.*, GUJARATI, *supra* note 12, at 642–45.

[16] *See, e.g.*, PINDYCK & RUBINFELD, *supra* note 14, at 22–23.

[17] *See, e.g.*, GREENE, *supra* note 12, at 294–95 (giving an example of parameter bias when least-squares is used rather than two-stage least squares to estimate a system of simultaneous equations).

The regression analysis uses the TNS Telecoms survey data set to determine the demand for wireless services.[18] The data set contains survey results from the long-distance and wireless bills from the third quarter of 1999 to the first quarter of 2001. The data set encompasses customers in the forty-eight contiguous states and the District of Columbia. Each data variable listed in Table 2 was extracted from the TNS Telecoms survey database.[19] The variables *metropop, popdensity,* and *population* in Table 3 were collected from the U.S. Census Bureau and matched to the appropriate survey respondent's state of residence.[20]

We applied both least squares and two-staged least squares techniques on a regression sample of 5888 respondents from a survey conducted between the third quarter of 1999 and the first quarter of 2001.[21] Table 4 summarizes the regression data, and Table 5 presents

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[18] TNS TELECOMS, SYNDICATED QUARTERLY TRACKING DATA (2004), *at* http://www.tnstelecoms.com/quarterlytrackingdata.html (last visited Sept. 6, 2004). The specific TNS data we used consisted of the Quarterly Residential Bill Harvesting Data. The TNS data are proprietary. Consequently, one cannot give the data to a third party who might wish to replicate results. However, the data may be readily purchased from TNS Telecoms.

[19] We derived the per-minute price of wireless service by dividing the total wireless bill amount by the total wireless usage minutes. We derived the per-minute price of wireline service by dividing long-distance wireline charges by long-distance wireline minutes. Long-distance wireline charges are the sum of seven components from the customer's long-distance bill: (1) total charges for direct-dialed long-distance calls, (2) long-distance service charges, (3) taxes for long-distance calls, (4) long-distance promotion charges, (5) access fees, (6) FCC Universal Service Fund charges, and (7) minimum usage charges. Charges for international calls were excluded.

[20] POPULATION DEPARTMENT, U.S. CENSUS BUREAU, ANNUAL ESTIMATES OF THE POPULATION FOR THE UNITED STATES AND STATES, AND FOR PUERTO RICO: APRIL 1, 2000 TO JULY 1, 2003 (May 11, 2004) (containing data on U.S. population by state), *available at* http://www.census.gov/popest/states/NST-EST2003-ann-est.html; U.S. CENSUS BUREAU, NUMBER AND PERCENT OF POPULATION IN METROPOLITAN AREAS BY STATE, 2000 (Dec. 7, 2001) (containing data on the percentage of state population residing in a metropolitan area), *available at* http://www.census.gov/population/cen2000/atlas/ma_st.pdf. Data estimates on population density by zip code were downloaded from the Census 2000 CD produced by Geolytics.

[21] The regression sample only includes households with positive wireless and wireline minutes. We examined the data for outliers and excluded 339 observations with either (1) per-minute wireline prices exceeding $2, or (2) per-minute wireless prices exceeding $0.50 and more than 100 wireless minutes. We include observations with wireless prices greater than $0.50 and fewer than 100 minutes because some consumers may subscribe to a wireless service only for emergency purposes. The demand for wireless service is inelastic for these consumers because they pay a price for service but use it little, and thus their per-minute price is very high. Consumers

the least squares and two-stage least squares regression estimates.[22]

TABLE 4. SUMMARY STATISTICS FOR REGRESSION VARIABLES, THIRD QUARTER 1999 TO FIRST QUARTER 2001

Variable	Mean	Standard Deviation	Minimum	Maximum
lines	1.226	0.473	1	3
$p_{wireless}$	-0.165	1.389	-6.531	5.276
popdensity	0.926	1.826	0.0002	37.955
Mid Atlantic	0.119	0.324	0	1
East North. Central	0.152	0.359	0	1
West North. Central	0.090	0.286	0	1
South. Atlantic	0.217	0.413	0	1
East South. Central	0.064	0.245	0	1
West South. Central	0.100	0.301	0	1
Mountain	0.084	0.277	0	1
Pacific	0.159	0.366	0	1
Population	11.625	9.710	0.492	34.600
Metropop	78.773	15.683	26.9	100
$p_{long\text{-}distance}$	-1.893	0.933	-21.934	0.678
Single	0.120	0.325	0	1
Married	0.694	0.461	0	1
White collar	0.431	0.495	0	1
Income	10.772	0.597	8.923	11.513
Age	46.982	12.544	25	65
Household Size	2.635	1.233	1	5
Time trend	4.150	1.939	1	7
Teenagers	0.171	0.377	0	1

paying wireless prices greater than $0.50 and using more than 100 minutes are outliers.

[22] The results from the first-stage regression in the two-stage least squares procedure are as follows (t-statistics are located below the coefficients):

$$p_{wireless_i} = \underset{(0.68)}{0.145} + \underset{(2.02)}{0.0066}\,population_i - \underset{(-0.28)}{0.0005}\,metropop_i - \underset{(-4.22)}{0.044}\,popdensity_i - \underset{(-0.97)}{0.153}\,midatlantic_i - \underset{(-1.01)}{0.157}\,enc_i$$
$$- \underset{(-3.06)}{0.511}\,wnc_i - \underset{(-1.07)}{0.164}\,satlantic_i - \underset{(-0.74)}{0.126}\,esc_i - \underset{(-4.17)}{0.685}\,wsc_i - \underset{(-2.33)}{0.373}\,mountain_i - \underset{(-2.80)}{0.466}\,pacific_i + e_i$$

TABLE 5. DEMAND FOR WIRELESS SERVICES, THIRD QUARTER 1999 TO FIRST QUARTER 2001

	Least Squares		Two-Stage Least Squares	
Variable	**Coefficient**	**t-statistic**	**Coefficient**	**t-statistic**
$p_{wireless}$	-1.1234***	-193.67	-1.2942***	-30.00
$p_{long\text{-}distance}$	0.0220***	2.67	0.0219**	2.49
Single	0.0201	0.67	0.0235	0.73
Married	-0.0216	-0.96	0.0008	0.03
White Collar	0.0349**	2.09	0.0218	1.20
Income	0.0825***	5.62	0.0747***	4.72
Age	-0.0043***	-5.93	0.0009	0.59
Household Size	0.0227***	2.59	0.0052	0.50
Time Trend	0.0212***	5.35	0.0093*	1.79
Teenagers	0.0427*	1.81	0.0159	0.61
Constant	2.7711***	17.90	2.6740***	15.95
R-squared	0.8839		0.8667	
Observations	5,888		5,888	
F (Zero slopes)	4,473.47		719.63	

Note: *** Significant at one percent level. ** Significant at five percent level. * Significant at ten percent level.

The regression estimates in Table 5 have high R-squared values, indicating that the regression specification fits the data well. Additionally, an F-test for the simultaneous significance of all the regression parameters rejects the hypothesis that either the least squares regression or the two-stage least squares regression is insignificant as a whole. The estimate for the own-price elasticity of demand for wireless services is –1.12 according to the least squares regression and –1.29 according to the two-stage least squares procedure. Both of those estimates are statistically significant at the one percent level of confidence.[23]

On the basis of this regression, we find that wireless services compete with wireline long-distance service. The coefficient on $p_{long\text{-}distance}$ indicates that a ten percent increase in the price of wireline long-

[23] A Hausman test for simultaneity rejects the null hypothesis that the error terms in the demand equation are unrelated to the error terms in a supply equation. *See* J.A. Hausman, *Specification Tests in Econometrics*, 46 ECONOMETRICA 1251 (1978). The supply equation was estimated as the regression of wireless minutes on wireless price and the instrumental variables. *See, e.g.*, GUJARATI, *supra* note 12, at 670–71 (illustrating how to perform Hausman test when estimating a demand relationship). Therefore, the least squares regression parameters are likely biased and inconsistent — that is, they do not approach their true values as the regression sample becomes large. Hence, the two-stage least squares parameter estimates more accurately reflect the coefficients from the true demand equation.

distance service will increase the usage of wireless services by 0.2 percent. The coefficient on $p_{long\text{-}distance}$ is the cross-price elasticity of demand for wireless service with respect to wireline long-distance service. The coefficient's positive and statistically significant nature shows wireless service is a consumption substitute for (retail) wireline long-distance service.[24] Wireless carriers, of course, purchase long-distance capacity in bulk and make it available to their subscribers at a lower price — zero. The income elasticity of demand for wireless services is also significant statistically at the one percent level. A ten percent increase in household income increases the usage of wireless minutes by 0.75 percent.

Finally, we find that the usage of wireless minutes increased significantly between the third quarter of 1999 and the first quarter of 2001. We now apply our estimates of the elasticity of the own-price elasticity of demand for wireless service to a basic model of economic efficiency to determine the welfare loss from the incremental taxation of wireless service.

III. Efficiency Loss From the Taxation of Wireless Services

When an *ad valorem* tax — that is, a tax proportional to the purchase price — is levied, producers internalize the tax as an increase in cost. Supply decreases when production cost rises. Consequently, the equilibrium market price of the taxed good increases, and the quantity consumed declines. Because consumption is below what it would be without the tax, economic efficiency is lost. Equation (2) demonstrates the marginal change in economic efficiency from an incremental tax:[25]

$$(2)\quad \frac{\eta\left(1-\frac{m}{p}\right)+\eta\frac{t}{p}+\left(\eta\frac{tm}{p^2}-0.5\eta\frac{t^2}{p^2}\right)\frac{\partial p}{\partial t}}{1-\eta\frac{t}{p}\frac{\partial p}{\partial t}}$$

In Equation (2), m is the marginal cost of the good in question, p is the market price of the good, t is the tax rate, η is the absolute value of the own-price elasticity of demand, and $\frac{\partial p}{\partial t}$ is the change in market

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[24] *See, e.g.*, PINDYCK & RUBINFELD, *supra* note 14, at 33–34 (noting that goods that are substitutes have positive cross-price elasticities).

[25] Hausman, *supra* note 10, at 738.

price that results from a small increase in the tax rate.[26] In our analysis, we assume several different marginal costs for wireless service. We apply the subscriber-weighted tax rates in Table 6 to Equation (2).

TABLE 6. FEDERAL AND STATE WIRELESS TAXES, JANUARY 2003

STATE	FEDERAL & STATE TAX(%)	State Tax (%)	STATE BUSINESS TAX (%)
New York	20.14	16.04	8.13
Illinois	19.71	15.61	8
Nebraska	19.23	15.13	7
Washington	19.22	15.12	9.5
Texas	18.32	14.22	8.25
Rhode Island	18.21	14.11	7
Florida	18.06	13.96	7
California	17.69	13.59	7.85
Tennessee	15.71	11.61	8.25
D.C.	15.28	11.18	5.75
Missouri	15.22	11.12	6.93
Arizona	15.18	11.08	7.85
North Dakota	15.09	10.99	6.25
Utah	14.42	10.32	6.6
Kentucky	14.13	10.03	6
Kansas	13.79	9.69	6.35
Colorado	13.79	9.69	6.7
Oklahoma	13.7	9.6	7.94
Arkansas	13.46	9.36	6.26
Wyoming	13.23	9.13	5
Mississippi	13.21	9.11	7
Indiana	12.36	8.26	6
South Dakota	12.15	8.05	6
Virginia	12.01	7.92	4.5
Georgia	11.91	7.81	7
Minnesota	11.88	7.78	7
North Carolina	11.79	7.69	6.5
New Mexico	11.76	7.66	7.19
Alabama	11.58	7.48	8
Michigan	11.2	7.1	6
Ohio	10.73	6.63	6.63
Maine	10.66	6.56	5
Iowa	10.65	6.56	6

[26] *See id.* at 736–37.

South Carolina	10.62	6.52	5.5
Pennsylvania	10.6	6.5	6.5
Connecticut	10.52	6.42	6
Maryland	10.37	6.27	5
Hawaii	10.24	6.14	4
New Jersey	10.1	6	6
Massachusetts	9.73	5.63	5
Vermont	9.66	5.56	5
Wisconsin	9.65	5.55	5.55
Delaware	9.61	5.52	0
New Hampshire	9.48	5.39	0
Montana	9.11	5.02	0
Louisiana	8.52	4.42	9
Alaska	8.18	4.08	2.5
Oregon	6.42	2.32	0
West Virginia	6.08	1.98	6
Nevada	5.26	1.16	7.13
Idaho	4.27	0.17	7
	Average: 12.43	*Average: 8.33*	*Average: 5.99*

Source: COMM. ON STATE TAXATION, 50-STATE STUDY AND REPORT ON TELECOMMUNICATIONS TAXATION (2000) (data updated in Nov. 2002 by Verizon Wireless). *Note:* Average monthly revenue of $47.37 is used to calculate effective tax rates for flat rate taxes and fees. All rates reflect taxes in effect on January 1, 2003.

Table 6 demonstrates that wireless taxes vary considerably across states. In New York, wireless consumers pay state and federal taxes that amount to over twenty percent of their wireless bills. California also aggressively taxes wireless services, as wireless consumers in California pay total taxes of 17.7 percent. The subscriber-weighted tax in New York and California is 18.5 percent. Idaho, where wireless consumers face taxes of less than five percent, lies at the opposite end of the spectrum. The average wireless tax rate in the United States is 12.4 percent, while the average subscriber-weighted tax rate is 14.3 percent. Table 7 lists calculations of the marginal efficiency losses from an additional dollar of wireless taxes under different marginal costs and elasticities of demand.

TABLE 7. MARGINAL EFFICIENCY LOSS FROM A $1.00 INCREASE IN WIRELESS TAXES

MARGINAL COST		**$0.01**		**$0.02**		**$0.03**	
DEMAND ELASTICITY		**1.123**	**1.294**	**1.123**	**1.294**	**1.123**	**1.294**
TAX RATE	**14.3 %**	1.422	1.688	1.329	1.577	1.235	1.465
	20.1 %	1.620	1.953	1.525	1.839	1.430	1.725
	17.7 %	1.534	1.836	1.439	1.723	1.345	1.610
	18.5 %	1.561	1.873	1.467	1.760	1.372	1.647

At the weighted U.S. average of 14.3 percent, the efficiency loss ranges from $1.24 to $1.69 depending on the marginal cost of providing service and the estimate of the demand elasticity one uses. In New York, where wireless taxes are highest, raising an additional dollar from wireless taxation would result in a welfare loss of between $1.43 and $1.95.

IV. CONCLUSION

The distortionary effects of an *ad valorem* tax on wireless services vary inversely with the own-price elasticity of demand for wireless services. Although the demand for wireless service has become more elastic over the last decade, wireless taxes have increased. Consequently, the efficiency loss from wireless taxation has also risen during that period. In states that tax wireless services most aggressively, the efficiency loss from an additional dollar of tax revenue raised may be as high as two dollars. Therefore, federal, local, and state governments should carefully scrutinize the tax rates they currently impose on wireless consumers, recognizing that the tax policies in place can produce more harm than good.