HAS INTERNET ACCESS TAXATION AFFECTED INTERNET USE?

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Most arguments in favor of the Internet Tax Freedom Act (ITFA) assume that taxing Internet access would reduce Internet use. The authors investigate this possibility empirically, making use of panel data covering all U.S. states for the years 1998, 2000, and 2001. Statutory variation in the taxation of Internet access occurs because 10 states were permitted to continue their existing Internet access taxes as of the initial passage of the ITFA in 1998. None of the econometric analyses provides any evidence that Internet access taxes have had an effect on Internet access rates.

Keywords: *Internet Tax Freedom Act; Internet access; taxation*

The October 1998 Internet Tax Freedom Act (ITFA) originally placed a 3-year moratorium on the taxation of Internet access and other discriminatory taxation directed toward the Internet. In other words, states were prohibited from levying new taxes on Internet access charges or discriminatory taxes on sales of goods and services over the Internet. The moratorium was extended for 2 years in November 2001 and is set to expire in November 2003.

Proponents of the ITFA argue that taxation of the Internet, among other reasons, will hinder the growth of the information revolution and limit individuals' abilities to gather knowledge efficiently. Fundamentally, most arguments in favor of such a policy assume that a tax on Internet access would reduce the number of people who use the Internet. However, no empirical support has been provided for this assertion.

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In this article, we empirically examine the relationship between Internet access and taxation. Using a 3-year panel of data from every U.S. state and a variety of econometric techniques, we find no empirical evidence that Internet access rates are lower in states that have levied a tax on Internet access, all else equal. We begin by providing a review of the various arguments for and against Internet access taxation. Next we present an overview of the current state of Internet access taxation in the United States. Last, we discuss our statistical procedures and findings.

SHOULD INTERNET ACCESS BE TAXED?

Most arguments favoring a ban on taxation of Internet access stem from the perception that taxation will deter Internet access. This argument seems consistent with elementary microeconomic theory in the most basic framework. If a tax is levied on Internet access, it will raise the price paid by consumers and/or lower the price retained by producers, which will in turn reduce the quantity of Internet access demanded. However, if demand and/or supply are sufficiently inelastic with respect to price, or if the price change is quantitatively small, the effect of a tax on Internet access may be small enough to go unnoticed. As such, this is inherently an empirical question.

Proponents of the ITFA usually assume (perhaps implicitly) that the quantity of Internet access will respond significantly to a (tax-induced) price change. The fear is that access to information will be limited, thereby dampening the growth of the Information Revolution and decreasing the number of transactions made over the Internet. Certainly, a ban on Internet access taxation may be warranted in this scenario if one believes that fostering the growth of the Internet is desirable and if it could be proven that Internet connection rates would respond significantly to taxation. This line of reasoning is strengthened if the Internet is still in its infancy and fast growth is attainable. However, data suggest that the Internet has grown rapidly past what many would consider "infancy" (U.S. Department of Commerce 2002).

Another argument in favor of a ban on access taxation relates to a "digital divide" in the United States. That is, the Internet and other information technologies are more prevalent among the wealthier population than among lower income individuals (U.S. Department of

Commerce 1999). The Department of Commerce reported that this gap was widening in the mid- to late 1990s, and it seemed likely that, if taxation reduced Internet connection rates, the lowest income individuals would be the first to forgo the Internet. This would further widen the digital divide. However, more recent studies have shown that the digital divide has lessened in the past few years and that the Internet is becoming almost as prevalent among lower income households as among wealthier households (U.S. Department of Commerce 2002).

Some proponents have argued in favor of a ban on Internet access taxation on the basis of network externalities. This is the notion that consumer benefits increase as the number of consumers rises. Therefore, to fully take advantage of network effects, we should avoid discouraging Internet connection rates by taxing Internet access (again, assuming that consumers are responsive to taxation). This is similar to the classic example of a positive externality, wherein efficiency would call for subsidization (or exemption from taxation) of the good that generates the positive externality. Zodrow (2000) examines the question of network effects and concludes that arguments for preferential treatment of the Internet on these grounds are weak and that a complete tax exemption of the Internet would be inappropriate, even if network externalities were assumed to exist.[1]

Another argument in favor of a ban on Internet access taxation relates to the perceived difficulty that multistate firms would have in collecting taxes for many state and local governments. The presumption is that it would be very costly for a firm serving multiple states to collect access taxes for every customer it serves, given the widely different tax structures and rates across state and local governments. A similar presumption was a primary reason why the U.S. Supreme Court ruled in the *Quill v. North Dakota* (1992) case that multistate firms could not be required to collect sales taxes on purchases by customers who are not located within a state in which the firm has a physical presence. This concern does not apply to local Internet providers that only operate in one state.

Conversely, those opposing the ban on Internet access taxation generally believe that Internet connection rates would be relatively unresponsive to taxation. Classical optimal tax theory suggests that taxing relatively inelastic goods at higher rates would minimize the to-

tal deadweight loss of taxation (Diamond and Mirrlees 1971). Therefore, if Internet access were relatively inelastic, efficiency would call for relatively high taxation of it—the polar opposite of a ban on taxation. Another argument against the ban is that states need revenue, and broadening the sales tax base can be an appropriate way to achieve this goal. Internet access is simply another good that can be taxed to generate revenue for states that are in budget crises.[2]

Mazerov and Lav (1998) discuss arguments that states should not unfairly target Internet services, pointing out that none of the states that tax Internet access actually enumerated it for taxation. Instead, Internet access has fit within the definition of taxable transactions under current state taxation of telecommunications, electronic information, or other services. Mazerov and Lav argue that this indicates that Internet access taxes have certainly not been unfairly directed toward the Internet. Furthermore, they state that "in some instances these determinations were issued at the request of Internet service providers seeking guidance on their obligation to charge taxes on their services" (Mazerov and Lav 1998).[3] They go on to note that the Internet can be a substitute for many services that are already taxable. For example, the Internet can be used to make long-distance telephone calls, send faxes, download online magazines, and so on, all of which would normally be taxable in many states.

A key concern with a permanent ban on Internet access taxation is that companies can bundle Internet access with other telecommunications services and label the entire bundle "Internet access" to escape taxation altogether. That is, a company could sell Internet access, telephone services, cable television, and/or other telecommunication goods all in one bundle and avoid all taxation on the sale. Another possibility is that a firm could sell "digitized content" over the Internet (i.e., downloads of music, video, etc.), and due to unclear wording, the entire package could be deemed "Internet access," allowing the music and video to escape taxation.[4]

3. INTERNET ACCESS TAXATION IN THE UNITED STATES

The ITFA only permits imposition of a tax on Internet access by those 10 states that were already doing so at the time of ITFA's initial

TABLE 1: Status of Internet Access Taxation in Grandfathered States

State	*Status of Access Taxation*
Connecticut	Dropped tax on access July 2001
Iowa	Dropped tax on access May 2000
Ohio	Currently levies tax on access
New Mexico	Currently levies tax on access
North Dakota	Currently levies tax on access
South Carolina	Dropped tax on access October 1998
South Dakota	Currently levies tax on access
Tennessee	Currently levies tax on access
Texas	First $25 of access charges exempt as of October 1999
Wisconsin	Currently levies tax on access

passage by Congress in 1998.[5] Seven of those original 10 states continue to tax Internet access, but 3 have subsequently dropped the tax voluntarily. Table 1 summarizes the current status of Internet access taxation in these 10 states. In all cases, the taxation of Internet access occurs through existing state tax legislation as no state has specifically introduced an "Internet access tax." For example, New Mexico taxes Internet access charges through its gross receipts tax, and Tennessee levies the tax through a telecommunications service tax (Wright 1998). Little data are available to analyze the receipts from taxing Internet access. Data from Tennessee suggest that the revenue implications to date are relatively small, perhaps less than $5 million.[6]

One complication surrounding Internet access taxation is that interstate firms can only be required to collect taxes on sales of Internet access to consumers in states where the firms have nexus. The minimum physical presence necessary for online service providers to have nexus is yet to be determined and is currently being addressed in the courts. America Online, which is based in Virginia, was provided a summary judgment by the trial court in a Tennessee nexus case, but the Court of Appeals recently ruled that the trial court did not have sufficient information to reach a summary judgment ruling. As such, the case has been remanded to the trial court for further proceedings. Any effect that Internet access taxes may have on Internet access rates would likely be dampened by court rulings that limit a state's ability to require firms to collect the tax. Also, many Internet access purchasers actually buy from smaller, single-state firms. Therefore, Internet access taxes could potentially affect Internet connection rates.

DOES INTERNET ACCESS TAXATION AFFECT INTERNET ACCESS?

Ten states have imposed a tax on Internet access for at least 1 year, but the other states (including the 35 others that impose a general sales tax) have not, providing an excellent opportunity to examine what effect, if any, Internet access taxation has on Internet connection rates. The effect of Internet access taxation is analyzed by comparing Internet connection rates between the taxing and nontaxing states. The finding of a significant difference in Internet connection rates between the two groups of states, holding all other determinants of Internet access equal, would lead to the conclusion that Internet access taxation has affected Internet connection rates within the United States during the time frame of our analysis.

The empirical analysis is carried out using a 3-year discontinuous panel of data representing every U.S. state.[7] The data set includes the percentage of households in a state that are connected to the Internet and the percentage that own a computer for 1998, 2000, and 2001 (U.S. Department of Commerce, various years). Similar data are not available for 1999.

The primary goal is to examine the effect that Internet access taxation has had on Internet access rates. To achieve this, we must control for other determinants of Internet access, including some measure of computer ownership. However, to foreshadow the empirical issues encountered in our analysis, computer ownership decisions are likely to be simultaneous with Internet access decisions, leading to familiar endogeneity concerns. A proper multivariate regression analysis would thus require an instrumental variable that explains computer ownership but does not independently influence Internet access. Unfortunately, we were unable to find a sufficiently strong instrument; the close relationship between the two variables makes this difficult.[8]

For this reason, a broader, more disaggregated focus is chosen over an analysis that focuses on Internet access rates exclusively. More specifically, the relationship between Internet access taxes and the following three measures is examined: the Internet access rate (*NET*), the computer ownership rate (*Computer*), and the Internet access rate conditional on computer ownership (*NET/Computer*). This

broad focus enables an understanding of any effect of Internet access taxation from a variety of angles, and endogeneity issues can be avoided.

The first step is a simple ranking of the values of these three indicators for all states, in which the ranking is based on the average across the 3 years of data (see Table 2). The first ranking shows the percentage of households in each state that is connected to the Internet. States that have taxed Internet access for at least 1 of the 3 years are denoted in bold print. With the exception of Connecticut, all of the states that have taxed Internet access charges lie within the lower half of the distribution. The second ranking presents data on computer ownership rates. Here, most of the taxing states are still within the lower half, although Iowa and Wisconsin appear in the upper half. The third column presents the ranking in terms of Internet users as a share of computer owners. Here, two taxing states are within the upper half, whereas the rest are in the lower half. These rankings provide weak evidence that a tax on Internet access might have lowered Internet access rates, regardless of whether we condition on computer ownership.

The second step is to compare sample means of the three measures between those states that have taxed Internet access and those that have not to determine whether a significant difference exists between the two groups of states in terms of access rates, computer ownership rates, and Internet users as a share of computer owners. The means and standard deviations of these variables for the two groups of states are reported as follows:

	Mean	*Standard Deviation*
Internet access rate (*NET*)		
States that *did not* levy access taxes	39.75	11.90
States that *did* levy access taxes	36.96	11.06
Computer ownership rate (*Computer*)		
States that *did not* levy access taxes	50.77	9.30
States that *did* levy access taxes	48.45	7.00
Internet users as a share of computer owners (*NET/Computer*)		
States that *did not* levy access taxes	76.78	12.27
States that *did* levy access taxes	74.68	13.13

TABLE 2: State Rankings of Key Variables

State	*Internet Access*	*State*	*Ownership*	*State*	*Internet Users as a Share of Computer Owners*
Alaska	55	Alaska	65	**Connecticut**	**84**
New Hampshire	52	Utah	65	Florida	84
Washington	49	New Hampshire	62	Alaska	83
Colorado	48	Washington	61	New Hampshire	82
Oregon	47	Colorado	61	New Jersey	82
Utah	46	Oregon	59	Massachusetts	81
Connecticut	**46**	Minnesota	56	Vermont	80
New Jersey	45	Idaho	56	Maryland	80
California	44	California	55	Delaware	79
Maryland	44	Maryland	55	Nevada	79
Vermont	44	New Jersey	55	Washington	79
Massachusetts	43	**Connecticut**	**54**	Rhode Island	79
Delaware	43	Vermont	54	Pennsylvania	79
Minnesota	43	Wyoming	54	Georgia	79
Virginia	42	Maine	54	California	79
Hawaii	42	Virginia	53	New York	79
Florida	41	Hawaii	53	Virginia	79
Arizona	41	Delaware	53	Colorado	79
Idaho	41	Arizona	52	Hawaii	78
Maine	41	Kansas	52	Oregon	78
Kansas	40	Massachusetts	52	Arizona	78
Nevada	40	**Iowa**	**51**	**Ohio**	**77**
Rhode Island	40	Michigan	51	Illinois	77
Michigan	40	**Wisconsin**	**50**	Indiana	77
Wyoming	39	Missouri	50	Alabama	76
Missouri	39	Nevada	50	Missouri	76
Ohio	**39**	Montana	49	**Texas**	**76**
Wisconsin	**39**	**Ohio**	**49**	Michigan	76
Pennsylvania	38	Rhode Island	49	**Wisconsin**	**76**
New York	38	**South Dakota**	**49**	West Virginia	76
Illinois	38	Nebraska	49	Kentucky	76
Indiana	38	Illinois	49	Kansas	75
Iowa	**37**	Florida	49	North Carolina	75
Texas	**37**	Indiana	49	**Tennessee**	**75**
Montana	37	**Texas**	**48**	Oklahoma	74
South Dakota	**36**	Pennsylvania	47	Maine	74
Georgia	36	New York	47	Minnesota	74
Nebraska	35	**North Dakota**	**47**	**New Mexico**	**74**
North Dakota	**35**	**New Mexico**	**47**	**South Carolina**	**73**
New Mexico	**35**	Georgia	45	**South Dakota**	**73**

(continued)

TABLE 2 (continued)

State	*Internet Access*	*State*	*Ownership*	*State*	*Internet Users as a Share of Computer Owners*
Tennessee	**34**	**Tennessee**	**45**	Louisiana	73
Kentucky	34	Kentucky	44	**North Dakota**	**73**
North Carolina	33	**South Carolina**	**44**	Idaho	72
South Carolina	**33**	North Carolina	43	Montana	72
Oklahoma	33	Oklahoma	43	Wyoming	71
Alabama	32	Alabama	41	Utah	71
West Virginia	31	West Virginia	40	Nebraska	71
Louisiana	30	Louisiana	39	**Iowa**	**70**
Arkansas	26	Arkansas	38	Mississippi	70
Mississippi	25	Mississippi	35	Arkansas	66

NOTE: Bold indicates those states that have taxed Internet access for at least 1 year.

All three measures are higher, on average, in those states that have never taxed Internet access. However, the difference is very small in all cases—only around 2 to 3 percentage points. In fact, the null hypothesis that the two means are equal cannot be rejected at conventional confidence levels using *t* tests. Similar results were found when the figures were examined on a year-by-year basis.

Of course, the above analyses are overly simplistic because they do not account for other factors that affect Internet usage. Multivariate regression analysis is used to correct this deficiency. Three different regression frameworks are used in the analysis, one for each of the above three measures of Internet access or computer ownership. The key independent variable of interest is a dummy variable for whether a state levied a tax on Internet access in a given year (*TAX*). *TAX* takes the value of 1 if a state levied a tax on Internet access for at least 1 month out of the year and 0 otherwise.

Also included in our regression analyses are several commonly used socioeconomic variables that are expected to be important predictors of Internet access rates. Among these are the percentage of a state's residents older than age 65 (*AGE*), population density (*DENSITY*), per capita personal income (*INCOME*), the poverty rate (*POV-*

TABLE 3: Variable Descriptions and Sources

NET	Percentage of households in a state that have an Internet connection (Department of Commerce 1999, 2000, 2002)
Computer	Percentage of households in a state that own a computer (Department of Commerce 1999, 2000, 2002)
NET/Computer	Households with Internet access as a share of households that own computers (Department of Commerce 1999, 2000, 2002)
TAX	1 if state levies tax on Internet access for at least 1 month out of the year, 0 otherwise (authors' calculations)
AGE	Percentage of people in a state who are older than age 65 (*Statistical Abstract of the United States*, various years)
DENSITY	Population per square mile of land area in a state (*Statistical Abstract of the United States*, various years)
INCOME	Real state personal income per person, in thousands (Bureau of Economic Analysis, various years)
POVERTY	Percentage of a state's residents who live below the poverty line (*Statistical Abstract of the United States*, various years)
RACE	Percentage of a state's residents who are White (*Statistical Abstract of the United States*, various years)
RATE	State general sales tax rate added to the average county and city rate for the state (Sales Tax Clearinghouse, www.taxch.com/STRates.stm)
SCHOOL	Percentage of a state's residents, older than age 25, who have a bachelor's degree (*Statistical Abstract of the United States*, various years)
URBAN	Percentage of a state's residents who live in an urban area (*Statistical Abstract of the United States*, various years)

NOTE: All percentages are on a 0 to 100 scale.

ERTY), the percentage of residents who are white (*RACE*), the percentage older than age 25 who hold a B.A. or higher (*SCHOOL*), and the percentage living in an urban area (*URBAN*). A weighted average state and local sales tax rate for each state (*RATE*) is also included, as earlier research suggests that individuals are significantly more likely to shop online when their sales tax rate is higher (Goolsbee 2000). Table 3 provides a brief summary of all regression variables as well as their sources, and Table 4 provides summary statistics. Three years of data are used for 50 states, providing a sample size of 150.

A panel regression model with random effects for the cross-sectional units is used in the analysis. To further control for potential endo-

TABLE 4: Summary Statistics

	Mean	*Standard Deviation*	*Minimum*	*Maximum*
NET	39.2	11.8	13.6	64.1
Computer	50.3	8.9	25.7	68.7
NET/Computer	76.4	12.4	49.2	94.5
TAX	18.7	39.1	0	1
AGE	12.6	1.9	5.5	18.3
DENSITY	177.1	241.6	1.1	1134.2
INCOME	25.6	3.9	18.5	37.8
POVERTY	11.6	3.2	5.2	21.2
RACE	83.2	12.3	24.3	98.4
RATE	5.7	2.1	0	8.35
SCHOOL	23.6	4.6	13.3	38.7
URBAN	68.1	16.8	27.8	100

NOTE: For definitions of variables, see Table 3.

geneity, we lagged all independent variables one period.[9] The model is specified as follows:

$$NET_{i,t} = \beta_0 + \beta_1 TAX_{i,t-1} + \beta_2 AGE_{i,t-1} + \beta_3 DENSITY_{i,t-1} + \beta_4 INCOME_{i,t-1} + \beta_5 POVERTY_{i,t-1} + \beta_6 RACE_{i,t-1} + \beta_7 RATE_{i,t-1} + \beta_8 SCHOOL_{i,t-1} + \beta_9 URBAN_{i,t-1} + \beta_{10} Year\ 2 + \beta_{11} Year\ 3 + \varepsilon_{it},$$

where i and t are state and year indices, and $\varepsilon_{it} = u_i + w_{it}$. The traditional error term is denoted by w_{it} and is assumed to meet all of the usual requirements, and u_i represents the state-specific random effect. Two dummy variables are included to control for year effects, where *Year 2* represents 2000 and *Year 3* represents 2001. To test the findings of this specification, we repeat the analysis by replacing *NET* with *Computer* and *Net/Computer.* The results of these regressions are presented in Table 5.

Beginning with the first column of results, *TAX* does not have a statistically significant effect on Internet access rates, meaning that Internet access taxation has not deterred Internet usage.[10] The rest of the regression is a good fit, as the overall R^2 indicates that the model is explaining the vast majority of the variation in *NET.* However, the random state effects explain around 67% of the variation. This indicates that other quantifiable and nonquantifiable effects that differ by states are very important determinants of Internet access. In addition, we

TABLE 5: Random Effects Regression Results

	NET	Computer	NET/Computer
TAX	–0.504 (1.017)	–0.775 (1.100)	–0.583 (1.015)
AGE	–0.826** (0.250)	–1.058** (0.268)	–0.056 (0.241)
DENSITY	–0.003 (0.003)	–0.004 (0.003)	0.002 (0.002)
INCOME	0.747** (0.183)	0.261 (0.201)	0.687** (0.193)
POVERTY	–0.156 (0.115)	–0.400** (0.130)	–0.880 (0.167)
RACE	0.090** (0.035)	0.153** (0.038)	–0.009 (0.036)
RATE	–0.871** (0.214)	–0.915** (0.230)	–0.411* (0.208)
SCHOOL	0.258** (0.099)	0.370** (0.111)	0.002 (0.113)
URBAN	0.026 (0.024)	0.076** (0.027)	–0.012 (0.028)
Constant	10.94* (6.377)	34.75** (6.975)	46.3** (6.676)
Year 2	12.95** (0.519)	6.60** (0.586)	18.35** (0.647)
Year 3	21.77** (0.593)	12.26** (0.667)	26.22** (0.717)
R^2	0.925	0.850	0.928

NOTE: Standard errors in parentheses. For definitions of variables, see Table 3.
*Significant at the 10% level. **Significant at the 1% level.

find that the year effects have a large amount of predictive power, with access growing over time.

Income is a strong determinant of Internet access rates, with access rates rising about 0.75 percentage points for each $1,000 increase in real state personal income per person, all else equal. In addition, states with smaller minority populations, more education, and younger populations have higher Internet connection rates. Interestingly, states with higher sales tax rates have lower Internet connection rates, ceteris paribus. The results indicate that a 1 percentage point sales tax rate increase will lead to a 2.2% decrease in the percentage of households that are connected to the Internet.

To be sure, this specification suffers from the inability to control for computer ownership. It may be the case that these factors influence computer ownership rates but have no independent effect on Internet access rates. This possibility is addressed in the second specification, in which the computer ownership rate is the dependent variable. Corresponding to the earlier results, this model finds that Internet access taxation is not a statistically significant determinant of computer ownership rates, thus adding support to the previous finding that *TAX* has no statistically distinguishable effect on *NET*. This model also has strong explanatory power given the overall R^2 of 0.85. However, as with the above model, the random state effects explain most of this

variation. Likewise, year effects also have strong explanatory power. Strangely, income is not a significant determinant of computer ownership rates, although states with more people living in poverty have lower computer ownership rates. Also, other demographic characteristics—including having a more urban, nonminority, or more educated population—positively influence computer-owning households, and states with older populations have lower ownership, all else equal. Finally, a higher sales tax rate translates into a lower computer ownership rate. This suggests that the price effect of high sales tax rates discourages computer ownership.

The results from the first two specifications indicate that computer ownership is a crucial omitted variable that must be controlled for because the omitted variable bias in the access equation could be large because of the strong relationship between computer ownership and the other independent variables. However, the inability to lag computer ownership in the *NET* regression and the more important lack of suitable instrumental variables mean that an alternative method must be used to control for computer ownership. This is achieved in the third specification by using *NET/Computer* as the dependent variable. As with the first two specifications, *TAX* is not found to have a statistically significant effect. This model again results in a high predictive power, as evidenced by the R^2 estimate, and again the random state effects explain most of this variation.

The importance of conditioning on computer ownership becomes abundantly clear, as characteristics that would likely predict both computer use and Internet use independently are no longer significant predictors of the relationship. For example, *AGE*, *RACE*, *SCHOOL*, and *URBAN*, which were significant in at least one of the previous two regressions, are no longer significant once access is conditioned on computer ownership. Instead, per capita income and the sales tax rate are the only statistically significant predictors of the ratio of Internet users to computer owners. Among computer-owning households, higher per capita personal income and lower sales tax rates lead to increased Internet access rates. The negative coefficient on the sales tax rate suggests that people who fail to purchase a computer because of the sales tax are ones who would be particularly likely to go online, so that net access drops relatively faster than computer ownership. Over-

all, the tax results indicate that sales taxation of computer purchases is the dominant tax feature rather than taxation of Internet access. This is not a surprising result because the taxable base from the purchase of a computer can easily represent 100 or more months of Internet access.

A common econometric concern with panel data is whether the random-effects specification is appropriate. An alternative approach would be a fixed-effects specification, whereby changes in variables within states would drive the empirical results. However, the random-effects approach is preferred because the key variable of interest, *TAX*, does not vary significantly during the period of analysis. Consequently, state fixed effects would likely capture most of the influence of *TAX* on our three dependent variables. Clearly, this would produce a less meaningful result, as the effect of *TAX* would be driven entirely by the three states that repealed their Internet access taxes.

However, despite this preference, the possibility remains that a random-effects approach could be econometrically inappropriate if the random effects are correlated with any of the included regressors. A Hausman (1978) test is used to examine whether this correlation exists. The Hausman test leads to rejection of the null hypothesis that the error term and regressors are correlated under the first (with *NET* as the dependent variable) and second specifications (with *Computer*). The null hypothesis cannot be rejected under the third model.[11] Nonetheless, we accept this potential bias and place our reliance on the random-effects models because of the inappropriateness of the fixed-effects framework. Furthermore, even in the fixed-effects models, *TAX* was never found to have a statistically significant effect on any of our three dependent variables.[12]

The main findings are tested further in several other ways. First, regressions are performed without any panel effects (i.e., with neither fixed nor random effects). The analyses are also conducted in a year-by-year framework, running separate ordinary least squares (OLS) regressions for each of the 3 years of data. Finally, the focus is shifted from the levels of *NET*, *Computer*, and *NET/Computer* in each year to their growth rates. The growth rates from 1998 to 2001 are calculated for each of the variables and then regressed on the 1998 values of the set of independent variables used in Table 5. The overarching conclusion from all of these checks is that Internet access taxation (*TAX*) is

never a statistically significant determinant of any of our three dependent variables or their growth rates.

5. CONCLUSION

This study has attempted to understand whether Internet access taxation has affected Internet usage in any way. The United States has provided something of a laboratory for such an experiment, given that 10 states have taxed Internet access at some point in recent history, whereas the other 40 have not. Regression analysis is conducted to compare Internet access, computer ownership, and Internet access conditional on computer ownership between the taxing and nontaxing states. Results show that Internet access taxation has had no statistically discernible effect on any of these three measures. Furthermore, this general conclusion is found to be robust to a wide variety of econometric specifications.

NOTES

1. Goolsbee and Zittrain (1999) also address these issues.

2. See Mazerov and Lav (1998) and Mazerov (2001) for more about the revenue consequences of a tax exemption of Internet access and other revenue implications of the Internet Tax Freedom Act (ITFA).

3. This source may be viewed online at www.cbpp.org/512webtax.htm.

4. See Mazerov (2001) for a discussion.

5. Other states have also taxed Internet access in different ways. New Hampshire levies a two-way telecommunications tax that affects Internet access only in special cases. Washington imposes a business gross receipts tax (the Business and Occupations Tax) that falls on Internet access indirectly. These states are not included as Internet access taxing states in our analysis because our main focus is on states that impose sales-like taxes on Internet access. However, when we repeated our analysis after including these two states in the list of Internet access taxing states, our results did not change.

6. Separating the revenue associated with taxation of Internet access from that arising from other taxable transactions is very difficult because the same vendor may be involved in the provision of Internet access and other taxable activities.

7. An alternative way of addressing the issue at hand would be to examine Internet access rates over time, perhaps in the framework of a natural experiment, for those states that have dropped their Internet access taxes since the ITFA was initially passed. Unfortunately, due to data limitations and the fact that those states removed their access taxes very late in our time period of

analysis, we must wait for more years of data to become available before such an analysis is feasible and appropriate.

8. One possible candidate for an instrumental variable is the presence of a sales tax holiday on computer hardware purchases. However, only two states introduced such a holiday within the time frame of our analysis. Therefore, it proves to be a weak instrument (i.e., it is not a statistically significant determinant of computer ownership).

9. This further complicated the ability to adequately control for computer ownership because computer ownership data could only be obtained for the same 3 years for which Internet access data are available. All other regression variables were available for all "lag" years.

10. An alternative partial explanation is that states are unable to effectively enforce the tax either because of difficulties in identifying service providers or because some Internet service providers assert that no taxable nexus exists. For example, Tennessee estimates that there are 750 Internet service providers in the state, creating significant collection problems. Consumers may see no price effect from the imposition of the tax, even in states where the tax is legally due, if the tax is not being broadly collected.

11. The test statistics for the Hausman (1978) tests in the three regressions were 26.5, 27.8, and 10.7, respectively.

12. Full results from this and all other robustness checks are available from the authors on request.

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