IS STATE TAXATION OF THE WIRELESS INDUSTRY COUNTERPRODUCTIVE?

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EXECUTIVE SUMMARY

The current system of state taxation of wireless services harms consumers and impedes the growth of the U.S. economy. Most states tax wireless services at higher rates than general business services. At their current levels, state taxes on wireless services cause more economic harm per dollar raised than do other forms of taxation. Furthermore, future decreases in the price of wireless services would cause consumers of wireless services to be increasingly sensitive to the price of wireless telephony, and would further increase the economic damage that state taxes impose on the wireless industry.

In this paper, I assess the economic impact of state taxation of the wireless industry. Empirical evidence demonstrates that the own-price elasticity of wireless services is elastic,

which means that a one-percent increase in the price of wireless services causes a decline in the demand for wireless services that exceeds one percent. I calculate that every dollar reduction in taxes on wireless services would increase economic welfare by between $1.25 and $2.06. When the multiplier effect of such tax reductions on wireless equipment manufacturers is considered, the gain in economic welfare is even greater. By bringing state wireless tax rates down to the prevailing rates for general business taxes, the United States would, in current dollars, increase the nation's gross domestic product (GDP) by between $53.6 billion and $65.6 billion over ten years.

The substantial benefits to consumers and taxpayers that would result from lower state tax rates on wireless services are evidence that current state tax rates on wireless services are inefficient. Although federalism is an important political principle, and states should be allowed to set disparate tax rates, each individual state should seek to maximize consumer welfare when formulating its tax policy. Because the economic fundamentals of the wireless industry have evolved substantially over time, states should reconsider whether their current taxes on wireless services are consistent with their citizen's best interests.

INTRODUCTION

State taxation of the wireless industry is inefficient and impedes growth in the wireless industry. State taxes on existing wireless services[1] are high and thus dampen consumers' subscriptions to, and usage of, those services. In addition, state taxes have reduced and will

1. I use the term "state taxes" to refer to both state and local taxes. Examples of state taxes on wireless services include sales taxes levied on consumers, excise taxes levied on carriers, and service charges such as E-911 and state universal service funds.

continue to reduce the usage of newly deployed wireless services, a result that will harm consumers and impede growth in the wireless industry and in the U.S economy more broadly.

Part I of this report reviews the taxes that states currently impose on the wireless industry and reviews the economic justification for high wireless taxes. State taxation of wireless services is varied and, in many cases, severe. On average, states tax wireless services at 8.6 percent, while the average general business tax is 6.0 percent. New York's tax on wireless services is nearly 10 percentage points higher than its general business tax.

Part II of this paper analyzes the economic benefits from reducing state taxes on wireless services. Using a comprehensive data set of telephone usage between the third quarter of 1999 and the first quarter of 2001, I estimate empirically that the own-price elasticity of wireless services is –1.29. With this elasticity estimate I find that reducing the taxation of wireless services by one dollar would improve economic welfare by between $1.25 and $2.06.

In part III of this paper, I calculate the increase in U.S. GDP that a reduction in wireless taxes would generate. If wireless taxes in states that aggressively tax wireless services were reduced to the general business tax rates in those states, U.S. GDP would increase by between $15 billion and $20 billion over ten years. Additional tax revenues generated from the economic stimulus would offset most of the initial tax cut, leading to a net loss in state and federal tax revenue as low as 20 cents.

I. STATE TAXATION OF THE WIRELESS INDUSTRY

The average state sales tax on wireless services is 2.64 percentage points higher than the average state sales tax on general business services. Despite the states' aggressive taxation of wireless services, the price of wireless services has fallen dramatically in recent years.

Consequently, the usage of wireless services has risen. According to accepted economic analysis, high state taxes on wireless services would be justified if the demand for wireless services were insensitive to changes in the price of those services. However, if the consumption of wireless services is sensitive to price, then state taxation of the wireless industry would harm its growth as well as growth in the U.S. economy.

A. Taxation of Wireless Services

State taxation of wireless services is disparate and in many jurisdictions severe. States tax wireless services at different rates. In addition, the tax burden that consumers of wireless services bear relative to the average consumer varies from state to state. Although wireless services are typically subject to general state taxes on consumers, such as sales taxes, many states also tax wireless services specifically. States can tax wireless services by taxing either wireless service providers, consumers of wireless services, or both. These taxes usually take the form of either an "*ad valorem*" tax, which is proportional to revenue or a "specific" a tax, which imposes a monthly tax that is invariant to the size of a customer's wireless bill.[2] I model all state taxes as *ad valorem* taxes on wireless service producers, whereby the state requires the wireless service providers to send a percentage of their revenues to the state. Such a simplification does not affect the analysis of state taxation because it is not important, from an economic perspective, whether a tax is levied on the consumer or the producer.[3] The statistics in Table 1 show the tax burden that states impose on wireless consumers.

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2. *See, e.g.*, ROBERT S. PINDYCK & DANIEL L. RUBINFELD, MICROECONOMICS 318 (Prentice-Hall 4th ed. 1998). An *ad valorem* tax is levied as a constant fraction of the price of a good. An example of an *ad valorem* tax is a sales tax. The revenue from a sale is taxed at a certain rate, and the size of the tax, in absolute terms, depends on the value of the sale. *See, e.g., id.* An example of a specific tax would be a 20-cent tax on a pack of cigarettes. The tax is specific to the good sold, and does not vary if the producer were to raise or lower the price of a pack of cigarettes. *See, e.g., id.* An example of a specific wireless tax is the wireless 911 tax, which is between 50 cents and $1.00 per month in many states and does not vary with the size of a customer's bill.

3. *See, e.g., id.*

TABLE 1. FEDERAL AND STATE TAXATION OF WIRELESS SERVICES, DECEMBER 2002

State	Federal & State Tax(A) (%)	State Tax (B) (%)	State General Business Tax (C) (%)	State Excess Burden (B)-(C) (%)
Nebraska	19.23	15.13	7.00	8.13
New York	20.14	16.04	8.13	7.91
Illinois	19.71	15.61	8.00	7.61
Rhode Island	18.21	14.11	7.00	7.11
Florida	18.06	13.96	7.00	6.96
Texas	18.32	14.22	8.25	5.97
California	17.69	13.59	7.85	5.74
Washington	19.22	15.12	9.50	5.62
Delaware	9.61	5.52	0.00	5.52
D.C.	15.28	11.18	5.75	5.43
New Hampshire	9.48	5.39	0.00	5.39
Montana	9.11	5.02	0.00	5.02
North Dakota	15.09	10.99	6.25	4.74
Missouri	15.22	11.12	6.93	4.19
Wyoming	13.23	9.13	5.00	4.13
Kentucky	14.13	10.03	6.00	4.03
Utah	14.42	10.32	6.60	3.72
Virginia	12.01	7.92	4.50	3.42
Tennessee	15.71	11.61	8.25	3.36
Kansas	13.79	9.69	6.35	3.34
Arizona	15.18	11.08	7.85	3.23
Arkansas	13.46	9.36	6.26	3.10
Colorado	13.79	9.69	6.70	2.99
Oregon	6.42	2.32	0.00	2.32
Indiana	12.36	8.26	6.00	2.26
Hawaii	10.24	6.14	4.00	2.14
Mississippi	13.21	9.11	7.00	2.11
South Dakota	12.15	8.05	6.00	2.05
Oklahoma	13.70	9.60	7.94	1.66
Alaska	8.18	4.08	2.50	1.58
Maine	10.66	6.56	5.00	1.56
Maryland	10.37	6.27	5.00	1.27
North Carolina	11.79	7.69	6.50	1.19
Michigan	11.20	7.10	6.00	1.10
South Carolina	10.62	6.52	5.50	1.02
Georgia	11.91	7.81	7.00	0.81
Minnesota	11.88	7.78	7.00	0.78
Massachusetts	9.73	5.63	5.00	0.63
Vermont	9.66	5.56	5.00	0.56
Iowa	10.65	6.56	6.00	0.56
New Mexico	11.76	7.66	7.19	0.47
Connecticut	10.52	6.42	6.00	0.42
Wisconsin	9.65	5.55	5.55	0.00
New Jersey	10.10	6.00	6.00	0.00
Ohio	10.73	6.63	6.63	0.00
Pennsylvania	10.60	6.50	6.50	0.00
Alabama	11.58	7.48	8.00	-0.52
West Virginia	6.08	1.98	6.00	-4.02
Louisiana	8.52	4.42	9.00	-4.58
Nevada	5.26	1.16	7.13	-5.97
Idaho	4.27	0.17	7.00	-6.83
	Average: 12.43	*Average: 8.33*	*Average: 5.99*	*Average: 2.34*

Source: COMMITTEE ON STATE TAXATION, 50-STATE STUDY AND REPORT ON TELECOMMUNICATIONS TAXATION (Nov. 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.

The average state tax rate for wireless services at the end of 2002 was 8.6 percent. The median state tax rate on business services in general was 6.0 percent. The difference between the median state tax on wireless services and the median state tax on general business service was therefore 2.6 percentage points. Also, the difference between the state tax on wireless services and the state tax on general business services was 2.3 percentage points at the *median* at the end of 2002.[4] Hence, the representative state taxes wireless services at a rate that is approximately 2 percentage points higher than the rate at which it taxes the general business product or service. Also, only thirty-nine of the fifty states and the District of Columbia tax wireless services at a greater rate than they tax the average business. Finally, populated states with many wireless subscribers tax wireless services more aggressively than states with fewer wireless subscribers. At 17.9 percent, New York has the highest state tax on wireless services. New York boasts over 7.7 million wireless subscribers.[5] Over 15 million persons subscribe to wireless services in California,[6] which taxes wireless services at 13.6 percent. The lowest state tax on wireless services is 0.2 percent in Idaho, a state with 500,000 wireless subscribers.[7] Weighting the state tax on wireless services by the number of subscribers in each state, one finds that the average wireless consumer pays a 14.8 percent tax to the states.

B. Principles and Practice of Efficient Taxation

The economics of efficient taxation can provide insight to whether state taxation of wireless services is optimal. A state tax system is considered efficient economically when

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4. The median, which is the data point at which half of the observations in a distribution lie on either side of that data point, is another measure that economists use to determine where the center of a distribution lies. It is of particular use in small samples where the distribution does not likely fit the bell-curve. *See, e.g.,* RICHARD J. LARSEN & MORRIS L. MARX, AN INTRODUCTION TO MATHEMATICAL STATISTICS AND ITS APPLICATIONS 110-11 (Prentice Hall 2d ed. 1986).

5. CELLULAR TELECOMMUNICATIONS & INTERNET ASSOCIATION, CTIA'S SEMI-ANNUAL SURVEY RESULTS JUNE 1985-JUNE 2002, 2002 [hereinafter CTIA SURVEY].

6. *Id.*

consumer welfare is maximized subject to the condition that the local government raises a certain amount of revenues. According to the general principles of optimal taxation of commodities, an efficient commodity tax will (1) induce little change in consumer behavior and (2) not fall on a good that is relatively important in the budgets of the poor. Both propositions are fairly straightforward, but as these goals are often in conflict, optimal taxation involves a trade-off between efficiency and equity.[8]

The market is a mechanism for efficiently allocating society's scarce resources. A tax on a particular commodity in a competitive market that causes consumers to substitute to other products will be inefficient because the other products to which the consumer switches (because they seem cheaper) actually require more of society's scarce resources to produce.[9] Therefore, an optimal tax will be one that is not easily avoided, which leads to the conclusion that a particular tax's efficiency will be greater the more insensitive is consumer demand to the price of that good.[10] 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[11] for all products

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7. *Id.*

8. *See, e.g.,* Frank P. Ramsey, *A Contribution to the Theory of Taxation*, 37 ECON. J. 47 (1927) (providing the pathbreaking derivation of the optimal tax structure in an economy with many commodities).

9. *Cf.* RICHARD A. POSNER, ANTITRUST LAW 12 (2d ed., University of Chicago Press 2001) (explaining the societal cost of the inefficient pricing of a monopolist).

10. Nicholas Stern, *Optimal Taxation*, in 3 THE NEW PALGRAVE DICTIONARY OF ECONOMICS 735 (John Eatwell, Murray Milgate & Peter Newman, eds., Stockton Press, 1991).

11. To be precise, this rule, know 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 8, at 47-61. Compensated demands differ from the concept of consumer demand that one is taught in an introductory economics course. The basic demand curve, that of the *ordinary* demand curve, is derived from the economic problem where a consumer maximizes welfare subject to a budget constraint. *See, e.g.,* ANDREU MAS-COLELL, MICHAEL D. WHINSTON & JERRY R. GREEN, MICROECONOMIC THEORY 50-51 (Oxford University Press 1st ed. 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., id.* at 58-61. 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.

proportionally.[12] That is to say, it is essential to consider the effect of a commodity tax on those products that are substitutes and complements so as to minimize distortions to consumer purchasing decisions.[13]

The theory of optimal taxation indicates that states should revisit their taxes on wireless service. Jerry Hausman estimated that the own-price elasticity of demand is at least –0.51.[14] Below, I use a more recent dataset to estimate the price sensitivity for wireless services and find that the own-price elasticity of demand for wireless services to be between –1.12 and –1.29. As a result, the economic welfare loss from an additional dollar of revenue raised from the taxation of wireless services is between $1.25 and $2.06. Economic research indicates that other forms of state taxation, such as an income tax, cause a smaller loss in economic welfare. Charles Ballard, John Shoven, and John Whalley find that between 15 cents and 50 cents of marginal efficiency loss occur when an income tax is used to generate an additional dollar of tax revenue.[15] Therefore, states should carefully monitor the taxes they impose on the wireless industry to ensure that their tax policy is efficient.

In the past, where states have inefficiently taxed certain goods and services, the federal government has imposed a limit on the allowable tax rate for those goods and services. For example, the federal government has mandated that state and local taxes on cable television

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12. Stern, *supra* note 10, at 735.

13. 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.

14. Jerry Hausman, *Efficiency Effects on the U.S. Economy from Wireless Taxation*, 53 NAT'L. TAX J. 738 (2000) (using data through 1993 yields an estimate of –0.51, but the estimate is –0.71 after expanding the dataset to include later years).

15. Charles L. Ballard, John B. Shoven & John Whalley, *The Total Welfare Cost of the United States Tax System: A General Equilibrium Approach*, 38 NAT'L TAX J. 125 (1985). *See also* Charles Stuart, *Welfare Costs per Dollar of Additional Tax Revenue in the U.S.*, 74 AM. ECON. REV. 352 (1984) (finding similar results).

services are not to exceed 5 percent,[16] a rate that is lower than the median state tax rate on general business services.[17] The stipulation of this maximum tax rate on cable services is reasonable because the demand for cable services is price-elastic. The FCC estimates this own-price elasticity to be –1.95,[18] indicating that a one percent increase in the price of cable services would cause the consumption of cable services to decrease by 1.95 percent. Because the demand for cable services is price-elastic, the theory of efficient taxation implies that cable should be taxed less aggressively than a good or service whose demand is price-inelastic.[19] Therefore, if states continue to tax the wireless industry in a manner that is inconsistent with sound economic policy, there would be a strong economic case for federal legislation that would limit the states' ability to tax wireless services.

C. The Price and Consumption of Wireless Services

Since 1993, when the wireless industry was effectively deregulated,[20] the price of wireless services has fallen, and the consumption of wireless minutes has risen. Figure 1 displays these trends.

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16. *See* 47 U.S.C. § 542(b).

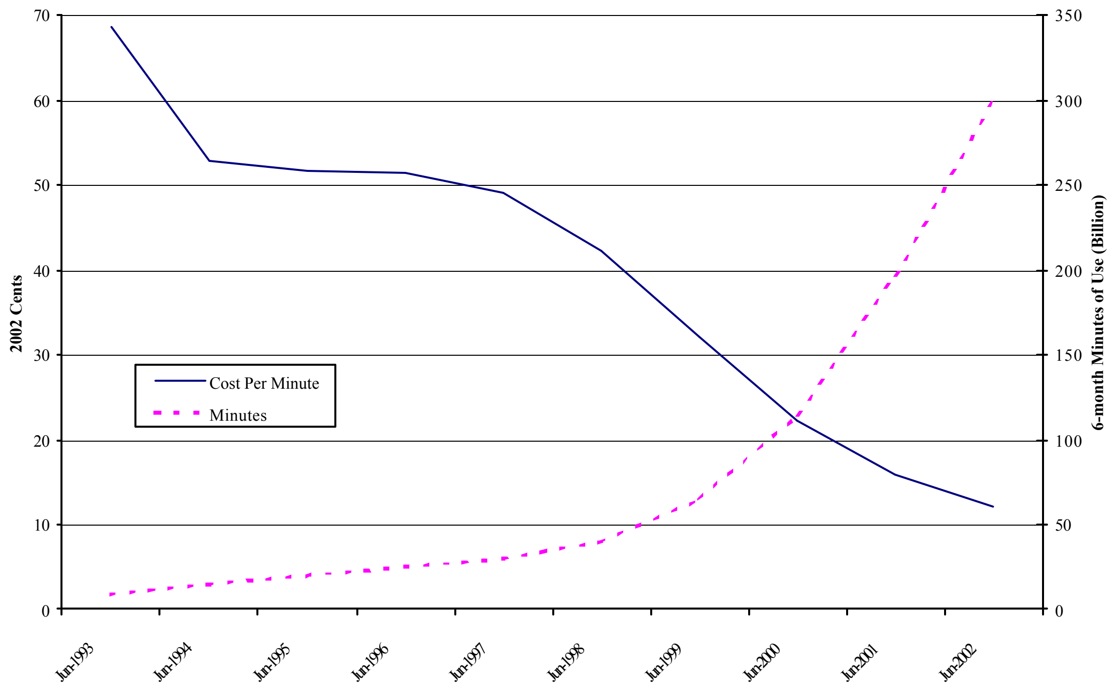
17. *See* Table 1, *infra* page 6.

18. *See* Implementation of Section 3 of the Cable Television Consumer Protection and Competition Act of 1992, Statistical Report on Average Rates for Basic Service, Cable Programming Services, and Equipment, 16 F.C.C.R. 4346 (2001).

19. *See* Stern, *supra* note 10, at 735.

20. State regulation of the pricing of cellular service was preempted through Title VI of the Omnibus Reconciliation Act of 1993, in which Congress stated that "no State or local government shall have any authority to regulate the entry of or the rates charged by any commercial mobile service or any private mobile service" unless a state could demonstrate to the FCC that there was significant market failure in the provision of wireless services within the state. Omnibus Budget and Reconciliation Act, Title VI, § 6002(b), Pub. L. No. 103-66 (1993), amending the Communications Act of 1934 and codified at 47 U.S.C. § 332(c)(3). Also through Title VI, Congress instructed the FCC to amend the process it used to allocate spectrum for commercial use. *See* id., codified at 47 U.S.C. § 332(a). The FCC began implementing this legislation by letting spectrum at competitive auction. *See* Implementation of Title VI of the Omnibus Budget Reconciliation Act of 1993, Regulatory Treatment of Mobile Services, 8 F.C.C.R. 7988 (1993). The FCC's spectrum auctions began in 1995. *See* Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993, Annual Report and Analysis of Competitive Market Conditions with Respect to Commercial Mobile Services, First Report, 10 F.C.C.R. 8844, 8845 (1995). With multiple private sector firms bidding at auction for the spectrum necessary to provide wireless services, the wireless industry was effectively deregulated as a result of the 1993 Act.

FIGURE 1. PRICE PER MINUTE AND MINUTES OF USE OF WIRELESS VOICE SERVICE, JUNE 1993–JUNE 2002



Source: CELLULAR TELECOMMUNICATIONS & INTERNET ASSOCIATION, CTIA'S SEMI-ANNUAL SURVEY RESULTS: JUNE 1985-JUNE 2002, 2002; BUREAU OF LABOR STATISTICS, MONTHLY CONSUMER PRICE INDEX, *available at:* http://www.bls.gov/data/home.htm.

Figure 1 indicates that in June 1993, the average cost per minute for wireless voice service, expressed in 2002 currency, was 69 cents. By June 2002, the cost of wireless services had fallen to 12 cents per minute of use—an 82 percent decrease in price. Consumption of wireless services increased over 3,000 percent between 1993 and 2002. In particular, consumption of wireless minutes increased from 8.75 billion minutes per six-month period in June 1993 to approximately 300 billion minutes per six-month period in June 2002. These trends have prevailed despite high state taxes for wireless services, a trend that would indicate, on the surface, that the demand for wireless services is insensitive to the price. However, as the usage of wireless services expands, each successive consumer who begins to use wireless services is increasingly sensitive to price.

For example, a consumer who has waited for the price of wireless services to decline 82 percent before consuming those services is more sensitive to price than a consumer who began using those services when prices were high. Therefore, to estimate the impact of state taxation on the wireless industry, one must first empirically measure consumers' current demand sensitivity to the price of wireless services.

II. THE EFFICIENCY GAINS FROM REDUCING THE AVERAGE STATE TAX ON WIRELESS SERVICES

When a state taxes the consumption of wireless services, it may do so by either levying taxes on producers, or on consumers. Regardless of who pays the tax in the technical sense, the economic burden of a tax on wireless services will be shared between consumers and wireless carriers.[21] Consequently, the price of wireless services will increase, and the consumption of wireless services will decrease.[22] If consumers are insensitive to changes in price then the economic harm from the tax (known as "deadweight loss") is small.[23] Specifically, if the demand for wireless services is price inelastic, the government could turn consumer welfare into tax revenue without distorting the consumption of wireless services.[24] Therefore, the high tax rates on wireless services might be justified if wireless consumers were insensitive to changes in the price of wireless services. But that is not the case.

Rigorous empirical research indicates that the taxation of wireless services is excessive. Jerry Hausman estimated that the own-price elasticity of demand for wireless services is between

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21. *See, e.g.,* PINDYCK & RUBINFELD, *supra* note 2, at 318. For simplicity, I thus model all such taxes as state-specific *ad valorem* taxes on wireless service providers.

22. *See, e.g., id.*

23. *See, e.g., id.*

24. *See, e.g.,* MICHAEL L. KATZ & HARVEY S. ROSEN, MICROECONOMICS 366-67 (McGraw-Hill 3rd ed. 1998).

–0.51 and –0.71.[25] An additional dollar of revenue raised through the taxation of wireless services causes an average efficiency loss of $0.72.[26] For states that tax wireless services the most, raising an additional dollar of revenue through the taxation of wireless services causes $0.93 of harm to the economy.[27] Given that other forms of taxation cause less economic harm, Hausman concluded that higher taxes on wireless services were not justified.[28] Hausman noted that the efficiency loss from the taxation of wireless services could exceed his estimates, which relied partially on wireless prices and wireless usage data from 1993, because wireless usage increased dramatically after 1993.[29] Applying Hausman's methodology to a more recent dataset would allow one to understand more fully how the incremental taxation of wireless services today would decrease economic efficiency and thus harm consumers.[30]

The taxation of wireless services causes economic harm.[31] A tax on wireless services increases the price of wireless services by increasing the carriers' marginal costs.[32] Consumers will purchase fewer minutes of wireless services when the price of those services rises. Therefore, the welfare-maximizing decision that a consumer would make without the tax is distorted, and the consumer is worse off.[33] The extent to which consumers are harmed depends on the own-price elasticity of demand for wireless services.[34] In particular, if a small percentage increase in the price of wireless services would induce a large decrease in the consumption of

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25. Hausman, *supra* note 14, at 738 (using data through 1993 yields an estimate of –0.51, but the estimate is –0.71 after expanding the dataset to include later years).

26. *Id.* at 733, 739.

27. *Id.*

28. *Id.* at 739-40.

29. Using a dataset with observations from years after 1993, Hausman found the own-price elasticity of demand for wireless services to be –0.71. However, this number was not statistically different from –0.51. Hausman therefore concluded that a better understanding of the demand for wireless services would require the collection of additional data. *See Id.*

30. *Id.*

31. *See, e.g.,* PINDYCK & RUBINFELD, *supra* note 2, at 318-21.

32. *Id.* at 319.

wireless services, then the economic harm from a tax would be substantial.[35] Alternatively, if consumers are insensitive to changes in the price of wireless services, then the economic harm from the tax would be small.[36]

A. Econometric Model and Data

With additional data on wireless prices and usage, it is possible to produce a current estimate of the own-price elasticity of demand for wireless services. The following equation defines consumer *i*'s demand for wireless services:

$$(1) \qquad q_{wireless_i} = a_0 + a_1 p_{wireless_i} + a_2 p_{long-distance_i} + a_3 t_i + \sum_{j=4}^{M} a_j X_j + e_i ,$$

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 $p_{long\text{-}distance}$ is the natural logarithm of the price per minute of wireline long-distance service. I included the variable $p_{long\text{-}distance}$ because most wireless service plans now offer free long-distance when the customer purchases a pre-specified number of monthly minutes. Once a customer has purchased such a wireless plan, the marginal cost placing a long-distance call on her wireless phone is zero, so long as she does not exceed her monthly allotment of minutes. Because the marginal minute of long-distance wireline service incurs additional charges, a wireless customer would likely prefer to use her pre-paid wireless minutes rather than incur additional long-distance charges on her wireline phone. Therefore, wireless services should service as a substitute for wireline long-distance service.

Given empirical specification in equation (1), the coefficient a_1 is the own-price elasticity of demand for wireless services. That is, when the price of wireless services increases

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33. *Id.* at 320-21.
34. *Id.* at 321.
35. *Id*.

by 1 percent, the quantity of wireless minutes consumed will rise by a_1 percent. (There can be a negative value for a_1, of course.) Similarly, a_2 is the cross-price elasticity of demand between wireless services and long-distance wireline telephony. The term $\sum_{j=4}^{M} a_j X_j$ is the summation of a series of demographic variables, such as income and age, that affect the consumption of wireless services. 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; …)
X_j	**demographic variables, as listed below:**
single	1 if survey respondent is single and has never married, 0 otherwise
married	1 if survey respondent is single and has never 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 members is age 13-17, 0 otherwise

Regression "instruments" and a regression procedure called two-stage least-squares are typically used to estimate a demand equation.[37] Instruments are variables that are used to predict an endogenous variable on the right-hand side of the regression equation.[38] In particular, one instrument is a supply equation for wireless services that, along with equation (1), determines the

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36. *Id.*
37. *See, e.g.,* DAMODAR N. GUJARATI, BASIC ECONOMETRICS 686-93 (McGraw-Hill 3rd ed. 1995) (providing an elementary description of the two-stage least-squares estimation process); WILLIAM H. GREENE, ECONOMETRIC ANALYSIS 708-11, 740-41 (Prentice Hall 3rd ed. 1997) (explaining the construction of the two-stage least squares estimator and its properties when the sample size becomes large).
38. *See, e.g.,* GUJARATI, *supra* note 37, at 687.

equilibrium price and quantity of wireless minutes in the market.[39] If one were to ignore the supply equation, then one would arbitrarily attribute all changes in price and quantity to demand conditions alone.[40] 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.[41] By first predicting the price of wireless minutes using the supply equation, one can obtain a superior estimate of the demand equation.[42] Table 3 lists the instruments used here to predict 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 survey respondent's state population living in metropolitan areas (x100)
popdens	population density of survey respondent's zip code (thousand persons per square kilometer)
statepop	population of survey respondent's state (millions)
Mid Atlantic	1 if Middle Atlantic (New Jersey, New York, and Pennsylvania), 0 otherwise
East North Central	1 if East North Central (Illinois, Indiana, Michigan, Ohio, and Wisconsin), 0 otherwise
West North Central	1 if West North Central (Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota), 0 otherwise
South Atlantic	1 if South Atlantic (Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, and West Virginia), 0 otherwise
East South Central	1 if East South Central (Alabama, Kentucky, Mississippi, and Tennessee), 0 otherwise
West South Central	1 if West South Central (Arkansas, Louisiana, Oklahoma, and Texas), 0 otherwise
Mountain	1 if Mountain (Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming), 0 otherwise
Pacific	1 if Pacific (Alaska, California, Hawaii, Oregon, and Washington), 0 otherwise

The regression analysis uses the TNS Telecoms survey dataset to determine the demand for wireless services.[43] The dataset contains survey results from the long-distance and wireless

39. *See, e.g.,* PINDYCK & RUBINFELD, *supra* note 2, at 20.
40. *See, e.g.,* GUJARATI, *supra* note 37, at 642-45.
41. *See, e.g.,* PINDYCK & RUBINFELD, *supra* note 2, at 23.
42. *See, e.g.,* GREENE, *supra* note 37, 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).
43. 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. *See* http://www.tnstelecoms.com/quarterlytrackingdata.html.

bills from the third quarter of 1999 to the first quarter of 2001. The dataset encompasses customers in the 48 contiguous states and the District of Columbia. Each data variable listed in Table 2 was extracted from the TNS Telecoms survey database.[44] The variables *metropop, popdens,* and *statepop* in Table 3 were collected from the U.S. Census Bureau and matched to the appropriate survey respondent's state of residence.[45]

B. Regression Results

I applied both least-squares and two-staged least-squares techniques on a regression sample of 5,888 respondents from a survey conducted between the third quarter of 1999 and the first quarter of 2001.[46] Table 4 summarizes the regression data, and Table 5 presents the least-squares and two-stage least-squares regression estimates.[47]

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44. I derived the per-minute price of wireless service by dividing the total wireless bill amount by the total wireless usage minutes. I 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.

45. *See* U.S. CENSUS BUREAU, ANNUAL POPULATION ESTIMATES BY STATE AND INTERCENSAL ESTIMATES, *available at* http://eire.census.gov/popest/data/states.php (containing data on U.S. population by state); U.S. CENSUS BUREAU, 2001 STATISTICAL ABSTRACT OF THE UNITED STATES, *available at* http://eire.census.gov/popest/archives/1990.php#metro (containing data the percentage of state population residing in a metropolitan area). Data estimates on population density by zip code were downloaded from the Census 2000 CD produced by Geolytics.

46. The regression sample only includes households with positive wireless and wireline minutes. I 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. I 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 paying wireless prices greater than $0.50 and using more than 100 minutes are outliers.

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

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

TABLE 4. SUMMARY STATISTICS FOR PER-MINUTE WIRELESS PRICE REGRESSION VARIABLES, THIRD QUARTER 1999-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 N. Central	0.152	0.359	0	1
West N. Central	0.090	0.286	0	1
S. Atlantic	0.217	0.413	0	1
East S. Central	0.064	0.245	0	1
West S. 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

TABLE 5. DEMAND FOR WIRELESS SERVICES, THIRD QUARTER 1999–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^2	0.8839		0.8667	
Observations	5,888		5,888	
F (Zero slopes)	4,473.47		719.63	

Note: *** Significant at 1 percent level. ** Significant at 5 percent level. * Significant at 10 percent level.

The regression estimates in Table 5 are accurate and meaningful. The regressions have high R^2 values, indicating that the regression specification fits the data well. Also, an F-test for the simultaneous significance of all the regression parameters rejects the hypothesis that either the least-squares or the two-stage least-squares regressions are 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 significant statistically at the 1 percent level of confidence.[48]

On the basis of this regression, I find that wireless services compete with wireline long-distance service. The coefficient on $p_{long\text{-}distance}$ indicates that a 10 percent increase in the price of

48. 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. The supply equation was estimated as the regression of wireless minutes on wireless price and the instrumental variables. *See, e.g.,* GUJARATI, *supra* note 37, at 670-71 (giving an elementary illustration of how to perform the 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

wireline long-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 substitution between wireless and wireline long-distance services. Because that coefficient is positive and significant statistically, wireless services and wireline long-distance service are substitutes of consumption.[49] The income elasticity of demand for wireless services is also significant statistically at the 1 percent level. A 10 percent increase in household income increases the usage of wireless minutes by 0.75 percent.

Finally, I find that the usage of wireless minutes increased significantly between the third quarter of 1999 and the first quarter of 2001.

C. Efficiency Gains

Figure 3 illustrates the economic benefits that would occur if the states were to reduce their taxation of wireless services. Consistent with a model in which state taxes on wireless services are levied on wireless service providers, these taxes become a component of wireless service providers' production costs.

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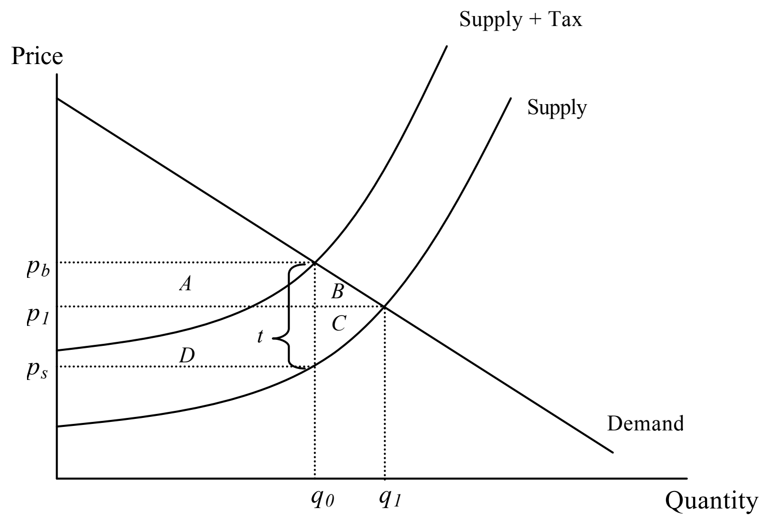
as the regression sample becomes large. Hence, the two-stage least-squares parameter estimates more accurately reflect the coefficients from the true demand equation.

49. *See e.g.,* PINDYCK & RUBINFELD, *supra* note 2, at 34.

FIGURE 3. THE WELFARE GAIN FROM REDUCING STATE TAXATION OF WIRELESS SERVICES



In Figure 3, p_b is the market price that buyers pay for wireless services. Sellers collect that revenue, but then must pay a tax, *t,* to state and federal governments. Therefore, sellers collect p_s net of the tax.

If the tax is eliminated, then the supply curve would shift down by the amount of the tax. The quantity of wireless services consumed would then increase to q_1, because the market price of wireless services would decrease to p_1. All wireless minutes consumed between quantities q_0 and q_1 would be purchased at a market price of p_1. However, the demand for wireless services between the quantities q_0 and q_1 exceeds the value p_1. These wireless minutes would be consumed at a price less than the maximum that consumers would have willingly paid for them. Consequently, wireless consumers' economic welfare would rise by *B*.

Similarly, wireless providers' welfare would increase by *C*. In particular, the supply of wireless services is less than p_1 between the quantities q_0 and q_1. Therefore, absent a tax, wireless service providers would be able to sell those minutes at a price above their marginal costs, which are given by the market supply curve. The wireless service providers would therefore gain the area *C* if wireless taxes were eliminated.[50]

Finally, because consumers would gain *B* and producers would gain *C* from the elimination of the tax, the total economic benefit from this policy measure is *B* + *C*.

Using Hausman's approximation for the marginal efficiency loss from wireless taxation,[51] I calculate the marginal benefits from a reduction in the tax rate on wireless services. The current price of wireless service is $0.12.[52] From Table 5, the elasticity of demand for wireless services is –1.123 or –1.294. In addition, I provide results under different assumptions of tax rates[53] and marginal costs.[54] I assume, as did Hausman, that the market price of wireless

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50. I am not advocating the elimination of wireless taxes. In this example, the elimination of the tax, *t*, is used for simplicity. The results apply equally well to a reduction in the tax.

51. *See* Hausman, *supra* note 14, at 738. The marginal change in economic efficiency from an incremental tax is written as $\frac{h\left(1-\frac{m}{p}\right)+h\frac{t}{p}+\left(h\frac{tm}{p^2}-0.5h\frac{t^2}{p^2}\right)\frac{\partial p}{\partial t}}{1-h\frac{t}{p}\frac{\partial p}{\partial t}}$, where *m* is the incremental cost of wireless service, *p* is the market price of wireless service, *t* is the tax rate on wireless service, h is the absolute value of the own-price elasticity of demand for wireless service, and $\frac{\partial p}{\partial t}$ is the change in market price that results from a small increase in the tax rate. *Id.*

52. CTIA SURVEY, *supra* note 5.

53. The subscriber weighted-average tax rate in the United States is 14.8 percent. I also apply the results that use tax rates from New York and California. *See* FCC, LOCAL TELEPHONE COMPETITION: STATUS AS OF JUNE 30, 2002, Table 11.

54. Hausman estimates marginal costs of 5 cents per minute for wireless service. *See* Hausman, *supra* note 14, at 737. However, marginal costs have likely fallen since Hausman's results were published. Wireless service providers now have *revenues* that can average as little as 4 cents per minute of usage. Also, wireless service providers' revenues have fallen substantially. Although profit margins have fallen considerably, they have not declined as rapidly as wireless revenues. Therefore, marginal costs must be in decline. *See* Implementation of Section 6002(b) of the Omnibus Reconciliation Act of 1993, Annual Report and Analysis of Competitive Market Conditions with Respect to Commercial Mobile Services, Seventh Report, 17 F.C.C.R. 12,985, 13,023 (2002) (describing First Cellular's most popular average rate plan as 4 cents per minute, and a decline in revenues of 70 percent, coupled with an 8 percent drop in profit margins); DEUTSCHE BANK SECURITIES INC., U.S. WIRELESS SECTOR 6 (Feb. 2003) (stating the low margins of U.S. wireless firms are indicative of the competitive nature of the industry). If revenues average 4 cents per minute, then marginal costs are certainly below five cents per minute for the carrier to remain in business.

services changes by the amount of the tax.[55] Table 6 displays the increase in economic welfare that occurs for every dollar decrease in revenue that is collected through the taxation of wireless services.

TABLE 6. CHANGE IN MARGINAL EFFICIENCY RESULTING FROM A CHANGE IN TAXATION

Marginal Cost:	$0.01		$0.02		$0.03	
Demand Elasticity:	-1.123	-1.294	-1.123	-1.294	-1.123	-1.294
Tax Rate:						
Weighted-Average U.S. (14.8%)	1.439	1.710	1.345	1.598	1.251	1.487
New York (22.2%)	1.697	2.059	1.602	1.943	1.507	1.828
California (17.9%)	1.541	1.845	1.446	1.732	1.352	1.619
Weighted-Average NY & CA (19.3%)	1.590	1.912	1.495	1.798	1.401	1.685

Every dollar reduction in the taxation of wireless services increases economic welfare by between $1.25 and $2.06. If the marginal cost of providing wireless service is $0.03 per minute and the own-price elasticity of demand for wireless services is –1.29, then the U.S. economy would experience an efficiency gain of $1.49 by lowering the revenue raised from the taxation of wireless services by $1.00. If the marginal cost of providing a minute of wireless service in New York is $0.02, then lowering the taxation of wireless services by $1.00 would improve economic welfare in New York by between $1.60 and $1.94. Put simply, the gains in economic efficiency from reducing the taxation of wireless services would be substantial and would outweigh the forgone tax revenue.

III. THE EFFECT ON THE NATIONAL ECONOMY OF LOWERING STATE TAXES ON WIRELESS SERVICES

In addition to improving economic efficiency, lowering the average state tax on wireless services would increase U.S. GDP and raise secondary tax revenues. If states were to reduce

55. *See* Hausman, *supra* note 14, at 739. The assumption that the market price of wireless service changes by the amount of the tax is made for computational reasons. If anything, the assumption leads to a conservative estimate because the efficiency loss would be higher if prices declined by less than $1 for each $1 decrease in taxes.

their taxation of the wireless industry, consumers would use wireless services with greater intensity. Wireless revenues would then increase, causing U.S. GDP to rise. The additional income in the U.S. economy would be subject to taxation by the U.S. Treasury and the states. Tax revenues would increase at both the federal and state levels, which would offset a portion of the revenue that states would loose by decreasing their taxes on the wireless industry.[56]

A. The Effect on Gross Domestic Product of Lowering States Taxes on the Wireless Industry

Increased wireless usage will stimulate the U.S. economy by increasing the revenues of wireless service providers. Because the wireless industry is still expanding, wireless service providers will use a portion of their additional revenues to expand and improve their networks. Consequently, the wireless equipment manufacturers' revenues will increase, which will allow them to hire new employees. Therefore, a decrease in the taxation of wireless services will stimulate U.S. GDP, primarily within the wireless industry.

An initial increase in the revenues of the wireless service providers will have a multiplicative effect on the economy.[57] The multiplier specific to the wireless service providers determines to what extent a reduction in wireless taxes will increase U.S. GDP. The Bureau of Economic Analysis (BEA) in the U.S. Department of Commerce estimates that the multiplier effect for telecommunications services is 2.51.[58] Therefore, a one-dollar increase in the output of wireless service providers would increase U.S. GDP by $2.51. The timeframe over which GDP

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56. It is a standard principle of economics that an increase in GDP represents an equivalent increase in income. *See, e.g.*, Robert J. Gordon, Macroeconomics 33 (6th ed., Harper Collins, 1993).

57. The multiplier is a standard principle in the macroeconomics literature. *See, e.g.,* RUDIGER DORNBUSCH & STANLEY FISCHER, MACROECONOMICS 66 (McGraw Hill 6th ed. 1994). Richard Kahn first introduced the multiplier concept as an "employment multiplier." *See* Richard F. Kahn, *The Relation of Home Investment To Employment,* 41 ECON. J. 173, 173-98 (1931). John Maynard Keynes expanded upon this concept by introducing the "investment multiplier," which is the multiplier used in my analysis. *See* JOHN MAYNARD KEYNES, A GENERAL THEORY OF EMPLOYMENT, INTEREST, AND MONEY 115 (Harcourt Brace & Co. 1964) (1936).

would increase is debatable. The BEA considers one year to be the appropriate time horizon for its multipliers to have achieved full effect.[59] Other economists have estimated that two years may be required for incremental investment to achieve its full impact on the macroeconomy.[60]

A 1 percent decrease in the tax on wireless services would stimulate the demand for wireless services by between 1.12 and 1.29 percent. If states that tax wireless services more aggressively than general business services were to equate their wireless taxes with their respective taxes on general business services, wireless usage would increase by between 3.7 percent and 4.25 percent.[61] If prices were to fall by the amount of the tax relief, then revenues would increase by between 3.7 percent and 4.25 percent as well. Therefore, wireless service providers' revenues would increase by between $2.7 billion and $3.1 billion in the first year that taxes were reduced.[62] Based on a multiplier of 2.51, this additional wireless revenue would increase U.S. GDP by between $6.8 billion and $7.8 billion within two years of the tax reduction.

A reduction in the taxation of wireless services would, over time, increase U.S. GDP considerably. Between June 2000 and June 2002 the revenues of wireless carriers increased by $12.1 billion per year.[63] If wireless taxes are reduced by 1 percent and U.S. wireless revenues continue to expand by $12.1 billion annually for ten years, the net present value (NPV) of the economic stimulus from states' equating wireless taxes with their respective taxes on general

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58. BUREAU OF ECONOMIC ANALYSIS, U.S. DEPARTMENT OF COMMERCE, Regional Input-Output Modeling System (RIMS II), Table 1.4, June 2002.

59. *Id.* at 8.

60. *See, e.g.,* ROBERT J. GORDON, MACROECONOMICS 483-84 (Harper Collins 6th ed. 1993).

61. The price of wireless service would fall, on average, by approximately 3.3 percent as a result of the tax decrease. Multiplying 3.3 percent by 1.12 yields 3.7 percent, and multiplying 3.3 percent by 1.29 yields 4.25 percent.

62. Between June 2001 and June 2002 the wireless industry produced $71.1 billion in revenue. *See* CTIA SURVEY, *supra* note 5. Increasing $71.1 billion by between 3.7 percent and 4.25 percent would cause revenues to increase by between $6.8 billion and $7.8 billion.

business services would exceed $50 billion. Table 7 shows how this economic stimulus is calculated when the own-price elasticity of demand is –1.29 and the multiplier effect occurs within one year. Table 8 shows the increases in GDP that would occur if the own-price elasticities of demand for wireless services was –1.12 or –1.29 and the multiplier effect was spread over one or two years.

TABLE 7. ECONOMIC STIMULUS BETWEEN 2003 AND 2012
FROM REDUCING STATE TAXES ON WIRELESS SERVICES

Year	Time period (t)	Wireless Revenues Under Current Tax Regime ($B) (A)	Wireless Revenues Under Tax Rate Adjustment ($B) (B)	NPV Economic Stimulus ($B) $2.51x(B-A)/(1+0.042)^t$
2003	0	85.5	88.6	7.8
2004	1	97.5	100.7	7.5
2005	2	109.6	112.7	7.2
2006	3	121.7	124.8	6.9
2007	4	133.7	136.8	6.7
2008	5	145.8	148.9	6.4
2009	6	157.8	161.0	6.1
2010	7	169.9	173.0	5.9
2011	8	182.0	185.1	5.6
2012	9	194.0	197.2	5.4
			Total Stimulus:	65.6

TABLE 8. THE ECONOMIC STIMULUS FROM EQUATING STATE WIRELESS TAX RATES WITH THE STATE GENERAL BUSINESS TAX RATES: 2003-2012

Multiplier effect spread over 1 year	**NPV $Billion**
Economic stimulus from tax relief if taxes are reduced by 3.4 percent and *h* = -1.123	57.0
Economic stimulus from tax relief if taxes are reduced by 3.4 percent and *h* = -1.294	65.6
Multiplier effect spread over 2 years	
Economic stimulus from tax relief if taxes are reduced by 3.4 percent and *h* = -1.123	53.6
Economic stimulus from tax relief if taxes are reduced by 3.4 percent and *h* = -1.294	61.7

63. *Id*.

If state taxes on wireless services are not reduced, the wireless industry's annual revenues will increase from $85.5 billion in 2003 to $194.0 in 2012. However, setting the states' wireless taxes equal to their general business taxes would cause revenues in the wireless industry to increase to $197.2 billion by 2012. The increased revenue would permeate through the economy and cause U.S. GDP to increase by up to $65.6 billion. Depending on the elasticity of demand for wireless services and the time necessary for the wireless service providers' annual revenue increase to have its full impact on the economy, U.S. GDP would increase by between $53.6 billion and $65.6 billion by 2012 over ten years.

B. The Effect of Tax Relief on State Revenues, the U.S. Treasury, and Consumers

A one-dollar decrease in the taxation of wireless services by the state governments would have several effects on the U.S. economy. First, economic efficiency would improve by between $1.25 and $2.06, as described above. Consumers of wireless services and wireless service providers would experience this welfare gain. Second, revenues to the wireless industry would increase by between $1.02 and $1.19, which would in turn increase U.S. GDP by between $2.57 and $2.99 via the multiplier effect.

However, the stimulus to U.S. GDP would result from a reduction in the taxation of wireless services by the states. Therefore, state tax revenues would initially decline by $1. The reduction in state tax revenues would be muted by additional tax revenue that would be collected once U.S. GDP increased.[64] At the median general business tax rate of 6.35 percent, state tax revenues would rise by between $0.16 and $0.19. Therefore, the net effect to state budgets would

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64. Economists still debate the full impact that a tax cut would have on tax revenue. Supply-side theory states that economic growth comes from a tax reduction. If economic growth is strong then tax revenues will rise considerably and offset the initial loss in tax revenue. *See, e.g.,* ROBERT J. GORDON, MACROECONOMICS 396-99 (HarperCollins 6th ed. 1993). In this analysis, my model does not contain any supply-side growth effects that would

be a $0.81 to $0.84 loss in revenue. Also, revenues collected by the U.S. Treasury would increase depending on the tax rates imposed on the recipients of the GDP increase.[65] At an average tax rate of 10 percent, federal tax revenues would rise by between $0.26 and $0.30 if the states were to decrease taxes on wireless services by $1.00. If the average recipient of the stimulus to U.S. GDP were taxed at 20 percent, then federal tax revenues would rise by between $0.52 percent and $0.60. Consequently, the gain in tax revenues to the federal government would largely offset the tax revenues that the states would loose from a $1.00 reduction in the taxation of wireless services.

CONCLUSION

The aggressive state taxation of wireless services impedes growth in the wireless industry. Most states tax wireless services at a higher rate than the general business tax, resulting in economic harm to consumers of wireless services. A dollar reduction in the taxation of wireless services would stimulate the consumption of wireless services and increase economic efficiency by between $1.25 and $2.06. Decreasing the taxation of wireless services would also increase U.S. GDP. A one-dollar decrease in wireless taxes would stimulate U.S. GDP by between $2.57 and $2.99. The increase in both state and federal tax revenues from the stimulus to U.S. GDP would offset a portion of the initial loss in state tax. If the average recipient of the economic stimulus were taxed at 20 percent, then between $0.68 and $0.79 of tax revenue would be recovered by either the states or the U.S. Treasury.

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result from a reduction in the taxation of wireless services. Therefore, the net-benefits from the reduction in the taxation of wireless services that I calculate are conservative.

65. If businesses were to gain the entire stimulus to U.S. GDP then it would be appropriate to multiply the stimulus by the corporate tax rate to determine the additional federal tax revenue from the stimulus. However, employees of firms would certainly receive a portion of the stimulus. Therefore, the U.S. treasury would collect less than 35 percent—that is, the current corporate tax rate—of the stimulus.

Relieving the wireless industry of aggressive state taxes would improve economic efficiency and increase U.S. GDP. If the evolution of the wireless industry continues as consumers and regulators hope, the price of wireless services will decrease further. Consequently, the current state taxation of wireless services will cause even greater economic harm in the future. State governments should therefore consider the impact of the increased usage of wireless services on consumers' sensitivity to the price of wireless services. States should revisit their taxation of the wireless industry and levy taxes that are efficient in an economic sense.

APPENDIX: STATE AND LOCAL TAXES ON WIRELESS

State	Type of Tax	Rate (%)
Alabama	AL Cell Service Tax	6.00
	E911	1.48
	Total Transaction Tax	**7.48**
Alaska	Local Sales Tax	2.50
	E911	1.58
	Total Transaction Tax	**4.08**
Arizona	State sales (transaction priv.)	5.60
	local sales (transaction priv.)	4.70
	911	0.78
	Total Transaction Tax	**11.08**
Arkansas	State sales tax	5.13
	Local sales taxes	2.38
	State USF	0.80
	Wireless 911	1.06
	Total Transaction Tax	**9.36**
California	Local Utility User Tax	8.75
	911	0.72
	PUC fee	0.11
	ULTS	1.45
	Deaf/CRS	0.48
	CHCF - A & B	1.78
	CTF	0.30
	Total Transaction Tax	**13.59**
Colorado	State Sales Tax	2.90
	Local Sales Taxes	2.65
	Local sales -- RTD, CD, BS	0.80
	911	1.04
	USF	2.30
	Total Transaction Tax	**9.69**
Connecticut	State sales tax	6.00
	911	0.42
	Total Transaction Tax	**6.42**
Delaware	Public Utility Gross Receipts Tax	4.25
	Local 911 tax	1.27
	Total Transaction Tax	**5.52**
D.C.	Telecommunication Privilege Tax	10.00
	911	1.18
	Total Transaction Tax	**11.18**
Florida	State Communications services	9.17
	Local Communicaitons services	3.73
	911	1.06
	Total Transaction Tax	**13.96**
Georgia	State sales tax	2.96
	Local sales tax	2.22
	Local 911	2.64
	Total Transaction Tax	**7.81**
Hawaii	Public service co. tax	5.89
	PUC Fee	0.25
	Total Transaction Tax	**6.14**
Idaho	Telephone service asst. program	0.17
	Total Transaction Tax	**0.17**

Illinois	State telecom excise tax	7.00
	Simplified municipal tax	6.50
	Wireless 911	2.11
	Total Transaction Tax	**15.61**
Indiana	State sales tax	6.00
	Utility receipts tax	0.00
	Wireless 911	2.11
	PUC fee	0.15
	Total Transaction Tax	**8.26**
Iowa	State sales tax	5.00
	Local option sales taxes	0.50
	Wireless 911	1.06
	Total Transaction Tax	**6.56**
Kansas	State sales tax	4.90
	Local option sales taxes	1.45
	USF	3.34
	Total Transaction Tax	**9.69**
Kentucky	State sales tax	6.00
	School utility gross receipts	1.50
	Lifeline support charge	1.06
	Wireless 911	1.48
	Total Transaction Tax	**10.03**
Louisiana	State sales tax	3.00
	Wireless 911	1.42
	Total Transaction Tax	**4.42**
Maine	State sales tax	5.00
	911 tax	1.06
	USF	0.50
	Total Transaction Tax	**6.56**
Maryland	State sales tax	5.00
	Local telecom excise	0.00
	State 911	0.21
	County 911	1.06
	Total Transaction Tax	**6.27**
Massachusetts	State sales tax	5.00
	Wireless 911	0.63
	Total Transaction Tax	**5.63**
Michigan	State sales tax	6.00
	Wireless 911	1.10
	Total Transaction Tax	**7.10**
Minnesota	State sales tax	6.50
	Local sales tax	0.50
	911	0.57
	Telecom access MN fund	0.21
	Total Transaction Tax	**7.78**
Mississippi	State sales tax	7.00
	Wireless 911	2.11
	Total Transaction Tax	**9.11**
Missouri	State sales tax	4.23
	Local sales taxes	2.65
	Local license tax	4.25
	Total Transaction Tax	**11.12**
Montana	Telecom excise tax	3.75
	911 & E911 tax	1.06
	TDD tax	0.21
	Total Transaction Tax	**5.02**

Nebraska	State sales tax	5.50
	Local sales tax	1.50
	State USF tax	6.95
	Wireless 911	1.06
	TRS	0.13
	Total Transaction Tax	**15.13**
Nevada	Local franchise / gross receipts	0.63
	Local 911 tax	0.53
	Total Transaction Tax	**1.16**
New Hampshire	Communication services tax	4.50
	911 tax	0.89
	Total Transaction Tax	**5.39**
New Jersey	State sales tax	6.00
	Total Transaction Tax	**6.00**
New Mexico	State gross receipts (sales) tax	5.00
	Local gross receipts taxes	1.25
	Wireless 911	1.08
	TRS surcharge	0.33
	Total Transaction Tax	**7.66**
New York	State sales tax	4.00
	Local sales taxes	4.00
	MCTD sales tax	0.13
	State excise tax (186e)	2.50
	MCTD excise/surcharge (186e)	0.30
	Local utility gross receipts tax	1.51
	State and local wireless 911	3.17
	MCTD surcharge (184)	0.07
	NY franchise tax (184)	0.38
	Total Transaction Tax	**16.05**
North Carolina	State sales tax	6.00
	Wireless 911	1.69
	Total Transaction Tax	**7.69**
North Dakota	State sales tax	5.00
	Local sales taxes	1.25
	State gross receipts tax	2.50
	Local 911 tax	2.11
	TRS	0.13
	Total Transaction Tax	**10.99**
Ohio	State sales tax	5.00
	Local sales taxes	1.63
	Total Transaction Tax	**6.63**
Oklahoma	State sales tax	4.50
	Local sales taxes	3.65
	911 Tax	1.06
	USF	0.40
	Total Transaction Tax	**9.60**
Oregon	911 tax	1.58
	TDD / low income subsidy	0.74
	Local franchise taxes	unknown
	Total Transaction Tax	**2.32**
Pennsylvania	State sales tax	6.00
	Local sales tax	0.50
	911 tax	unknown
	Total Transaction Tax	**6.50**

Rhode Island	State sales tax	7.00
	Gross receipts tax	5.00
	Wireless 911	2.11
	Total Transaction Tax	**14.11**
South Carolina	State sales tax	5.00
	Local sales tax	0.00
	Municipal license tax	0.30
	911 tax	1.22
	Total Transaction Tax	**6.52**
South Dakota	State sales tax	4.00
	local option sales tax	2.00
	911 excise	1.58
	TRS fee	0.32
	PUC fee	0.15
	Total Transaction Tax	**8.05**
Tennessee	State sales tax	7.00
	Local sales tax	2.50
	911 tax	2.11
	Total Transaction Tax	**11.61**
Texas	State sales tax	6.25
	Local sales tax	2.00
	Telecom Infrastructure Fund	1.25
	Wireless 911 tax	1.06
	Texas USF	3.60
	Equalization surcharge	0.06
	Total Transaction Tax	**14.22**
Utah	State sales tax	4.75
	Local sales taxes	1.85
	Local utility wireless	2.11
	911 tax	1.12
	Poison Control	0.15
	State USF	0.34
	Total Transaction Tax	**10.32**
Vermont	State sales tax	4.36
	State USF	1.20
	Total Transaction Tax	**5.56**
Virginia	Local utility users tax	6.33
	Wireless 911	1.58
	Total Transaction Tax	**7.92**
Washington	State sales tax	6.50
	Local sales tax	1.90
	B&O / Utility Franchise -- local	6.19
	911 -- county excise	0.53
	Total Transaction Tax	**15.12**
West Virginia	Wireless 911	1.98
	Total Transaction Tax	**1.98**
Wisconsin	State sales tax	5.00
	Local sales tax	0.55
	Total Transaction Tax	**5.55**
Wyoming	State sales tax	4.00
	Local sales tax	1.00
	TRS	0.13
	USF	4.00
	Total Transaction Tax	**9.13**

Source: COMMITTEE ON STATE TAXATION, 50-STATE STUDY AND REPORT ON TELECOMMUNICATIONS TAXATION (Nov. 2000) (data updated Dec. 2002 by Verizon Wireless)
Note: Average monthly revenue of $47.37 is used to calculate effective tax rates for flat rate taxes and fees.