Electronic Tax Filing in the United States: An Analysis of Possible Success factors

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Abstract: This study summarizes and analyses the demographic, socio-economic, and geographic factors affecting electronic tax filing (e-filing) in the United States for the years 1999, and 2004–2007 and the growth in e-filing between 1999 and 2007. Beyond the descriptive analysis, two issues related to electronic tax filing are target of further analysis: First, the variables having a positive impact on e-filing rates and e-filing growth are analysed. Second, because a more detailed look at state and county data indicates high variability within and between states, some demographic, socio-economic, and geographic variables are examined in more detail. This second question addresses the possibility that e-filing – just like other initiatives involving electronic media – could increase the digital gap. We use zip-code level e-filing information and county level demographic, income and unemployment data for each of the years in question. Our findings indicate significant variation in e-filing rates across and within states, and rapid growth over time. E-filing rates are found to be lower in rural counties, counties with low population size, counties with a lower share of females, counties with a higher share of Hispanics and Asians, and counties with a higher share of the elderly population. Surprisingly, educational attainment is negatively correlated with e-filing rate and growth in e-filing.

Keywords: e-government; electronic tax filing rates; electronic tax filing growth; technology acceptance; socio-economic, demographic, and geographic factors

1 Introduction

This study has two main purposes. First, it provides a descriptive analysis of electronic tax return filing (e-filing) at the individual taxpayer level in the United States for the years 1999, and 2004–2007. Second, using county-level data it examines the correlations between certain demographic, socio-economic, and geographic factors and e-filing rates in an attempt to explain some of the variability in e-filing rates and e-filing growth.

Electronic government (e-government) initiatives are an important public policy and public administration issue of the 21st century. A review of the recent literature indicates that e-government concerns many different groups of academics, practitioners, and citizens alike (e.g., Justice et al. 2006; Sprecher 2000; Moon 2002; Yang and Rho 2007; Gil-Garcia and Martinez-Moyano 2007; Yildiz 2007; The Economist, Vol. 386 (February 16, 2008); Salkever and Kharif 2002). Promoters of e-government initiatives believe that these programs will support the goal of more transparency, democracy and equity as well as more efficient and effective governments (Leitner 2003; Wong and Welch 2004; Beynon-Davies 2005). However, critics have been concerned about issues like infrastructure, privacy and security – including homeland security – as well as the digital divide, economic disparities and cost (Seifert 2002; Deakins and Dillon 2002; Jaeger 2003; Jaeger and Thompson 2003). Evaluations of several e-government programs are mixed. For example, many federal agencies fail to meet security standards (Vijayan 2008).

Among various e-government programs, the introduction of electronic tax administration including electronic tax filing (e-filing) has been the largest – in terms of citizens affected – e-government initiatives in the United States. Starting in the 1980s as a partnership between the Internal Revenue Service (IRS) and the tax preparer H&R Block, the program has developed to a successful public-private partnership. In fact, the IRS has been described as one of the most efficient tax collection agencies in the world (Fletcher 2003). Recent announcements by the IRS indicate that e-filing has increased at an impressive rate since its introduction in the late 1990s. Our statistical analysis shows that e-filing for individual taxpayers increased from an average of about 23% in 1999 to around 60% in 2007. More recent IRS information indicates an individual e-filing rate of 61% in 2008 and 69% in 2009. One purpose of this study is therefore to describe e-filing and e-filing growth across different regions in the United States and to identify (some of) the factors that lead to the relative success of federal e-filing.

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While federal e-filing rates in the United States are high and have increased at a high rate, these numbers are not uniform across different population segments and across U.S. regions. Moreover, despite the large increase, between and within state variability has remained high. Thus, the second purpose of this research is to examine the determinants of e-filing by different population segments and regions. More specifically, we address the question whether underprivileged taxpayer groups are falling behind in e-filing. Although some variation is to be expected and acceptable, significant differences both regionally and demographically can be problematic from the equity and possibly the efficiency & effectiveness perspective of public policy. In particular, a non-uniform e-filing rate and e-filing growth rate might be an indicator of the digital gap between the technology users and those who do not have access to electronic services. This could be an indicator of an "equity-efficiency" trade-off. In addition to that, in the long run, these inequities – just as any other inequality within our population – could become costly to the government as the government may have to intervene separately to enhance equity, for example through new government programs aimed at increasing e-filing among some underprivileged groups.

E-filing has been subject to recent academic studies because it provides a rich research setting for the following reasons. Most of the households in the U.S. have to file tax returns; thus, while individuals may not be too familiar with the tax law and the country's tax policy, they are familiar with filing and paying taxes. Furthermore, the tax domain is different from other situations where individuals may choose electronic services over traditional services, such as electronic retail services or online banking because the domain (i.e., the tax law) is fairly complex and most taxpayers are not experts. In addition, e-filing introduces the issues of security and privacy protection and taxpayers' dislike and distrust of the IRS and the government in general. Last but not least, e-filing research provides an intersection of various academic disciplines, namely information systems, public finance, public administration, public policy, and accounting (taxation).

We contribute to the literature by examining not only economic and demographic but also geographic determinants of e-filing within the United States using actual e-filing data from IRS for the years 1999 and 2004 through 2007. Thus, this study complements other e-government literature where individual perceptions and intentions towards e-government are examined with information and analysis of actual e-government use. It is also different from and a complement to survey studies because our data consists of the entire U.S. taxpayer population and not a sample. Hence it is not subject to sample biases as in some other studies.

Our results indicate that e-filing varies significantly across and within states. Specifically, we show that e-filing rates are lower in rural counties, counties with low population size, counties with a lower share of females, counties with a higher share of Hispanics and Asians, and counties with a higher share of the elderly population. E-filing rates grew dramatically between 1999 and 2007 with significant cross-county variation. We point to some rather puzzling results on e-filing. First, e-filing rates and e-filing growth are higher in counties with a larger share of non-whites and Blacks, yet these correlations are negative if the minority in question is the Hispanic population or the Asian population. The most surprising result in our opinion is the negative relationship between education attainment and e-filing rates and e-filing growth.

The remainder of this paper is structured as follows. Section two provides background information and summarizes prior literature. Section three introduces the data and methodology. Section four discusses the results and section five concludes the paper.

2 Background and Literature Review

The introduction of electronic initiatives into various levels of government has been subject to intensive academic and practitioner discussion (e.g., Justice et al. 2006; Sprecher 2000; Moon 2002; Yang and Rho 2007; Gil-Garcia and Martinez-Moyano 2007; Yildiz 2007). E-government services have been described as tools to improve democracy, transparency, and accountability and possibly government performance (Leitner 2003; Beynon-Davies 2005). However, the perception of what e-government should be varies among expert groups from anything that involves the government and the internet to using any type of information technology to provide government services (e.g., Justice et al. 2006; Li and Feeney 2014). Since experts' definitions of e-government and e-government goals vary, no clear measure of e-government success has been established. One stream of e-government research examines the development of e-government and describes it in various stages (Moon 2002; Esteves and Joseph 2008). Other studies survey perceptions of either government managers or citizens (Wang and Liao 2008) or evaluate the websites of government organizations (de Jong and

Lentz 2006; van den Haak et al. 2009). Finally, e-government initiatives may also be analysed in the context of general public administration goals such as enhancing equality and justice as well as efficiency and effectiveness of government services (Mandl et al. 2008; Asgharkani 2005; Krishnan et al. 2013).

Our paper contributes to the growing literature concerning e-government programs and their success. However, the purpose of this paper is not to provide an overall measurement of e-government in the United States. Rather, we examine only one electronic program, namely electronic tax filing, at the federal level. We chose this program because it includes a very large segment of the U.S. population and – at least at the surface – it seems to be a success story in terms of absolute and relative values. Furthermore, we believe that examining this particular program is of interest because the Internal Revenue Service (IRS) interacts with more Americans than any other public or private organization (Fletcher 2003). Most individuals have tax filing experience even if they do not know much about tax laws and/or tax policy. Moreover, most taxpayers are interested in an improved relationship with the tax collection agency through faster refunds, fewer audits, and lower cost of tax filing.

In that context, the main benefits of electronic filing to the customer (taxpayer) are faster preparation of the returns, better accuracy of the returns, and faster refunds. The main benefits to the IRS are fewer unintentional (i.e., computational) errors, lower processing cost, and lower storage cost of the tax return information. Lowering the overall cost of tax administration should be considered good policy because low administration cost is considered a characteristic of a good tax policy (e.g., Brunori 2001, p. 22-24). In fact the IRS's cost of collecting $100 has recently decreased from almost $0.48 to $0.44. Similarly, increasing accuracy and processing speed are consistent with the e-government goals and objectives of improving government efficiency (OECD 2002).

2.1 History of e-filing in the United States

Although an e-filing pilot program existed since the mid-1980s, the actual promotion of this initiative started with the introduction of the 1998 "Internal Revenue Service Restructuring and Reform Act of 1998" (P.L. 105-206) ("RRA"). The purpose of this law was to improve public perception of the IRS, which had suffered from various corruption scandals, as well as increase its overall efficiency. With regard to the latter, §2001(a)(2) of RRA stated the specific goal of 80% electronic tax filing by the year 2007. In the context of this new law, the IRS adopted a strategic plan that included ensuring that all electronically prepared returns can also be filed electronically.

The 80% rate was not been reached in 2007; however, the e-filing rates for 2006 and 2007 and the e-filing growth rates are quite impressive. Our data shows that in 2006 and 2007 overall e-filing rates were at almost 60%. Statistical information retrieved from the IRS website suggests that for the 2008 and 2009 years e-filing of individual tax returns was at 61% and 69%. Furthermore, approximately one-third of these returns was self-prepared while two-thirds were prepared by tax professionals. The next years showed another dramatic increase with the most recent numbers of 119.6 million returns (about 80%) and 122.5 million returns (about 83%) e-filed in 2012 and 2013 respectively. In other words, the stated e-filing goal was reached in 2012 (for the 2011 tax year). Thus, at first glance, federal e-filing of tax returns appears to be an example for a very successful e-government initiative. One purpose of this paper is therefore to summarize the factors that may have contributed to e-filing adoption across the country. Understanding these key "success factors" may help improve other e-government initiatives.

An over 80% electronic filing is an impressive number. Yet, 80% e-filing also implies that even with the great effort of promoting e-filing some returns are still filed using some method other than electronic data transmission (generally regular mail). Further, despite a significant increase of e-filing over the past thirteen years, e-filing rates and e-filing growth rates are not uniform. In fact, average e-filing varies quite significantly by state and within states as illustrated in Tables 1 through 3. Table 1 shows the average county e-file rate for each state for the five sample years (1999, 2004–2007). E-filing averages range from 13% (Alaska) to 38% (South Carolina) in 1999 and 48% (Maine) to 73% (Minnesota) in 2007. Table 2 provides information about the spread of the county averages within states for the 2007 and Table 3 lists the top and bottom five counties for the five sample years (i.e., the tax years 1999, 2004–2007). In 2007 e-filing rates varied within states between under 6 (Hawaii) to around 60 (South Dakota) percentage points. Top e-filing rates in 1999 were over 50% and in 2007 they have increased to around 80%. Bottom e-filing rates range from under 2% in 1999 to around 15%

in 2007 again indicating a large variation across regions. In other words, despite an overall increase of e-filing rates large variations within and between states remained. If e-filing provides significant advantages to both the taxpayer and the tax collection agency, it is important to know which taxpayer and which regions are less likely to e-file. That is, if e-filing rates and e-filing growth are not uniform across population groups and regions, the program might have distributional consequences. Thus, the second issue discussed in this paper is how e-filing rates and e-filing growth differ for underprivileged groups such as minorities, elderly, and the poor as well as across different geographic areas.

Table 1. Average County E-Filing Rates by State

	1999	2004	2005	2006	2007
AK	0.13	0.42	0.47	0.51	0.51
AL	0.31	0.59	0.64	0.67	0.63
AR	0.30	0.56	0.60	0.63	0.59
AZ	0.23	0.49	0.55	0.59	0.60
CA	0.17	0.54	0.58	0.62	0.62
CO	0.15	0.39	0.43	0.48	0.50
CT	0.17	0.42	0.55	0.60	0.62
DC	0.21	0.43	0.48	0.52	0.55
DE	0.23	0.48	0.53	0.57	0.60
FL	0.26	0.49	0.54	0.58	0.58
GA	0.34	0.57	0.62	0.65	0.63
HI	0.15	0.39	0.44	0.48	0.51
IA	0.25	0.64	0.68	0.71	0.70
ID	0.19	0.52	0.58	0.62	0.62
IL	0.22	0.48	0.54	0.57	0.58
IN	0.26	0.50	0.55	0.58	0.65
KS	0.20	0.49	0.54	0.59	0.61
KY	0.27	0.54	0.59	0.63	0.61
LA	0.29	0.50	0.56	0.59	0.58
MA	0.15	0.44	0.55	0.59	0.61
MD	0.20	0.43	0.48	0.52	0.54
ME	0.16	0.37	0.43	0.46	0.48
MI	0.19	0.60	0.65	0.67	0.68
MN	0.22	0.67	0.71	0.73	0.73
MO	0.25	0.53	0.58	0.60	0.60
MS	0.34	0.57	0.63	0.66	0.61
MT	0.16	0.46	0.52	0.56	0.57
NC	0.27	0.50	0.55	0.59	0.58
ND	0.15	0.49	0.55	0.58	0.54
NE	0.14	0.47	0.54	0.57	0.57
NH	0.20	0.42	0.48	0.51	0.53
NJ	0.17	0.43	0.51	0.56	0.59
NM	0.21	0.47	0.51	0.55	0.56
NV	0.23	0.50	0.55	0.58	0.60
NY	0.20	0.41	0.54	0.60	0.61
OH	0.21	0.46	0.52	0.56	0.58
OK	0.23	0.53	0.58	0.62	0.61
OR	0.20	0.50	0.55	0.59	0.60
PA	0.17	0.41	0.47	0.51	0.52

	1999	2004	2005	2006	2007
RI	0.16	0.40	0.47	0.51	0.55
SC	0.38	0.61	0.65	0.68	0.67
SD	0.16	0.45	0.51	0.55	0.53
TN	0.31	0.55	0.60	0.62	0.60
TX	0.23	0.45	0.50	0.53	0.53
UT	0.20	0.50	0.57	0.61	0.63
VA	0.21	0.45	0.50	0.53	0.54
VT	0.14	0.39	0.46	0.50	0.52
WA	0.19	0.45	0.51	0.54	0.56
WI	0.20	0.60	0.65	0.67	0.68
WV	0.21	0.43	0.48	0.54	0.53
WY	0.20	0.46	0.52	0.56	0.59
All Counties	0.23	0.51	0.56	0.59	0.59

Table 2. Lowest and Highest E-Filing Rate by State in 2007

State	Low	High	Standard Dev.
AK	0.38	0.66	0.09
AL	0.52	0.70	0.04
AR	0.37	0.70	0.06
AZ	0.49	0.75	0.06
CA	0.50	0.69	0.04
CO	0.33	0.61	0.06
CT	0.58	0.63	0.02
DC	0.55	0.55	NA
DE	0.57	0.64	0.04
FL	0.48	0.67	0.04
GA	0.52	0.78	0.05
HI	0.48	0.54	0.03
IA	0.53	0.79	0.05
ID	0.49	0.71	0.07
IL	0.44	0.70	0.05
IN	0.56	0.74	0.04
KS	0.37	0.80	0.08
KY	0.40	0.73	0.06
LA	0.47	0.66	0.04
MA	0.59	0.67	0.02
MD	0.44	0.59	0.03
ME	0.41	0.53	0.04
MI	0.50	0.75	0.05
MN	0.64	0.80	0.04
MO	0.31	0.79	0.06
MS	0.31	0.70	0.05
MT	0.23	0.74	0.12
NC	0.45	0.75	0.05

ND	0.15	0.75	0.12
NE	0.25	0.72	0.11
NH	0.50	0.57	0.03
NJ	0.53	0.67	0.04
NM	0.26	0.76	0.10
NV	0.47	0.70	0.06
NY	0.52	0.71	0.04
OH	0.44	0.69	0.05

State	Low	High	Standard Dev.
OK	0.45	0.74	0.06
OR	0.51	0.69	0.04
PA	0.43	0.62	0.05
RI	0.51	0.57	0.03
SC	0.60	0.74	0.03
SD	0.23	0.76	0.12
TN	0.48	0.72	0.05
TX	0.28	0.71	0.07
UT	0.43	0.73	0.06
VA	0.34	0.67	0.07
VT	0.46	0.59	0.04
WA	0.41	0.65	0.05
WI	0.52	0.78	0.05
WV	0.40	0.65	0.06
WY	0.37	0.70	0.07

Table 3. Bottom Five and Top Five E-Filing Counties in 1999 and 2004–2007

	Bottom Five Counties		Top Five Counties	
	County	Rate	County	Rate
1999	Burke, ND	0.01	Shannon, SD	0.66
	Divide, ND	0.02	Camden, GA	0.54
	Liberty, MT	0.02	Liberty, GA	0.52
	Harding, SD	0.03	Butler, KY	0.52
	Highland, VA	0.03	Early, GA	0.51
2004	Liberty, MT	0.17	Shannon, SD	0.81
	Perkins, SD	0.18	Yellow Medicine, MN	0.77
	Harding, NM	0.20	Pipestone, MN	0.76
	Miner, SD	0.20	Lac Qui Parle, MN	0.76
	Meagher, MT	0.21	Jackson, MN	0.76
2005	Liberty, MT	0.21	Shannon, SD	0.84
	Perkins, SD	0.23	Yellow Medicine, MN	0.80
	Gregory, SD	0.23	Lyon, IA	0.80
	Meagher, MT	0.25	Lac Qui Parle, MN	0.79
	Brown, NE	0.25	Pipestone, MN	0.79
2006	Divide, ND	0.19	Shannon, SD	0.86
	Liberty, MT	0.22	Monroe, IA	0.81
	Perkins, SD	0.27	Lyon, IA	0.81

	Meagher, MT	0.27		Yellow Medicine, MN	0.80
	De Baca, NM	0.28		Marion, IA	0.80
2007	Divide, ND	0.15	2007	Yellow Medicine, MN	0.80
	Carter, MT	0.23		Waseca, MN	0.80
	Perkins, SD	0.23		Dodge, MN	0.80
	Wheeler, NE	0.25		Geary, KS	0.80
	Faulk, SD	0.25		Clark, MO	0.79

3 Research Questions

Several papers have examined individual adoption of tax preparation software and/or electronic tax filing. For example, Goolsbee 2002 examines the impact of technology – specifically tax preparation software – on reducing tax compliance cost. He concludes that tax planning programs are concentrated on a small group of taxpayers and that the use of these programs is unlikely to increase. In addition to that, he finds that individuals' adoption of tax preparation is not related to the complexity of their returns but rather to their tech savviness. Further, he argues that the individuals who would most benefit from reducing cost of compliance – namely low income taxpayers and/or people whose native language is not English – are least likely to adopt and use tax preparation programs. Since only electronically prepared tax returns can be electronically filed, Goolsbee's finding indicates that the IRS e-filing initiative could have distributional consequences because of the digital gap. Kopczuk and Pop-Eleches (2005), on the other hand, find that the availability of tax preparation software through professional preparers or volunteer sites has a positive impact on participation in the earned income tax credit (EITC). That is, more people who are eligible for this particular credit will be able to receive it because the availability of electronic tax preparation programs significantly decreased their cost of filing the required forms.

The fact that the IRS, in conjunction with promoting the e-filing initiative, partners with communities to provide tax preparation assistance for the elderly and the poor indicates that officials are concerned about the digital gap. More broadly speaking, one goal of the e-filing program in the United States can be described as reaching out to low income taxpayers to provide them with a low cost opportunity and a quick return (Fletcher 2003; Holden and Fletcher 2005). Because the IRS's private partners want to make a profit, this goal constitutes a conflict in the public-private partnership. To resolve this conflict the IRS provides also free e-filing through various partners – aside from providing tax preparation assistance. It seems that the aggressive promotion of e-filing through the IRS combined with the local assistance programs and the free-filing program are key factors of the overall e-filing success.

Another stream of the e-filing literature – mostly in the information systems discipline – focuses on individual characteristics and perceptions using survey methodology. For example, Wang 2003, Chang et al. 2005, Fu et al. 2006, and Tan and Foo 2012 examined e-filing in Taiwan and Malaysia using modified versions of the technology acceptance model (Davis 1989) and survey methodology. They find that in addition to the traditional technology acceptance constructs – perceived ease of use, perceived usefulness, social environment, and demographics – security and privacy, timeliness, relevance and accuracy, system reliability, response time, and ease of navigation, and compatibility with the taxpayers needs and experience are important determinants of individuals' intention to e-file.

Our study will incorporate the hypotheses related to demographics and technology acceptance – to the extent possible – but will not focus on individual perceptions and intentions. Instead we focus on other factors that have been discussed in the e-government literature. We use actual e-filing information by county for five years (namely 1999 and 2004–2007) and combine these data with demographic and geographic information.

Digital technology use has been shown to vary among different demographic groups, socio-economic classes, and between different types of regions, such as cities versus rural areas (De Blasio 2008; Polat 2012; Wodajo and Kimmel 2013). Specifically, prior research finds that in general, white urban young males with higher incomes are more likely to use electronic technology (Reddick 2005). However, our situation is confounded by the IRS's effort to bring e-filing to the poor, non-white, and non-English speaking population. If poor, non-white, female taxpayers are less likely to electronically file their tax returns but the IRS is specifically reaching out to them via community service programs, e-filing might actually be higher in areas with a low-income non-

white more female population. Another confounding variable is the fact that some paid tax preparers heavily advertise their services – including the availability of refund anticipation loans (RALs) – to low income and non-English speaking individuals. A study by the Children's Defense Fund (2008) shows that nationwide over 25% of the returns with EITC also had RALs. To the extent possible we will try to take these confounding factors into account when discussing our results.

In summary, the literature suggests that adoption of technology depends on the following individual characteristics:

- Demographic factors such as age, gender, education, ethnicity
- Individual economic factors (income, unemployment)
- Individual perceptions of the technology (such as perceived user friendliness and anticipated learning curve as well as perceived influence of others)

At the same time facilitating conditions also play a role. In this case, the IRS's promotion of e-filing, the presence of Volunteer Income Tax Assistance (VITA) and Tax Counseling for the Elderly (TCE) programs can be categorized as facilitating conditions. Geographic aspects such as rural versus urban areas may be additional – but likely highly correlated – factors. These relationships are illustrated in figure 1 below.

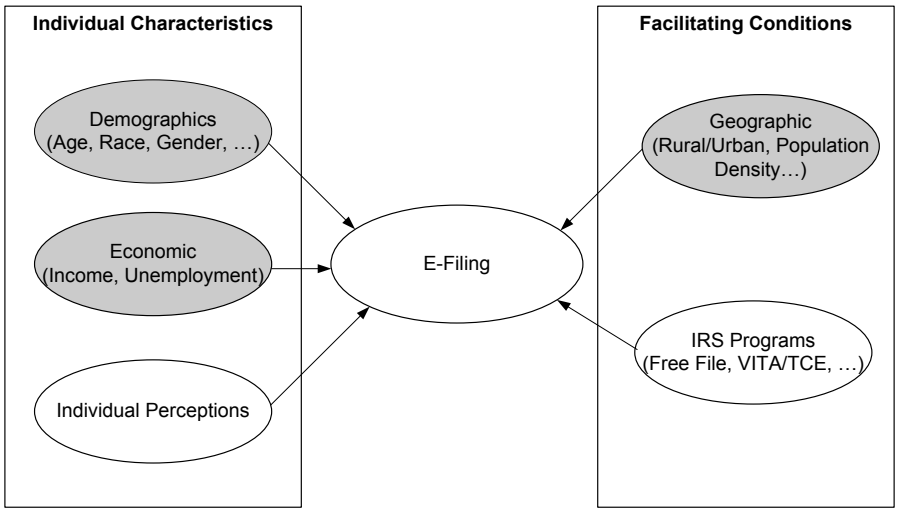

Figure 1. Individual Factors and Facilitating Conditions Affecting E-Filing Rates

The present study addresses some individual characteristics (demographics and economic factors) as well as certain facilitating conditions (geographic area) by asking the following research questions:

- How are a county's average demographic factors such as aging and young population, gender and minority distribution and education attainment correlated to its e-filing rate and growth?
- How are a county's economic measures such as average income and unemployment rates correlated to its e-filing rate and growth?
- Is there a relationship between rural and urban classification of a county and its e-filing rate and growth?

The next section introduces and describes the dataset and the empirical methodology.

4 Data and Methodology

We use e-filing data from the IRS Statistics of Income ("SOI") Division and additional demographic and geographic information from the Bureau of Economic Analysis (BEA), the Bureau of Labor Statistics (BLS) and the census bureau. The IRS e-filing information is available for five years (1999 and 2004 through 2007) for each zip-code. We aggregated the zip-code information to county data and combined this information with the BEA, the BLS, and the census data. After eliminating missing information 15,683 observations (roughly 3,100 counties) for the five years remained.

For our analysis we use the following OLS regression models and control for year and individual state effects:

(1) $EFILE_{it} = \beta_0 + \beta_1 MINORITY_{it} + \beta_2 POP20YOUNGER_{it} + \beta_3 POP65OLDER_{it} + \beta_4 GENDER_{it} + \beta_5 LOGPOP_{it} + \beta_6 LOGINC_{it} + \beta_7 UNEMP_{it} + \beta_8 RURAL_{i2000} + \beta_9 EDUC_{i2000} + \sum_i \gamma_i S_i + \sum_t \delta_t T_t$

(2) $EFILEGROWTH_i = \beta_0 + \beta_1 EFILE_{i99} + \beta_2 MINORITY_{i99} + \beta_3 POP20YOUNGER_{i99} + \beta_4 POP65OLDER_{i99} + \beta_5 GENDER_{i99} + \beta_6 LOGPOP_{i99} + \beta_7 LOGINC_{i99} + \beta_8 UNEMP_{i99} + \beta_9 RURAL_{i2000} + \beta_{10} EDUC_{i2000} + \sum_i \gamma_i S_i$

Our dependent variables are the e-filing percentage in year t (1999 and 2004–2007) and county i (model (1)) and the e-filing growth rate in county i (model (2)). For the e-filing growth variable we calculated the growth rate between 1999 and 2007 for each county i and included the 1999 e-filing rates as independent variable. The other independent variables in the growth regression (model (2)) are also from the 1999 tax year.

The demographic variables include ethnicity, gender, and age. We test for the impact of minority populations with several separate *MINORITY* variables, namely the proportion of the non-white, the Hispanic, the Black, and the Asian population (measured as percentage of total population in each county). *POP20YOUNGER* (population 20 and younger) and *POP65OLDER* (population 65 and older) indicate whether the county is inhabited by older and/or younger people (as percentage of total population). For *GENDER* we test the impact of the percentage of female population in each county and year. Two economic variables, namely an income measure (*LOGINC*) and the unemployment rate (*UNEMP*) assess the effect of income per capita and employment status. *LOGINC* is the natural log of the per-county average personal income per capita and *UNEMP* is the number of unemployed individuals as percentage of the total labor force. Facilitating conditions are measured using the counties' geographical information. The natural log of the total population (*LOGPOP*) is included to account for the fact that more populated counties may have higher e-filing rates because there are more IRS services available. The rural measure is the percentage of population living in rural versus urban areas for each county. We use the percentage of population older than 25 with at least a four-year college degree as a measure of education attainment. Unfortunately, the rural population and the education measures are only available for the year 2000. S_i represents the state fixed effects where the state dummies control for systematic differences between states. T_t is the set of time indicator variables where dummy variables for each but one year included in the panel. The year dummy variables control for time effects in regression (1). Summary statistics for the dataset for all years combined and each year individually are provided in Table 4.

Table 4. Summary Statistics for Independent Variables

All Years combined

Variable	Mean	Median	Standard Deviation	Minimum	Maximum
Non-white percentage	0.133	0.063	0.160	0.000	0.952
Hispanic percentage	0.072	0.025	0.125	0.001	0.975
Black percentage	0.090	0.022	0.144	0.000	0.864
Asian percentage	0.010	0.004	0.023	0.000	0.468
Young (<20) percentage	0.266	0.264	0.035	0.130	0.499
Older (> 64) percentage	0.151	0.148	0.042	0.018	0.362
Female percentage	0.503	0.507	0.021	0.252	0.581
Unemployment rate	0.052	0.049	0.020	0.007	0.306
Total population	94,433	25,252	305,832	54	9,862,049
Income per capita	$26,897	$25,794	$7,401	$451	$132,728
Education attainment in 2000	16.536	14.500	7.788	4.900	63.700
Rural population in 2000 (in %)	0.599	0.603	0.310	0.000	1.000

Year 1999

Variable	Mean	Median	Standard Deviation	Minimum	Maximum
Non-white percentage	0.128	0.055	0.161	0.002	0.952
Hispanic percentage	0.062	0.018	0.120	0.001	0.975
Black percentage	0.089	0.018	0.146	0.000	0.864
Asian percentage	0.009	0.003	0.022	0.000	0.468
Young (<20) percentage	0.284	0.281	0.034	0.164	0.499
Older (> 64) percentage	0.147	0.144	0.042	0.018	0.347
Female percentage	0.504	0.507	0.020	0.328	0.575
Unemployment rate	0.049	0.042	0.027	0.007	0.306
Total population	89,992	24,721	293,496	358	9,544,112
Income per capita	$21,996	$21,217	$5,289	$8,170	$79,631

Year 2004

Variable	Mean	Median	Standard Deviation	Minimum	Maximum
Non-white percentage	0.133	0.063	0.160	0.002	0.943
Hispanic percentage	0.071	0.025	0.125	0.001	0.972
Black percentage	0.090	0.021	0.144	0.000	0.859
Asian percentage	0.010	0.004	0.023	0.000	0.450
Young (<20) percentage	0.265	0.263	0.033	0.150	0.472
Older (> 64) percentage	0.150	0.146	0.042	0.021	0.355
Female percentage	0.503	0.507	0.021	0.290	0.578
Unemployment rate	0.057	0.054	0.018	0.016	0.201
Total population	94,213	25,092	305,788	295	9,846,010
Income per capita	$26,299	$25,308	$6,287	$11,414	$89,413

Year 2005

Variable	Mean	Median	Standard Deviation	Minimum	Maximum
Non-white percentage	0.134	0.064	0.160	0.000	0.942
Hispanic percentage	0.073	0.026	0.126	0.001	0.972
Black percentage	0.090	0.022	0.144	0.000	0.859
Asian percentage	0.010	0.004	0.023	0.000	0.447
Young (<20) percentage	0.262	0.260	0.034	0.140	0.468
Older (> 64) percentage	0.151	0.147	0.042	0.027	0.356
Female percentage	0.503	0.506	0.021	0.272	0.580
Unemployment rate	0.054	0.051	0.018	0.018	0.209
Total population	95,076	25,220	307,769	57	9,826,493
Income per capita	$27,373	$26,220	$6,852	$451	$100,904

Year 2006

Variable	Mean	Median	Standard Deviation	Minimum	Maximum
Non-white percentage	0.135	0.066	0.160	0.000	0.942
Hispanic percentage	0.075	0.027	0.127	0.001	0.972
Black percentage	0.091	0.023	0.144	0.000	0.860
Asian percentage	0.011	0.005	0.024	0.000	0.449
Young (<20) percentage	0.260	0.258	0.034	0.130	0.461
Older (> 64) percentage	0.153	0.148	0.042	0.027	0.360
Female percentage	0.503	0.506	0.021	0.252	0.581
Unemployment rate	0.049	0.046	0.017	0.016	0.205
Total population	96,009	25,463	309,525	54	9,807,870
Income per capita	$28,474	$27,203	$7,513	$8,264	$119,141

Year 2007

Variable	Mean	Median	Standard Deviation	Minimum	Maximum
Non-white percentage	0.136	0.067	0.160	0.002	0.941
Hispanic percentage	0.077	0.028	0.128	0.001	0.973
Black percentage	0.091	0.023	0.144	0.000	0.860
Asian percentage	0.011	0.005	0.024	0.000	0.446
Young (<20) percentage	0.257	0.255	0.035	0.137	0.455
Older (> 64) percentage	0.155	0.151	0.043	0.029	0.362
Female percentage	0.503	0.506	0.022	0.261	0.580
Unemployment rate	0.049	0.046	0.017	0.015	0.199
Total population	96,871	25,598	312,377	281	9,862,049
Income per capita	$30,339	$28,953	$8,006	$8,579	$132,728

Variable explanation:

Nonwhite percentage: Nonwhite population as a percentage of total population of county i
Hispanic percentage: Hispanic population as a percentage of total population of county i
Black percentage: Black population as a percentage of total population of county i
Asian percentage: Asian population as a percentage of total population of county i
Young percentage: Population younger than 20 as a percentage of total population of county i
Older percentage: Population 65 and older as a percentage of total population of county i
Female percentage: Female population as a percentage of total population of county i
Unemployment rate: Number of unemployed as a percentage of the total labor force of county i
Total population: Total population of county i
Income per capita: Personal income per capita for county i
Education attainment: Population with at least a four-year college degree as percentage of total population in the year 2000 in county i
Rural population in 2000: Population living in rural areas as a percentage of total population in 2000

5 Empirical Results

The results of regression models (1) and (2) are listed in Table 5 and Table 6 respectively, which illustrates the impact of the demographic, socio-economic, and geographic variables on the level of e-filing in each county and how the 1999 variables determined e-filing growth between 1999 and 2007.

The results show that e-filing is more prevalent in more urban counties with a larger population, a larger non-white or Black population but a smaller Hispanic or Asian population. Additionally, the share of females and under 20 year olds in the population and the number of unemployed individuals is also positively related to

the e-filing rate. Older individuals and a more educated population appear to affect the county's e-filing rate negatively.

Of these results several are quite surprising. For example, we find it puzzling that on the one hand the share of non-whites and the share of Blacks positively impacts e-filing while the share of Hispanics and Asians have a negative impact. Similarly, one would expect the female percentage in the population to be either not significant because of relatively low variability across counties or negatively correlated with the adoption of e-filing because – as prior research has shown – women tend to be more hesitant in accepting new technology. The most remarkable unexpected results are the negative relationships of income and e-filing and education attainment and e-filing and the positive correlation of unemployment rate and e-filing. Possible explanations for this phenomenon are discussed below.

Table 5. Determinants of Electronic Tax Filing: OLS Regression Results

Dependent Variable: E-filing Rate

		Minority Variable is:			
		Non-white	Hispanic	Black	Asian
R-square		0.855	0.855	0.854	0.855
Intercept	Parameter estimate	0.534	0.592	0.533	0.521
	Standard error	0.037	0.038	0.037	0.037
	p-value	<.0001	<.0001	<.0001	<.0001
Minority Variable	Parameter estimate	0.045	-0.055	0.035	-0.297
	Standard error	0.005	0.006	0.006	0.033
	p-value	<.0001	<.0001	<.0001	<.0001
Young percentage	Parameter estimate	0.080	0.196	0.124	0.112
	Standard error	0.027	0.028	0.027	0.027
	p-value	0.003	<.0001	<.0001	<.0001
Older percentage	Parameter estimate	-0.425	-0.405	-0.427	-0.450
	Standard error	0.024	0.024	0.024	0.024
	p-value	<.0001	<.0001	<.0001	<.0001
Female percentage	Parameter estimate	0.215	0.163	0.199	0.177
	Standard error	0.033	0.033	0.033	0.033
	p-value	<.0001	<.0001	<.0001	<.0001
Log total population	Parameter estimate	0.007	0.006	0.007	0.007
	Standard error	0.001	0.001	0.001	0.001
	p-value	<.0001	<.0001	<.0001	<.0001
Log income per capita	Parameter estimate	-0.047	-0.051	-0.047	-0.044
	Standard error	0.004	0.004	0.004	0.004
	p-value	<.0001	<.0001	<.0001	<.0001
Unemployment rate	Parameter estimate	0.056	0.156	0.111	0.168
	Standard error	0.035	0.033	0.034	0.033
	p-value	0.103	<.0001	0.001	<.0001
Rural percentage 2000	Parameter estimate	-0.020	-0.027	-0.019	-0.022
	Standard error	0.003	0.003	0.003	0.003
	p-value	<.0001	<.0001	<.0001	<.0001
Education Attainment 2000	Parameter estimate	-0.002	-0.002	-0.002	-0.002
	Standard error	0.000	0.000	0.000	0.000
	p-value	<.0001	<.0001	<.0001	<.0001

Year and state dummies omitted.

Variable explanation:

Nonwhite percentage: Nonwhite population as a percentage of total population of county i
Hispanic percentage: Hispanic population as a percentage of total population of county i
Black percentage: Black population as a percentage of total population of county i
Asian percentage: Asian population as a percentage of total population of county i
Young percentage: Population younger than 20 as a percentage of total population of county i
Older percentage: Population 65 and older as a percentage of total population of county i
Female percentage: Female population as a percentage of total population of county i
Unemployment rate: Number of unemployed as a percentage of the total labor force of county i
Log total population: Natural log of total population of county i
Log income per capita: Natural log of personal income per capita for county i
Rural population in 2000: Population living in rural areas as a percentage of total population in 2000
Education attainment: Population with at least a four-year college degree as percentage of total population in the year 2000 in county i

With regard to the e-filing growth rate between 1999 and 2007 we find evidence of "catching up" for counties with low e-filing rates in 1999. Specifically, we find that the 1999 e-filing rate is strongly negatively related with e-filing growth (at around –0.56) indicating that counties with low e-filing rates in 1999 have higher e-filing growth between 1999 and 2007. Also, population size, unemployment rates, and share of female population are negatively and share of elderly is positively related to the e-filing growth rate. On the other hand, rural population and college education attainment are not significant and income is only marginally significantly related to e-filing growth. The young population not only impacts the e-filing rate positively (Table 5) but also the e-filing growth rate. Finally, with the exception of the Asian population measure, the sign for the minority variables is the same as for the level regression (i.e., positive for share of non-whites and share of Blacks; negative for share of Hispanics).

Table 6. Determinants of E-Filing Growth: OLS Regression Results

Dependent Variable: Growth of E-filing between 1999 and 2007

		Minority Variable is:			
		Non-white	Hispanic	Black	Asian
R-square		0.844	0.844	0.844	0.844
Intercept	Parameter estimate	0.237	0.251	0.238	0.239
	Standard error	0.031	0.031	0.031	0.031
	p-value	<.0001	<.0001	<.0001	<.0001
E-filing Rate in 1999	Parameter estimate	-0.564	-0.561	-0.564	-0.560
	Standard error	0.008	0.008	0.008	0.008
	p-value	<.0001	<.0001	<.0001	<.0001
Minority Variable	Parameter estimate	0.007	-0.016	0.010	0.025
	Standard error	0.004	0.005	0.004	0.029
	p-value	0.041	0.001	0.022	0.381
Young percentage	Parameter estimate	0.118	0.143	0.124	0.128
	Standard error	0.022	0.022	0.021	0.021
	p-value	<.0001	<.0001	<.0001	<.0001
Older percentage	Parameter estimate	0.038	0.047	0.038	0.042
	Standard error	0.020	0.020	0.020	0.020
	p-value	0.064	0.022	0.065	0.038
Female percentage	Parameter estimate	-0.088	-0.103	-0.091	-0.092
	Standard error	0.029	0.029	0.028	0.028
	p-value	0.002	0.000	0.001	0.001
Log total population	Parameter estimate	-0.002	-0.002	-0.002	-0.002
	Standard error	0.001	0.001	0.001	0.001
	p-value	<.0001	<.0001	0.000	<.0001
Log income per capita	Parameter estimate	0.006	0.004	0.006	0.005
	Standard error	0.003	0.003	0.003	0.003
	p-value	0.067	0.144	0.067	0.081

Unemployment rate	Parameter estimate	-0.086	-0.067	-0.084	-0.078
	Standard error	0.019	0.019	0.019	0.019
	p-value	<.0001	0.001	<.0001	<.0001
Rural percentage 2000	Parameter estimate	0.000	0.000	0.000	0.000
	Standard error	0.000	0.000	0.000	0.000
	p-value	0.797	0.518	0.713	0.656
Education Attainment 2000	Parameter estimate	-0.002	-0.003	-0.001	-0.002
	Standard error	0.002	0.002	0.002	0.002
	p-value	0.425	0.131	0.561	0.417

State dummies omitted.

Variable explanation:

E-filing in 1999: E-filing rate in 1999 for county i
Nonwhite percentage: Nonwhite population as a percentage of total population of county i
Hispanic percentage: Hispanic population as a percentage of total population of county i
Black percentage: Black population as a percentage of total population of county i
Asian percentage: Asian population as a percentage of total population of county i
Young percentage: Population younger than 20 as a percentage of total population of county i
Older percentage: Population 65 and older as a percentage of total population of county i
Female percentage: Female population as a percentage of total population of county i
Unemployment rate: Number of unemployed as a percentage of the total labor force of county i
Log total population: Natural log of total population of county i
Log income per capita: Natural log of personal income per capita for county i
Rural population in 2000: Population living in rural areas as a percentage of total population in 2000
Education attainment: Population with at least a four-year college degree as percentage of total population in the year 2000 in county i

These results imply that the IRS's enormous effort to reach out and improve e-filing has been, to a certain extent, successful. Note that despite this effort cross-county variability of e-filing rates remains high (Tables 2 and 3).

5.1 Robustness Analysis

In order to test if some of our results relate to specific variables, multi-collinearity, and other biases, we re-estimated our models as follows. First, we ran regression model (1) without the rural and the education attainment variables because these two measures are only available for the year 2000 (not tabulated). We also repeated model (1) for each of the five years separately (see footnote **Error! Bookmark not defined.**). Qualitatively, the results remain similar. Next, we excluded the county population size variable in model (1) and in model (2) because population is also the denominator of the dependent and several independent variables (not tabulated). Again, qualitatively the results are similar.

Since the e-filing initiative was not strongly promoted until the passage of the RRA in 1998, we removed the 1999 tax year from the sample for model (1). The only notable difference is that when excluding the 1999 information the unemployment rate is negatively correlated with e-filing. The remaining results are qualitatively similar (not tabulated).

Since professional preparers are more likely to use e-filing services, we include a variable to control for the percentage of returns filed by professional services. Note that this variable includes the returns filed through local volunteer programs, such as the volunteer income tax assistance (VITA) program and the assistance for the elderly programs. The results (not tabulated) show that preparer variable is positive and significant for both regression models. Yet including a preparer variable does not significantly change the overall results.

In summary, our robustness checks show that the results hold in various situations. The next section discusses some of these findings in more detail and concludes.

6 Discussion and Conclusion

The purpose of this research was two-fold. First, we set out to describe the various factors that facilitated the federal e-filing "success story." In particular, we show that several individual as well as environmental factors play a role. In this case, the fact that the IRS had a mandate to increase e-filing to 80% by 2007 had a huge impact on the program's success. The public-private partnership between tax software produces and the federal agency is quite unique and served the purpose well. While adoption of e-filing happened incredibly fast, the rates of increase have decreased in the past years (see Figure 2 below). In order to reach more segments of the population, the program needs to continue its effort. Just recently, the Electronic Advisory Committee of the IRS submitted a report with ten recommendations including making tax preparers e-file certain returns, rebranding e-filing, and collaborating with industry on software standards.

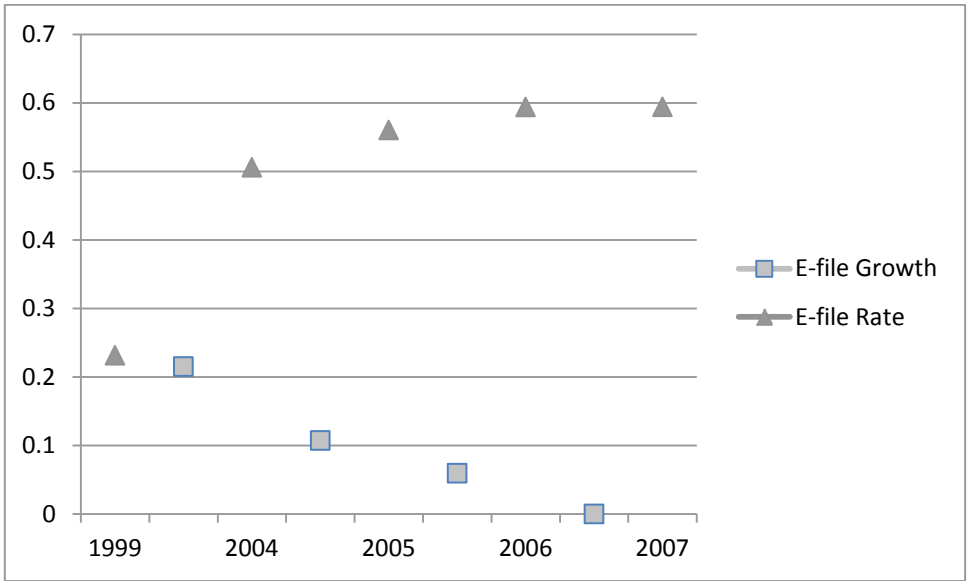

Figure 2. Overall E-filing Rates and E-filing Growth Rates in the U.S. (Years 1999; 2004–2007)

The second purpose of this paper was to investigate how different population groups and regions adopt e-filing. Our results indicate that e-filing varies significantly across and within states. Specifically, we show that e-filing rates are lower in rural counties, counties with low population size, counties with a lower share of females, counties with a higher share of Hispanics and Asians, and counties with a higher share of the elderly population. E-filing rates grew dramatically between 1999 and 2007; however, the cross-county variability remains significant. At first glance the results of model (2), the e-filing growth regression, show evidence of convergence in e-filing across counties. Most notable the negative relationship between the 1999 level data and the growth rate suggests that counties that originally had low e-filing rates are catching up over time. However, the results for the other variables in the growth regression (model (2), Table 6) reveal that it is not that simple. For example, counties with a high share of younger people have higher e-filing rates as well as higher e-filing growth rates. Similarly, and more problematically, counties with a high share of Hispanics and a low share of Asian population have lower e-filing rates and lower e-filing growth rates. This could be evidence for the presence of the digital gap and needs to be addressed if the e-filing program should be equitable.

In addition, this research provides several rather puzzling results. First, e-filing rates and e-filing growth are higher in counties with a larger share of non-whites and Blacks, yet these correlations are negative if the minority in question is the Hispanic population or the Asian population. This could be an indicator that certain minorities are more likely to use community outreach programs for tax return preparation assistance than others. The fact that high unemployment and low income as well as higher female population also positively affect e-filing rates supports this possibility. Without more information about the presence of VITA and TCE programs in each county it is difficult to prove this hypothesis. Alternatively, this phenomenon could also be related to language barriers assuming that non-whites other than Hispanics are mostly African-American. If this is the case, the e-filing program should focus (even more) on Spanish translations.

The most surprising result in our opinion is the negative relationship between education attainment and e-filing rates and e-filing growth. This indicates that taxpayers in counties with more college educated people are less likely to use e-filing. One possibility for this could be the presence of tax preparation services in conjunction with the offer of refund anticipation loans. We suspect that more educated people are less likely to use these services. (Most of these services use e-filing and the data available to us does not distinguish between e-filing from home, from a community outreach program, or from a paid tax preparer.)

We think that our findings will be useful for officials who are concerned with the incidence of e-filing at the federal level. Some of these findings can also be generalized to other government levels and therefore improve policymakers' understanding of e-filing of various other taxes at the state and local levels. Furthermore, findings regarding e-filing may also apply to the adoption of other e-government initiatives.

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