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# The Effect of Innovation on Corporate Tax Avoidance

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# THE EFFECT OF INNOVATION ON CORPORATE TAX AVOIDANCE

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I dedicate this dissertation to my husband.  This is for you.

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## TABLE OF CONTENTS

## LIST OF TABLES

## ABSTRACT

A large body of literature examines the determinants of corporate tax avoidance. In this paper I examine a new determinant of tax avoidance: innovation. Firms with more innovation generate more patents. Due to information asymmetry between the managers of the firm and tax authorities, firms have considerable discretion in choosing which country the patent revenue is generated in. In this study, I predict that firms with more patents will choose to attribute the revenue from those patents to countries with low tax rates. Using a relatively new data source which contains data on patents, I find evidence consistent with my predictions. Specifically, I find that patent activity is negatively associated with firms' tax rates. The results are robust to different measures of effective tax rates and to propensity-score matching.

## 1. INTRODUCTION

Tax avoidance includes activities that reduce explicit taxes per dollar of pre-tax accounting earnings (Hanlon and Heitzman 2010).[1] Tax avoidance increases firm value because it reduces the firms' tax burden and creates a wealth transfer from the government to shareholders. On the other hand, tax avoidance is costly. For example, costs of tax avoidance include hiring tax accountants and lawyers, reputational costs, penalties and interests for taking risky tax positions that are subsequently challenged by the tax authorities. Recent research also suggests that tax avoidance is associated with agency cost between the firm and its shareholders.[2]

A large body of research seeks to understand the determinants of corporate tax avoidance (see Shackelford and Shevlin (2001) and Hanlon and Heitzman (2010) for a review). For example, Rego (2003) finds that firms with greater international operations are able to avoid more taxes. Phillips (2003) finds that compensating managers based on after-tax income results in lower effective tax rates. Desai and Dharmapala (2006) find that managers with greater equity incentives are less likely to engage in tax avoidance.[3] To summarize, the tax avoidance literature has identified a slew of manager and firm characteristics associated with tax avoidance. However, this literature has not considered how the level of innovation at the firm can influence tax avoidance.

More innovative firms generate more intellectual property, such as patents and copyrights. If a firm owns a foreign subsidiary, the foreign subsidiary should be charged a fee to use the intellectual property. The fee the firm charges must be an "arm's length price", i.e., a

[1] Consistent with Hanlon and Heitzman (2010), I do not distinguish between legal and illegal tax avoidance activities (illegal tax avoidance is also called tax evasion). Rather, I view tax avoidance as a continuum of tax saving strategies that range from the least aggressive type (e.g., purchasing municipal bonds) to the most aggressive type (e.g., tax evasion).
[2] Tax avoidance creates agency cost by increasing the complexity of transactions. Managers can use tax avoidance to mask for opportunistic behaviors, such as earnings management and rent extraction.
[3] I review the tax avoidance literature in more detail in section 2.

price that two unrelated parties would agree to for the use of a similar asset (IRS Code Section 482). However, in practice it is difficult to assess the value of intellectual property (Rotkowski and Miller 2012). This difficulty means that managers have considerable discretion in choosing the fee the parent company charges to its foreign subsidiary for the use of patents or copyrights. For example, Apple Computer uses a strategy whereby it charges its Ireland subsidiary a very low fee for the use of several of its key patents. The subsidiary then uses those patents to generate large profits in Ireland, which are then subject to a lower tax rate than the U.S. statutory tax rate (Gleckman 2013). Thus, Apple maximizes its income from intellectual property in the low tax-rate subsidiary while minimizing income in the U.S.[4]

Thus, while charging abnormally low fees for the use of intellectual property is a relatively simple form of tax avoidance, the extant literature has not produced evidence that this practice is widespread. The goal of this paper is, therefore, to investigate whether more innovative firms engage in more tax avoidance. I measure innovation using the number of patents a firm produces in a given year (Atanassov 2013; Bernstein 2012; He and Tian 2013).[5] Tax avoidance is measured using firms' effective tax rates. Using a sample of 25,967 firm-year observations over the sample period 1993 to 1999, I find a negative relationship between my patent-based measure of innovation and firms' effective tax rates, suggesting that more innovative firms are able to avoid more taxes. A one standard deviation increase in my innovation measure is associated with a decrease of 0.7 percent decrease in a firm's effective tax

[4] Of Apple's $34 billion in 2011 pre-tax income, $22 billion was allocated to two entities in Ireland (Gleckman 2013). Given the size of the Irish market compared with that of the U.S., it seems implausible that the Irish market accounted for such a high percentage of Apple's income.

[5] This variable is adjusted to reflect the fact that innovation is stronger in certain years. More details on the measure are provided in section 3.

rate. Given that the mean effective tax rate (cash effective tax rate) for the sample is 30.7 percent (25.0 percent), a decrease of 0.7 percent translates to a 2.3 percent (2.8 percent) decrease.[6]

The results are robust to controlling for other known determinants of tax avoidance, including firm profitability (Gupta and Newberry 1997; Rego 2003; Frank *et al*. 2009), firm leverage (Badertscher *et al*. 2010; Hanlon and Heitzman 2010), net operating loss carryforwards (Chen *et al*. 2010), foreign income, depreciation, intangible assets, and equity income (Rego 2003; Cheng *et al*. 2012), firm size (Watts and Zimmerman 1986; Mills *et al*. 2013), and the level of cash holdings (Dhaliwal *et al*. 2011). The results are also robust to using alternative measures of tax avoidance, including firms' GAAP effective tax rate, cash effective tax rate, and long-run measures of tax avoidance (e.g., Dyreng *et al*. 2008). Finally, the results are robust to using a propensity-score matched sample where firms without patents are matched with firms with patents on the basis of R&D and intangible assets.

This paper contributes to two streams of literature. First, it contributes to the literature on the determinants of tax avoidance. While this literature has found a considerable number of executive characteristics (Dyreng *et al*. 2010; Chyz 2013), auditor characteristics (McGuire *et al*. 2012), firm ownership structure (Badertscher *et al*. 2010; Chen *et al*. 2010), and firm characteristics (Gupta and Newberry 1997; Rego 2003; Cheng *et al*. 2012) are associated with tax avoidance, it has not considered firm innovation as a determinant of tax avoidance. Second, by demonstrating that the level of innovation at the firm affects corporate tax policy, the findings in this paper contribute to the burgeoning literature on the determinants and consequences of firm innovation (Atanassov 2013; Bernstein 2012; He and Tian 2013). A third contribution of this study is to begin to open the "black box" of tax strategies used by firms. The existing

[6] i.e., 0.7/30.7 = 2.3 percent.

research generally fails to explore the mechanism firms actually use to avoid taxes and firms generally do not reveal these mechanisms. The evidence in this study is also of use to tax authorities in deciding which firms to investigate for tax avoidance. The results suggest that if the IRS is targeting firms suspected of abusing the discretion inherent in Section 482 of the Internal Revenue Code, it would do best to investigate multinational firms with valuable patents.

The remainder of this paper is organized as follows. Section 2 contains background information, a literature review, and the hypothesis development. Section 3 contains the research design, while section 4 discusses the data used in the study and the sample. Section 5 summarizes the main empirical results, section 6 contains additional analyses, and section 7 concludes.

## 2. BACKGROUND, LITERATURE REVIEW, AND HYPOTHESIS

### 2.1 Definition of Tax Avoidance

In this paper, I consider tax avoidance as any activity that reduces tax paid given the level of earnings. This definition is broad. Tax avoidance includes any transaction that has any effect on the firm's tax burden. This includes real activities which have tax benefits, lobbying activities aimed at reducing a firm's tax burden, and activities undertaken solely for the purpose of avoiding taxes.[7]

One may ask why all firms do not choose to engage in tax avoidance. Why is there significant variation in the level of tax avoidance (e.g., Dyreng *et al*. 2008)? The answer is twofold. First, tax avoidance has both costs and benefits. The benefit of tax avoidance is to save tax payments. Firms in higher tax brackets receive greater benefits from avoiding taxes. There also are costs associated with tax avoidance. One direct cost is the salaries paid to tax accountants and tax lawyers. Reputation cost is another cost of tax avoidance. For example, after news broke that General Motors earned $14.2 billion in worldwide profits in 2010, yet paid no taxes in the U.S. and claimed a tax benefit of $3.2 billion, its reputation took a hit. "The company's reputation took a steep drop and two months to recover to pre-crisis levels"- Marzilli (2012).

A third cost of engaging in tax avoidance is the risk that the firm's tax position will be challenged by the tax authorities. If a company owes a tax deficiency, the firm must pay tax owed, plus interest, and penalty. Finally, a less direct but potentially large cost of tax avoidance is agency cost. Managers can use tax avoidance to construct complicated transactions, which

[7] This definition follows Hanlon and Heitzman (2010) who note that "tax avoidance represents a continuum of tax planning strategies where something like municipal bond investments are at one end (lower explicit tax, perfectly legal), then terms such as 'noncompliance', 'evasion', 'aggressiveness', and 'sheltering' would be closer to the other end of the continuum." – Hanlon and Heitzman (2010, 137).

increase the information asymmetry between the managers and the shareholders. To the extent that managers use this increased information asymmetry to engage in opportunistic behavior, this agency cost is born by the shareholders (Desai and Dharmapala 2009). Shareholders may respond to the increased agency cost by discounting the firm's stock price. The second reason there is variation in tax avoidance is that certain aspects of a firm's operations may create opportunities for tax avoidance which are unavailable to other firms. This paper focuses on firms' opportunity to manipulate intellectual properties.

**2.2 Literature on Determinants of Tax Avoidance**

Tax researchers have identified firm characteristics, executive characteristics, firm ownership structures, and other characteristics which are associated with tax avoidance. I will first discuss firm characteristics.

An early study by Gupta and Newberry (1997) finds that tax avoidance is associated with firm profitability, leverage, and capital intensity. More profitable firms generally pay higher taxes. On the other hand, one could argue that more profitable firms have greater incentives to engage in tax avoidance due to the greater potential savings (Rego 2003; Frank *et al*. 2009; McGuire *et al*. 2012). As well, Manzon and Plesko (2002) argue that more profitable firms can make better use of tax deductions, exemptions, and credits. The literature also has shown that multinational corporations have lower effective tax rates, since these firms' foreign operations allow them to avoid more taxes (Rego 2003). Dhaliwal *et al*. (2011) find that firms with low levels of cash holdings are more likely to engage in tax avoidance. There is also considerable evidence that firms with higher political costs are less likely to engage in tax avoidance (Zimmerman 1983; Mills *et al*. 2013). Recent research also has examined whether firms which engage in aggressive financial reporting are more or less likely to avoid taxes. Frank *et al*. (2009)

find a positive relationship between aggressive financial reporting and tax aggressiveness. However, Lennox *et al*. (2013) find a negative relationship between the two constructs. Therefore, the relationship is not clear.[8]

Because individual executives, and not firms, make decisions, there is considerable research which examines the effect of individual executives on tax avoidance. A recent paper by Dyreng *et al*. (2010) find that top executives (e.g., the CEO and CFO) have considerable influence on their firm's tax policies. The authors provide some evidence that more optimistic executives are more likely to engage in tax avoidance.[9] Phillips (2003) investigates the role of incentives in determining tax avoidance. He finds evidence that basing business-unit managers' compensation on after-tax earnings leads to lower effective tax rates.[10]

Recent research has begun to explore the backgrounds of top executives to better understand their influence on corporate tax policies. For example, Chyz (2013) identifies "suspect executives" as those who appear to have engaged in stock option backdating and finds that these executives are significantly more tax aggressive. To the extent that executives who engage in option backdating report more aggressively, Chyz's (2013) findings are consistent with Frank *et al*.'s (2009) finding of a positive relationship between financial reporting aggressiveness and tax aggressiveness. The board of directors also can have a significant influence on corporate tax policy. For example, recent research finds that firms which share a

[8] Frank et al. (2009) use earnings quality measures to measure financial reporting aggressiveness while Lennox et al. (2013) use the incidence of accounting fraud. A disadvantage of using earnings quality measures is that they are noisy proxies for the construct being studied (Eshleman and Guo 2014). However, using a dichotomous measure ignores variation in the construct. In the case of Lennox et al.'s (2013) study, using accounting fraud as a measure of financial reporting aggressiveness forces the researcher to assume that financial reporting quality is similar across all of the firms which did not engage in fraud. An alternative way to capture fraud firms is the use of Benford's Law (Suh et al. 2011).

[9] See Table 7 of the study.

[10] However, he also finds that basing CEO compensation on after-tax earnings does not lead to lower effective tax rates.

common board member are significantly more likely to utilize similar tax avoidance strategies (Brown 2011). Robinson *et al*. (2010) examine how certain aspects of a firm's tax department can influence the level of tax avoidance. The authors find that firms which designate the tax department as a profit center have lower effective tax rates than firms which designate the tax department as a cost center. Apparently, members of corporate tax departments respond to profit incentives by finding ways to avoid more taxes.

The ownership structure of a firm also can affect the firm's level of tax avoidance (Desai and Dharmapala 2006). Firms with more concentrated ownership structures may avoid more taxes because the controlling shareholders benefit more from the savings. Alternatively, these firms may engage in lower levels of tax avoidance because the controlling shareholders' wealth is more sensitive to costs of tax avoidance, including reputational damage and suspicions from minority shareholders that the firm is masking rent extraction (Desai *et al*. 2007). Empirical evidence on this issue is found in Chen *et al*. (2010), who study family firms. Family firms often have a different ownership structure in which the family members have a controlling interest and the minority shareholders do not. Chen *et al*. (2010) find that firms which are owned and run by founding family members avoid fewer taxes than do other firms. The authors suggest that family firms do this to avoid a potential price discount arising from minority shareholders who are concerned that the controlling shareholders are engaging in rent extraction and masking it via tax avoidance.[11] However, a competing explanation is found in Badertscher *et al*. (2013), who predict and find that firms with more diffuse ownership structures are more likely to engage in tax avoidance. The authors argue that concentrated owners are less likely to engage in risky

[11] The authors also note that the results are consistent with the controlling shareholders being more concerned with reputational damage which could arise if the tax avoidance were to be challenged by the IRS.

activities and tax avoidance is a risky activity. Finally, Cheng *et al*. (2012) find that firms with significant hedge fund ownership avoid more taxes.

In addition to firm characteristics, executive characteristics, and ownership structure, researchers have identified at least two other determinants of tax avoidance. McGuire *et al*. (2012) find that firms who purchase tax services from an industry specialist are able to avoid more taxes. This finding highlights the fact that certain tax strategies are industry-specific.[12]

Finally, the characteristics of the country a firm operates in can affect the extent of tax avoidance firms headquartered in that country engage in. For example, Porcano et al. (2011) find that firms' tax avoidance behavior is influenced by the level of economic development of the country the firm operates in.

### 2.3 Literature on Income Shifting and Transfer Pricing

If multinational corporations were applying the arms-length principle, we would not observe any difference in the transfer prices of related parties as compared to the transfer prices of unrelated parties. However, the research in this area consistently finds that U.S. multinational corporations use their discretion in the tax code to shift income to subsidiaries in low-tax jurisdictions. For example, Clausing (2003) finds that the exports of parent firms tend to have lower intra-firm transfer prices when compared to transactions with unrelated parties. She also finds that the intra-firm import prices to the parent company are higher when compared to unrelated parties' import prices. Similarly, Harris (1993) finds that multinational firms with affiliates in countries with low tax rates tend to have lower tax liabilities in the U.S., compared to other firms without affiliates. Additional evidence can be found in Clausing (2009) who uses country-level data to show that foreign profitability is higher in jurisdictions with lower tax rates.

[12] Bonner et al. (1992) find that tax expertise consists of client-specific, as well as industry-specific knowledge.

This behavior is also found in Europe. Huizinga and Laeven (2008) show that European multinationals tend to shift income away from Germany, since they have a high tax rate, and towards low tax rate countries. Finally, Klassen and Laplante (2012a) show that income shifting into and out of the U.S. has become more rampant in recent years.[13] To summarize, research using country and industry-level data has provided evidence that firms are engaging in income shifting. The next question is through what means do firms engage in such behavior.

One way U.S. multinational firms can shift income from high-tax jurisdictions to low-tax jurisdictions is by choosing to hold debt in the affiliate located in a low-tax country. Using a sample of bond offerings in Australia, Canada, France, Germany, Italy, Japan, and the U.K., Newberry and Dhaliwal (2001) provide evidence that firms do consider the tax rate of the country in which they are raising debt financing.

A second way multinational firms can shift income from high-tax to low-tax jurisdictions is by charging their subsidiaries an abnormally low fee for the use of intellectual property, such as patents or copyrights. This type of behavior is referred to as "transfer pricing". However, the literature has produced little evidence that firms are indeed engaging in this type of behavior. Bartelsman and Beetsma (2003) use industry-level data and find that there is some evidence of income shifting for OECD countries. They particularly find strong evidence for industries with high levels of intangible assets, such as the pharmaceutical industry. A limitation of Bartelsman and Beetsma's (2003) finding is the use of industry-level data, which prevents the authors from capturing variation in income shifting within an industry. In addition, Grubert and Slemrod (1998) find that firms with high levels of intangible assets, such as pharmaceutical companies, are more likely to choose to manufacture their products in Puerto Rico in order to avoid taxes. A

[13] See also Grubert (1998) and Klassen and Laplante (2012b).

limitation of Grubert and Slemrod's findings is that they deal with real activities, i.e., the choice of location of a firm's manufacturing. Finally, Grubert (2003) finds that approximately 50 percent of the income shifted to low-tax jurisdictions is related to research and development (R&D) investments made by the parent. A limitation of Grubert's (2003) study is the use of R&D as a proxy for intellectual property. R&D is a poor proxy for the amount of intellectual property a firm owns because it is not clear that more R&D always leads to more valuable intellectual property. Some firms' R&D efforts are not successful. Finally, the amount of reported R&D may not be equal to the amount of R&D the firm spent as firms can engage in classification shifting of R&D (Skaife et al. 2014).

To summarize, the literature has shown that multinational firms shift income out of high-tax jurisdictions into low-tax jurisdictions. However, we lack direct evidence on the methods firm use to shift this income.

**2.4 Literature on Innovation**

Recently, accounting and finance researchers have explored the determinants of corporate innovation. Atanassov (2013) finds that anti-takeover laws stifle corporate innovation, suggesting that corporate governance fosters greater innovation. In addition, Brav *et al.* (2014) find that firms targeted by hedge fund activists experience an increase in innovation. On the other hand, enhanced scrutiny from outside investors may not encourage firms to be more innovative, particularly if the outside investors have short investment horizons. For example, He and Tian (2013) find that firms with greater analyst following produce fewer patents and those patents have a lower impact. In addition, Bernstein (2012) finds that firms are less innovative after initial public offerings (i.e., after going public). Bernstein attributes his findings to skilled inventors leaving firms which go public and the remaining inventors becoming less productive after the IPO.[14] Finally, Mukherjee *et al.* (2014) find that increases in corporate tax rates lead to less innovation. The argument is that higher taxes are a disincentive to work hard. In addition, higher taxes make debt financing more attractive, but creditors are unlikely to extend debt financing to firms engaging in research and development projects with no standalone liquidation value (Mukherjee *et al.* 2014).

Top management can also affect the level of innovation at the firm. Hirshleifer *et al.* (2012) find that firms with more overconfident Chief Executive Officers tend to generate more patents, and those patents tend to have a greater impact. Given the same level of research and development expenditures, firms with more overconfident CEOs generate more patents. Hirshleifer *et al.* (2013) extend this analysis and find that the ratio of patents to research and development expenditures (innovative efficiency) is a strong predictor of future stock returns. It appears the market does not fully appreciate innovation. The authors attribute this mispricing to the limited attention hypothesis of Hirshleifer and Teoh (2003).

The competition in the industry can also affect the level of corporate innovation. Aghion *et al.* (2005) provide evidence of an inverted-U relationship between product market competition and corporate innovation. If competition is very low or very high, innovation suffers. Innovation is highest when competition is medium.

### 2.5 Hypothesis Development

The hypothesis for this study is based on the difficulty of enforcing certain parts of the tax code. If a firm generates intellectual property such as patents or copyrights, the company may charge its foreign subsidiaries a fee for the use of that intellectual property in generating revenues. Section 482 of the Internal Revenue Code mandates that the parent company charge an

[14] Bernstein (2012) does find that after going public, firms have the resources to attract new human capital, and find innovation externally. However, the net result is a decline in innovation.

"arm's length" fee to the subsidiary for the use of the intellectual property (Rotkowski and Miller 2012). Because the value of intellectual property is ambiguous, the enforcement for this part of the tax code can be difficult (Gleckman 2013). Therefore, I posit that firms with strong innovation will generate more patents, and they will tend to charge their subsidiaries abnormally low fees for the use of these patents. If these subsidiaries are located in jurisdictions with tax rates lower than that of the U.S.,[15] I will observe that these firms have lower effective tax rates than comparable firms without patents. This observation leads to the hypothesis, stated in alternate form:

Hypothesis: There is a negative association between a firm's level of innovation and its effective tax rate.

Alternatively, innovation may have no association with tax avoidance if either (i.) the IRS is able to enforce the arm's length principle in transfer pricing for patents or (ii.) managers choose to use fair transfer pricing in selling patents to their subsidiaries. As well, if innovative companies do not have tax expertise, they may not use the discretion inherent in the tax code to avoid taxes with their patents.

[15] The U.S. corporate tax rate is currently 35 percent, which is much higher than that of many foreign countries, such as Ireland (12.5 percent), Luxembourg (29.22 percent), Hong Kong (16.5 percent), Iceland (20 percent), Germany (29.55 percent), Denmark (25 percent), Sweden (22 percent), Canada (26 percent), Chile (20 percent), and Australia (30 percent) (KPMG 2013).

## 3. RESEARCH DESIGN

In order to test the hypothesis, I estimate the following linear regression model using ordinary least squares:

$$\begin{aligned} ETR_{it} = {} & \beta_0 + \beta_1 INNOV_{it} + \beta_2 ROA_{it} + \beta_3 CASH_{it} + \beta_4 EQUIC_{it} + \beta_5 RND_{it} + \beta_6 MVE_{it-1} \\ & + \beta_7 NOL_{it} + \beta_8 \Delta NOL_{it} + \beta_9 LEV_{it} + \beta_{10} FI_{it} + \beta_{11} INTANG_{it} + \beta_{12} DEP_{it} \\ & + \beta_{13} MTB_{it-1} + \beta_{14} INSTOWN_{it} + \beta_{15} FEDCUST_{it} + \beta_{16} AAER_{it} \\ & + Industry\ Fixed\ Effects + Year\ Fixed\ Effects + \varepsilon_{it} \qquad (1) \end{aligned}$$

Table 1 contains variable definitions.

Table 1 Variable Definitions
(in the order they appear)

| Variable | | Definition |
|---|---|---|
| $INNOV$ | = | Innovation, measured as the number of patents a firm generates in a given year divided by the mean number of patents generated by all firms in that year. Patent data is obtained from the Hall *et al*. (2001) database. |
| $ETR$ | = | The firm's effective tax rate, calculated as tax expense ($txt$) divided by pretax income ($pi$) less special items ($spi$). This variable is winsorized to have a range from 0 to 1. |
| $CASH\_ETR$ | = | The firm's cash effective tax rate, calculated as cash taxes paid ($txpd$) divided by pretax income ($pi$) less special items ($spi$). This variable is winsorized to have a range from 0 to 1. |
| $CURR6$ | = | The firm's long-run current effective tax rate, calculated as the sum of tax expense ($txt$) over the current and prior five years divided by the sum of pre-tax book income ($pi - spi$) over the current and prior five years. If data is missing, I use the prior four years. If data is still missing, I use the prior three years. Values greater than 1 or less than 0 are deleted. |
| $CASH6$ | = | The firm's long-run cash effective tax rate, calculated as the sum of cash taxes paid ($txpd$) over the current and prior five years divided by the sum of pre-tax book income ($pi - spi$) over the current and prior five years. If data is missing, I use the prior four years. If data is still missing, I use the prior three years. Values greater than 1 or less than 0 are deleted. |
| $ROA$ | = | Return on assets, calculated as income before extraordinary items ($ib$) divided by lagged assets ($at$). |
| $CASH$ | = | The firm's cash balance at end of year ($che$) divided by total assets ($at$). |
| $EQUIC$ | = | The firm's equity income calculated as earnings from subsidiaries ($esub$) divided by lagged assets ($at$). |
| $RND$ | = | Research & development expense ($xrd$) divided by lagged assets ($at$). |

(Table 1 continued)

| Variable | | Definition |
|---|---|---|
| $MVE$ | = | The natural logarithm of the firm's market value of equity ($prcc\_f \times csho$). |
| $NOL$ | = | Net operating loss carryforward, which is equal to 1 if the firm has a positive net operating loss carryfoward ($tlcf$), 0 otherwise. |
| $\Delta NOL$ | = | Change in NOL, calculated as the change in net operating loss carryforward ($tlcf$) divided by lagged assets ($at$). |
| $LEV$ | = | Leverage, calculated as long-term debt ($dltt$) divided by total assets ($at$). |
| $FI$ | = | Foreign income, calculated as pre-tax income from foreign operations ($pifo$) divided by lagged assets ($at$). |
| $INTANG$ | = | Intangible assets, calculated as intangibles ($intan$) divided by lagged assets ($at$). |
| $DEP$ | = | Depreciation, calculated as depreciation expense ($dp$) divided by lagged assets ($at$). |
| $MTB$ | = | The market-to-book ratio, calculated as market value ($prcc\_f \times csho$) divided by book value ($ceq$). |
| $INSTOWN$ | = | The percentage of the firm's shares held by institutional investors. |
| $FEDCUST$ | = | An indicator variable equal to 1 if one of the firm's major customers is the federal government, zero otherwise. |
| $AAER$ | = | An indicator variable equal to 1 if the firm is subject to an Accounting and Auditing Enforcement Release in the current year, 0 otherwise. |

This Table contains variable definitions for all variables used in the study. Compustat mnemonics are in parentheses.

The dependent variable is the firm's GAAP effective tax rate ($ETR$). To ensure the generalizability of the results, I also estimate Equation (1) with alternate effective tax rate variables such as the firm's cash effective tax rate ($CASH\_ETR$), long-run GAAP effective tax rate ($CURR6$), and long-run cash effective tax rate ($CASH6$).[16] When calculating effective tax rates, special items are excluded from the denominator because special items can be quite large and can lead to very volatile effective tax rates (Dyreng *et al*. 2008). The variable of interest is $INNOV$, which is equal to the number of patents the firm generated in the year scaled by the mean number of patents generated by all firms in that year. Scaling by the mean number of

[16] $CURR6$ and $CASH6$ are calculated as in Donohoe and Knechel (2014).

patents generated by all firms in the year controls for intertemporal differences in the level of innovation. Patent data is obtained from the Hall *et al*. (2001) database.

Using the patent-based measure to capture innovation has several advantages over using R&D. First, not all R&D leads to intellectual property; much R&D is unsuccessful (Thoma 2005; Pielke 2012). Second, the amount of R&D reported by the firm is not necessarily equal to the amount spent on research and development (Skaife *et al.* 2014). There is a limitation to using a patent-based measure – it ignores other forms of intellectual property, such as copyrights.

The model controls for numerous firm characteristics which have been shown by prior literature to affect the level of taxes avoided. The model controls for the profitability of the firm ($ROA$) because Gupta and Newberry (1997) document a negative relation between the level of tax avoidance and firm's profitability. On the other hand, it could be argued that more profitable firms have greater incentives to engage in tax avoidance due to the greater potential tax savings (Rego 2003; Frank *et al* 2009; McGuire *et al*. 2012). As well, Manzon and Plesko (2002) argue that more profitable firms can make better use of tax deductions, exemptions, and credits. I include the level of cash holdings (*CASH*) because Dhaliwal *et al* (2011) find a negative association between the level of tax avoidance and the firm's cash holding. I control for leverage ($LEV$) because firms with different capital structures may have different incentives for tax avoidance. For example, firms with high leverage may have a greater incentive to avoid taxes because they need the cash to pay off their debt and interest.

I expect firms with net operating loss carryforwards (NOLs) to pay less tax. To control for this effect, the model includes $NOL$ and $\Delta NOL$. I expect to observe a negative association of $\Delta NOL$, consistent with firms that are using NOLs exhibiting greater tax avoidance. The model includes a control for foreign income ($FI$), because foreign income is not subject to US tax until the time it's repatriated.[17] I include depreciation expense ($DEP$) and intangible assets ($INTANG$) because the depreciation and amortization rules are different for book purpose and tax purpose (Cheng *et al*. 2012).[18] The model controls for the firm's equity income ($EQUIC$) because income from subsidiaries is recognized as book income under the equity method but it is not necessarily included in taxable income. Firm size ($MVE$) is included because large firms may have higher political costs (Zimmerman 1983; Watts and Zimmerman 1986). In addition, larger firms may have greater resources which allow them to avoid more taxes.

I follow McGuire *et al*. (2012) to include R&D ($RND$), depreciation ($DEP$), and the firm's market-to-book ratio ($MTB$). The model controls for firms which list the U.S. Federal Government as one of their major customers because Mills *et al*. (2013) find that these firms avoid fewer taxes, possibly due to higher political costs. Data on major customers comes from the Compustat customer file. The model controls for firms which received Accounting and Auditing Enforcement Releases (AAERs) because Lennox *et al*. (2013) document a positive relationship between effective tax rates and AAERs.[19] The model controls for institutional ownership ($INSTOWN$) because prior research has shown that sophisticated shareholders can have a significant effect on firms' tax policies (e.g., Cheng *et al*. 2012). Institutional ownership data are obtained from the Thomson Reuters database.

The model also includes year fixed effects to control for possible differences in tax laws across years. As well, industry fixed effects are included to control for variation in tax-saving

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[17] Technically, firms are required to recognize a deferred tax expense on foreign income, unless the foreign income is designated as permanently reinvested foreign income. However, many firms choose to designate some or all of the foreign income as permanently reinvested (Rego 2003).

[18] Specifically, while purchased goodwill is amortized over 15 years under U.S. tax rules, it is tested for impairment under current U.S. GAAP.

[19] AAER data are obtained from the Center for Financial Reporting and Management at University of California, Berkeley. See Dechow et al. (2011) for details on the dataset. The dataset contains details on AAERs up to 2011.

opportunities across industries. Industries are defined using four-digit Global Industry Classification Standard (GICS) codes following Bhojraj *et al*. (2003).[20] Standard errors are clustered by firm as recommended by Peterson (2009) and Gow *et al*. (2010). Results are similar if I cluster standard errors by firm and year.

[20] Bhojraj, Lee, and Oler (2003) provide evidence that the GICS classifications are superior to SIC codes in explaining stock return co-movements, and key financial ratios.

## 4. DATA, SAMPLE SELECTION, AND DESCRIPTIVE STATISTICS

### 4.1 Data and Sample Selection

Financial statement data are obtained from the Compustat fundamentals annual file. Institutional ownership data are obtained from the Thomson Reuters database. AAERs are obtained from the Center for Financial Reporting and Management (see Dechow *et al*. 2011), and data on patents come from the Hall *et al*. (2001) patent database. The sample spans 1993 to 1999. I choose a post-1993 sample because of the passage of FAS 109 *Accounting for Income Taxes* in 1993. I start from 1993 to ensure the consistency of the tax avoidance measures. Panel A of Table 2 outlines the sample selection procedure.

Table 2 Sample Selection and Sample Composition

| Panel A: Sample Selection | |
|---|---|
| All firm-years on Compustat post-1993 with non-missing innovation data: | 78,605 |
| Less observations with negative pre-tax income: | (33,258) |
| Less financial services firms: | (10,662) |
| Less firms without necessary data to estimate Eq. (1): | (8,718) |
| Primary Sample | 25,967 |

Panel B: Industry Composition

| GICS Industry | N | Percentage of Sample | Percentage of Compustat Sample |
|---|---|---|---|
| Energy (1010) | 1,606 | 6.2% | 5.6% |
| Materials (1510) | 2,061 | 7.9% | 6.6% |
| Capital Goods(2010) | 2,917 | 11.2% | 8.5% |
| Commercial & Professional Services (2020) | 1,557 | 6.0% | 6.0% |
| Transportation (2030) | 748 | 2.9% | 2.3% |
| Automobile and Components (2510) | 571 | 2.2% | 1.6% |
| Consumer Durables & Apparel (2520) | 1,845 | 7.1% | 5.8% |
| Consumer Services (2530) | 1,155 | 4.5% | 4.4% |
| Media (2540) | 969 | 3.7% | 4.3% |
| Retailing (2550) | 1,572 | 6.1% | 5.6% |
| Food & Staples Retailing (3010) | 433 | 1.7% | 1.4% |
| Food, Beverage, & Tobacco (3020) | 899 | 3.5% | 2.8% |
| Household & Personal Products (3030) | 343 | 1.3% | 1.1% |
| Health Care Equipment & Services (3510) | 1,995 | 7.7% | 8.4% |
| Pharmaceuticals, Biotechnology & Life Sciences (3520) | 692 | 2.7% | 5.5% |
| Software & Services (4510) | 1,656 | 6.4% | 11.4% |

(Table 2 continued)

| GICS Industry | N | Percentage of Sample | Percentage of Compustat Sample |
|---|---|---|---|
| Technology Hardware & Equipment (4520) | 2,617 | 10.1% | 9.8% |
| Semiconductors & Semiconductor Equipment (4530) | 514 | 2.0% | 1.7% |
| Telecommunication Services (5010) | 483 | 1.9% | 3.3% |
| Utilities (5510) | 1,302 | 5.0% | 3.9% |

Panel A contains details on the sample selection. Panel B displays the industry composition of the sample, compared to Compustat during the same sample period. The sample spans 1993 to 1999.

I begin with all firm-year observations on Compustat during the period 1993 to 1999. The sample ends in 1999 because that is the last year the patent data are available from the Hall *et al*. (2001) database. Firm-year observations with negative pre-tax earnings are deleted as my focus is on tax avoidance. Financial services firms (GICS codes beginning with 40) are deleted to be consistent with prior literature (e.g., Cheng *et al*. 2012).[21] After deleting 8,718 observations, due to a lack of data necessary to estimate Eq. (1), I am left with 25,967 firm-year observations. After trimming the sample in this way, each independent variable is winsorized at the 1st and 99th percentile to reduce in the influence of outliers on the regression results.

Panel B of Table 2 contains an industry breakdown of my sample, compared to the population of firms on Compustat during this time period. The composition of industries in my sample is quite similar to that of Compustat. For example, 6.2 percent of the firms in my sample are in the Energy industry as compared to 5.6 percent for the Compustat population. In addition, the percentage of firms operating in the Commercial & Professional Services industry, Consumer Durables industry, Household & Personal Products industry, and Health Care Equipment & Services industry are quite similar to the Compustat population. A notable exception is Software

[21] Results are robust to including financial services firms.

& Services (GICS code 4510) which accounts for only 6.4 percent of my sample and 11.4 percent of the Compustat firms during the same time period.

**4.2 Descriptive Statistics**

Table 3 contains descriptive statistics for each variable used in the analysis.

Table 3 Descriptive Statistics

| Variable | N | Mean | Q1 | Median | Q3 | Std Dev |
|---|---|---|---|---|---|---|
| # of Patents | 25,967 | 3.890 | 0.000 | 0.000 | 0.000 | 44.626 |
| $INNOV$ | 25,967 | 1.291 | 0.000 | 0.000 | 0.000 | 6.796 |
| $ETR$ | 25,967 | 0.307 | 0.225 | 0.350 | 0.392 | 0.174 |
| $CASH\_ETR$ | 25,967 | 0.250 | 0.056 | 0.243 | 0.367 | 0.216 |
| $CURR6$ | 21,234 | 0.322 | 0.271 | 0.345 | 0.385 | 0.134 |
| $CASH6$ | 18,956 | 0.296 | 0.209 | 0.305 | 0.377 | 0.146 |
| $ROA$ | 25,967 | 0.089 | 0.035 | 0.066 | 0.115 | 0.085 |
| $CASH$ | 25,967 | 0.133 | 0.016 | 0.059 | 0.189 | 0.167 |
| $EQUIC$ | 25,967 | 0.001 | 0.000 | 0.000 | 0.000 | 0.005 |
| $RND$ | 25,967 | 0.032 | 0.000 | 0.000 | 0.032 | 0.063 |
| $MVE$ | 25,967 | 5.210 | 3.680 | 5.121 | 6.708 | 2.193 |
| $NOL$ | 25,967 | 0.200 | 0.000 | 0.000 | 0.000 | 0.400 |
| $\Delta NOL$ | 25,967 | -0.006 | 0.000 | 0.000 | 0.000 | 0.066 |
| $LEV$ | 25,967 | 0.177 | 0.012 | 0.140 | 0.290 | 0.172 |
| $FI$ | 25,967 | 0.009 | 0.000 | 0.000 | 0.000 | 0.024 |
| $INTANG$ | 25,967 | 0.098 | 0.000 | 0.006 | 0.113 | 0.186 |
| $DEP$ | 25,967 | 0.053 | 0.032 | 0.047 | 0.066 | 0.034 |
| $MTB$ | 25,967 | 2.923 | 1.313 | 2.070 | 3.431 | 3.241 |
| $INSTOWN$ | 25,967 | 0.173 | 0.000 | 0.000 | 0.322 | 0.246 |
| $FEDCUST$ | 25,967 | 0.006 | 0.000 | 0.000 | 0.000 | 0.075 |
| $AAER$ | 25,967 | 0.035 | 0.000 | 0.000 | 0.000 | 0.183 |

This table reports the number of observations (N), Mean, First quartile (Q1), Median, Third quartile (Q3), and Standard Deviation (Std Dev) for each variable used in the analysis. Each independent variable is winsorized at the 1$^{st}$ and 99$^{th}$ percentile to reduce the influence of outliers.

The first row of Table 3 reports descriptive statistics for the number of patents each firm has. The average firm has 3.89 patents, although the median number of patents is zero. The innovation measure ($INNOV$) is right skewed with a mean of 1.291 and a median of zero. This situation reflects that fact that most firms do not generate patents. The mean value for $ETR$ is

0.307, implying an average GAAP effective tax rate of 30.7 percent. This value is comparable to recent research in this area, such as Dyreng *et al*. (2010) who report a mean ETR of 30.9 percent. The mean $CASH\_ETR$ is slightly lower at 25 percent, also consistent with recent research in this area (e.g., Dyreng *et al*. 2010 report a mean cash effective tax rate of 26.3 percent). The long-run measures of tax avoidance ($CURR6$ and $CASH6$) have higher mean values, reflecting the fact that avoiding taxes for a prolonged period of time is more difficult than avoiding taxes for one year. The mean value of $NOL$ is 0.20, suggesting that approximately 20 percent of the firm-years have a net operating loss carryforward. The average firm has 17.3 percent of its stock held by institutional investors, although the median amount is zero percent, suggesting that this variable is right-skewed. Finally, only 3.5 percent of firm-years in the sample involve an AAER.

Table 4 contains Spearman correlation coefficients for all variables used in the analysis. Consistent with the hypothesis, my proxy for innovation ($INNOV$) is negatively correlated with both $ETR$ and $CURR6$. However, $INNOV$ is also positively correlated with the other two proxies for effective tax rates. I caution against putting too much weight on these correlations, as they do not control for other known determinants of tax avoidance. The innovation measure is positively correlated with R&D (0.29) and foreign income (0.27). The correlations are sufficiently low as to suggest that innovation captures a different construct than either R&D or foreign income. In general, the tax avoidance measures are positively correlated. The fact that none of the correlations among the tax avoidance measures exceeds 0.62 suggests that these measures capture different aspects of tax avoidance, consistent with the argument made by Hanlon and Heitzman (2010). The highest correlation between my variable of interest ($INNOV$) and any other independent variable is that of $RND$ (0.29). I have conducted a variance inflation factor test and find that the largest variance inflation factor is 1.81, which is far below the threshold of 10

Table 4 Spearman Correlations

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 $INNOV$ | | | | | | | | | | | | | | |
| 2 $ETR$ | *-0.02* | | | | | | | | | | | | | |
| 3 $CASH\_ETR$ | *0.06* | *0.47* | | | | | | | | | | | | |
| 4 $CURR6$ | *-0.03* | *0.60* | *0.39* | | | | | | | | | | | |
| 5 $CASH6$ | *0.04* | *0.36* | *0.62* | *0.52* | | | | | | | | | | |
| 6 $ROA$ | *0.03* | *-0.03* | 0.00 | 0.00 | *-0.05* | | | | | | | | | |
| 7 $CASH$ | -0.01 | *-0.12* | *-0.07* | *-0.09* | *-0.03* | *0.31* | | | | | | | | |
| 8 $EQUIC$ | *0.05* | -0.01 | -0.01 | -0.01 | 0.01 | *-0.03* | *-0.07* | | | | | | | |
| 9 $RND$ | *0.29* | *-0.17* | *-0.05* | *-0.14* | *-0.06* | *0.18* | *0.31* | *-0.02* | | | | | | |
| 10 $MVE$ | *0.24* | *0.14* | *0.15* | *0.07* | *0.02* | *0.04* | *-0.11* | *0.16* | *0.04* | | | | | |
| 11 $NOL$ | *0.02* | *-0.12* | *-0.18* | *-0.07* | *-0.11* | *-0.05* | *0.03* | *-0.02* | *0.10* | *-0.07* | | | | |
| 12 $\Delta NOL$ | 0.00 | *0.06* | *0.09* | *0.04* | *0.07* | *-0.08* | *-0.04* | 0.00 | *-0.02* | *0.10* | 0.00 | | | |
| 13 $LEV$ | -0.01 | *0.08* | *-0.02* | *0.05* | *-0.07* | *-0.37* | *-0.52* | *0.08* | *-0.30* | *0.17* | *0.02* | *0.05* | | |
| 14 $FI$ | *0.27* | -0.01 | *0.05* | *-0.02* | -0.01 | *0.07* | *0.03* | *0.07* | *0.24* | *0.27* | *0.06* | 0.01 | 0.00 | |
| 15 $INTANG$ | *0.03* | *0.13* | *0.10* | *0.11* | *0.08* | *-0.02* | *-0.16* | *0.02* | *-0.04* | *0.10* | *0.06* | *0.02* | *0.17* | *0.10* |

(Table 4 continued)

| Variable | $INNOV$ | $ETR$ | $CASH\_ETR$ | $CURR6$ | $CASH6$ | $ROA$ | $CASH$ | $EQUIC$ | $RND$ |
|---|---|---|---|---|---|---|---|---|---|
| $DEP$ | *0.05* | 0.00 | *-0.03* | *0.02* | *-0.05* | *0.06* | *-0.10* | -0.01 | *0.03* |
| $MTB$ | *0.07* | -0.01 | *0.03* | -0.01 | *-0.07* | *0.40* | *0.16* | -0.01 | *0.20* |
| $INSTOWN$ | *0.14* | *0.06* | *0.12* | *0.05* | *0.04* | *0.10* | 0.00 | *0.02* | *0.10* |
| $FEDCUST$ | -0.01 | -0.01 | -0.01 | -0.01 | 0.00 | 0.00 | 0.01 | -0.01 | *0.03* |
| $AAER$ | 0.00 | -0.01 | *-0.03* | -0.01 | *-0.03* | -0.01 | -0.01 | 0.00 | 0.00 |

| Variable | $MVE$ | $NOL$ | $\Delta NOL$ | $LEV$ | $FI$ | $INTANG$ | $DEP$ | $MTB$ | $INSTOWN$ | $FEDCUST$ |
|---|---|---|---|---|---|---|---|---|---|---|
| $DEP$ | *0.06* | *0.03* | 0.01 | *0.14* | *0.04* | *0.09* | | | | |
| $MTB$ | *0.38* | 0.01 | 0.01 | *-0.13* | *0.12* | *0.09* | *0.09* | | | |
| $INSTOWN$ | *0.24* | *-0.02* | *0.03* | *-0.05* | *0.12* | *0.04* | *0.03* | *0.13* | | |
| $FEDCUST$ | 0.01 | 0.01 | -0.01 | -0.01 | 0.00 | *0.02* | -0.01 | 0.00 | 0.01 | |
| $AAER$ | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | *0.03* | 0.00 | *0.02* | *-0.05* | 0.01 |

This table reports Spearman correlation coefficients. Correlations significant at the 5 percent level are in *italics*.

recommended by both Kennedy (1992) and Neter *et al*. (1996). Therefore, multicollinearity is not likely to cloud my inferences for any of the independent variables.

## 5. EMPIRICAL RESULTS

The first column of Table 5 reports the results of estimating Equation (1).

Table 5
Do firms with more innovation avoid more taxes?

| | | Dependent Variable = Effective Tax Rate | | | |
|---|---|---|---|---|---|
| Variable | Predicted Sign | (1) $ETR$ | (2) $CASH\_ETR$ | (3) $CURR6$ | (4) $CASH6$ |
| $INNOV$ | - | -0.001*** | -0.001** | -0.001*** | -0.000* |
| | | [-6.78] | [-2.27] | [-5.16] | [-1.80] |
| $ROA$ | ? | -0.143*** | -0.277*** | -0.089*** | -0.241*** |
| | | [-6.19] | [-12.63] | [-3.50] | [-8.98] |
| $CASH$ | - | -0.022** | -0.013 | -0.021* | -0.021 |
| | | [-2.01] | [-1.04] | [-1.79] | [-1.53] |
| $EQUIC$ | - | -1.401*** | -1.771*** | -0.541 | -0.914** |
| | | [-4.32] | [-4.82] | [-1.57] | [-2.42] |
| $RND$ | - | -0.277*** | -0.233*** | -0.176*** | -0.175*** |
| | | [-9.70] | [-6.94] | [-5.50] | [-4.62] |
| $MVE$ | + | 0.016*** | 0.011*** | 0.009*** | 0.007*** |
| | | [16.68] | [9.20] | [8.84] | [5.30] |
| $NOL$ | - | -0.038*** | -0.067*** | -0.012*** | -0.031*** |
| | | [-9.55] | [-14.94] | [-3.10] | [-6.44] |
| $\Delta NOL$ | + | 0.146*** | 0.198*** | 0.110*** | 0.190*** |
| | | [6.73] | [11.04] | [3.89] | [5.56] |
| $LEV$ | - | -0.042*** | -0.131*** | -0.037*** | -0.135*** |
| | | [-3.77] | [-10.45] | [-3.17] | [-10.50] |
| $FI$ | - | 0.113* | 0.035 | 0.075 | -0.084 |
| | | [1.77] | [0.47] | [1.22] | [-1.22] |
| $INTANG$ | - | 0.059*** | 0.065*** | 0.047*** | 0.039*** |
| | | [6.84] | [6.57] | [5.65] | [4.01] |
| $DEP$ | - | 0.038 | -0.025 | 0.142** | -0.061 |
| | | [0.70] | [-0.43] | [2.51] | [-0.96] |
| $MTB$ | - | -0.003*** | -0.002*** | -0.002*** | -0.003*** |
| | | [-5.03] | [-3.62] | [-3.37] | [-3.48] |
| $INSTOWN$ | - | 0.027*** | 0.048*** | 0.019*** | 0.012* |
| | | [4.85] | [6.36] | [3.39] | [1.75] |
| $FEDCUST$ | + | -0.028* | -0.024 | -0.004 | 0.005 |
| | | [-1.80] | [-1.38] | [-0.26] | [0.26] |
| $AAER$ | ? | -0.012 | -0.026*** | -0.003 | -0.015 |
| $CONSTANT$ | ? | 0.216*** | 0.233*** | 0.361*** | 0.341*** |
| | | [6.65] | [6.73] | [8.75] | [6.32] |
| Adjusted $R^2$ | | 0.110 | 0.100 | 0.077 | 0.108 |
| | | [-1.36] | [-2.68] | [-0.32] | [-1.37] |

(Table 5 continued)

| Variable | Predicted Sign | (1) $ETR$ | (2) $CASH\_ETR$ | (3) $CURR6$ | (4) $CASH6$ |
|---|---|---|---|---|---|
| Industry Fixed Effects | Yes | Yes | Yes | Yes | Yes |
| Year Fixed Effects | Yes | Yes | Yes | Yes | Yes |
| Observations | | 25,967 | 25,967 | 21,234 | 18,956 |

This table contains the results of estimating four linear regressions using ordinary least squares. Each row displays the estimated coefficient with its associated t-statistic in brackets below. The dependent variable in (1) is $ETR$, in (2) it is $CASH\_ETR$, in (3) it is $CURR6$, and in (4) it is $CASH6$. *, **, and *** denote statistical significance at the 10, 5, and 1 percent levels, respectively, using a two-tailed test. The model includes industry and year fixed effects, where industries are defined using four-digit GICS codes.

The coefficient on the variable of interest ($INNOV$) is -0.001 and it is significant at the 1 percent level using a two-tailed test (t-stat. = -6.78). This indicates that more innovative firms are associated with lower GAAP effective tax rates. The coefficient on $ROA$ is negative and significant, consistent with the notion that more profitable firms have greater incentives to avoid taxes due to the larger potential tax savings (Rego 2003; Frank *et al* 2009; McGuire *et al*. 2012). The significantly negative coefficient on $LEV$ is consistent with highly levered firms using the interest expense on their debt as a tax shield in order to pay lower taxes. The adjusted $R^2$ of the model is 11 percent, which is consistent with recent research in this area (e.g., Cheng *et al*. (2012) report an adjusted $R^2$ of 0.110).

The second column of Table 5 reports the results of estimating Eq. (1) using the cash effective tax rate ($CASH\_ETR$) as the dependent variable. Cash effective tax rates have the advantage of not being affected by changes in estimates such as valuation allowances (Dyreng *et al*. 2008). In addition, a firm could have accelerated depreciation for tax purposes, which would reduce cash taxes paid but would not affect the GAAP ETR. Therefore, it is important to test whether the results are robust to using the cash effective tax rate to measure tax avoidance.[22] The results are quite similar in that the coefficient on $INNOV$ is -0.001 and it is significant at the 5 percent level (t-stat. = -2.27).

Columns 3 and 4 report the results when using long-run effective tax rates to measure tax avoidance. Long-run effective tax rates have the advantage of being less influenced by short-term fluctuations in effective tax rates attributable to unusual operating years. The results are quite similar, with the coefficient on $INNOV$ significant and negative in both regressions. To summarize, the results reported in Table 5 offer strong support for the hypothesis.

[22] See Hanlon (2003) for a thorough discussion of issues in measuring tax avoidance.

## 6. ADDITIONAL ANALYSIS

### 6.1 Propensity-Score Matching Test

In this section I conduct sensitivity analyses to ensure that the association found in Section 5 is actually the tax avoidance mechanism I am trying to capture. One concern is that firms with patent activity engage in higher levels of research and development (R&D) and have greater intangible assets. Since prior research has shown that R&D and intangible assets are associated with effective tax rates, the concern is that the association I am capturing is nothing more than a negative association between R&D and/or intangible assets and effective tax rates. To mitigate this concern I have controlled for both R&D and intangible assets in my main test. However, as a sensitivity analysis I conduct a propensity-score matched sample by estimating the following logistic regression:

$$PATENT_{it} = \omega_0 + \omega_1 RND_{it} + \omega_2 INTANG_{it} + \sum CONTROLS_{it} + \varepsilon_{it} \qquad (2)$$

Where $PATENT_{it}$ is equal to 1 if firm i generates at least 1 patent in year t; zero otherwise. Conceptually, the propensity-score matching technique creates a pseudo-random sample in which one group of firms (i.e., the treatment group) receives the treatment and the other group of firms does not. In my setting, the treatment is the patent. The model is estimated using a logistic regression, as this approach is the most common technique used in propensity-score matching (Guo and Fraser 2010, 135). I estimate the model separately for each year. After estimating the model, each observation has a fitted value. I match each patent firm to the non-patent firm with the closest fitted value, with replacement, requiring that the two fitted values do not differ in absolute value by more than 0.01. I also require that the two matched firms share the same two-digit GICS code industry.[23] Following Lawrence *et al*. (2011), the set of control

[23] This technique follows that used in Eshleman and Guo (2014).

variables in the propensity-score matching regression includes the control variables listed in Equation (1). After performing this procedure, I obtain a propensity-score matched sample of 4,422 firm-year observations. The number of observations is slightly less when using the long-run effective tax rate measures. The first column of Table 6 reports the results of estimating Eq. (1) using the propensity-score matched sample.

Table 6
Sensitivity Analysis using Propensity-score Matched Sample

| | | Dependent Variable = Effective Tax Rate | | | |
|---|---|---|---|---|---|
| Variable | Predicted Sign | (1) $ETR$ | (2) $CASH\_ETR$ | (3) $CURR6$ | (4) $CASH6$ |
| $INNOV$ | - | -0.001*** | -0.000 | -0.000** | -0.001* |
| | | [-2.83] | [-0.72] | [-2.15] | [-1.68] |
| $ROA$ | ? | 0.013 | -0.235*** | 0.051 | -0.244*** |
| | | [0.18] | [-3.39] | [0.88] | [-4.08] |
| $CASH$ | - | 0.032 | 0.054 | 0.032 | -0.007 |
| | | [1.12] | [1.53] | [1.23] | [-0.23] |
| $EQUIC$ | - | -2.880*** | -2.131*** | -1.826*** | -1.222** |
| | | [-4.26] | [-3.12] | [-3.02] | [-1.97] |
| $RND$ | - | -0.304*** | -0.219*** | -0.240*** | -0.163** |
| | | [-4.87] | [-2.72] | [-4.33] | [-2.11] |
| $MVE$ | + | 0.012*** | 0.006** | 0.008*** | 0.005* |
| | | [4.29] | [2.07] | [3.70] | [1.76] |
| $NOL$ | - | -0.004 | -0.030*** | -0.003 | -0.013 |
| | | [-0.43] | [-2.86] | [-0.39] | [-1.32] |
| $\Delta NOL$ | + | 0.199** | 0.315*** | 0.156** | 0.184** |
| | | [2.15] | [5.73] | [2.21] | [1.98] |
| $LEV$ | - | -0.000 | -0.153*** | -0.006 | -0.105*** |
| | | [-0.01] | [-5.09] | [-0.27] | [-3.69] |
| $FI$ | - | 0.036 | -0.034 | -0.023 | -0.205* |
| | | [0.33] | [-0.30] | [-0.28] | [-1.91] |
| $INTANG$ | - | 0.051** | 0.115*** | 0.040* | 0.016 |
| | | [2.18] | [3.49] | [1.88] | [0.63] |
| $DEP$ | - | 0.025 | 0.385** | 0.112 | 0.287* |
| | | [0.19] | [2.12] | [1.09] | [1.73] |
| $MTB$ | - | -0.002 | -0.000 | -0.000 | -0.001 |
| | | [-1.46] | [-0.14] | [-0.31] | [-0.37] |
| $INSTOWN$ | - | 0.013 | 0.026* | -0.012 | -0.007 |
| | | [1.17] | [1.89] | [-1.24] | [-0.54] |
| $FEDCUST$ | + | -0.047 | -0.161*** | -0.016 | -0.053 |
| | | [-1.26] | [-3.22] | [-0.32] | [-0.62] |

(Table 6 continued)

| Variable | Predicted Sign | (1) $ETR$ | (2) $CASH\_ETR$ | (3) $CURR6$ | (4) $CASH6$ |
|---|---|---|---|---|---|
| $AAER$ | ? | -0.027 | -0.023 | 0.008 | -0.005 |
| | | [-1.41] | [-1.20] | [0.41] | [-0.18] |
| $CONSTANT$ | ? | 0.187*** | 0.203*** | 0.222*** | 0.222*** |
| | | [5.49] | [4.89] | [8.69] | [5.88] |
| Industry Fixed Effects | | Yes | Yes | Yes | Yes |
| Year Fixed Effects | | Yes | Yes | Yes | Yes |
| Observations | | 4,422 | 4,422 | 3,977 | 3,737 |
| Adjusted $R^2$ | | 0.0807 | 0.0865 | 0.0822 | 0.0973 |

This table contains the results of estimating four linear regressions using a propensity-score matched sample. Each row displays the estimated coefficient with its associated t-statistic in brackets below. The dependent variable in (1) is $ETR$, in (2) it is $CASH\_ETR$, in (3) it is $CURR6$, and in (4) it is $CASH6$. *, **, and *** denote statistical significance at the 10, 5, and 1 percent levels, respectively, using a two-tailed test. The model includes industry and year fixed effects, where industries are defined using four-digit GICS codes.

The coefficient on $INNOV$ is -0.001 and is significant at the 1 percent level, suggesting that more innovative firms have lower effective tax rates. The coefficient on $INNOV$ is negative, but not significant when using $CASH\_ETR$ to measure tax avoidance in Column 2. However, the results are again significant when using long-run measures of tax avoidance in Columns 3 and 4. Overall, the evidence in Table 6 suggests that the main results are not sensitive to using a propensity-score matched sample.

**6.2 Change Model**

The main results are based on an association between a firm's patent level and its level of tax avoidance. Although the association is suggestive of patents leading to greater tax avoidance, it is also consistent with a correlated omitted variable causing both greater patent activity and greater tax avoidance. In this section I attempt to alleviate these concerns by estimating the following change model:

$$\Delta ETR_{it} = \delta_0 + \delta_1 \Delta PATENT_{it} + \sum CONTROLS_{it} + \varepsilon_{it} \qquad (3)$$

Where $\Delta ETR_{it}$ is the firm's effective tax rate in year t less the firm's effective tax rate in the prior year, all scaled by the firm's effective tax rate in the prior year. The variable $\Delta PATENT_{it}$ equals 1 if the firm has at least one patent in year t but did not have any patents in the prior year, otherwise this variable equals zero. The coefficient $\delta_1$ captures the change in the firm's effective tax rate attributable to the generation of a patent. The model includes all control variables included in Eq. (1). Table 7 reports the results of estimating Eq. (3) using the GAAP effective tax rate and the cash effective tax rate.[24]

Table 7
Sensitivity Analysis Using a Change Model

| | | Dependent Variable = Change in Effective Tax Rate | |
|---|---|---|---|
| Variable | Predicted Sign | (1) $\Delta ETR$ | (2) $\Delta CASH\_ETR$ |
| $\Delta PATENT$ | - | -0.434 | -1.047*** |
| | | [-1.57] | [-3.49] |
| $ROA$ | ? | -4.456 | -1.413 |
| | | [-1.24] | [-0.30] |
| $CASH$ | - | -0.179 | -0.820 |
| | | [-0.19] | [-1.01] |
| $EQUIC$ | - | -14.612** | -9.492 |
| | | [-2.18] | [-0.51] |
| $RND$ | - | -0.058 | 4.663 |
| | | [-0.04] | [0.70] |
| $MVE$ | + | -0.185*** | -0.592*** |
| | | [-2.78] | [-5.48] |
| $NOL$ | - | -0.379 | -0.057 |
| | | [-1.30] | [-0.15] |
| $\Delta NOL$ | + | -0.216 | 0.408 |
| | | [-0.24] | [0.22] |
| $LEV$ | - | -0.974 | -3.398* |
| | | [-0.88] | [-1.65] |
| $FI$ | - | -3.916 | -11.590** |
| | | [-1.29] | [-2.32] |
| $INTANG$ | - | -0.362 | 3.657 |
| | | [-0.59] | [1.50] |
| $DEP$ | - | 19.981 | 0.440 |
| | | [1.17] | [0.08] |

[24] I do not report results using long-run effective tax rates as changes in patents in year t will likely take a considerable time to affect long-run tax rates.

(Table 7 continued)

| Variable | Predicted Sign | (1) $\Delta ETR$ | (2) $\Delta CASH\_ETR$ |
|---|---|---|---|
| $MTB$ | - | 0.110 | 0.223** |
| | | [1.05] | [2.03] |
| $INSTOWN$ | - | -0.815** | -1.185* |
| | | [-2.12] | [-1.93] |
| $FEDCUST$ | + | 0.538 | -1.636 |
| | | [0.81] | [-1.14] |
| $AAER$ | ? | 0.308 | -0.523 |
| | | [0.56] | [-0.90] |
| $CONSTANT$ | ? | 0.986 | 1.910 |
| | | [0.95] | [1.57] |
| Industry Fixed Effects | | Yes | Yes |
| Year Fixed Effects | | Yes | Yes |
| Observations | | 22,029 | 20,336 |
| Adjusted $R^2$ | | 0.002 | 0.004 |

This table reports the results of estimating Eq. (3) using either the change in the GAAP effective tax rate ($\Delta ETR$) or the change in the cash effective tax rate ($\Delta CASH\_ETR$) as the dependent variable. Each row displays the estimated coefficient with its associated t-statistic in brackets below. Standard errors are clustered by firm (Peterson 2009). *, **, and *** denote statistical significance at the 10, 5, and 1 percent levels, respectively, using a two-tailed test. The model includes industry and year fixed effects, where industries are defined using four-digit GICS codes.

The first column reports the results when using the change in the GAAP effective tax rate as the dependent variable while the second column reports the results when using the cash effective tax rate. In either case, the coefficient on $\Delta PATENT$ is negative. The effective is more pronounced when using the change in the cash effective tax rate, where the coefficient is -1.047 and it is significant at the 1 percent level (t-stat. = -3.49). To summarize, the results suggest that the generation of a patent is associated with a reduction in taxes paid. In addition, I have estimated a model which includes change variables for all of the control variables, with the exception of dichotomous variables such as $FEDCUST$ or $AAER$. Using this model, I continue to find a significantly negative coefficient on $\Delta PATENT$. However, the number of observations is reduced to 683 for this test, as I require data necessary to calculate change variables for all variables in the model.

### 6.3 Alternative Measures of Innovation

The main results are based on measuring innovation using $INNOV$, which is the number of patents the firm has in a given year divided by the average number of patents firms have in that year. To assess whether the results are sensitive to alternative measures of innovation, I construct two additional proxies as follows.

$Patent\ Dummy$ = 1 if firm has at least one patent, 0 otherwise.
$NumPatents$ = The number of patents the firm has.

I then re-estimate Eq. (1) using all four measures of tax avoidance. Table 8 reports the results for each of the eight possible combinations of the four tax avoidance proxies and the two innovation proxies.

Table 8
Sensitivity Analysis Using Alternative Measures of Innovation

Panel A: Alternative Measure is a Patent Dummy Variable

| | | Dependent Variable = Effective Tax Rate | | | |
|---|---|---|---|---|---|
| Variable | Predicted Sign | (1) $ETR$ | (2) $CASH\_ETR$ | (3) $CURR6$ | (4) $CASH6$ |
| $Patent\ Dummy$ | - | -0.016*** | 0.001 | -0.014*** | 0.005 |
| | | [-3.53] | [0.14] | [-3.07] | [0.92] |
| $ROA$ | ? | -0.143*** | -0.275*** | -0.089*** | -0.238*** |
| | | [-6.16] | [-12.54] | [-3.47] | [-8.86] |
| $CASH$ | - | -0.021* | -0.012 | -0.021* | -0.019 |
| | | [-1.94] | [-0.93] | [-1.73] | [-1.42] |
| $EQUIC$ | - | -1.409*** | -1.768*** | -0.547 | -0.912** |
| | | [-4.34] | [-4.82] | [-1.58] | [-2.42] |
| $RND$ | - | -0.278*** | -0.237*** | -0.176*** | -0.184*** |
| | | [-9.71] | [-7.07] | [-5.52] | [-4.87] |
| $MVE$ | + | 0.016*** | 0.010*** | 0.009*** | 0.006*** |
| | | [16.30] | [8.71] | [8.57] | [4.73] |
| $NOL$ | - | -0.038*** | -0.067*** | -0.012*** | -0.031*** |
| | | [-9.53] | [-14.98] | [-3.08] | [-6.46] |
| $\Delta NOL$ | + | 0.147*** | 0.199*** | 0.111*** | 0.192*** |
| | | [6.77] | [11.11] | [3.93] | [5.63] |
| $LEV$ | - | -0.041*** | -0.131*** | -0.037*** | -0.134*** |
| | | [-3.75] | [-10.40] | [-3.19] | [-10.40] |

(Table 8 continued)

| Variable | Predicted Sign | (1) $ETR$ | (2) $CASH\_ETR$ | (3) $CURR6$ | (4) $CASH6$ |
|---|---|---|---|---|---|
| $FI$ | - | 0.090 | 0.009 | 0.057 | -0.108 |
| | | [1.41] | [0.13] | [0.94] | [-1.57] |
| $INTANG$ | - | 0.060*** | 0.066*** | 0.048*** | 0.040*** |
| | | [6.89] | [6.65] | [5.70] | [4.13] |
| $DEP$ | - | 0.034 | -0.030 | 0.139** | -0.068 |
| | | [0.63] | [-0.50] | [2.45] | [-1.07] |
| $MTB$ | - | -0.003*** | -0.002*** | -0.002*** | -0.002*** |
| | | [-5.04] | [-3.55] | [-3.38] | [-3.39] |
| $INSTOWN$ | - | 0.027*** | 0.047*** | 0.019*** | 0.011 |
| | | [4.83] | [6.24] | [3.41] | [1.64] |
| $FEDCUST$ | + | -0.029* | -0.025 | -0.005 | 0.004 |
| | | [-1.88] | [-1.41] | [-0.34] | [0.23] |
| $AAER$ | ? | -0.012 | -0.027*** | -0.003 | -0.015 |
| | | [-1.40] | [-2.70] | [-0.34] | [-1.38] |
| $CONSTANT$ | ? | 0.218*** | 0.234*** | 0.363*** | 0.343*** |
| | | [6.72] | [6.75] | [8.85] | [6.35] |
| Industry Fixed Effects | | Yes | Yes | Yes | Yes |
| Year Fixed Effects | | Yes | Yes | Yes | Yes |
| Observations | | 25,967 | 25,967 | 21,234 | 18,956 |
| Adjusted $R^2$ | | 0.109 | 0.0996 | 0.0757 | 0.107 |

Panel B: Alternative Measure is the Number of Patents

| | | Dependent Variable = Effective Tax Rate | | | |
|---|---|---|---|---|---|
| Variable | Predicted Sign | (1) $ETR$ | (2) $CASH\_ETR$ | (3) $CURR6$ | (4) $CASH6$ |
| $NumPatents$ | - | -0.000** | -0.000* | -0.000*** | -0.000 |
| | | [-2.57] | [-1.68] | [-2.92] | [-0.95] |
| $ROA$ | ? | -0.142*** | -0.276*** | -0.088*** | -0.239*** |
| | | [-6.12] | [-12.59] | [-3.44] | [-8.94] |
| $CASH$ | - | -0.020* | -0.013 | -0.020* | -0.020 |
| | | [-1.84] | [-0.97] | [-1.66] | [-1.47] |
| $EQUIC$ | - | -1.404*** | -1.773*** | -0.544 | -0.917** |
| | | [-4.32] | [-4.83] | [-1.58] | [-2.43] |
| $RND$ | - | -0.284*** | -0.237*** | -0.184*** | -0.180*** |
| | | [-9.94] | [-7.08] | [-5.75] | [-4.77] |
| $MVE$ | + | 0.015*** | 0.011*** | 0.008*** | 0.006*** |
| | | [16.32] | [9.17] | [8.54] | [5.17] |
| $NOL$ | - | -0.038*** | -0.067*** | -0.013*** | -0.031*** |
| | | [-9.60] | [-14.99] | [-3.14] | [-6.46] |
| $\Delta NOL$ | + | 0.147*** | 0.198*** | 0.112*** | 0.191*** |
| | | [6.80] | [11.08] | [3.95] | [5.60] |
| $LEV$ | - | -0.041*** | -0.131*** | -0.036*** | -0.134*** |
| | | [-3.70] | [-10.43] | [-3.13] | [-10.47] |

(Table 8 continued)

| Variable | Predicted Sign | (1) $ETR$ | (2) $CASH\_ETR$ | (3) $CURR6$ | (4) $CASH6$ |
|---|---|---|---|---|---|
| $FI$ | - | 0.080 | 0.020 | 0.050 | -0.096 |
| | | [1.25] | [0.27] | [0.82] | [-1.41] |
| $INTANG$ | - | 0.060*** | 0.065*** | 0.048*** | 0.039*** |
| | | [6.95] | [6.62] | [5.75] | [4.07] |
| $DEP$ | - | 0.032 | -0.027 | 0.138** | -0.064 |
| | | [0.60] | [-0.46] | [2.43] | [-1.01] |
| $MTB$ | - | -0.003*** | -0.002*** | -0.002*** | -0.003*** |
| | | [-5.00] | [-3.62] | [-3.38] | [-3.46] |
| $INSTOWN$ | - | 0.026*** | 0.047*** | 0.018*** | 0.012* |
| | | [4.52] | [6.23] | [3.14] | [1.68] |
| $FEDCUST$ | + | -0.029* | -0.025 | -0.005 | 0.004 |
| | | [-1.88] | [-1.42] | [-0.34] | [0.22] |
| $AAER$ | ? | -0.012 | -0.027*** | -0.003 | -0.015 |
| | | [-1.41] | [-2.70] | [-0.37] | [-1.39] |
| $CONSTANT$ | ? | 0.219*** | 0.234*** | 0.363*** | 0.342*** |
| | | [6.71] | [6.75] | [8.89] | [6.34] |
| Industry Fixed Effects | | Yes | Yes | Yes | Yes |
| Year Fixed Effects | | Yes | Yes | Yes | Yes |
| Observations | | 25,967 | 25,967 | 21,234 | 18,956 |
| Adjusted $R^2$ | | 0.108 | 0.100 | 0.076 | 0.107 |

This table contains the results of estimating eight linear regressions using ordinary least squares. Each row displays the estimated coefficient with its associated t-statistic in brackets below. The dependent variable in (1) is $ETR$, in (2) it is $CASH\_ETR$, in (3) it is $CURR6$, and in (4) it is $CASH6$. Panel A presents results using $Patent\ Dummy$ as a measure of innovation while Panel B presents results using $NumPatents$ as a measure of innovation. *, **, and *** denote statistical significance at the 10, 5, and 1 percent levels, respectively, using a two-tailed test. The model includes industry and year fixed effects, where industries are defined using four-digit GICS codes.

Panel A reports the results when using $Patent\ Dummy$ to measure innovation. Using this measure, I find that the coefficient on $Patent\ Dummy$ is significantly negative in two out of the four regressions. Interestingly, the coefficient is not significantly negative for the cash-based measures of effective tax rates (columns 2 and 4). Panel B reports the results when using $NumPatents$ to capture innovation. This measure may be more powerful in detecting innovation than the dichotomous measure used in Panel A. Indeed, the coefficient is negative for all four regressions and is significant for three of them. The results in Table 8 alleviate concerns that the findings are driven by a specific measure of innovation. It appears the results continue to hold using alternate measures.

**6.4 Does the Effect of Innovation on Tax Avoidance Depend on Firm Size?**

In this section I test whether the effect of innovation on tax avoidance depends on the size of the firm. To do this, I estimate the following linear regression:

$$ETR_{it} = \delta_0 + \delta_1 INNOV_{it} + \delta_2 MVE_{it} + \delta_3 INNOV_{it} \times MVE_{it} + \sum CONTROLS_{it}$$
$$+ Industry\ Fixed\ Effects + Year\ Fixed\ Effects + \varepsilon_{it} \qquad (4)$$

Subscripts i and t denote firm and year, respectively. The model includes all controls variables included in Eq. (1) as well as industry and year fixed effects. The variable $MVE_{it}$ is the firm's market value of equity, as defined in Table 1. If larger (smaller) firms are better able to take advantage of patents to avoid taxes, I expect the coefficient on $INNOV \times MVE$ to be significantly negative (positive). Table 9 reports the results.

Table 9
Does the Effect of Innovation on Tax Avoidance Depend on Firm Size?

| | | Dependent Variable = Effective Tax Rate | | | |
|---|---|---|---|---|---|
| Variable | Predicted Sign | (1) $ETR$ | (2) $CASH\_ETR$ | (3) $CURR6$ | (4) $CASH6$ |
| $INNOV$ | - | -0.001*** | -0.000 | -0.001*** | -0.000 |
| | | [-6.17] | [-1.53] | [-5.18] | [-1.19] |
| $INNOV \times MVE$ | ? | -0.000 | -0.000*** | 0.000 | -0.000* |
| | | [-1.49] | [-2.73] | [0.16] | [-1.65] |
| $ROA$ | ? | -0.143*** | -0.277*** | -0.089*** | -0.241*** |
| | | [-6.20] | [-12.65] | [-3.50] | [-9.01] |
| $CASH$ | - | -0.022** | -0.013 | -0.021* | -0.021 |
| | | [-2.00] | [-1.01] | [-1.79] | [-1.51] |
| $EQUIC$ | - | -1.404*** | -1.779*** | -0.541 | -0.922** |
| | | [-4.33] | [-4.84] | [-1.57] | [-2.44] |
| $RND$ | - | -0.278*** | -0.235*** | -0.176*** | -0.177*** |
| | | [-9.71] | [-7.00] | [-5.50] | [-4.68] |
| $MVE$ | + | 0.016*** | 0.011*** | 0.009*** | 0.007*** |
| | | [16.69] | [9.24] | [8.83] | [5.34] |

(Table 9 continued)

| Variable | Predicted Sign | (1) $ETR$ | (2) $CASH\_ETR$ | (3) $CURR6$ | (4) $CASH6$ |
|---|---|---|---|---|---|
| $NOL$ | - | -0.038*** | -0.067*** | -0.012*** | -0.031*** |
| | | [-9.55] | [-14.97] | [-3.10] | [-6.47] |
| $\Delta NOL$ | + | 0.145*** | 0.197*** | 0.110*** | 0.189*** |
| | | [6.73] | [11.02] | [3.89] | [5.55] |
| $LEV$ | - | -0.042*** | -0.131*** | -0.037*** | -0.135*** |
| | | [-3.77] | [-10.45] | [-3.17] | [-10.50] |
| $FI$ | - | 0.111* | 0.028 | 0.075 | -0.090 |
| | | [1.74] | [0.38] | [1.23] | [-1.30] |
| $INTANG$ | - | 0.059*** | 0.065*** | 0.047*** | 0.039*** |
| | | [6.84] | [6.56] | [5.65] | [4.00] |
| $DEP$ | - | 0.037 | -0.027 | 0.142** | -0.063 |
| | | [0.69] | [-0.45] | [2.51] | [-0.99] |
| $MTB$ | - | -0.003*** | -0.002*** | -0.002*** | -0.002*** |
| | | [-5.03] | [-3.61] | [-3.37] | [-3.47] |
| $INSTOWN$ | - | 0.027*** | 0.047*** | 0.019*** | 0.012* |
| | | [4.83] | [6.32] | [3.39] | [1.72] |
| $FEDCUST$ | + | -0.028* | -0.024 | -0.004 | 0.004 |
| | | [-1.80] | [-1.39] | [-0.26] | [0.25] |
| $AAER$ | ? | -0.012 | -0.026*** | -0.003 | -0.015 |
| | | [-1.37] | [-2.68] | [-0.32] | [-1.38] |
| $CONSTANT$ | ? | 0.216*** | 0.233*** | 0.361*** | 0.341*** |
| | | [6.65] | [6.73] | [8.75] | [6.31] |
| Industry Fixed Effects | | Yes | Yes | Yes | Yes |
| Year Fixed Effects | | Yes | Yes | Yes | Yes |
| Observations | | 25,967 | 25,967 | 21,234 | 18,956 |
| Adjusted $R^2$ | | 0.110 | 0.100 | 0.077 | 0.108 |

This table contains the results of estimating four linear regressions using ordinary least squares. Each row displays the estimated coefficient with is associated t-statistic in brackets below. The dependent variable in (1) is $ETR$, in (2) it is $CASH\_ETR$, in (3) it is $CURR6$, and in (4) it is $CASH6$. *, **, and *** denote statistical significance at the 10, 5, and 1 percent levels, respectively, using a two-tailed test. The model includes industry and year fixed effects, where industries are defined using four-digit GICS codes.

The results indicate that the effect of innovation on corporate tax avoidance is slightly stronger for larger companies, consistent with these companies being better able to take advantage of patents to avoid income taxes. Specifically, the coefficient on $INNOV \times MVE$ is significantly negative when using $CASH\_ETR$ or $CASH6$ as measure of tax avoidance.

### 6.5 Is the Effect of Innovation on Tax Avoidance Affected by Foreign Income?

In this section I test whether the effect of innovation on corporate tax avoidance depends on the amount of foreign income the firm generates. To test this, I estimate the following model:

$$ETR_{it} = \delta_0 + \delta_1 INNOV_{it} + \delta_2 FI_{it} + \delta_3 INNOV_{it} \times FI_{it} + \sum CONTROLS_{it}$$
$$+ Industry\ Fixed\ Effects + Year\ Fixed\ Effects + \varepsilon_{it} \quad (5)$$

Subscripts i and t denote firm and year, respectively. The model includes all controls in Eq. (1) as well as industry and year fixed effects. If innovation leads to lower taxes only when firms have substantial foreign income, I expect to observe a significantly negative coefficient on $INNOV \times FI$ and an insignificant coefficient on $INNOV$ in the regression. Table 10 reports the results.

Table 10
Does the Effect of Innovation on Tax Avoidance Depend on Foreign Income?

| | | Dependent Variable = Effective Tax Rate | | | |
|---|---|---|---|---|---|
| Variable | Predicted Sign | (1) $ETR$ | (2) $CASH\_ETR$ | (3) $CURR6$ | (4) $CASH6$ |
| $INNOV$ | - | -0.001*** | -0.000 | -0.001*** | -0.000 |
| | | [-5.69] | [-1.15] | [-3.45] | [-0.73] |
| $INNOV \times FI$ | ? | 0.005 | -0.003 | -0.001 | -0.004 |
| | | [1.49] | [-0.63] | [-0.20] | [-0.81] |
| $ROA$ | ? | -0.144*** | -0.276*** | -0.089*** | -0.240*** |
| | | [-6.22] | [-12.61] | [-3.50] | [-8.95] |
| $CASH$ | - | -0.022** | -0.014 | -0.021* | -0.021 |
| | | [-2.00] | [-1.04] | [-1.79] | [-1.53] |
| $EQUIC$ | - | -1.398*** | -1.773*** | -0.542 | -0.918** |
| | | [-4.31] | [-4.82] | [-1.57] | [-2.43] |
| $RND$ | - | -0.277*** | -0.233*** | -0.176*** | -0.176*** |
| | | [-9.67] | [-6.95] | [-5.50] | [-4.63] |
| $MVE$ | + | 0.016*** | 0.011*** | 0.009*** | 0.007*** |
| | | [16.69] | [9.17] | [8.81] | [5.26] |
| $NOL$ | - | -0.037*** | -0.067*** | -0.012*** | -0.031*** |
| | | [-9.51] | [-14.95] | [-3.10] | [-6.45] |
| $\Delta NOL$ | + | 0.145*** | 0.198*** | 0.110*** | 0.190*** |
| | | [6.73] | [11.04] | [3.89] | [5.56] |
| $LEV$ | - | -0.042*** | -0.131*** | -0.037*** | -0.135*** |
| | | [-3.77] | [-10.45] | [-3.17] | [-10.50] |

(Table 10 continued)

| Variable | Predicted Sign | (1) $ETR$ | (2) $CASH\_ETR$ | (3) $CURR6$ | (4) $CASH6$ |
|---|---|---|---|---|---|
| $FI$ | - | 0.094 | 0.047 | 0.078 | -0.067 |
| | | [1.37] | [0.61] | [1.18] | [-0.92] |
| $INTANG$ | - | 0.059*** | 0.065*** | 0.047*** | 0.039*** |
| | | [6.85] | [6.56] | [5.65] | [4.00] |
| $DEP$ | - | 0.038 | -0.025 | 0.142** | -0.061 |
| | | [0.71] | [-0.43] | [2.51] | [-0.96] |
| $MTB$ | - | -0.003*** | -0.002*** | -0.002*** | -0.003*** |
| | | [-5.05] | [-3.60] | [-3.36] | [-3.47] |
| $INSTOWN$ | - | 0.028*** | 0.048*** | 0.019*** | 0.012* |
| | | [4.86] | [6.35] | [3.39] | [1.76] |
| $FEDCUST$ | + | -0.027* | -0.024 | -0.004 | 0.004 |
| | | [-1.78] | [-1.39] | [-0.26] | [0.25] |
| $AAER$ | ? | -0.012 | -0.026*** | -0.003 | -0.015 |
| | | [-1.37] | [-2.67] | [-0.32] | [-1.37] |
| $CONSTANT$ | ? | 0.217*** | 0.232*** | 0.361*** | 0.340*** |
| | | [6.66] | [6.73] | [8.74] | [6.31] |
| Industry Fixed Effects | | | | | |
| Year Fixed Effects | | | | | |
| Observations | | 25,967 | 25,967 | 21,234 | 18,956 |
| Adjusted $R^2$ | | 0.110 | 0.100 | 0.077 | 0.108 |

This table contains the results of estimating four linear regressions using ordinary least squares. Each row displays the estimated coefficient with is associated t-statistic in brackets below. The dependent variable in (1) is $ETR$, in (2) it is $CASH\_ETR$, in (3) it is $CURR6$, in (4) it is $CASH6$. *, **, and *** denote statistical significance at the 10, 5, and 1 percent levels, respectively, using a two-tailed test. The model includes industry and year fixed effects, where industries are defined using four-digit GICS codes.

Column 1 reports the results using the effective tax rate as a measure of tax avoidance. Using this measure, the coefficient on $INNOV$ remains negative and statistically significant (t-stat. = -5.69) while the coefficient on the interaction of innovation with foreign income ($INNOV \times FI$) is not significantly different from zero. Similar results are found in Column 3 when using a long-run measure of the firm's effective tax rate. Although the significance on the innovation variable wanes in Columns 2 and 4, the coefficient on the interaction of innovation and foreign income is never statistically different from zero. Thus, it appears that the effect of innovation on corporate tax avoidance is not affected by the amount of foreign income the firm generates.

## 7. CONCLUSION

In this study I examine the effect of firm innovation on corporate tax avoidance. While prior literature has found a host of variables to be associated with tax avoidance (e.g., Gupta and Newberry 1997; Phillips 2003; Rego 2003; Frank *et al*. 2009; Dyreng *et al*. 2010; Chen *et al*. 2010; Robinson *et al*. 2010; Cheng *et al*. 2012; McGuire *et al*. 2012; Badertscher *et al*. 2013; Chyz 2013; Lennox *et al*. 2013; Mills *et al*. 2013), this literature has not considered firm innovation. The results I document in this study are consistent with firms selling patents to their foreign subsidiaries for a very low fee, which allows the foreign subsidiary to generate higher revenue from the patents. Assuming the foreign subsidiary is located in a jurisdiction with a lower corporate tax rate than the United States, the firm pays lower taxes. By showing that firms with more patent activity have lower effective tax rates, this study begins to open the black box of tax avoidance. Prior studies have not directly tested whether firms use certain tax avoidance strategies.

However, this study is subject to a few limitations. Most importantly, the evidence in this study in no way proves that firms actually charge abnormally low fees to their foreign subsidiaries for the use of patents. In practice, firms generally do not reveal their tax avoidance strategies, probably out of concern of an IRS audit. Second, the results in this study depend upon the ability of the tax avoidance proxies to capture firms' tax avoidance. To mitigate this concern I have conducted my analyses using four measures of tax avoidance and generally find consistent results for all four measures. In addition, while my sample ends in the year 1999, there have been tax law changes introduced afterwards. A major change has been the introduction of schedule M-1, which requires a reconciliation of book income to taxable income. In addition, the research and development tax credit was expanded in 2013, the American Jobs Creation Act took place in

2004, and there was a major economic stimulus which affected corporate taxes in 2008.[25]

Therefore, the results in this paper may not be generalizable due to these tax law changes.

[25] For a full list of tax law changes since 2000, see http://www.taxpolicycenter.org/legislation/2000.cfm.

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# THE VITA

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