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**The “Wireless Tax Premium” Harms American Consumers  
and Squanders the Potential of the Mobile Economy**

**Glenn Woroch**  
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37<sup>th</sup> & O Streets, NW Rafik B. Hariri Building, Suite 558 Washington, DC 20057  
PHONE: 202.687.3686 EMAIL: [cbpp@msb.edu](mailto:cbpp@msb.edu) WEB: <http://cbpp.georgetown.edu/>

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As everyone knows, the growth of cellular phone service in the U.S. has been simply spectacular. What is not so obvious is that the current fiscal woes of state and local governments have painted a bull's eye on every one of the more than 300 million cell phones in this country. The temptation to generate badly-needed tax revenues from this popular service has been irresistible. Tax authorities have treated cell phone service as a luxury from its early days as a "car phone," and they did not adapt when the cell phone took its place among the necessities of the American household. Today, cellular phone service is burdened with a "tax premium" far in excess of the average state and local tax on goods and services and that premium continues to grow with time.

The concern in this policy vignette is the economic harm inflicted by this tax premium on American consumers and on the U.S. economy. I estimate that at current levels the American consumer forgoes over \$15 billion in surplus annually compared to when cell phones receive the same tax treatment as other goods and services. This tax burden is not evenly shared by all consumers since, as might be expected, low-income families bear a disproportionately larger amount. More subtle, but no less significant, are the foregone benefits to the broader economy that arise when this valuable service is underused by individuals and enterprises alike. In particular, the deployment of wireless internet access to remote and underserved communities is slowed by the tax premium, running counter to the economic needs of the nation and to the objectives of the President's national broadband plan in particular.

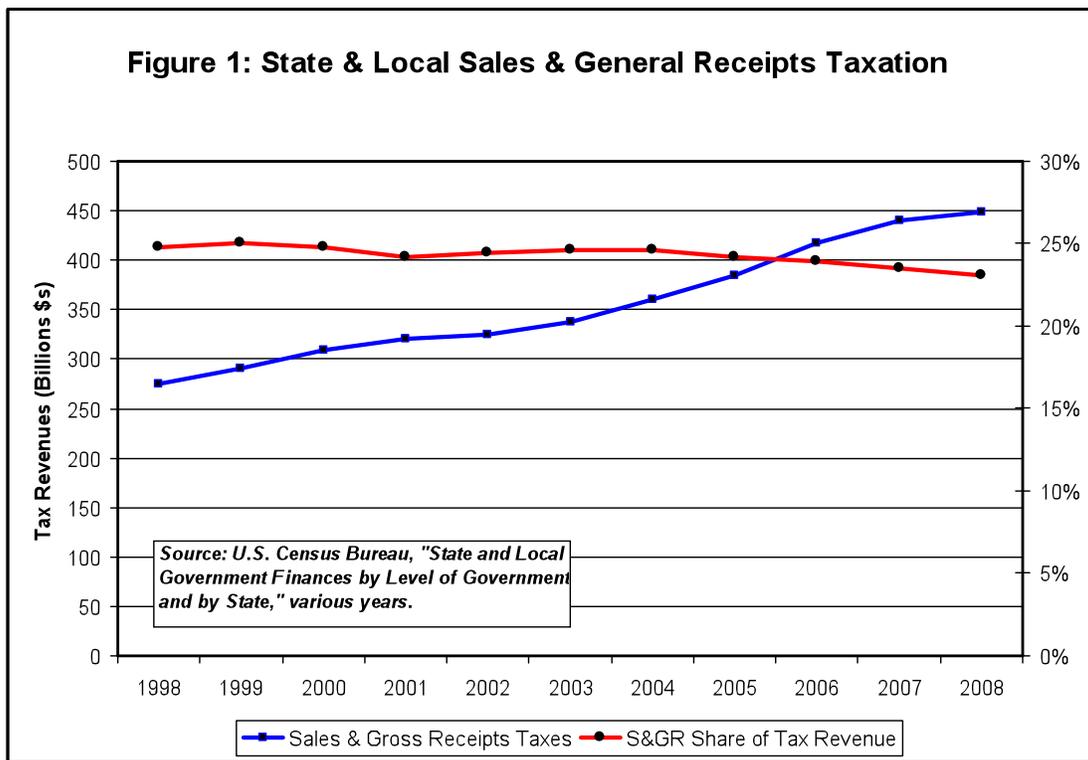
1. State and Local Governments Impose a Tax Premium on Wireless Mobile Services and that Premium Continues to Increase Over Time

Sales and use taxation represents a significant source of revenue for state and local governments. While these taxes have remained a stable fraction of overall state and local receipts over the last decade or more, the various surcharges applied to mobile bills increased appreciably over the same period. This pattern is shown in Figure 1 below.<sup>1</sup> The tax rate on wireless services, when averaged across states by their populations, has increased a full percentage point between 2003 and 2010. This can be seen in Figure 2 which plots the national average tax rate on wireless

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<sup>1</sup> The dollar amount of sales and use taxes has increased over the past decade in parallel with the growth in the size of state and local governments.

services (inclusive of state and local general sales tax and federal taxes and fees) over time. The “wireless tax premium”—the gap between the wireless tax rate and the general sales tax rate applied to other goods and services—grew by nearly a half percentage point over this period. Notice that the wireless tax rate increased despite the fact that in 2006 the federal telecommunications excise tax was partially repealed. Increases in state and local taxes and fees more than made up for the reduction in the federal taxes.

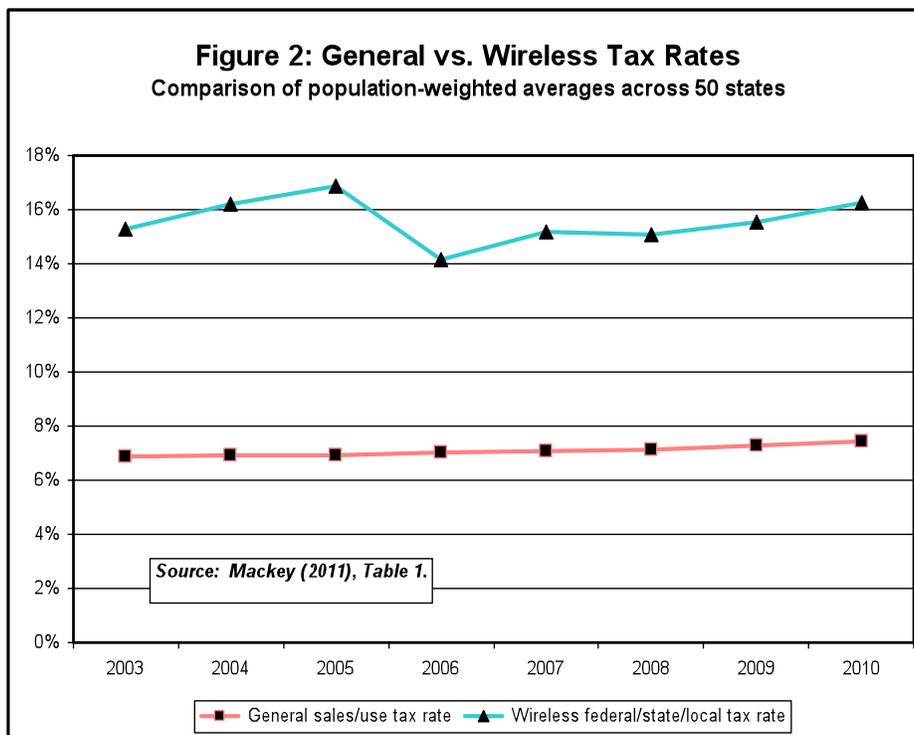


A striking feature of U.S. wireless taxation is the great variety of the types of taxes and fees. Besides state and local sales and gross receipts taxes, there are state and federal charges for support of the Universal Service Fund,<sup>2</sup> and fees to defray the cost of 911 emergency services and Telecommunications Relay Service. Some states and municipalities impose utility user taxes.<sup>3</sup> State and local sales taxes are also applied when consumers purchase mobile handsets.

<sup>2</sup> Contributions to the USF have much the same effect as a sales tax on cellular service because little of those receipts are used to subsidize cellular service.

<sup>3</sup> A few states impose a “business and occupation tax” on mobile services that exceed the rate applied to other products and services sold in their jurisdictions.

In fact, in California, sales taxes are set according to the unbundled price of the phone, and not on the subsidized price paid when customers sign a long-term contract.<sup>4</sup>



Still other taxes and fees have been imposed on wireless services to support activities with no direct connection to communication services. As one example, a report to the governor of New York observes that “Telecommunications services are subject to local sales taxes imposed by 104 separate taxing units including counties, cities, and school districts.”<sup>5</sup> Small cities in New York State are allowed to assess a “school district utility tax” on wireless services up to 3% to finance local schools.<sup>6</sup> The downstate Municipal Commuter Transportation Districts

<sup>4</sup> See California State Board of Equalization, “Cell Phones and Other Wireless Telecommunication Devices,” Sales and Use Tax Facts Publication 120. The U.S. Supreme Court agreed to hear the case of *AT&T Mobility v. Concepcion* (130 S.Ct. 3322 (2010)) in its current session. This case involves that payment of sales tax on a cell phone that was advertised as “free,” though it raises entirely different legal issues for the courts.

<sup>5</sup> “Local Telecommunications Taxes and Fees in New York State Report to Governor,” New York State Department of Taxation and Finance, January 2001, pp.1-2.

<sup>6</sup> See “State Aid to Schools -- A Primer Pursuant to Laws of 2002,” The University of the State of New York, The State Education Department, Fiscal Analysis and Research Unit, November 2002.

levy a ¼% tax on cellular bills to help pay for metropolitan transportation infrastructure.<sup>7</sup> In other examples, the state of Utah adds 7 cents to every monthly cellular bill to support poison control service, and Wisconsin adds 75 cents to support “Police and Fire Protection.”<sup>8</sup> A particularly egregious example occurred recently when Baltimore raised its wireless-specific fee to \$4 per month to defray the general revenue needs of the city.<sup>9</sup>

Clearly, governments of all sorts have tapped this rich vein of revenue to help close their budget gaps. The temptation to do so is strong. Wireless services represent a huge tax base given its near universal adoption, whose growth marches on with each new generation of technology. A government, whether state or city or county, that levies a small incremental tax or fee on wireless bills gets lost in the overall tax burden and does not fully bear its economic impact on the broader constituency.

## 2. The Wireless Tax Premium Violates Basic Economic Principles of Good Tax Policy

How does the existing system of wireless taxation in the U.S. square with a tax policy based on sound economic principles? To begin with, any tax system should strive to produce revenue to finance government activities in a way that does least harm to the economy and that treats taxpayers fairly. With few exceptions, this objective implies that the same tax rate should apply to similar goods and services and to similar individuals as well.

It is true that economic principles single out a specific good or service for higher taxes under certain circumstances. This occurs when the higher tax discourages consumption of products that cause incidental harm to individuals or businesses. This is the main reason behind high taxes on gasoline and cigarettes. The tax premiums on those products would be set at the level that approximates the additional harm caused to the environment and to non-smokers, respectively, when those products are consumed.

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<sup>7</sup> New York Public Authorities Title 11, Metropolitan Commuter Transportation Authority §1264.

<sup>8</sup> See Scott Mackey (2011), “A Growing Burden: Taxes and Fees on Wireless Service,” *State Tax Notes*, Feb. 14, 2011, pp. 475-487.

<sup>9</sup> Joseph Henchman, “States Target Cell Phones for Stealth, Burdensome Taxes,” February 18, 2011, Fiscal Fact No. 259, The Tax Foundation: Washington, DC. See also Daniel P. Slowey, “*T-Mobile USA, Inc. v. Department Of Finance For Baltimore City: What The Latest Salvo In Disproportional Cellular Phone Taxation Means For The Future*,” *Duke Technology & Law Review*, Dec. 2006.

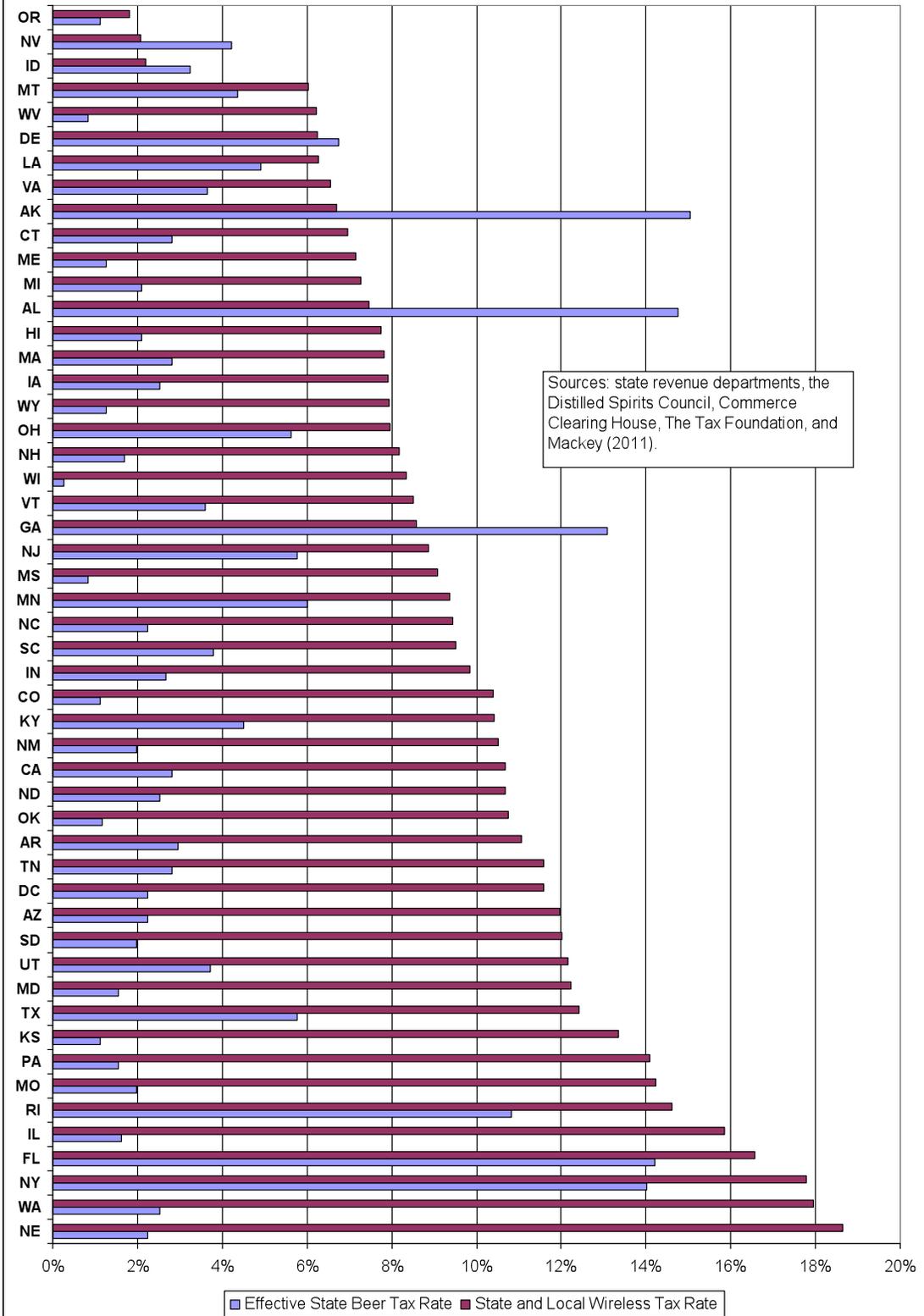
Consumption of wireless services, in contrast, does not cause collateral damage that would justify a tax premium. We may all agree that it is annoying when a cell phone rings in a crowded theater. More serious is the increased risk of traffic accidents when drivers use cell phone without hands-free devices. Nevertheless, a tax premium is not an efficient deterrent for these externalities since it is paid by all uses, including the conscientious ones. Direct regulation and the legal system offer more cost-effective means to address these problems than taxation.

Despite the lack of harmful side effects, the taxes applied to mobile services sometimes approach the levels of so-called “sin taxes” that are levied on alcohol and cigarettes. In fact, the state of Missouri taxes wireless services at a rate that exceeds the implicit state *ad valorem* tax on cigarettes.<sup>10</sup> Quite a few states have wireless tax rates that, when combined with federal excise taxes, exceed the implicit rate imposed on beer sales. Figure 3 below compares the state and local taxes on beer and on wireless services. Both tax rates exclude federal taxes and it should be pointed out that the federal excise tax on beer is substantial.

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<sup>10</sup> In comparing tax rates of cigarettes and wireless services, I did not include federal taxes and fees on the two products. Missouri’s combined sales and excise taxes on cigarettes came to 9.37% of the average retail price of a pack, while its current sales tax rate on wireless services is 14.23%, a difference of 4.86%.

**Figure 3: Comparison of State & Local Sales Taxes on Wireless Services and Beer**



Nor does the supply of mobile wireless services generate harmful side effects. They do not inflict pollution on third parties. The costs of providing the services are born by private equipment vendors and service providers, including the use of the public airwaves that have been purchased at federal spectrum auctions. Further, unlike landline phone and cable TV providers, mobile carriers do not need to dig up the streets or plant utility poles to provide service. They erect or rent their towers and acquire backhaul transmission services from private providers.

In the end, I do not find any economic reasons that mobile wireless services carry tax rates that, on average, are more than twice the general state and local levels. Why should we care about this discrepancy? Economists dislike differential taxation that is not justified by external costs because they distort relative prices that guide consumer purchases and the expenditure of resources to supply the goods. The wireless tax premium makes mobile services relatively more expensive than other goods, steering consumers to substitute services that they otherwise decided were less desirable. Consumers have voted with their dollars as they disconnect their landlines which lack the functionality found in even the most basic cell phone.

Other distortions in prices arise when wireless tax policy differs across jurisdiction. The state and local portion of wireless taxes vary widely around the country. Total taxes excluding federal charges but including general sales tax ranges from a low of 1.81% in Oregon to a high of 18.64% in Nebraska.<sup>11</sup> A prime case for geographic distortion arises when one steps across the border from Oregon and enters Washington State causing state and local taxes on wireless service to jump to 17.95%.<sup>12</sup>

Discriminatory taxation of mobile services runs contrary to the objectives of national policies to promote mobile wireless as a viable gateway to the internet—especially for poorer Americans and those living in underserved rural areas. In his 2011 State of the Union address, President Obama called for a national initiative to achieve universal wireless broadband access foreseeing benefits in the form of access by rural farmers and improved delivery of emergency

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<sup>11</sup> See Mackey (2011), *op. cit.*, Table 2. For details on the methodology of constructing these average tax rates see Council on State Taxation, “50-State Study and Report on Telecommunications Taxation,” May 2005.

<sup>12</sup> *Ibid.*

services.<sup>13</sup> The national broadband plan proposed that the FCC make available 300 MHz for mobile use in the next 5 years and up to 500 MHz for wireless broadband use over the next 10 years.<sup>14</sup> Already cellular service offers capabilities unavailable on fixed-line connections such as SMS texting. Equipped with a smart phone, a user can send and receive email just like a fixed-line internet connection. In fact, smart phones are gradually approaching the level of internet access currently available through DSL and cable modem connections as 3G and soon 4G technology becomes widely deployed. The wireless tax premium works to slow progress of these developments and to defeat the goals of these policy initiatives.

### 3. The Wireless Tax Premium Causes Harm to American Consumers Estimated to be Over \$15 Billion Per Year

Economists have a dollar figure that measures the economic harm when consumers pay more than they have to for goods and services: “Consumer surplus” is the difference between what consumers are willing to pay for a good or service and the amount they actually pay. Since a tax will drive up the price paid by consumers, it reduces the consumer surplus they derive from the service. Higher post-tax prices cause consumers to cut back on purchases relative to pre-tax prices, forgoing the benefits of greater consumption.

It is possible to estimate the loss of surplus to American consumers caused by the wireless tax premium with some knowledge of cellular demand.<sup>15</sup> I began with the tax premium of 8.84% which is the average difference in the wireless tax rate above the general tax rate.<sup>16</sup> This premium translates to \$4.17 of the current average monthly wireless bill of \$47.21 in the U.S.<sup>17</sup> I then used an own-price elasticity of mobile access demand estimate of -0.8 to translate

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<sup>13</sup> “Within the next five years, we’ll make it possible for businesses to deploy the next generation of high-speed wireless coverage to 98 percent of all Americans,” he said. “This isn’t about faster Internet or fewer dropped calls. It’s about connecting every part of America to the digital age.” January 25, 2011.

<sup>14</sup> Federal Communications Commission, *Connecting America: The National Broadband Plan*, March 2010.

<sup>15</sup> I do not separately estimate the loss in “producer surplus” caused by the wireless tax premium. Such a calculation would measure the lost profits to wireless service and equipment suppliers when subscriptions fall as a result of the tax.

<sup>16</sup> See Mackey (2011), *op. cit.*, Table 2.

<sup>17</sup> To back out the amount attributable to the tax premium, I first estimate the price under general sales taxation. Using the average monthly pre-tax bill of \$47.21 reported in “Semi-Annual Wireless Industry Survey,” CTIA-The Wireless Association: Washington, DC, I compute this to be \$50.71. See the Appendix.

this cost increase into a reduction of about 7% in the number of subscribers.<sup>18</sup> Since there are 302.9 million mobile subscribers in the U.S. at present, about 23 million Americans dropped cell service in response to the tax premium. Combining the increased payments by infra-marginal subscribers with the lost surplus of marginal subscribers, I find that the lost consumer surplus exceeds \$15 billion per year. Details of the calculation can be found in the Appendix.

This calculation measures the direct impacts on the consumers who drop cell service in response to the wireless tax premium. Consumers who continue to subscribe to cellular service despite the tax premium will bear indirect cost, however, when they curtail their use of voice services. In principle, use of internet services on cell phones is free of taxation due to federal exemption of taxation of internet access services.<sup>19</sup> Taxes have been applied to data usage by some wireless carriers and the practice remains a legal gray area.<sup>20</sup> In any event, purchases of smart phones themselves are subject to sales taxation.

#### 4. Wireless Taxation is Regressive, Burdening Lower Income Groups More Than High Income Consumers

In its early years, cellular phone service was viewed as a luxury, reserved for select consumers who could afford the high charges, and for businesses that could benefit from the mobility it provided. In this context, it was more understandable that luxury-type taxes were levied on cellular phone service when it first became commercially available. What is not understandable, however, is how those high tax rates persisted over time and continued to increase long after wireless services became essential part of American life.

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<sup>18</sup> See Michael Ward and Glenn Woroch, “The Effect of Prices on Fixed and Mobile Telephone Penetration: Using Price Subsidies as Natural Experiments,” *Information Economics & Policy*, Jan. 2010, 22(1), 18-32, which finds an own-price elasticity of about -0.8. Other published studies find estimates that are slightly less elastic, e.g., Jerry Hausman, “Efficiency Effects on the U.S. Economy from Wireless Taxation,” *National Tax Journal*, 53(3) September 2000, 733-42. A price elasticity falling in this range is indicative of a good that is a consumer “necessity.” If wireless service met the economic definition of a “luxury” it would display an elasticity that exceeded -1.0.

<sup>19</sup> The exemption of internet access was first put in place during an era of dialup when President Clinton signed “The Internet Tax Freedom Act” on October 21, 1998. That act precludes federal, state and local governments from taxing internet access services. The ITFA was extended three times, most recently when President Bush signed the “Internet Tax Freedom Act Amendment Acts of 2007” which extended the Act until November 2014.

<sup>20</sup> In November 2010, AT&T Mobility settled a class action lawsuit filed by users who paid taxes on their data usage for certain services such as accessing email accounts. That settlement was approved on June 2, 2011 by the U.S. District Court. AT&T contends that charging the taxes was legal.

Sales taxation is a textbook example of “regressive” taxation since the fraction of household income devoted to taxes falls with income level.<sup>21</sup> Since cellular phone service is a personalized service, unlike a landline phone which is usually shared by the entire household, we should measure the tax burden on a *per capita* basis. The average number of household members does not vary much over income groups, and so average per capita income necessarily falls as household income increases.<sup>22</sup> This pattern exaggerates the regressivity of wireless taxation, though some cellular “family plans” might soften the impact on low-income households.

State law makers are sensitive to regressivity of sales taxation.<sup>23</sup> It is the principal reason that the majority of states exempt food purchases from sales taxation.<sup>24</sup> In contrast, cellular bills are hit with higher tax rates than other goods and services. We might dismiss the regressivity of the tax as merely hypothetical if poor people did not consume this product in any great quantities. In fact, the lowest income groups are more dependent on mobile services than other consumers. An ongoing federal government survey of U.S. households recently reported that 39.3% of survey respondents that live in households that fall below the federal poverty line

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<sup>21</sup> “Typically, economists and political theorists posit that a vertically equitable tax regime is a progressive tax regime. Excise taxes are almost always classified as regressive taxes, since they do not take into account the individual’s ability to pay.” Steven Maguire and Brent Mast “The Telephone Excise Tax: An Economic Analysis,” *Congressional Research Service*, Report RL33382, June 29, 2006.

<sup>22</sup> The average household size ranges from 3.12 to 3.34 persons across income groups up through \$55,000 per annum, peaking somewhere in the \$15,000-30,000 region. U.S. Census Bureau, Current Population Survey, 2010 Annual Social and Economic Supplement, Table HINC-01: Selected Characteristics of Households, by Total Money Income in 2009.

<sup>23</sup> Economists are in agreement that under certain conditions the taxation of individual products is an inferior means of generating government revenue compared to an income tax. “Therefore the income tax is definitely superior to the [sales or excise] tax in the sense that you can raise the same amount of revenue from a consumer and still leave him or her better off under the income tax than under the [sales or excise] tax.” Hal Varian, *Intermediate Microeconomics: A Modern Approach*, 7<sup>th</sup> Edition, W. W. Norton: New York, 2006, p.88.

<sup>24</sup> As of 2009, 36 states did not tax groceries out of the 45 states and the District of Columbia that have a general sales tax. Two states apply the general tax rate to food while another 12 either levy a reduced tax rate or offer a credit for tax paid on food purchases. See “Which States Tax The Sale Of Food For Home Consumption In 2009?” *The Center for Budget and Policy Priorities*, November 4, 2009, <http://www.cbpp.org/cms/?fa=view&id=1230>.

depend exclusively on mobile wireless for their communications, compared to 21.7% of respondents who are above the poverty line.<sup>25</sup>

Econometric studies of the demand for mobile service confirm another pattern that is rather unsurprising: lower-income households are more responsive to mobile prices than higher-income households.<sup>26</sup> As a result, the wireless tax premium causes low income households to cut back more drastically on mobile services than high income groups.<sup>27</sup>

#### 5. The Potential Benefits of Mobile Services for the U.S. Economy May Be Squandered by the Wireless Tax Premium

Today, mobile phones are found on every street in every corner of the world. It is estimated that 5 billion people now enjoy wireless services, demonstrating the value they place on this remarkable technology. Might it be the case that this service provides economic returns beyond consumption benefits, perhaps increasing the overall productivity of the economy? Or could it be that “You can see mobile wireless everywhere but in the productivity statistics” -- to paraphrase a famous quip by Nobel laureate Robert Solow?<sup>28</sup>

It may be too early to draw conclusions with scientific precision, but evidence is mounting that wide spread adoption of mobile wireless services delivers economic gains to the broader economy. This is not surprising when one considers the findings for mobile’s predecessor, fixed line telephony. Several studies based on data ranging back more than 50

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<sup>25</sup> See Stephen Blumberg and Julian Luke, “Wireless Substitution: Early Release of Estimates from the National Health Interview Survey, January through June of 2010,” Center for Disease Control, Division of Health Interview Statistics, National Center for Health Statistics, Hyattsville, MD, Dec 21, 2010. Other demographic characteristics of these income groups are likely to underpin this fact. For instance, the percentage of households that rent is higher among lower income groups, and since renters change locations more often, renting has been associated with greater demand for mobile service relative to fixed line. See estimation results in Mark Rodini, Michael Ward, and Glenn Woroch, “Going Mobile: Substitution between Fixed and Mobile Access,” *Telecommunications Policy*, 2003, 27, pp. 457-476.

<sup>26</sup> See, e.g., Janice Hauge, Eric Chiang, and Mark Jamison, “Whose call is it? Targeting universal service programs to low-income households’ telecommunications preferences,” *Telecommunications Policy*, 33 (3-4), April-May 2009, 129-145.

<sup>27</sup> This pattern was confirmed in Ward and Woroch (2010), *op. cit.*, which observed that low-income households shifted away from mobile subscription when they received a subsidy in the form of Lifeline discount on landline service.

<sup>28</sup> The original quote was “You can see the computer age everywhere but in the productivity statistics.” Robert Solow, “We’d better watch out,” *New York Times Book Review*, July 12, 1987, pg. 36.

years confirm the benefits of landline phones to the macro economy in the form of output and productivity growth.<sup>29</sup> The evidence for the impact of wireless communications and information technology is less complete, but there is little doubt that advances of this technology has boosted economic wealth and the growth in that wealth as well. Taxation that delays the spread of mobile wireless, and its usage, will then postpone the benefits that this technology offers for the U.S. economy.

In the last couple years a feature has surfaced that distinguishes wireless technology from its older landline predecessor. Mobile technology now offers a “platform” that hosts the applications, services and content delivered to users. “Mobile apps” are the best known byproduct of cellular platforms based on operating systems such as Apple’s iOS, Google’s Android, RIM’s Blackberry OS and Nokia’s Symbian. The hundreds of thousands of mobile apps would not have been developed were it not for the sales of millions of smart phones using this software, and vice versa. In particular, the innovations developed for mobile platforms promise to deliver a new generation of services including mobile health, mobile banking, mobile education and emergency services. A wireless tax premium necessarily slows the adoption of smart phones which, in turn, threatens the size and growth of the capabilities they deliver. To cover the fixed costs of building these services, developers require minimum target audience.

#### 6. The Wireless Tax Premium is Bad Fiscal Policy in the Short Term and Over the Long Run

Understandably, state and local governments are exploring every potential source for operating revenue given their challenging fiscal environment. The widespread adoption of wireless services, and the continued growth in the sector, makes cell phone service a tempting target for the tax collector. The significant tax premium that is currently imposed on wireless services, however, violates basic economic principles of efficient and equitable taxation. The tax premium distorts relative prices and causes consumers to curtail mobile usage and to turn to inferior alternatives. Billions of dollars in consumer welfare is lost annually as a result of the premium. The structure of wireless taxation also ensures that it is regressive since it amounts to

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<sup>29</sup> See Francis Cronin, Edwin Parker, Elisabeth Colleran and Mark Gold, “Telecommunications Infrastructure and Economic Growth: An Analysis of Causality,” *Telecommunications Policy*, 15 (6), December 1991, 529-535 for econometric evidence of the causal relationship between telephone penetration and economic growth using U.S. data over the period 1958-1988.

a sales taxation on a service that is popular among low income households. It is exactly those households that state and federal telecommunications policies hope to connect to the national system, and in particular to use their mobile handsets as an on-ramp to the internet. These consumer harms are quite apart from the forgone knock-on benefits to the broader U.S. economy that derive from widespread deployment and use of wireless technologies.

As a nation we should be concerned that mounting pressures on state and local treasuries will spur further increases the tax premium as the mobile wireless subscribers and minutes of use continue to grow—even as the U.S. struggled through its third year of the Great Recession. As it is, many empirical estimates of the tax policy conclude that only about 60 cents of economic value is realized from each dollar of more efficient income taxation.<sup>30</sup> That might be a bargain when compared to the wireless tax premium which likely generates far less wealth for the U.S. economy, and may even destroy more value than it collects.

If we are determined to pursue efficiency in this critical sector, sound economic analysis prescribes a roll back in the wireless tax premium. Of course, we must be realistic, and given the fiscal emergencies facing many states and municipalities, and the related political pressures, such a move is implausible. Nevertheless we should not ignore history which shows that tax policies in this area die hard. The federal telecommunications excise tax provides a clear example. Created to finance the Spanish-American War in 1898, this federal tax was repealed, reinstated and extended by Congress more than two dozen times.<sup>31</sup> It was not until 2006 that the tax was suspended for wireless services. At a bare minimum, it is in our national interest to halt the upward creep of wireless taxes, and in the process, to freeze the level of harm they inflict on American consumers and the U.S. economy.

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<sup>30</sup> See Charles Ballard, John Shoven and John Whalley, “The Welfare Cost Of Distortions in the United States Tax System: A General Equilibrium Approach,” *American Economic Review* 75, March 1985, 128-38.

<sup>31</sup> See Louis Alan Talley, “The Federal Excise Tax on Telephone Service: A History,” *Congressional Research Service Report for Congress RL30553*. 2001, Table 1.

## APPENDIX

The impact of the wireless tax premium on consumer surplus is composed of two parts: (1) the additional amount that consumers must spend on the service they purchase due to a higher retail price and (2) the forgone benefits when the higher price causes some consumers to drop the service altogether. The two parts of the change in consumer surplus can be represented formally as:

$$\Delta CS = -\Delta p \times q^1 + \frac{1}{2} \Delta p \times \Delta q$$

where  $p^0, p^1$  are wireless subscription prices before and after the tax premium is imposed. Note that the general sales tax is applied in both cases. Assuming the *ad valorem* tax premium  $t$  is completely passed through into higher retail prices, the price change is:  $\Delta p = p^1 - p^0 = t \times p^0 > 0$ . Corresponding to the two retail prices are the quantities of subscriptions  $q^0, q^1$ . The corresponding change in quantity sold is then given by  $\Delta q = q^1 - q^0 < 0$ . The first term above measures the higher cost of wireless service to users who continue to subscribe. The second term approximates the lost surplus to users who would have subscribed to the service at price  $p^0$  but not at price  $p^1$  with a triangle that is exact when the wireless mobile demand curve is linear. This expression can then be rewritten as:

$$\Delta CS = -\Delta p \times q^1 + \frac{1}{2} \Delta p \times \Delta q = \Delta p \left[ -q^1 + \frac{1}{2}(q^1 - q^0) \right] = -\Delta p \times \left( \frac{q^0 + q^1}{2} \right)$$

This expression is just the price increment caused by the tax premium multiplied by the average quantity before and after the premium is applied. We can plug in values for the various terms that appear in this expression to get an estimate of lost consumer surplus attributable to the wireless tax premium. In so doing, it is necessary to keep in mind that the historical data were generated under the wireless tax premium.

Begin with the national average mobile bill of \$47.21 per month.<sup>32</sup> Since this amount excludes all taxes and fees, we need to add in the general sales tax rate to establish a baseline for comparison. As of mid 2010, the weighted-average general sales tax was 7.42%, and so I take the price  $p^0$  to be \$50.71. Taking the difference in the population-weighted-average wireless tax in mid 2010 (*i.e.*, 16.26%) and the average sales tax of 7.42% yields a tax premium of 8.84%. Applied to the pre-tax price of \$47.21, this tax premium would add \$4.17 to the monthly bill, bringing it up to \$54.89. This is  $p^1$  in our notation, and  $\Delta p$  is \$4.17.

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<sup>32</sup> CTIA (2011), *op. cit.* See table reporting “Annualized Wireless Industry Survey Results - December 1985 To December 2010.” The average wireless bill in this table excludes all taxes and fees.

Next, I need to translate this price increase into the corresponding decrease in quantity. The current number of mobile subscriptions, 302.9 Million, is the post-tax quantity  $q^1$ . I adjust this level to back out the quantity  $q^0$  absent a tax premium using a price elasticity of demand of -0.8. This calculation gives the hypothetical pre-tax quantity of 325.95 millions.<sup>33</sup> Putting all these figures together gives lost consumer surplus per month:

$$\Delta CS = -\$4.17 \times \frac{302.9M + 325.95M}{2} = -\$1.31 \text{Billion}$$

Multiplying by 12 results in an annual loss of consumer surplus of \$15.73 Billion. Stated in other terms, this amounts to about \$52 per year for every cell phone user in the U.S.

In estimating the consumer loss, I implicitly assumed away any supply-side response to the tax premium imposed on wireless services. Mobile carriers are likely to share part of the burden of the tax though it should not be substantial due to the fact that this is a highly competitive industry. Since the wireless service providers will give up the margin they earn on every subscriber and every minute of use that is lost due to higher prices, there will be lost producer surplus as well, and so my estimate above of the harm should be viewed as conservative.

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<sup>33</sup> Formally, the relation between before and after tax premium quantities is given by  $q^0 + q^0 \times \eta \times \frac{\Delta p}{p^0} = q^1$  where  $\eta < 0$  is the price elasticity of demand for cell phone subscriptions.

Solving for  $q^1$  gives  $q^0 = q^1 / \left( 1 + \eta \times \frac{\Delta p}{p^0} \right)$ .