
Jeffrey A. Dubin*

This paper tests empirically whether measurable activities of the IRS Criminal Investigation Division (CI) affect taxpayer compliance. The analysis is based on a state-level cross-section for the time period: 1988 through 2004. I find that IRS audits and CI enforcement activities have a measurable and significant effect on voluntary compliance. Simulations using the estimated models show that the direct effect of doubling the audit rate on assessed tax collections (reported amounts and additional taxes and penalties) is $22.0 billion. Doubling CI tax and money laundering sentences is forecast to increase assessed collections by $11.2 billion. IRS enforcement is found to be extremely cost effective but underutilized. I estimate the general deterrence or spillover effects from either audit or CI activities to be approximately 95%.

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* The author is Professor of Economics, California Institute of Technology, Pasadena, California, 91125. James Lin (Ph.D candidate, U.C. Irvine) provided excellent research assistance. The author thanks Patrick Travers (Operations Research Analyst in CI Research), Debbie King (Director of CI Research), Alan Plumley (Economist and Technical Advisor in IRS Office of Research), and Colleen McGuire (Senior Associate, ICF Consulting) for their assistance and comments.
1. **INTRODUCTION**

Recent estimates from the Internal Revenue Service (IRS) indicate that the annual tax gap (i.e., the difference between taxes owed and taxes paid on a timely basis) was $345 billion for tax year 2001.\(^1\) Of this amount, IRS enforcement activities and late payments recovered about $55 billion, leaving a net tax gap of $290 billion. According to the IRS, roughly $197 billion of the tax gap was attributable to individual taxpayers, nearly triple the level estimated in 1985.\(^2\) While the tax gap has grown, the IRS’ ability to audit and enforce the tax code has diminished. For instance, in 2002, the IRS had roughly 13,000 revenue and tax agents devoted to examination. This number decreased from the 18,000 revenue and tax agents employed in 1995. Next to these numbers, the Criminal Investigations Division of the IRS (CI) appears small. In 1970, CI had approximately 2,500 agents. By 1998, the number of CI agents had increased to approximately 3,000 agents. Due to the increases in the tax gap, it is important to reassess the role played by examination in taxpayers’ voluntary compliance and to ascertain what effect CI investigations play in general deterrence.

The empirical approach used in this paper follows Dubin, Graetz and Wilde (1990) (DGW). The DGW method can determine both specific and general deterrence effects of CI activities, as well as the effects of audit rates on taxpayer

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\(^2\) The tax gap attributable to individual taxpayers was estimated to be $70 billion in 1988 the date of the last complete Taxpayer Compliance Measurement Program (TCMP) audit. Recent estimates of the tax gap are based on the audits of 46,000 individual income tax returns from 2001 conducted as part of the National Research Program (NRP). The NRP reported a noncompliance rate of 16.3 percent of true tax liability, 80 percent of which was due to under-reported income.
compliance. Although the general deterrence effects provided by audits have been widely acknowledged, the IRS never reported the “spillover” benefits of audits. Spillover benefits are the increase in collections from taxpayers, whether or not they are audited, who report more taxes in response to an increased likelihood of an audit. DGW’s principal innovation was to directly estimate taxes due, rather than first attempting to construct a noncompliance measure and then extrapolating from noncompliance to revenue. The empirical analysis in DGW was based on two econometric models that were both estimated using a state level time-series cross-section data set for the years 1977-86. One model specified reported taxes per return filed as a function of audit rates and a variety of socioeconomic factors. The other model specified returns filed per capita as a function of the same variables.

The current study’s purpose is to reassess the role of IRS examination in tax compliance. Specifically, I have updated the DGW analysis using data from the period 1987-2004. This provides an additional eighteen years of data beyond the DGW study. In addition to updating the DGW analysis, additional information made available by the IRS allows a more refined consideration of IRS enforcement activities. The individual audit rate is now separated into three components: examinations conducted by revenue agents, examinations conducted by tax agents, and correspondence audits. This allows me to test the proposition, often advanced by the IRS, that audits conducted by mail (correspondence audits) are an effective substitute for traditional face-to-face audits. This study is also able to measure the effects of the CI enforcement on
I empirically test whether CI’s measurable activities affect taxpayer compliance. I also extend the DGW model to include a more detailed representation of Federal tax rates. This treatment was required given changes in tax policy that occurred during the 1987-2004 period, especially tax cuts occurring in 2001, and subsequent years that were part of the Bush administration's tax reform and tax stimulus packages.

I reach several conclusions. First, a significant structural change in tax administration occurred since the original DGW study due to the Tax Reform Act of 1986. Second, focusing on the last eighteen years, I find that IRS audits continue to have a measurable and statistically significant effect on taxpayer compliance. However, the individual audit rate has continued to decline since DGW first published their findings and is now only 35 percent of its level in 1977-1986. Of equal importance, the marginal effectiveness of audits has declined so that those audits that are now done are not as effective in promoting general deterrence as they were nearly twenty years ago. I do not find support for the proposition that correspondence audits are an effective substitute for face-to-face audits. Third, I find marginally significant results from CI sentenced cases on general tax deterrence. I performed simulations to determine the direct revenue (spillover) effect of audits and CI activities. I find that the direct effect of doubling the audit rate on assessed tax collections (reported amounts and additional taxes and penalties) is $22.0 billion. Further, doubling CI tax and money laundering sentences could increase assessed collections by $11.2 billion. I estimate the

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\( ^3 \) A detailed examination of CI and its role in tax compliance is presented in Dubin (2006).
spillover effects from both audit and CI activities to be approximately 95%.
Doubling the audit rate or CI sentenced cases produced similar increases in total collections. IRS enforcement is found to be extremely cost effective but underutilized.

The remainder of the paper is organized as follows. In Section 2, I briefly review the empirical tax evasion literature and data sources. In Section 3, I discuss the process of criminal investigations and potential influences on taxpayer compliance. In Section 4, I discuss model specification and econometric issues. Section 5 presents the empirical results while Section 6 presents the results of several simulations. In Section 7 I present conclusions.

2. LITERATURE REVIEW

Andreoni, Erard, and Feinstein (1998) and Slemrod and Yitzhaki (2002) provide summaries of the tax compliance literature. As discussed by these authors, the IRS has made few data sources that can be used to study tax compliance available to researchers. With respect to non-experimental and non-survey data for the United States, there continues to be limited data. There are essentially two data sources. The first data source is the Taxpayer Compliance Measurement Program (TCMP) data. These data have been analyzed by Dubin and Wilde (1988), Witte and Woodbury (1985), and Beron, Tauchen, and Witte (1993) for tax year 1969. These papers were important empirical studies on audit effects and compliance because they demonstrated the endogeneity of audit rates and positive compliance effects from audits in certain audit classes.

Subsequently, Dubin, Graetz, Udell, and Wilde (1992) used the 1979 TCMP data to study tax return preparation decisions by taxpayers. Recently, Mete (2002) combined TCMP surveys conducted by the IRS for several tax years to study the interaction between taxpayers, the IRS, and political ideology.

The second data source is based on time-series cross-sectional information available by state and year. Measures of audit activity, taxes assessed, and taxes collected are taken from the Annual Reports of the Commissioner of the IRS. For instance, DGW (1990) used IRS audit data and taxpayer information measured at the state level over a 10-year period to analyze taxpayer noncompliance. Plumley (1996) extended the analysis in Dubin, Graetz, Wilde (1990). His time-series cross-section analysis covered the period from 1982 to 1991, whereas the DGW study used data from 1977 to 1987.

Importantly, Plumley was the first to show that CI activities (measured as criminal convictions obtained per million people) were significant and positively related to compliance.\(^5\) The next section briefly reviews the role of IRS Criminal Investigations.

3. **IRS CRIMINAL INVESTIGATIONS**

The main role of the IRS CI Division is to investigate alleged violations of the tax and money laundering statutes. CI has focused its activities for some time on narrowing the tax gap. Tax gap investigations include both tax and money

\(^5\) Plumley modified some of the DGW reporting and compliance equations using: (i) income and offsets rather than tax collected; and (ii) tax return filings relative to expected filings rather than to population. Plumley introduced refinements to the DGW audit rate measure (based on start rates versus closure rates) and considered new factors for taxpayer burden and CI enforcement activity.
laundering cases that involve tax issues. Tax gap investigations normally do not include illegal activity associated with narcotics investigations.\(^6\) CI tax investigations are so-called *legal source* tax crimes because they encompass all cases involving tax violations where the income derives from legal activity, including questionable refund schemes, return preparer cases, excise tax cases, employment tax cases, and frivolous filers and nonfilers. CI also investigates *illegal source* financial crimes and narcotics-related financial crimes.

While the IRS can investigate and audit tax returns and recommend civil penalties, CI has the exclusive responsibility and authority to investigate tax fraud and to recommend prosecution for willful and egregious tax code violations. CI’s role as a tax crimes agency expanded in 1970 under the Bank Secrecy Act (BSA) and has further expanded over the last 30 years to include narcotics investigations and money laundering violations. Money laundering cases often result from the record keeping requirements established in the BSA.

Money laundering activity and tax activity can be closely related. Money laundering activity (i.e., activity involving illegal income sources) is often a precursor to tax evasion. As such, it is sometimes difficult to determine whether a case is primarily tax related or not. CI classifies its cases in terms of whether they are primarily related to tax or money laundering. CI further classifies cases according to whether they are both tax and money laundering cases, tax cases

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\(^6\) Tax-related investigations encompass all Title 26 violations (tax evasion, failure to file, filing of false returns, fraudulent returns, or aiding or providing assistance to fraudulent returns), as well as tax violations that fall under Title 18 USC §286, 287, 371 (conspiracy to defraud the government or commit offense or false claims). CI also has jurisdiction over Title 31 cases (currency reporting violations).
only, money laundering cases only, or neither. For this study, I treated any case with a tax-related component as a tax case and any case with a money laundering component as a money laundering case.\(^7\)

4. **MODEL SPECIFICATION**

As discussed above, this study updates and extends DGW (1990) to examine the role of CI activities on taxpayer noncompliance. The DGW empirical analysis was based on three models that were estimated using a state-level time-series cross-section. One model specified reported taxes per return filed as a function of audit rates and a variety of socioeconomic control variables. The second model used assessed taxes per return (combining reported taxes with additional taxes and penalties) as the dependent variable. The final model specified returns filed per capita as a function of the same variables. DGW selected explanatory variables for this system of equations based on two considerations: the size of the tax base and taxpayers’ compliance behavior. Clearly, some factors affect both the tax base and taxpayer compliance. In general, this effect may lead to ambiguous predictions for the *a priori* signs of some regression coefficients. Taxpayers confront three options: to file a return and report honestly, to file a return and underreport taxes, or not to file a return.

\(^7\) CI summarizes its activities in different ways. First, CI reports its cases by the Title and Section of law for which there is a violation or an alleged violation. For fiscal year 1999, for example, CI reports cases recommended for prosecution as follows: 1,068 for Title 26 violations; 1,988 for Title 18 violations; and 64 for Title 31 violations. Of these 3,120 cases, CI further classifies 1,959 cases as fraud related and 1,161 cases as narcotics related. Tax cases, in this study, include all primary and secondary recommended violations of tax-related offenses (Title 26, 18-287, 18-286, 18-371K). Money laundering cases, in this study, include all primary and secondary recommended violations of money laundering-related offenses (Title 18-1956, 18-371T, 18-371M, 18-1960 or Title 31).
Deterrence theory maintains that factors, which either reduce the benefit or increase the costs of filing a return and underreporting taxes, will increase the likelihood of selecting one of the other options. Variables related to compliance behavior either reflect opportunities to evade (e.g. more educated or savvy taxpayers) or the enforcement activity of the IRS (e.g. examination and criminal prosecution). With respect to variables that relate to the tax base, any change that increases the tax base (shifting taxpayers above minimum reporting requirements or into higher tax brackets) will increase reported taxes and the number of returns filed. In addition to updating the DGW models, a specific objective of this study was to measure the effect of CI activities on tax compliance.

Individuals face a complex decision process with respect to criminal activity. An individual may be deterred from tax evasion, money laundering, or other criminal acts based on the likelihood of being caught. This deterrence possibility is the empirical paradigm of modern criminal analysis. In this approach, a potential criminal may be deterred from committing a crime due to the high probability of being caught and sufficiently severe penalties that follow. Of course, not all individuals are rational actors with respect to the crimes they commit. However, rational calculus applied to crime and punishment is a benchmark test and provides policy makers with justification for increasing enforcement levels or changing the enforcement mix. Ultimately, the manner in which individuals respond is an empirical matter. Following DGW, I assume that individuals consider the likelihood of detection and punishment. This paradigm is
known as deterrence theory in the literature. It has also been persuasively argued that taxpayers may react to the actions of other taxpayers, especially as those actions concern notions of fairness and support for their decisions to voluntarily comply with the law. This is known as assurance theory (see, e.g., Roth et. al. 1989, Scholz 1998, Scholz and Lubell 1998a,b). Models of conformity and social dynamics (see e.g. Durlauf and Young, 2001) postulate that the utility of a given decision may in part be determined by the expected actions of others. Models of social dynamics bridge the deterrence and assurance theories of taxpayer compliance. IRS enforcement is measured in this study by audit rates (face-to-face audits conducted by tax or revenue agents), correspondence audits (audits conducted by mail) and by CI cases sentenced in a given year.

As an empirical matter, many non-exclusive measures of CI enforcement activity could have significance. This study simplifies the relevant set of CI factors as much as possible. Three econometric issues deserve further discussion. First, this study focuses on CI cases that ultimately receive sentences. I adopt this approach because the fraction of all cases that CI recommends for prosecution and that are eventually sentenced is quite large and has been growing for some time. Second, I treat CI activities as exogenous both on theoretical and empirical grounds. CI activity is largely a result of cases discovered and selected for examination that arise independently of tax gap or noncompliance issues.

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8 Limiting the analysis to sentenced cases introduces a potential selection bias. However, alternative specifications using a count of all CI prosecuted cases produced similar results. Moreover, the simulations performed below prescribe a larger number of sentenced CI cases, as opposed to a larger number of cases recommended for prosecution in order to induce greater tax compliance. The former is more difficult to effectuate than the latter, making the policy implications of this research more meaningful.
Therefore it is reasonable to treat CI factors exogenously in the reporting and filing econometric equations. Additionally, Hausman (1978) specification tests for endogeneity of the CI enforcement factors did not reveal endogenous behavior.  

5. EMPIRICAL RESULTS

The DGW analysis was based on data reported in the *Annual Report of the Commissioner of Internal Revenue* for the years 1977–1987. These reports include district-level data on IRS collections, number of returns filed, amount and number of refunds, number of examinations, total additional tax and penalties recommended after examination, and budgets. As discussed further below, the DGW econometric models were not structurally stable for time periods before and after 1988. Additionally, the CI enforcement data was not available for the period prior to 1988. Thus the data employed in this study is a compilation of annual tax enforcement, criminal investigation, and socioeconomic factors for each U.S. state from 1988 to 2004. I discuss the data used in this study in the following order: dependent variables, the IRS audit rate, instrumental variables used for consistent estimation of the audit effect, CI enforcement factors, and socio-economic control variables.

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9 The conclusion that CI enforcement factors are exogenous may be due to poor instruments. Unlike the case of the audit rate, I was not able to find good exogenous proxy instruments for CI enforcement factors. Those that served as reasonable possibilities showed, at best, weak correlations with CI activity. Analysis of CI budgets, for instance, did not reveal close correlation with CI cases prosecuted or case mix. These deficiencies may affect the specification test results.

10 The tax collections and examination variables rely on data reported in the Annual Report of the Commissioner of Internal Revenue, IRS Data Book, and IRS Statistics of Income Bulletin.
5.1 DEPENDENT VARIABLES

The dependent variables include (i) ALR (Assessed Liability Per Return): reported individual income tax plus additional tax and penalty recommended after examination divided by the number of individual income tax returns filed (1972 dollars); (ii) RTR (Reported Taxes Per Return): reported individual income tax divided by the number of individual tax returns filed (1972 dollars); and (iii) RCAP (Returns Per Capita): reported total individual income tax returns filed divided by total population. The average values for these factors are shown in Table 1. Generally, returns filed per capita rose only slightly in this period while assessed and reported taxes per individual return filed rose steadily.

5.2 IRS ENFORCEMENT FACTORS

The audit rate is defined as IAR (Individual Audit Rate): reported total individual income tax returns examined divided by total individual income tax returns filed and is treated endogenously.\(^{11}\) The dramatic decline in the individual audit rate (IAR) between 1977 and 1987 was followed by an equally staggering decline during the subsequent 20 years. Indeed, audit rates fell from 1.88 percent in 1977 to 0.83 percent in 1988. The decline continued through the end of the

\(^{11}\) Statistics on examination coverage variables such as numbers of returns examined, additional taxes and penalties recommended after examination, and costs incurred by the IRS were broken down by district office and service center in the IRS Data Book and Annual Report. In states where there were multiple districts, I performed an aggregation to derive state-level figures for those factors. The IRS Reform Act reorganized the entire district system and required many district offices to be responsible for the tax returns filed by multiple states. As a result, most of the district-level statistics from 1997 to 2001 included services provided to multiple states. Since only state-level data is used in the analysis, I took the 1996 allocation of examinations, additional taxes, and cost incurred for each state among all states in the newly defined districts and extrapolated the annual figures for 1997–2001 based on 1996 percentages. This step may introduce some unavoidable measurement error. Reorganization of the IRS after 2000 and 2001 and significant changes in IRS accounting undermine a state-level analysis for time periods after 2001.
analysis period, until the individual audit rate was roughly 0.13 percent in 2002.\textsuperscript{12} Meanwhile, individual returns filed per capita (RCAP) grew steadily over the 25-year period by 20 percent or 0.8 percent per annum but grew only modestly during the last decade. As a compliance factor, the audit rate is expected to be positively related to tax reporting and return filing because an increase in the likelihood of apprehension lowers the net benefit of filing a fraudulent return. However, it is theoretically and empirically fundamental that the audit rate be treated endogenously in the system of equations. Consistent estimation of the audit affect requires good instruments that are correlated with the audit rate but plausibly uncorrelated with taxpayer compliance.

As part of this study, the IRS provided several new factors to examine tax enforcement. These factors refine the individual audit rate used in DGW but are limited to a subset of the analysis period (from 1993 forward). The first factor measures examinations of individual tax returns conducted by revenue agents (AUDR1). Revenue agents are required to have extensive accounting knowledge. They are qualified to audit all tax returns and provide a more thorough audit. Revenue agents typically audit more complex issues that involve higher income levels or greater deductions. These agents conduct their audits in person rather than through the mail. As with the audit rate defined in the DGW study, I express the revenue agent audit rate as a fraction of individual returns examined. The rate of these audits fell from 0.313 percent to 0.065 percent during the period. The second examination factor represents the tax agents’ audit

\textsuperscript{12} The IRS claims that automated programs such as the CP2000 program and other correspondence audits have partially offset this decline in audit rates. I test this proposition below.
activity. Tax auditors or tax agents generally have less tax knowledge than revenue agents. They typically audit individual non-business returns and Schedule C returns (sole proprietorships). Relative to revenue agent audits, tax audits are less complex and involve lower income and expense levels. A tax audit is typically conducted in an IRS office, as opposed to a revenue agent audit, which takes place at the taxpayer’s (or his/her representative’s) business or residence. Expressed as a fraction of individual returns filed, tax audits (AUDR2) also show a dramatic decline over the last decade. The rate of these audits fell from roughly 0.428 percent to 0.086 percent by the end of the period. Finally, the IRS provided a measure of correspondence audits. These audits are done through the mail, as the name implies, and represent a modern extension of the CP2000 program. Correspondence audits have increased from 0.261 percent in 1993 to 0.962 percent in 1996. In recent years, however, the rate of correspondence audits has declined after significant fluctuation. The 2001 measurement shows an average rate of just 0.395 percent.

5.3 INSTRUMENTAL VARIABLES

I extended the budget per return variable (BPR): reported total IRS budget divided by total returns filed, in 1972 dollars used in the DGW study and added a new instrument. The IRS published the IRS budget per individual return filed until 1999. The budget (in real 1972 dollars) reached its peak of $5.62 per return in 1989. This growth was likely a consequence of the Tax Reform Act of 1986.
However, the budget per return subsequently underwent a significant decline, dropping to $4.10 per return by 2004.  

Next, the IRS provided a measure of the total available resources devoted to examinations (DIR_EXAM (Direct Examination)): Percentage of all examiners’ time allocated to direct examination of the returns.) This percentage further refines the budget variable described above; it should be highly correlated with audit activity but nevertheless is exogenously set by the IRS in any fiscal period as it corresponds to the planned examination activity. Beginning in 1980, with a state average of 64.4 percent, the direct examination percentage fell to 41.1 percent by 1988. While the percentage of time devoted to examinations rose somewhat through 1997 (to 54.1 percent), the pattern from 1997 to 2001 had been to reduce direct examination time (measured at 36.9 percent in 2001). However, this percentage has increased again and is now roughly 62.1 percent as of 2004.

5.4 CI ENFORCEMENT FACTORS

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13 The TRA was a major shift in United States tax policy. Tax rates were cut, the tax base was broadened, IRA rules were changed, and the tax laws were generally simplified.
14 Given the importance of this factor as an instrument for IRS audit levels, I extended this figure for the 2000 and 2001 period at 1999 levels. There is little consequence from this approximation in which budget per returns filed serves as an instrumental variable.
15 DGW used a measure of information returns filed as an instrument in some of their models, but this factor was not available at the state level for the time period covered in this study. I also assembled several political factors Mete (2002) to be used as potential instruments but found that they lacked systematic correlation with the audit rate.
16 As discussed by Plumley (1996), the direct examination measure is a reasonably exogenous measure of audit activity.
My analysis begins with those CI cases that were sentenced.\textsuperscript{17} Sentenced cases can arise as a result of a pure tax investigation, a pure money laundering investigation, a combination of both tax and money laundering investigations, or something not related to either tax or money laundering.\textsuperscript{18} There is evidence of a recent decline in the total cases that CI sentences. For instance, tax cases of this type have declined fairly steadily from 1988 to 2004 (from 1,876 cases per annum in 1988 to 845 cases in 2004). Conversely, money laundering cases rose from 132 cases per year in 1998 to a high of 1,170 cases per annum in 1994. CI conducted approximately 700 such cases per year in 2004. Total CI cases related to tax or money laundering (TOTTM) ranged from 30 to 53 per year per state, as shown in Table 1.\textsuperscript{19}

5.5 \textbf{SOCIOECONOMIC and TAX FACTORS}

I followed DGW and constructed several socioeconomic explanatory variables, all reported on a calendar year basis: STAXR (Average State Income Tax Rate): total state individual income tax paid as a percentage of total state personal income; PERED: percentage of the adult population with at least a high school education; PER65: percentage of the adult population over age 65; UI: the unemployment rate; PICAP: income per capita, in 1972 dollars; PMAN: percentage of the workforce employed in manufacturing; PSERV: percentage of

\textsuperscript{17} It is logical to expect that sentenced cases are most influential in affecting taxpayer compliance because such cases receive the greatest media attention. However, the empirical results were similar whether sentenced or prosecuted cases were used in the econometric models. Similarly, a factor measuring the percentage of cases recommended for prosecution that were sentenced was not statistically significant in the econometric models. The close correlation between indictment and conviction rates was originally discussed in Dubin, Graetz, and Wilde (1991).

\textsuperscript{18} The preponderance of CI cases had either tax or money laundering aspects.

\textsuperscript{19} Deterrence and assurance theories predict that compliance should increase with TOTTM.
the workforce employed in the service industry; FRMFAM: farms per household; FAMSIZ: households per capita; and PWELFAM: the percentage of all households on welfare. These explanatory factors are assumed to be exogenous and appear as control variables in both the filing and collections equations. The variables primarily related to the tax base are PER65, FAMSIZ, and PWELFAM. The variables related to both the tax base and taxpayers' compliance behavior are UI, PICAP, and STAXR. The variables primarily related to the taxpayers' compliance behavior are PERED, PMAN, PSERV, and FRMFAM. The effects of these variables are somewhat ambiguous. For example, an increase in PER65 may correlate with lower deductions causing reported taxes to rise. Simplification in the types of income categories for those over 65 (PER65) may also raise compliance and reported taxes. An increase in the percent of households on welfare should increase reported taxes per return since it effectively eliminates a portion of the lower tail of the income distribution. Meanwhile, increases in FAMSIZ (households per capita) are associated with fewer opportunities for deductions leading to higher reported taxes. Conversely, increases in FAMSIZ may be associated with simplified returns and greater tax compliance. Increases in UI and STAXR are expected to cause reported taxes to fall as the former leads to lower taxable income while the latter increases deductions. Increases in PICAP are expected to increase reported tax collections. Finally, the percent of the population with a high school education (PERED) is thought to be positively associated with tax noncompliance (lower reported tax) as the educated are better equipped to play the tax lottery. Increases in farms or individuals in service
industries were argued to be positively associated with tax noncompliance in DGW.\(^{20}\)

Most of the explanatory factors appeared to continue the trends discussed in DGW. First, the percentage of families on welfare (PWELFAM) rose to a peak of 4.4 percent in 1994 but declined to 1.56 percent by 2004. This decline possibly resulted from the welfare reform enacted in the Personal Responsibility and Work Opportunity Reconciliation Act of 1996 (PRA). Welfare cases fell when fewer individuals qualified for welfare under the PRA. Additionally, the number of farms per household (FRMFAM) continued to show a decline during the analysis period, reflecting fewer farms in the United States and a larger number of households. Unemployment (UI) generally declined with the exception of the recession that took place during the early 1990’s and the increase in unemployment that occurred in 2001. Personal income in real terms (PICAP) rose steadily from 1988 through 2004. From the early-1980’s forward, the state tax rate (STAXR) grew fairly steadily from 3.99 to 4.55 percent by 2004. The percentage of the population over age 65 (PER65) showed a relatively modest growth during the period. The percentage of employed individuals in manufacturing (PMAN) declined from just over 15.6 percent in 1988 to roughly 120 percent by 2004. The percentage of employed individuals in service industries (PSERV) increased from 21.1 percent in 1988 to nearly 28.5 percent in 2004. This pattern continues the trends described in the original DGW study.

\(^{20}\) In sum, increases in UI, STAXR, and PERED are expected to decrease compliance and reported taxes due. Increases in PICAP and PWELFAM are expected to increase reported taxes due, while increases in PER65 and FAMSIZ are expected to have ambiguous effects.
However, the importance of the manufacturing industry may have changed as compliance and collections associated with these sectors have shifted since the original 1977–1986 study of DGW as I discuss in the next section.

As discussed above, changes in tax policy after 2001 led to significant declines in Federal revenues that were partially reversed in 2003 with the Jobs and Growth Act of 2003. Of course, tax rates should matter in determining tax compliance. Several theoretical studies have investigated the connection between tax rates and compliance. Competing theories preclude a definite a priori theory for tax rates and compliance, as discussed in Yitzhakie (1974) or Witte and Woodbury (1983). Nonetheless, Clotfelter (1983), and Crane and Nourzad (1986) used tax rates in their empirical analyses to explain compliance. Clearly, the tax rate – and, more generally, the tax structure in combination with personal income – determines reported and assessed tax revenue. However, tax rates are themselves endogenous (i.e., taxpayers choose to some degree their tax bracket). An unobserved effect (such as noncompliance for some taxpayers) can simultaneously affect tax rates and taxable income. These issues require that tax rates be treated endogenously.

The original DGW study presented an empirical specification for tax collections that did not include Federal tax rates, for several reasons. First, the Federal marginal tax rates were not available to DGW at the state level in their study. Statutory Federal tax rates would be constant across states and would not show variation from state to state. Moreover, there was little variation in tax rates during the 1977-1987 period used by DGW. For these reasons, DGW
omitted Federal tax rates but included state tax rates. Since the DGW study, there has been significant improvement in measures of average and marginal tax rates at the Federal level. These factors are available from the National Bureau of Economic Research (NBER). NBER calculates the maximum (marginal) tax rate for an additional $1,000 of income for a married couple filing a joint return with $500,000 in annual wage income. Assuming a set of deductions, NBER uses its TAXSIM simulation model to calculate the effective maximum tax rate for its sample of taxpayers. These tax rates vary by state and time due to changes in tax law and changes in the state income tax deduction (if present) on the Federal return (this, also, varies by state and time). The maximum Federal tax rates described above are used typically as instruments because they should be exogenous but correlated with average tax rates. This factor is denoted FMXTAX and is the maximum federal tax rate with cross state tax deductions (see http://www.nber.org/~taxsim/state-rates/maxrate.html). NBER also tabulates an average Federal tax rate by state and time. This factor is denoted FAVTAX and is the Federal and state combined income tax rate based on the national 1995 income distribution (see http://www.nber.org/~taxsim/state-marginal/avratesffx.html). In addition to these two factors, I also use the product of Federal average tax rates and personal income per capita as an explanatory variable and denote the resulting factor by PFAVTAX. In sum the original specification of DGW that relied on state tax rates has been modified to additionally include the three factors: FMXTAX, FAXTAX, and PFAVTAX.
5.6 EMPIRICAL RESULTS

As discussed above, the original DGW model used data for the years 1977–1986. Adding data for later years more than doubled the observations. However, the overall explanatory power of the model fell in the period spanning from 1988 to 2004. This change, coupled with changes in the signs for some factors, suggests that the period after 1988 (and therefore the time period considered in the original DGW study) was different from the earlier period in significant ways.\(^\text{21}\)

Focusing on the period after 1988, the re-estimated models show some sign changes in the coefficients on socioeconomic factors, including a shift in the roles played by manufacturing and service industries. Since these effects were previously understood in terms of the possibility for individual noncompliance and opportunities to evade, it is more likely that TRA changes in IRS policy focused on service industry geographies or a change in the relative economic conditions of these two sectors explain the change in predicted compliance.

Several empirical experiments show that CI enforcement has statistical significance when considered as counts. However, little significance remains when these counts are expressed as rates. While a theoretical justification may be made for using rates as estimates of probabilities, and while probabilities are motivated by the theoretical criminology and economics literature, the empirical

\(^{21}\) It is not possible to employ a completely common specification for the two time periods 1977-1987 and 1988-2001, as key CI enforcement variables were not available for earlier time periods. Using a common specification, but omitting CI factors, I found that the DGW model failed a Chow test for temporal structural stability. This occurrence may be due to the passage of the Tax Reform Act of 1986, as suggested by one of the referees. As discussed below, coefficient sign changes were limited but nonetheless remain consistent with compliance theory.
finding is that CI rates reveal low correlation with compliance. However, the finding that absolute counts matter suggests that general deterrence may result from the overall level of CI activity rather than the rate at which these investigations take place. This interpretation affirms the assurance theory of CI activity.

In Table 2, I present the estimated econometric models for reporting and tax return filings. I also include the reduced form equation for the endogenous audit rate (IAR) to demonstrate the significance of the selected instrumental variables. As discussed above, these models replicate the DGW specification but add additional factors for CI enforcement, add marginal Federal tax rates, use new instrumental variables, and update the time-period.

The first model (Model 1) in Table 2 tests the proposition that correspondence audits and face-to-face audits (tax and revenue agent) both affect taxpayer non-compliance. As a threshold matter, I was limited in the number of years that the correspondence and face-to-face audits were available for analysis. For the period from 1993 through 2004, I was not able to determine separate and significant results using tax and revenue audit separately and consequently combined these factors into one explanatory variable that closely mirrors the definition of IAR. During this period, correspondence audits a have positive effect on tax compliance. The result is however only of borderline significance in the regression model. Nonetheless, this model provides some evidence that correspondence audits offset and complement face-to-face audits to some extent. Indeed the coefficients would suggest that one face-to-face audit
is roughly comparable to 60 audits by mail. Given the lack of significance of the measured effect and in order to increase degrees of freedom, Model 2 drops the correspondence audit measure from the main equations. We focus on the results from Model 2.

As the table shows, the IRS budget per return filed is a very significant factor in determining the audit rate. Also, the instrument for exam time devoted to direct examination is significant and positive in the audit reduced form. This finding implies that in districts and time periods with larger resources devoted a priori to examination, the audit rate is relatively greater. This result is clearly logical and expected.

The updated models show that audit rate effect remains statistically significant under IV-GLS estimation and continue to demonstrate a positive role for the audit rate. As the IRS audit rate increases, compliance and reported taxes similarly increase. However, the effect of audits on filings reveals a new finding. DGW argued that increases in the federal audit rate decrease the benefits and increase the costs of filing a return and underreporting taxes due. DGW expected (and found) that an increase in the audit rate decreased returns filed per capita. My results for the post-1987 period seemingly contradict the findings of DGW pre-1988. However, compliance theory predicts that either returns filed would decline or returns filed would increase with greater compliance. My results indicate that the latter situation is now in effect—

\[22\] At the margin, the estimated audit rate effects are approximately ten percent higher in the 1988–2001 period as compared to the 1977–1986 period. This result is expected when there are increasing returns to examination and a general decline in examination rates.
increases in the audit rate lead to greater levels of compliance and a greater number of honestly prepared returns. Several of the socioeconomic variables were found to lack statistical significance in the 1988-2004 period. These include factors for the percentage of families on welfare (PWELFAM), the percent in service and manufacturing (PSERV), and the percentage of farm households (FRMFAM). The explanatory variables for the percent of the population with at least a high school education (PERED), and unemployment (UI) are statistically significant with hypothesized effects. The percent of the population over 65 (PER65) and the percent employed in manufacturing (PMAN) are also statistically significant but with signs that differ from those determined in the 1977-1987 period. These effects are nonetheless consistent with deterrence theory as discussed above. The coefficient on the percent of educated adults has the same sign as the original DGW study but in fact has become more significant. Tax effects are somewhat difficult to determine as the specification is essentially a first-order Taylor’s series expansion in tax rates and personal income. The variables that were included are highly significant in the final specification. 23

Finally, I find that CI sentenced cases have a positive and significant effect on tax compliance based on a one-sided hypothesis test at the 90 percent level of significance. The next section explores the relative magnitude of the IRS audit and CI activities in fostering general tax compliance.

23 Specifications not presented but available from the author upon request demonstrate that the Federal tax rate factors were not statistically significant for the data period originally employed by DGW.
6. SIMULATIONS

I performed two basic simulations to determine the direct revenue (spillover) effect of audits. Following the methodology established in DGW, I calculated a predicted value for the increase in total assessed liability for a particular year that would result from a doubling of the audit rate. I also calculated the effect of this audit rate change on reported liabilities (excluding additional taxes and penalties resulting from IRS examinations). The difference between the two estimates represents the direct revenue effect of the increase in audit rates. DGW estimated that the spillover effects of audits produce six out of every seven dollars of additional revenue.

In these simulations, a change in the audit rate (and later, the levels of CI activity) leads to two measurable effects. First, the change in audit rate causes assessed liabilities and reported liabilities to increase. Let $d_{ALR}$ denote the change in assessed liability per return for a change in the audit rate of $d_{IAR}$. Similarly, let $d_{RTR}$ denote the change in reported tax liability per return for the same change in the audit rate $d_{IAR}$. DGW called the change, $d_{ALR}$, the total revenue effect (since it includes both reported amounts and additional taxes and penalties) and $d_{RTR}$, the indirect effect. The direct effect of audits is defined as $d_{ALR}-d_{RTR}$. Since $ALR-RTR$ is a measure of additional taxes and penalties, $d_{ALR}-d_{RTR}$ is simply the change in additional tax and penalties resulting from the audit change. Consequently, it is the direct effect. DGW defined the spillover measure as the ratio, $d_{RTR}/d_{ALR}$. It measures the percentage of total change that occurs from general deterrence resulting from the change in the audit rate.
I considered several experiments. In some cases, I doubled individual components such as the audit rate or the number of tax sentences or money laundering sentences. For marginal effects, I considered increasing the enforcement factors by 5 percent. The simulations are shown in Table 3. To understand the results, consider the simulation in which audit rates are doubled. The first row of Table 3 shows that estimated assessed tax collections would rise to $826.2 billion from $804.1 billion in 2004. The $22.0 billion change is the total revenue effect. These estimates also show that reported tax collections rise by $20.8 billion. This change is the indirect effect of doubling the audit rate. The difference between these two estimated differences is approximately $1.197 billion and represents the direct revenue effect. This amount is roughly 95 percent of the total revenue effect.

Using the same model, I find that doubling CI activity (tax and money laundering cases) leads to $10.64 billion in increased reported taxes, $11.16 billion in increased assessed tax revenue, and a direct revenue increase of $0.513 billion. Hence, I measured the spillover effect to be approximately 95 percent. Importantly, doubling CI activity or the IRS audit examination rate leads to similar revenue increases and implies similar levels of increased general deterrence.

The marginal analysis is also reported in Table 3. For instance, the second row of Table 3 (lower section) shows that increasing the audit rate by 5 percent leads to 9,708 additional audits and increases total revenues by $1.096 billion. The marginal effect is the increase in total revenue of $1.096 billion
divided by 9,708 audits or roughly $113,032 per audit in specific and general deterrence. The direct revenue effect is an increase of $59.63 million, or $6,142 per audit. The simulation in which the audit rate was doubled (Table 3, row 1) leads to an increase of $22.0 billion dollars of additional total revenue, and corresponded to 194,160 additional audits. These numbers average out to be $6,168 per audit – a figure not dissimilar from that obtained in the marginal simulation with a 5 percent increase. On the other hand, doubling CI sentenced cases (Table 3, row 4) leads to 1,502 additional cases and $11.2 billion in additional revenue. This corresponds to $7.48 million per additional sentenced case in specific and general deterrence.

7. CONCLUSIONS

This paper has updated and extended the original DGW state-level taxpayer compliance analysis from the period 1977 through 1987 to the period 1988 through 2004 while introducing new measures of CI enforcement activity, tax policy, and new instrumental variables. I find that the spillover effect of audits and CI enforcement is quite large and generally estimated to be 95 percent. I also find that an increase in IRS examination activity could have important fiscal impacts and make a large contribution toward reducing the tax gap. I now examine whether increasing IRS enforcement would be cost effective.

According to estimates from Plumley (1996, Table 5, pp. 41), the cost for a CI conviction was nearly 80 times more expensive than an audit in 1991. While
these unit costs are unlikely to apply to doubling CI activity, we can get some idea of the dollar magnitude of total costs using Plumley’s reported figures.\textsuperscript{24} In 1991, Plumley reported a unit cost of $1,298 per audit and a unit cost of $103,064 per CI conviction. These are $1,702 and $135,170 in 2004, after adjusting for inflation. In the same year, there were approximately 194,160 individual audits performed and only roughly 1,502 tax and money laundering sentences.\textsuperscript{25} Doubling tax and money laundering sentences would cost $203 million (at these unit cost estimates), while doubling the audit rate would cost $330 million. However, doubling the audit rate is estimated to result in a $22.0 billion increase in per annum reported collections, while doubling tax and money laundering cases was predicted to increase reported tax collection by $11.2 billion per annum. Hence, an additional dollar allocated to audit would return $67 in general deterrence\textsuperscript{26}, while an additional dollar allocated to CI would result in $55.\textsuperscript{27} The return to IRS enforcement is evidently quite large.

Fifteen years since the publication of the original DGW study the message remains the same: increases in IRS enforcement can go a long way to increasing

\textsuperscript{24} It is not too speculative to suggest that the IRS could double its audit rate without doubling its organizational size. Clearly, the IRS has not shrunk in size in the same proportion that audits have declined. Conversely, doubling CI activities might easily double the economic and physical resources devoted to CI. CI never sentenced a number of cases represented by the doubling of its current load.
\textsuperscript{25} Plumley’s 1991 estimates of unit costs include overhead, support, and follow-on costs. Upon further analysis, these estimates would appear somewhat low. For instance in 2001, the CI budget for tax and money laundering cases was $393.4 million. There were 1,732 tax or money laundering cases so that average costs are roughly $227,147 per case.
\textsuperscript{26} Plumley’s (1991) estimate of the return to audits was similar. He found a marginal indirect revenue to cost ratio of 55.
\textsuperscript{27} Because this difference is not statistically different from zero, little should be made of the point estimate differences reported here.
taxpayer compliance through general deterrence. However, the IRS should not rely solely on correspondence audits for enforcement. While much less expensive, these audits are not as effective as either face-to-face audits or CI investigations. Meanwhile, the marginal effectiveness of IRS audits has declined since the 1977-1986 period and the amount of direct enforcement has simultaneously declined. In conjunction, these findings help explain why the tax gap continues to grow with time.

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<tr>
<td>Farms Per Household</td>
<td>-5.47503</td>
<td>-5.18066</td>
<td>-0.27671</td>
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<td>-2.24607</td>
<td>-2.04073</td>
<td>-0.3984</td>
<td>3.25193</td>
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<tr>
<td>Percent of Adults with School</td>
<td>-0.98854</td>
<td>-0.99489</td>
<td>0.082007</td>
<td>-0.039304</td>
<td>-0.43902</td>
<td>-0.46436</td>
<td>0.015187</td>
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<tr>
<td>Percent of Pop Over 85</td>
<td>1.72784</td>
<td>1.71354</td>
<td>-0.1943</td>
<td>-3.72204</td>
<td>3.04293</td>
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<tr>
<td>Percent of Employed Persons in</td>
<td>-0.18803</td>
<td>-0.16524</td>
<td>0.0453</td>
<td>-0.04881</td>
<td>0.06049</td>
<td>0.059581</td>
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<tr>
<td>Unemployment Rate</td>
<td>-0.23828</td>
<td>-0.14882</td>
<td>-0.074449</td>
<td>1.69361</td>
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<td>1.51026</td>
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<tr>
<td>Dummy 2002-2004</td>
<td>-0.1492</td>
<td>-0.15006</td>
<td>0.001351</td>
<td>0.25322</td>
<td>-0.18233</td>
<td>-0.1841</td>
<td>-0.004102</td>
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<tr>
<td>Audit Rate for Revenue Agents</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>0.23978</td>
<td>0.22457</td>
<td>0.013492</td>
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<tr>
<td>Audit Rate for Revenue Agents</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>(5.502)</td>
<td>(5.220)</td>
<td>(3.100)</td>
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<td>Audit Rate</td>
<td>0.21816</td>
<td>0.19176</td>
<td>0.03672</td>
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<tr>
<td>Audit Rate (Correspondence)</td>
<td>0.003845</td>
<td>0.003764</td>
<td>-0.000117</td>
<td>0.00235</td>
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<tr>
<td>Direct Examination Time</td>
<td>--</td>
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<td>--</td>
<td>1.16606</td>
<td>--</td>
<td>--</td>
<td>0.68032</td>
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<tr>
<td>Budget Per Return</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>14.7657</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>24.81827</td>
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</tr>
<tr>
<td>Total Sentences</td>
<td>1.17E-05</td>
<td>1.14E-05</td>
<td>-3.17E-05</td>
<td>3.86E-05</td>
<td>0.000347</td>
<td>0.000332</td>
<td>-1.34E-05</td>
<td>7.06E-05</td>
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</tr>
</tbody>
</table>

Number of Obs: 600  
Years: 1993-2004
### Table 3: Results from IRS Collections Revenue Simulation

<table>
<thead>
<tr>
<th>Scenario Description</th>
<th>Estimated Assessed Tax Collections (Millions)</th>
<th>Estimated Reported Tax Collections (Millions)</th>
<th>Actual Reported Collections (Millions)</th>
<th>% of Estimated Reported Difference and Estimated Assessed Tax Revenue (F / G)</th>
<th>% Change in Estimated Assessed and Estimated Tax Revenue (C - F) / F</th>
<th>Direct Revenue Effect (Millions)</th>
<th>Indirect Revenue Effect (Millions)</th>
<th>Indirect Revenue Effect / Total Revenue Effect (L / K + L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAR audits doubled</td>
<td>$826,169.25 $804,138.31 $22,030.94</td>
<td>$820,767.25 $799,933.88 $20,833.38</td>
<td>$823,876</td>
<td>2.5%</td>
<td>2.6%</td>
<td>$1,197,562</td>
<td>$107,300</td>
<td>113,468</td>
</tr>
<tr>
<td>IAR audits increased by 5%</td>
<td>$805,235.63 $804,138.31 $1,097.31</td>
<td>$800,971.56 $799,933.88 $1,037.69</td>
<td>$823,876</td>
<td>0.1%</td>
<td>0.1%</td>
<td>$80,350</td>
<td>$1,034,500</td>
<td>94.49%</td>
</tr>
<tr>
<td>IAR audits increased by 200 per state</td>
<td>$805,234.75 $804,138.31 $1,096.44</td>
<td>$800,966.94 $799,933.88 $1,036.06</td>
<td>$823,876</td>
<td>0.1%</td>
<td>0.1%</td>
<td>$80,350</td>
<td>$1,034,500</td>
<td>94.49%</td>
</tr>
<tr>
<td>IAR total sentences (tax, money) doubled</td>
<td>$815,290.94 $804,138.31 $11,157.63</td>
<td>$810,578.06 $799,933.88 $10,644.19</td>
<td>$823,876</td>
<td>1.3%</td>
<td>1.3%</td>
<td>$513,440</td>
<td>$10,644,19</td>
<td>95.40%</td>
</tr>
<tr>
<td>IAR total sentences (tax, money) increased by 5%</td>
<td>$804,698.31 $804,138.31 $560.00</td>
<td>$800,468.13 $799,933.88 $534.25</td>
<td>$823,876</td>
<td>0.1%</td>
<td>0.1%</td>
<td>$46,794</td>
<td>$534,250</td>
<td>95.40%</td>
</tr>
<tr>
<td>IAR total sentences (tax, money) increased by 2 per state</td>
<td>$804,464.56 $804,138.31 $326.25</td>
<td>$800,245.25 $799,933.88 $311.38</td>
<td>$823,876</td>
<td>0.0%</td>
<td>0.0%</td>
<td>$46,794</td>
<td>$311,380</td>
<td>95.40%</td>
</tr>
</tbody>
</table>

### Additional Calculations

- **Direct Change in Revenue** = (D - A) + (F - D) + (E - F)
- **Indirect Change in Revenue** = (E - C) + (H - E) + (I - H)
- **Total Change in Revenue** = (D + E) + (G + H) + (I)
- **Direct Revenue Change per Audit or per Sentence** = (D / C) + (F / C) + (E / C)
- **Indirect Revenue Change per Audit or per Sentence** = (E / C) + (H / C) + (I / C)
- **Total Revenue Change per Audit or per Sentence** = (F / C) + (G / C) + (I / C)

<table>
<thead>
<tr>
<th>Scenario Description</th>
<th>Amount Before Change</th>
<th>Amount After Change</th>
<th>Difference (B-A)</th>
<th>Direct Change in Revenue</th>
<th>Indirect Change in Revenue</th>
<th>Total Change in Revenue (D + E)</th>
<th>Direct Revenue Change per Audit or per Sentence (D / C)</th>
<th>Indirect Revenue Change per Audit or per Sentence (E / C)</th>
<th>Total Revenue Change per Audit or per Sentence (F / C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAR audits doubled</td>
<td>194,160</td>
<td>368,320</td>
<td>194,160</td>
<td>$1,197,562,500</td>
<td>$20,833,375,000</td>
<td>$22,030,937,500</td>
<td>$6,168</td>
<td>$107,300</td>
<td>$113,468</td>
</tr>
<tr>
<td>IAR audits increased by 5%</td>
<td>194,160</td>
<td>203,957</td>
<td>9,797</td>
<td>$59,625,000</td>
<td>$1,037,675,000</td>
<td>$1,097,302,500</td>
<td>$6,142</td>
<td>$1,034,500</td>
<td>$94,49%</td>
</tr>
<tr>
<td>IAR audits increased by 200 per state</td>
<td>194,160</td>
<td>204,160</td>
<td>10,000</td>
<td>$60,375,000</td>
<td>$1,096,437,500</td>
<td>$1,156,812,500</td>
<td>$6,138</td>
<td>$103,660</td>
<td>$95,40%</td>
</tr>
<tr>
<td>IAR total sentences (tax, money) doubled</td>
<td>1,502</td>
<td>3,004</td>
<td>1,502</td>
<td>$513,437,500</td>
<td>$10,644,187,500</td>
<td>$11,157,625,000</td>
<td>$34,836</td>
<td>$7,086,676</td>
<td>$7,426,512</td>
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<tr>
<td>IAR total sentences (tax, money) increased by 5%</td>
<td>1,502</td>
<td>3,002</td>
<td>1,500</td>
<td>$513,437,500</td>
<td>$10,644,187,500</td>
<td>$11,157,625,000</td>
<td>$34,836</td>
<td>$7,086,676</td>
<td>$7,426,512</td>
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<tr>
<td>IAR total sentences (tax, money) increased by 2 per state</td>
<td>1,502</td>
<td>1,602</td>
<td>100</td>
<td>$14,875,000</td>
<td>$311,375,000</td>
<td>$326,250,000</td>
<td>$148,750</td>
<td>$3,113,750</td>
<td>$3,262,500</td>
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</tbody>
</table>