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Does a Firm's Life Cycle Explain Its Propensity to Engage in Corporate Tax Avoidance?

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ABSTRACT This study examines whether a firm's life cycle explains its propensity to engage in corporate tax avoidance. Based on the Dickinson (2011) model of firm life cycle stages and a large dataset of US publicly listed firms over the 1987–2013 period, we find that tax avoidance is significantly positively associated with the introduction and decline stages and significantly negatively associated with the growth and mature stages using the shake-out stage as a benchmark. We observe a U-shaped pattern in tax avoidance outcomes across the various life cycle stages in line with the predictions of dynamic resource-based theory. Our findings are consistent using several robustness checks. Overall, our results show that a firm's life cycle stage is a significant determinant of tax avoidance.

1. Introduction

Taxes significantly influence corporate economic decisions as they are a major component of a firm's cash outflows (Dyreng, Hanlon, & Maydew, 2008; Hanlon & Heitzman, 2010). The purpose of this study is to examine the association between the stages in a firm's life cycle and corporate tax avoidance. Although business and geographical diversification may result in multiple overlapping product life cycles, Dickinson (2011) claims that firm performance and resource allocation are likely to vary systematically based on the distinct stages of a firm's life cycle. In particular, differences in the operating, investment and financing decisions and activities across those stages (Dickinson, 2011; Javanovic, 1982; Spence, 1977, 1979, 1981) are likely to influence the level of a firm's tax avoidance at each stage. We investigate whether a firm's tax outcomes vary systematically based on the natural growth, maturity and decline of its businesses.

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An assessment of the association between firm life cycle progression and tax avoidance is likely to be interesting and important because it links 'real' corporate decisions of avoiding tax with firm life cycle dynamics. Thus, firm life cycle theory should assist in explaining why some firms avoid taxes more than others (Drake, 2015). We conjecture that differences in business strategy (Higgins, Omer, & Phillips, 2015), operating, investing and financing activities, economic fundamentals (e.g. cash flows, retained earnings, asset turnover and solvency-related risks), resource endowment, organizational capabilities and risk appetite (Helfat & Peteraf, 2003) across firm life cycle stages are likely to give rise to differences in tax avoidance across these stages. By understanding how managers differentially engage in and are exposed to tax incentives across life cycle stages, we address important questions about the determinants and outcomes of tax avoidance within a dynamic framework. Although a limited number of studies have examined the association between a firm's cash flow patterns and life cycle stages (e.g. Dickinson, 2011) or capital market decisions (e.g. dividend payments) and life cycle stages (e.g. DeAngelo, DeAngelo, & Stulz, 2006), this study appears to be the first to examine the association between firms' life cycle stages and tax avoidance.

We base our definition of corporate tax avoidance on that used by Hanlon and Heitzman (2010), which incorporates all transactions and arrangements that could result in a reduction in the amount of a firm's corporate tax expense (e.g. Dyreng et al., 2008; Lisowsky, Robinson, & Schmidt, 2013). Consistent with Hanlon and Heitzman (2010), we view corporate tax avoidance conceptually as falling along a continuum ranging from 'passive' (i.e. complying with tax provisions) to 'aggressive' (i.e. structuring transactions or activities with the principle aim of decreasing the amount of corporate tax payable). Tax avoidance may alternatively be achieved by illegal means or means that are not in compliance with tax legislation or regulations. This type of avoidance constitutes tax evasion. In this study, our tax avoidance proxy measures pick-up activities that involve all types of tax avoidance activities. We use five measures of tax avoidance in our study to cover the potential array of tax avoidance activities of a firm including GAAP effective tax rates (ETRs), book–tax differences, tax sheltering, cash ETRs and cash tax non-conformity.

We primarily rely on the Dickinson (2011) model to proxy for a firm's life cycle stages.[1] Dickinson (2011) claims that a firm's cash flow patterns provide a robust proxy of its life cycle stages as they capture the progression of an entire financial set instead of simply relying on a single metric (e.g. sales growth, firm size or age[2]) which assumes a uniform distribution across stages. In short, Dickinson (2011) relies on cash flows from operating, investing and financing activities to proxy for the stages of a firm's life cycle and shows that a firm's life cycle stage is not a linear function of its age, but rather a function of its cash flow patterns.[3]

Employing the Dickinson (2011) model of firm life cycle stages and a large sample of publicly listed US firms over the 1987–2013 period, we find that tax avoidance is significantly positively associated with the introduction and decline stages and significantly negatively associated with

[1]We also employ the alternative life cycle proxy measure of DeAngelo et al. (2006) as a robustness check of our main results. They use retained earnings scaled by total assets or total equity to proxy for a firm's life cycle.

[2]Although firm age and size have been used to measure life cycle stages in prior research (e.g. Bhattacharya, Black, Christensen, & Mergenthaler, 2004; Bradshaw, Drake, Myers, & Myers, 2012; Chen, DeFond, & Park, 2002), there is likely to be a degree of divergence between these attributes and stages because a firm's demise can occur at any point in its life cycle, although the probability of failure is greater in the early stages (Javanovic, 1982) and is contingent upon initial resource endowment (Dickinson, 2011).

[3]For instance, a firm may be in the growth stage at 10 years of age, while another firm may be in the introduction stage at 15 years of age. As asserted by Dickinson (2011), the reason for this is that a firm may develop new products, enter into new markets or restructure such that it can move across life cycle stages non-sequentially, so a monotonic association between firm age and life cycle stages is not directly observed.

the growth and mature stages using the shake-out stage as a benchmark. We detect a U-shaped pattern in tax avoidance outcomes across the life cycle stages as per the predictions of dynamic resource-based dependence theory. Our regression model shows that compared to the shake-out stage of firms' life cycle, the introduction (decline) stages have lower ETRs by 2.1% (2.9%), while the growth (mature) stages firms have ETRs that are 0.6% (0.3%) higher. Additionally, compared to the shake-out stage of a firm's life cycle, the odds of a tax shelter in the introduction stage is 17.58% higher, while the odds of a tax shelter in the growth and mature stages are 3.34% and 12.1% lower, respectively. Our results are consistent using several robustness checks and show that life cycle stages carry significant explanatory power in addition to other known determinants of tax avoidance.

This study contributes to the literature in the following ways. First, it extends the literature on the tax avoidance practices of US firms (e.g. Dyreng & Lindsey, 2009; Lisowsky et al., 2013; Slemrod & Wilson, 2009). Early research on tax avoidance assumes a generally static state of firm life cycle development, whereas more recent research emphasizes that operating, investing and financing activities, and management's access to resources are likely to vary systematically based on a firm's life cycle stage (e.g. Dickinson, 2011). Firm life cycle theory should assist us in explaining why some firms avoid taxes more than others (Drake, 2015). It is thus not unreasonable to expect that differences in the level of tax avoidance occur in line with differences in economic fundamentals and resource allocation or opportunities across the stages of that cycle. Drawing on resource-based theory, this study evaluates the sources and availability of resources accessible to management at each stage of a firm's life cycle and how they affect management's propensity to engage in tax avoidance at each stage. Our findings are best aligned with those of recent studies assessing a firm's business strategies regarding tax avoidance such as Higgins et al. (2015). Second, as many financial variables (e.g. cash, current profitability, asset turnover, growth in net operating assets, sales, leverage, dividend payout, level of retained earnings and cash flows) are likely to vary systematically based on a firm's life cycle (DeAngelo et al., 2006; Dickinson, 2011; Drobetz, Halling, & Schroder, 2015) and these attributes provide explanatory power for future profitability (Fairfield & Yohn, 2001), a firm's propensity to engage in tax avoidance is likely to vary according to its life cycle stage. Knowledge of such associations may be of assistance in mapping a firm's current and potential tax outcomes based on its life cycle stage. Drake (2015) argues that tax information available in a firm's financial statements is informative about its future earnings because the association between accounting and taxable income captures differences in cash flow patterns across a firm's life cycle. Third, information about the life cycle-tax avoidance link may be helpful in assessing the risk premiums associated with a firm's future cash flows and cost of capital. Finally, prior studies which have examined the association between tax avoidance and cash flows have mainly relied on one cash flow type such as cash holdings in their research (e.g. Stanfield, 2011) rather than a set of different cash flows as is the case in our study.

The rest of this paper is organized as follows. Section 2 provides the theory about firm life cycle stages, tax avoidance and their possible association. Section 3 describes the research design, and Section 4 reports the empirical results. Finally, Section 5 concludes the paper.

2. Firm Life Cycle Stages

2.1. Dynamics of Resourcing across Firm Life Cycle Stages

An examination of the differences in resourcing and in the operating, investment and financing decisions across the stages of a firm's life cycle is likely to explain the nature of the associations between these stages and tax avoidance. Early research in management science identifies five

distinct life cycle stages using different terminology: birth, growth, maturity, revival and decline (Miller & Friesen, 1984) or introduction, growth, mature, shake-out and decline (Gort & Klepper, 1982). Each stage is characterized by differences in environment, strategy, structure and decision-making style (Miller & Friesen, 1984). Dickinson (2011) further develops the stages of a firm's life cycle based on differences in operating, investing and financing activities, combined with the changing patterns of cash flows related to these activities, to effectively capture differences in firm performance and resource availability. Cash flows, firm performance, growth, risk and resource allocation all vary systematically across the five life cycle stages. While five distinct stages have been identified, the progression of a particular firm is dynamic in nature and contingent upon product and geographical diversification, innovation, mergers and acquisitions, structural changes and market shocks (Dickinson, 2011).[4]

The introduction stage is normally characterized by uncertainty in revenue flows and costs (Javanovic, 1982), high levels of managerial opportunism regarding investments, risk-taking (Miller & Friesen, 1984) and product innovation (Gort & Klepper, 1982; Miller & Friesen, 1984). In this stage, the managerial focus is on developing effective strategies to gain a competitive advantage, market share (Ramaswamy, Ueng, & Carl, 2007) and innovation (Audretsch & Feldman, 1996). Growth-oriented firms increase their borrowings (Barclay & Smith, 2005) with pecking-order theory[5] predicting that a firm accesses debt before equity (Diamond, 1991). A firm may face a high cost of capital due to uncertainties about future cash flows and earnings and the potential difficulty of raising additional capital (Hasan, Hossain, Cheung, & Habib, 2015). Consequently, the interests of stockholders and management are aligned as they mutually exploit innovation and investment opportunities.[6]

The growth stage of a firm's life cycle is exemplified by profit maximization, large investments, positive operating cash flows (Spence, 1981) and a continued preference for debt over equity financing due to the tax deductibility of interest expenditure and loan fees on that debt (Barclay & Smith, 2005). Dickinson (2011) claims that leverage is maximized in the growth phase during which time the number of business and geographical segments grows. Mueller (1972) asserts that a firm in this phase no longer faces capital raising-related issues and thus investment uncertainty is reduced, followed by a reduction in its cost of capital. At this stage, there is a shift in the firm toward greater transparency and increased monitoring and control by external providers of resources (Filatotchev, Toms, & Wright, 2006).

The mature stage of a firm's life cycle generally results in a shift toward efficiency maximization, reduced uncertainty and declining investment expenditure relative to the growth phase, greater capital distribution to shareholders and enhanced governance structures (Barclay & Smith, 2005; Filatotchev et al., 2006). Profit maximization in this stage is evidenced by growth in a firm's earnings per share, retained earnings/total assets, retained earnings/total equity and return on net operating assets, leading to higher and sustained dividend payouts (DeAngelo et al., 2006). Firm size and age also increase in the mature phase (Dickinson,

[4]For example, some firms are likely to have moved rapidly into the shake-out or decline phase during the 2008 global financial crisis before recovering. Further, innovation in a particular sought-after pharmaceutical product may propel a firm into a high-growth phase, whereas rapid changes in commodity prices may expose a firm in the extractive industries to periodic growth and shake-out stages within its overall life cycle progression.

[5]Pecking-order theory suggests that as a result of adverse selection costs, firms prefer debt to equity when raising external financing (Myers & Majluf, 1984).

[6]In terms of corporate governance, Ramaswamy et al. (2007) find that in the initial and growth stages, a firm often has weak governance structures as it may lack the time, resources, managerial expertise or leadership needed to establish operative governance structures, especially when exposed to rapid change and uncertainty.

2011). Dickinson (2011) claims that a firm in this stage also tends to reduce its level of debt financing, resulting in negative financing activity-related cash flows.

Declining growth rates, investment expenditure, innovation and efficiency typify the shake-out phase, while asset liquidation, liquidity and going-concern factors, a declining and possibly negative operating cash flow and debt repayments are the focus of the decline stage. Further, potential financial distress in these two stages may motivate managers to invest in risky projects as a potential turn-around strategy (Habib & Hasan, 2015) with debt-holders bearing the cost if those projects fail (Jensen & Meckling, 1976). Managerial rent-seeking opportunities increase, rendering a firm's governance system less transparent and less effective (Filatotchev et al., 2006). Akhtar (2012) also finds that a firm seeks or relies more on external debt in contraction or trough phases of a business cycle relative to the peak or boom phases. In fact, a firm in the decline stage may be heavily reliant on external debt financing to continue as a going concern and to fund revitalization or business restructuring (Akhtar, 2012; Edwards, Schwab, & Shevlin, 2016). Overall, a firm in the decline stage is more likely to exhibit an increased cost of capital, poorer credit ratings, reduced financing opportunities and an increased managerial disposition to take on more risk (Jensen & Meckling, 1976; Richardson, Lanis, & Taylor, 2015).

2.2. *Dynamics of Tax Avoidance across Firm Life Cycle Stages*

Employing dynamic resource-based theory,[7] we now assess how corporate tax avoidance changes as a firm progresses through its various life cycle stages. Different firm-level characteristics imply divergent associations between tax avoidance and life cycle stages. The extent to which a particular stage is associated with a firm's level of tax avoidance is contingent upon the relative differences in resourcing, managerial incentives and opportunities and economic fundamentals at each stage. As a firm engages in different transactions[8] and management face different incentives, opportunities and resourcing depend upon firm life cycle stages and because these factors map into tax avoidance differently, tax avoidance is expected to vary systematically with a firm's life cycle (Drake, 2015).

2.2.1. *Introduction phase*

In the introduction stage, a firm will have relatively higher levels of investment, capital expenditure, sales growth, R&D expenditure and accruals which are likely to translate into higher levels of deferred taxes (Audretsch & Feldman, 1996; Drake, 2015; Poterba, Rao, & Seidman, 2011). Drake (2015) argues that, in general, these transactions involve deferral of income for the main purpose of reducing taxable income. In terms of book–tax differences, deferrals give rise to higher levels of book income relative to taxable income, generating overall positive book–tax differences. Therefore, for a given level of income tax expense, as accounting profits increase, the accounting ETR (measured as

[7]In particular, dynamic resource-based theory is derived from evolutionary economics, strategic management and organizational science. It focuses on resource patterns and trajectories and capability evolution across a firm's life cycle. Helfat and Peteraf (2003) define organizational capabilities as: '. . . the ability of an organization to perform a coordinated set of tasks, utilizing organizational resources, for the purpose of achieving a particular end result,' and resources as '. . . an asset or input to production (tangible or intangible) that an organization owns, controls, or has access to on a semi-permanent basis' (p. 999).

[8]For instance, Drobetz et al. (2015) observe increases in asset tangibility, operating income, net working capital and capital expenditures in the growth and mature stages as compared to the other stages, and higher levels of market-to-book ratios, R&D, equity issuances and financing deficits in the introduction and decline stages.

income tax expense divided by pre-tax profits) is lower. Numerous tax deferral opportunities arise in the introduction stage. The larger positive book–tax differences generated through concerted tax deferral opportunities in this stage are normally considered to be reflective of aggressive, illegitimate or uncertain tax positions (Drake, 2015). Management may thus possess attributes akin to Higgins et al. (2015) prospector strategist group whereby they will aggressively seek out opportunities and pursue risky tax strategies to increase a firm's future earnings.

In line with resource-based theory, firms in the introduction stage will utilize resources to their competitive advantage including cash, innovations and investments, and competitive advantage may be attained through aggressive tax-planning activities (Koester, Shevlin, & Wangerin, 2013). Any increase in after-tax profits will then allow a firm to effectively compete with other firms in their industry (Helfat & Peteraf, 2003; Spence, 1981).[9] Drobetz et al. (2015) find that an additional dollar in cash is highly valuable in the introduction and growth stages as a firm lacks internal capital resources to finance investment and innovation. Cash policies appear to be driven by trade-off motives whereby a firm weighs the costs and benefits to determine a target cash ratio (Drobetz et al., 2015). Increasing after-tax cash flows is quite important for a firm in the introduction stage, thus providing managerial incentives to use all available innovations to significantly reduce the amount of corporate taxes payable.[10] More importantly, the knowledge deficits about future cash flows and profit margins, and the reduced precision or quality of information that are typical of the introduction stage (Javanovic, 1982) afford opportunities for management to engage in opaque arrangements to aggressively reduce the amount of corporate taxes payable, especially if they are tied to performance-based remuneration schemes (Desai & Dharmapala, 2006). Overall, tax efficient structures may be easier to implement in the introduction stage given the opportunities and incentives available to management in that stage. Finally, in the introduction phase, smaller firms may simply fall under the radar of the Internal Revenue Service (IRS), as they are much less frequently audited than larger firms (Hanlon, Hoopes, & Shroff, 2014).

2.2.2. Growth phase

Increased certainty of cash flow positions and investment opportunities are likely to provide management with the confidence to increase earnings during a firm's growth stage without necessarily resorting to aggressive tax planning. However, as a firm expands from the introduction stage into the growth phase, management have relatively more tax-planning opportunities available to them due to the rapidly changing environment and increased access to international markets and products. They are also likely to accept relatively higher levels of risk as the firm diversifies into new product and geographical segments and moves along the continuum of innovation that began in the introduction stage. Prior research shows that a firm in the growth stage has a higher percentage of working capital and intangible assets (e.g. R&D costs, patents and copyrights) that decrease as it enters the mature and decline stages (e.g. Ahmed & Jinan, 2011; Young & Huang, 2004). The ability to use intangible assets to shift income (and expenses) across multiple and variably taxed jurisdictions may provide a firm with significant opportunity to engage in tax avoidance (Hanlon & Heitzman, 2010).

[9]Research by Cai and Liu (2009) finds that where a firm is under substantial competitive pressure, it is more likely to avoid corporate taxes because it can then use the additional funds to compete.

[10]For example, R&D investment is also predicted to be higher during the introduction stage as a firm seeks ways to rapidly increase cash flows (Koester et al., 2013). Prior research finds R&D expenditure to be positively associated with tax aggressiveness because R&D may be used to facilitate aggressive transfer pricing or income shifting activities (Dyreng et al., 2008; Waegenaere, Sansing, & Wielhouwer, 2013).

During the growth phase, management are likely to have a better understanding of the environment in which the firm operates and have more resources at their disposal, which may allow them to identify more tax avoidance opportunities and give them additional capacity to use those resources for tax-planning purposes (Koester et al., 2013). However, in the growth phase, management may become more concerned about the reputational consequences of expanding into new markets and product lines as they face greater exposure to external parties including the tax authorities (Austin & Wilson, 2013; Dyreng, Hoopes, & Wilde, 2015; Graham, Hanlon, Shevlin, & Shroff, 2014; Hanlon & Slemrod, 2009). These concerns may, in turn, suppress their incentive to engage in aggressive tax-planning activities (Austin & Wilson, 2013; Graham et al., 2014).

2.2.3. Mature phase

A firm in the mature phase is characterized by reduced investment outgoings and innovations (Barclay & Smith, 2005; Dickinson, 2011; Drake, 2015) and resource and capability maintenance (Helfat & Peteraf, 2003). Access to greater resources such as expertise in the mature phase may mean that management focuses on core operating decisions rather than tax avoidance strategies, or does not manage core operating decisions in a tax-effective way (Koester et al., 2013). A firm may thus have a comparatively lower propensity to engage in tax avoidance in the mature phase of its life cycle than in the introduction, shake-out or decline phases. Unless new innovations and investments present themselves, assets are maintained and only replaced or revalued as required, generating fairly stable deferred taxes and smaller book–tax differences. A mature stage firm could also face reduced sales growth, more persistent net income (Black, 1998) and reduced cash flow volatility, so it will be more self-reliant on retained earnings. Thus, the certainty and reduced risk related to current (and possibly future) earnings and cash flows may mean that management have far less incentive to aggressively pursue tax avoidance strategies in this stage.

In the mature stage, management is expected to adopt defender-style strategic orientations (Higgins et al., 2015). In fact, the managers of a mature firm are likely to be confronted with limited tax-planning opportunities given their aversion to risk and uncertainty and their focus on non-tax cost efficiencies (Higgins et al., 2015).[11] In addition, Filatotchev et al. (2006) stress the greater need of the monitoring role of governance structures as a firm matures, which reduces the likelihood of engaging in risky tax planning (Robinson, Xue, & Zhang, 2012). Finally, management are also likely to be mindful of the potential reputational costs associated with the public dissemination of tax arrangements that may be construed as being overly tax aggressive (Higgins et al., 2015).

2.2.4. Shake-out phase

Reductions in the level of operating cash flows, increased uncertainty relating to future cash flows, earnings, innovations and investments and profit margins may mean that a firm searches for opportunities to significantly reduce the amount of corporate taxes payable in the shake-out stage (Black, 1998; Miller & Friesen, 1984). A firm in this stage is more likely to pursue cost-minimization strategies (Jenkins, Kane, & Velury, 2004) because corporate taxes represent one its major expense items. A firm may also undertake strategies to revitalize itself through the sale of assets and/or restructuring. Specifically, if large items of property, plant and equipment are

[11]This assertion is consistent with the research findings of O'Connor and Byrne (2015) who provide evidence that a mature firm practices better overall strength of governance as compared to a younger firm.

Table 1. Sample selection and distribution of the sample

Panel A: data and sample

Description	Total number of observations
Data available in Compustat annual file from 1987 to 2013	299,565
Less:	
Financial and utility firms	(87,250)
	212,315
Firms with missing cash flow variables to construct firm life cycle	(26,304)
	186,011
Firms with missing GAAP_ETR value	(34,716)
	151,295
Firms with missing values for the control variables used in regression model	(85,499)
Final sample (firm years)	65,796

Panel B: industry distribution

Industry name	Total number of observations	Percentage (%) of observations
Consumer nondurables	4923	7.48
Consumer durables	1876	2.85
Manufacturing	8725	13.26
Oil, gas, and coal extraction and products	4526	6.88
Chemicals and allied products	2086	3.17
Business equipment	12,775	19.42
Telephone and television transmission	2322	3.53
Wholesale, retail and services	8472	12.88
Healthcare, medical equipment and drugs	7739	11.76
Other	12,352	18.77
Total	65,796	100.00

Notes: Panel A shows sample selection for the GAAP_ETR measure of tax avoidance; and Panel B shows the industry distribution of the sample for the GAAP_ETR measure of tax avoidance.

disposed of with accumulated tax depreciation in excess of accounting depreciation, this may generate large negative book–tax differences for a firm (Drake, 2015).

Investors evaluate a firm's ability to deal with financial distress and recover profitability predominantly through its generation of cash flows and earnings potential (Black, 1998). Prior research finds that financially constrained firms often rely on tax avoidance strategies to generate badly needed cash flows (e.g. Koester et al., 2013). Tax avoidance strategies may include strategic use of carry forward tax losses, tax deferral, liquidation of assets and restructuring (Richardson et al., 2015). Reduced monitoring and the pursuit of riskier strategies to increase after-tax cash flows may provide management with the opportunity to actively pursue tax avoidance strategies during the shake-out stage (Koester et al., 2013; Richardson et al., 2015). For example, Chou, Li, and Yin (2010) find that during the periods of financial distress typical of the shake-out phase, outside directors exert reduced work effort at both the firm and individual director levels. The marginal benefits of monitoring and broader governance structures offered by directors may be reduced during such periods, increasing the risk of aggressive tax planning.

2.2.5. Decline phase

The combined tax effect of transactions typical of the decline stage such as the continued sale of assets, write-down in value of assets, reduced profitability and the existence of large negative accruals result in an increase in taxable income relative to accounting income, generating negative book–tax differences for a firm (Drake, 2015). Moreover, where a firm is financially constrained or distressed, it will actively engage in tax planning due to volatility in cash flows and low overall levels of liquidity in this stage (Akhtar, 2012; Brondolo, 2009; Edwards et al., 2016; Richardson et al., 2015). Koester et al. (2013) claim that effective resource use designed to increase after-tax cash flows is critical in times of need. Edwards et al. (2016) find that a financially constrained firm will take action to reduce its level of cash taxes paid. Unlike other expense types, reducing the amount of corporate taxes is less likely to adversely affect a firm's operations (Edwards et al., 2016). If liquidity issues become severe, management may be willing to pursue tax avoidance strategies as the potential costs (e.g. penalties imposed by the tax authorities and potential audit adjustments) may be perceived to be lower than the potential benefits (e.g. reduced debt, ability to continue as a going concern and positive cash flows) (Brondolo, 2009; Campello, Giambona, Graham, & Harvey, 2011; Richardson et al., 2015). Management may thus adopt a prospector style strategic framework (Higgins et al., 2015) in this stage as they are likely to pursue riskier projects that could involve aggressive financing and taxation strategies (Akhtar, 2012).

Overall, we contend that tax avoidance is likely to exhibit a U-shaped pattern across a firm's life cycle stages. Differences in resourcing, managerial incentives and opportunities and economic fundamentals across each stage suggest that tax avoidance is expected to be more pronounced in the early and later stages of a firm's life cycle and less prevalent in the growth and mature stages.

3. Research Design

3.1. Sample Selection and Data Source

Our sample originally comprised all firms in the Compustat annual file over the 1987–2013 period. Initially, this gave rise to 299,565 firm-year observations (see Panel A, Table 1). The sample was then reduced to 65,796 firm-year observations after excluding financial and utility firms (87,250 firm-year observations), firms with missing cash flow data required to construct firm life cycle stages (26,304 firm-year observations), firms with missing ETR values (34,716 firm-year observations) and firms with missing values for the control variables used in our regression model (85,499 firm-year-observations). In particular, financial firms were excluded due to the major differences in their application of accounting policies and derivation of accounting estimates relative to other firms and the different regulatory constraints they face. Utility firms were excluded because their capital structures are generally characterized by high levels of debt which would affect the computation of the various tax avoidance proxy measures. Our sample period begins in 1987, the first year in which the cash flow data required to estimate a firm's life cycle became available.[12] Data are winsorized at the 1st and 99th percentiles in our study to reduce the likelihood of outliers significantly influencing our empirical results.

Table 1 (Panel B) reports the distribution of the sample in accordance with the Fama-French 12 industry classification. We find that business equipment represents the highest proportion of

[12]Since the 1987 year, firms have been required to disclose cash flow data under the Statement of Financial Accounting Standards No. 95 (FASB, 1987).

observations (19.42%), followed by the other sector (18.77%), manufacturing (13.26%), wholesale, retail and services (12.88%), and healthcare, medical equipment and drugs (11.76%).

3.2. Regression Model

We empirically test the association between a firm's life cycle stages and tax avoidance using firm fixed effects regression analysis to include the unobserved time invariant characteristics of firm life cycle.[13] Because we argue that a firm exhibits different levels of tax avoidance in the different stages of its life cycle, a regression model with firm fixed effects appears to be the most appropriate research design choice (e.g. Wooldridge, 2010). Our regression model is estimated as follows:

$$\begin{aligned}\text{TAX\_AVOID}_{it} = {} & \alpha_{0it} + \beta_{1-4}\text{FLC\_DUM}_{it} + \beta_5\text{SIZE}_{it} + \beta_6\text{MTB}_{it} + \beta_7\text{LEV}_{it} + \beta_8\text{CASH}_{it} \\ & + \beta_9\text{PROFIT}_{it} + \beta_{10}\text{NOL}_{it} + \beta_{11}\Delta\text{NOL}_{it} + \beta_{12}\text{FI}_{it} + \beta_{13}\text{PPE}_{it} \\ & + \beta_{14}\text{INTANG}_{it} + \beta_{15}\text{EQINC}_{it} + \beta_{16}\text{R\&D}_{it} + \beta_{17}\Delta\text{SALE}_{it} + \beta_{18}\text{EMP}_{it} \\ & + \text{YEAR}_{\text{DUMMIES}} + \alpha_i + \varepsilon_{it},\end{aligned} \tag{1}$$

where, i = firm i, t = financial years 1987–2013, and α_i = firm specific unobserved fixed effects. We use three proxy measures of tax avoidance (TAX_AVOID) in our main analysis (i.e. GAAP_ETR, DD_BT, and SHELTER). The key variable of interest in our regression model is FLC_DUM. We predict relatively more tax avoidance during the introduction (INTRODUCTION) and decline (DECLINE) stages, and less tax avoidance during the growth (GROWTH) and mature (MATURE) stages. All of the variables incorporated in our regression model (including the control variables) are defined in Appendix A.[14]

3.3. Dependent Variable: Estimation of Tax Avoidance

We employ several proxy measures of tax avoidance as the dependent variable in our study, which have been used in prior research (e.g. Desai & Dharmapala, 2006; Dyreng et al., 2008; Hoi, Wu, & Zhang, 2013; Manzon & Plesko, 2002; McGuire, Omer, & Wilde, 2013). Hanlon and Heitzman (2010) claim that the use of different tax avoidance proxy measures avoids any inherent limitations of any specific measure. We therefore use three tax avoidance proxy measures in our main analysis:[15] the ETR (GAAP_ETR), discretionary book–tax differences (DD_BT) and the tax shelter model (SHELTER). Hanlon and Heitzman (2010) argue that tax expense and book–tax differences estimated from financial statements are the most commonly used proxy measures of tax avoidance. They also assert that taxes, taxable income and book–tax differences affect real business decisions such as investment and capital structure.

[13]We acknowledge that the different stages of a firm's life cycle may explain the unobserved time invariant features of tax avoidance. In fact, there may be partial co-movement between tax avoidance measures and life cycle stages. Fixed effects regression analysis may reveal if the determinants of life cycle stages stems from changes within a firm over time. Thus, a fixed effect model controls for the average differences in both observable and unobservable predictors across firms. The fixed effect coefficients incorporate all the across firm differences and what is retained is the within-firm differences (e.g. Wooldridge, 2010).

[14]We also note that the number of observations in any given regression model varies depending on the model-specific data requirements.

[15]We do not employ CASH_ETR as a main proxy measure of tax avoidance in this study as cash taxes paid are often fragmented in nature. For instance, it is possible that firms report nil or negligible amounts of cash taxes paid in some years followed by large absolute cash taxes paid upon IRS audit settlements in other years.

GAAP_ETR is calculated as total tax expense comprising both current and deferred tax expense divided by pre-tax book income less special items.[16] This measure considers tax avoidance practices that affect net income (Robinson, Sikes, & Weaver, 2010), which is used by investors and executives to measure a firm's overall tax burden and tax avoidance levels (Dyreng, Hanlon, & Maydew, 2010; Hoi et al., 2013; Rego, 2003; Wilson, 2009). Consistent with Dyreng et al. (2010), lower GAAP_ETR values represent higher levels of tax avoidance.

DD_BT is computed as the book-to-tax difference residual using the method developed by Desai and Dharmapala (2006).[17] Research by Desai (2003) and Wilson (2009) finds book–tax differences to be strongly positively associated with tax sheltering. We follow Desai and Dharmapala (2006) and estimate DD_BT as a residual obtained from a regression of permanent book–tax differences that is equal to $\mu_{i+}\,\epsilon_{it}$ from a fixed effects regression model of $BT_{it} = \beta_1 TA_{it} + \mu_i + \epsilon_{it}$ (see Appendix A for details). In accordance with Desai and Dharmapala (2006), higher values of DD_BT represent higher levels of tax avoidance.

SHELTER is calculated as per Wilson's (2009) tax shelter model, which investigates the firm-level characteristics associated with tax sheltering activities. He estimates a logistic regression of a binary variable (SHELTER = 1, 0) on a set of independent variables (i.e. book–tax differences, discretionary accruals, leverage, total assets, return on assets, foreign pre-tax income and R&D expenditure) expected to be associated with tax sheltering. Although it is possible that Wilson's (2009) tax shelter model generates noisy (i.e. out-of-sample) estimates, prior research finds that it provides a reasonable proxy measure of tax avoidance (e.g. Hoi et al., 2013; Kim, Li, & Zhang, 2011; Rego & Wilson, 2012). We specifically consider a firm to engage in tax sheltering activities when the predicted shelter probabilities are in the top quintile of the distribution (see Appendix A for details). In line with Wilson (2009), a higher value of SHELTER denotes a higher probability of engaging in tax avoidance.

3.4. Independent Variables: Life Cycle Stages

Assessing a life cycle stage at the firm level is difficult because a firm may be subject to many overlapping but distinct product life cycle stages. Moreover, a firm can compete in multiple industries and its product offerings can be fairly diverse (Dickinson, 2011). To overcome these complexities, we follow Dickinson's (2011) methodology to develop proxy measures of a firm's life cycle stages (FLC_DUM).[18] The identification of life cycle stages based on Dickinson (2011) relies on research across diverse areas such as production behavior, learning/experience, investment, market share and entry/exit patterns. Hence, this process can capture firm performance and the allocation of resources in a firm.

We classify all of the firm-year observations in our sample into different stages based on the following cash flow pattern classification in accordance with Dickinson (2011), where OANCF

[16]We also note that the GAAP_ETR is bounded between 0 and 1, which is consistent with prior research (e.g. McGuire et al., 2012).

[17]Graham, Raedy, and Shackelford (2012) claim that permanent differences are important in tax planning because they can reduce the taxable income reported to the tax authorities, whil maintaining the accounting income reported to shareholders.

[18]Anthony and Ramesh (1992) provide one of the first empirical methods for classifying firms into different life cycle stages. However, we do not use their method in our study for several reasons. First, their method requires a five year history of variables, removing true 'introduction stage' firms from the sample, so no data (and as such no meaningful analysis) on introduction stage firms are available. Second, Dickinson (2011) shows that using this method leads to an erronous classification of the stage of firms in the life cycle. Finally, their method is 'ad hoc' in nature, and relies on portfolio sorts to classify a firm into its different life cycle stages.

represents operating cash flows, IVNCF denotes investing activity cash flows and FINCF represents financing cash flows:

(1) INTRODUCTION: if OANCF < 0, IVNCF < 0 and FINCF > 0;
(2) GROWTH: if OANCF > 0, IVNCF < 0 and FINCF > 0;
(3) MATURE: if OANCF > 0, IVNCF < 0 and FINCF < 0;
(4) DECLINE: if OANCF < 0, IVNCF > 0 and FINCF $\leq$ or ≥ 0; and
(5) SHAKE-OUT: the remaining firm years are classified into the shake-out stage.

3.5. Control Variables

Prior research suggests that economies of scale and a firm's operational complexity are associated with tax avoidance (e.g. Mills, Erickson, & Maydew, 1998; Rego, 2003). In particular, large firms tend to benefit from economies of scale in tax planning, so we control for firm size (SIZE), capital intensity (PPE) and the natural logarithm of the number of employees (EMP) in our regression model. Larger firms are also more likely to be audited by the IRS (Ayers, Seidman, & Towery, 2015; Guedhami & Pittman, 2008; Hanlon et al., 2014; Hoopes, Mescall, & Pittman, 2012). Firms with substantial foreign operations also have the advantage of being able to shift income between low- and high-tax jurisdictions (Rego, 2003), so we also control for the proportion of income which is generated from foreign operations (FI) in our regression model. Highly levered firms may have greater incentive to engage in tax avoidance due to the tax shield offered by corporate debt (Gupta & Newberry, 1997) or alternatively, a substitution effect may exist between leverage and tax avoidance (Graham & Tucker, 2006), so we also control for leverage (LEV) in our regression model. Firms with positive pre-tax income are also likely to have more incentive to avoid corporate taxes, thus our regression model also controls for firm profitability (PROFIT) and net operating loss carry forwards (NOL and ΔNOL) (Chen, Dhaliwal, & Xie, 2010). We also include income related to the equity method of accounting (EQINC) in our regression model to control for differences in the financial and tax accounting treatment which may affect tax avoidance (Frank, Lynch, & Rego, 2009). Motivated by prior studies showing that rapidly growing firms are likely to invest in additional tax-planning activities (e.g. McGuire, Omer, & Wang, 2012), we also control for a firm's growth opportunities as reflected by the market-to-book ratio, R&D expenditure, intangible assets, sales and cash balances (i.e. MTB, R&D, INTANG, ΔSALE and CASH, respectively) in our regression model. Finally, we also include dummy variables to control for year and firm fixed effects.

4. Empirical Results

4.1. Descriptive Statistics

Table 2 presents the descriptive statistics of the variables included in our regression model. Specifically, Panel A reports the pooled descriptive statistics, while Panel B presents the life cycle-wise descriptive statistics. Panel A shows that the mean (median) values of GAAP_ETR, DD_BT and SHELTER are 0.246 (0.294), 0.001 (0.000) and 0.248 (0.000), respectively. The mean (median) GAAP_ETR value of our estimates is lower than that of Dyreng et al. (2010), that is, 0.309 (0.337) and McGuire et al. (2012), that is, 0.355 (0.367).[19] Our DD_BT measure of tax avoidance is close to the mean (median) value in Chen et al.

[19]Huseynov and Klamm (2012) also report a mean GAAP_ETR of 0.310. Our GAAP_ETR differs from that in prior studies because our sample covers the 1987–2013 period, which was characterized by lower corporate statutory tax rates. Before 1987, the corporate statutory tax rate was more than 46%. It was then reduced to 40% in 1987 and

(2010), that is, 0.018 (0.014) and Hoi et al. (2013), that is, 0.0001 (0.0034). The SHELTER measure of tax avoidance is a dummy variable that is equal to one if a firm's estimated sheltering probability is in the top quartile. The mean (median) values for SIZE 4.945 (4.829), MTB 2.693 (1.801) and ΔSALES 0.238 (0.080) suggest the presence of many young and growth firms in our sample. Finally, the mean (median) LEV 0.314 (0.206), CASH 0.212 (0.091), PROFIT 0.027 (0.118), PPE 0.330 (0.233), INTANG 0.141 (0.037) and R&D 0.056 (0.000) values for our sample firms are largely consistent with those in prior tax avoidance studies (e.g. Dyreng et al., 2010; Hoi et al., 2013; McGuire et al., 2012).

Panel B of Table 2 indicates that, on average, firms engage in greater tax avoidance in the introduction, shake-out and decline stages than in the growth and mature stages. For example, the mean GAAP_ETR for firms in the growth and mature stages is 0.293 and 0.299, respectively, compared to 0.117, 0.229 and 0.085, respectively, for firms in the introduction, shake-out and decline stages. The mean values of SIZE, MTB, ROA, R&D and ΔSALE across the life cycle stages are largely consistent with those in Dickinson (2011). For example, mean SIZE and ROA are higher in the mature and growth stages and lower in the introduction and decline stages. The life cycle-related sample distribution indicates that 65.30% of the sample firms fall into the growth and mature stages. Further analysis shows that SIZE, ROA, FI, EQINC and EMP progressively increase as firms move from the introduction stage to the mature stage and then decline as they move from the mature stage to the decline stage. In contrast, an inverted U-shaped trend in R&D and ΔSALE values is observed across the various life cycle stages. In addition, a non-linear association exists between firm life cycle stage and age as firms in the introduction stage may be older than some firms in, for instance, the mature stage. The mean (median) values of firm age (in years) across the introduction, growth, mature, shake-out and decline stages are 9.305 (6.334), 13.391 (9.132), 18.46 (14.144), 15.611 (11.233), and 10.672 (7.533), respectively. We note that firm age is not a control variable in our regression models, but is included here for comparative purposes. Overall, the cross-stage changes in the control variable estimates (i.e. Panel B, Table 2) are consistent with those in Dickinson (2011), indicating the reliability of our estimates.

Figure 1 graphically portrays tax avoidance (i.e. GAAP_ETR, DD_BT and SHELTER) over the different firm life cycle stages. It specifically shows a U-shaped pattern in tax avoidance outcomes across the life cycle, suggesting that tax avoidance is more common in the early and later stages of a firm's life cycle and less common in the growth and mature stages. Finally, the U-shaped pattern in tax avoidance outcomes is confirmed when we plot 95% confidence bounds.

4.2. Correlation Results

Table 3 reports the Pearson correlation results. We find that all of the tax avoidance proxy measures and most of the control variables are highly correlated with the various life cycle stage proxies. As expected, GAAP_ETR is negatively (positively) correlated ($p < .01$) with the introduction, shake-out and decline (growth and mature) stages. Further, the SHELTER proxy measure of tax avoidance is positively correlated ($p < .01$) with the introduction and decline stage, while negatively correlated ($p < .01$) with the growth and shake-out stages. In addition, SIZE, FI, EMP and ROA are negatively (positively) correlated ($p < .01$) with the introduction, shake-out and decline (growth and mature) stages, whereas MTB, LEV, PPE and ΔSALE are positively (negatively) correlated ($p < .01$) with the introduction and growth

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further reduced to 34% in 1988, before finally settling at 35% in 1993. Thus, the time-series average tax rate in our sample was 35%, which is lower than that in prior studies.

Table 2. Descriptive statistics

Panel A: pooled descriptive statistics

Variable	*N*	Mean	Std. Dev.	Minimum	0.25	Median	0.75	Maximum
GAAP_ETR	65,796	0.246	0.185	0.000	0.026	0.294	0.378	1.000
DD_BT	46,170	0.001	0.297	−1.136	−0.111	0.000	0.113	1.103
SHELTER	30,658	0.248	0.432	0.000	0.000	0.000	0.000	1.000
SIZE	65,796	4.945	2.470	−1.004	3.142	4.829	6.571	10.599
MTB	65,796	2.693	6.932	−33.909	0.990	1.801	3.261	46.270
LEV	65,796	0.314	0.570	0.000	0.033	0.206	0.395	6.045
CASH	65,796	0.212	0.384	0.000	0.025	0.091	0.260	5.235
PROFIT	65,796	0.027	1.466	−9.524	−0.109	0.118	0.280	10.140
NOL	65,796	0.588	0.492	0.000	0.000	1.000	1.000	1.000
ΔNOL	65,796	0.911	5.057	−2.113	0.000	0.000	0.047	41.808
FI	65,796	0.006	0.026	−0.073	0.000	0.000	0.000	0.128
PPE	65,796	0.330	0.324	0.000	0.095	0.233	0.468	2.264
INTANG	65,796	0.141	0.235	0.000	0.000	0.037	0.189	1.575
EQINC	65,796	0.000	0.005	−0.027	0.000	0.000	0.000	0.025
R&D	65,796	0.056	0.139	0.000	0.000	0.000	0.049	1.179
ΔSALES	65,796	0.238	1.002	−1.000	−0.044	0.080	0.244	9.096
EMP	65,796	7.704	20.353	0.000	0.139	0.800	4.343	130.700
Age (years)	65,796	15.079	14.382	0.532	4.753	10.616	20.567	71.940

Panel B: Life cycle-wise descriptive statistics

Variable	Statistics	Introduction	Growth	Mature	Shake-out	Decline
GAAP_ETR	Mean	0.117	0.293	0.299	0.229	0.085
	Median	0.000	0.335	0.334	0.240	0.000
	Standard Deviation	0.182	0.163	0.154	0.207	0.169
DD_BT	Mean	0.054	0.029	−0.028	−0.032	−0.007
	Median	0.046	0.021	−0.012	−0.008	0.000
	Standard Deviation	0.465	0.250	0.204	0.301	0.420
SHELTER	Mean	0.211	0.175	0.198	0.164	0.246
	Median	0.000	0.000	0.000	0.000	0.000
	Standard Deviation	0.408	0.380	0.400	0.370	0.431
SIZE	Mean	3.498	5.467	5.514	4.317	3.512
	Median	3.470	5.502	5.564	4.166	3.578
	Standard Deviation	1.890	2.115	2.536	2.456	1.986

MTB	Mean	3.496	2.818	2.410	2.197	2.516
	Median	1.930	2.037	1.736	1.383	1.521
	Standard Deviation	11.753	4.929	4.864	5.617	8.375
LEV	Mean	0.556	0.351	0.222	0.215	0.290
	Median	0.284	0.284	0.178	0.112	0.086
	Standard Deviation	1.020	0.421	0.281	0.422	0.684
CASH	Mean	0.327	0.210	0.143	0.225	0.297
	Median	0.092	0.084	0.077	0.137	0.182
	Standard Deviation	0.660	0.350	0.189	0.280	0.423
PROFIT	Mean	−0.319	0.150	0.173	−0.027	−0.293
	Median	−0.173	0.165	0.178	0.034	−0.267
	Standard Deviation	2.558	0.830	0.909	1.191	2.106
NOL	Mean	0.800	0.505	0.479	0.642	0.873
	Median	1.000	1.000	0.000	1.000	1.000
	Standard Deviation	0.400	0.500	0.500	0.480	0.333
ΔNOL	Mean	3.429	0.110	0.026	0.510	3.005
	Median	0.115	0.000	0.000	0.000	0.171
	Standard Deviation	9.506	1.614	0.857	3.634	8.693
FI	Mean	−0.001	0.008	0.011	0.005	−0.002
	Median	0.000	0.000	0.000	0.000	0.000
	Standard Deviation	0.018	0.026	0.029	0.024	0.018
PPE	Mean	0.266	0.466	0.329	0.212	0.162
	Median	0.153	0.353	0.269	0.141	0.087
	Standard Deviation	0.327	0.407	0.253	0.221	0.223
INTANG	Mean	0.139	0.181	0.133	0.102	0.089
	Median	0.015	0.058	0.051	0.020	0.004
	Standard Deviation	0.275	0.284	0.187	0.181	0.203
EQINC	Mean	−0.001	0.000	0.001	0.000	−0.002
	Median	0.000	0.000	0.000	0.000	0.000
	Standard Deviation	0.005	0.004	0.005	0.005	0.005
R&D	Mean	0.130	0.038	0.025	0.043	0.124
	Median	0.006	0.000	0.000	0.000	0.034
	Standard Deviation	0.244	0.091	0.057	0.094	0.198
ΔSALES	Mean	0.517	0.317	0.105	0.084	0.202
	Median	0.111	0.160	0.062	−0.003	−0.061
	Standard Deviation	1.674	0.812	0.467	0.873	1.452
EMP	Mean	1.231	8.149	11.872	5.755	1.330
	Median	0.127	1.365	1.985	0.447	0.118
	Standard Deviation	5.811	20.009	25.249	17.660	7.022
Age	Mean	9.305	13.391	18.46	15.611	10.672
	Median	6.334	9.132	14.144	11.223	7.533
	Standard Deviation	9.357	13.835	16.389	14.634	10.373

Note: Variable definitions: Refer to Appendix A.

Table 3. Pearson correlation results

Variable	Introduction	Growth	Mature	Shake-out	Decline
GAAP_ETR	−0.369***	0.207***	0.277***	−0.016***	−0.209***
DD_BT	0.070***	0.058***	−0.08***	−0.033***	−0.006
SHELTER	0.0203***	−0.018***	−0.004	−0.032***	0.022***
SIZE	−0.271***	0.174***	0.224***	−0.075***	−0.162***
MB	0.04***	0.012***	−0.030***	−0.029***	−0.001
LEV	0.178***	0.008***	−0.115***	−0.057***	−0.026***
CASH	0.235***	−0.020***	−0.175***	−0.036***	0.009***
PROFIT	−0.346***	0.145***	0.181***	0.041***	−0.052***
NOL	0.184***	−0.099***	−0.173***	0.028***	0.131***
ΔNOL	0.230***	−0.098***	−0.136***	−0.026***	0.111***
FI	−0.133***	0.057***	0.132***	−0.018***	−0.084***
PPE	0.023***	0.194***	−0.039***	−0.119***	−0.145***
INTANG	−0.007***	0.100***	−0.011***	−0.055***	−0.068***
EQINC	−0.077***	0.021***	0.073***	0.006***	−0.045***
R&D	0.255***	−0.086***	−0.177***	−0.051***	0.095***
ΔSALES	0.161***	0.036***	−0.123***	−0.056***	−0.018***
EMP	−0.292***	0.141***	0.272***	−0.038***	−0.185***

Note: Variable definitions: Refer to Appendix A.
***Statistical significance at the 1% level (two-tailed tests).

(mature, shake-out and decline) stages. Overall, the correlations among the tax avoidance proxies, life cycle proxies and control variables are generally in the expected direction, thus providing strong support for the validity of our key constructs and measures.

4.3. Univariate t-tests

Table 4 shows how tax avoidance activities change as a firm moves from one life cycle stage to another. It indicates that the mean GAAP_ETR, DD_BT and SHELTER proxy measures of tax avoidance for each stage differ significantly from that of the proceeding stage based on mean difference *t*-tests. In particular, the average level of tax avoidance decreases significantly from the introduction to the growth stage, from the growth to the mature stage, from the introduction to the mature stage and from the introduction to the shake-out stage ($p < .01$). However, the mean tax avoidance increases significantly from the shake-out to the decline stage, from the introduction to the decline stage and from the growth to the decline stage ($p < .01$). In general, the fluctuations in GAAP_ETR, DD_BT, and SHELTER suggest that tax avoidance is more common in the introduction, shake-out and decline stages and less common in the growth and mature stages, thus resembling a U-shaped pattern. These findings support the theoretical argument that firms in the three former life cycle stages have a greater propensity to engage in higher levels of tax avoidance to generate or reinforce the innovations and investments necessary to increase firm growth and shareholder returns.

4.4. Regression Results

Table 5 presents our regression results for Dickinson's (2011) model of life cycle stages and the different proxy measures of tax avoidance. In particular, we categorize the firm life cycle into five stages as per Dickinson's (2011) model: introduction, growth, mature, shake-out, and decline, with five dummy variables constructed for each category. However, to avoid

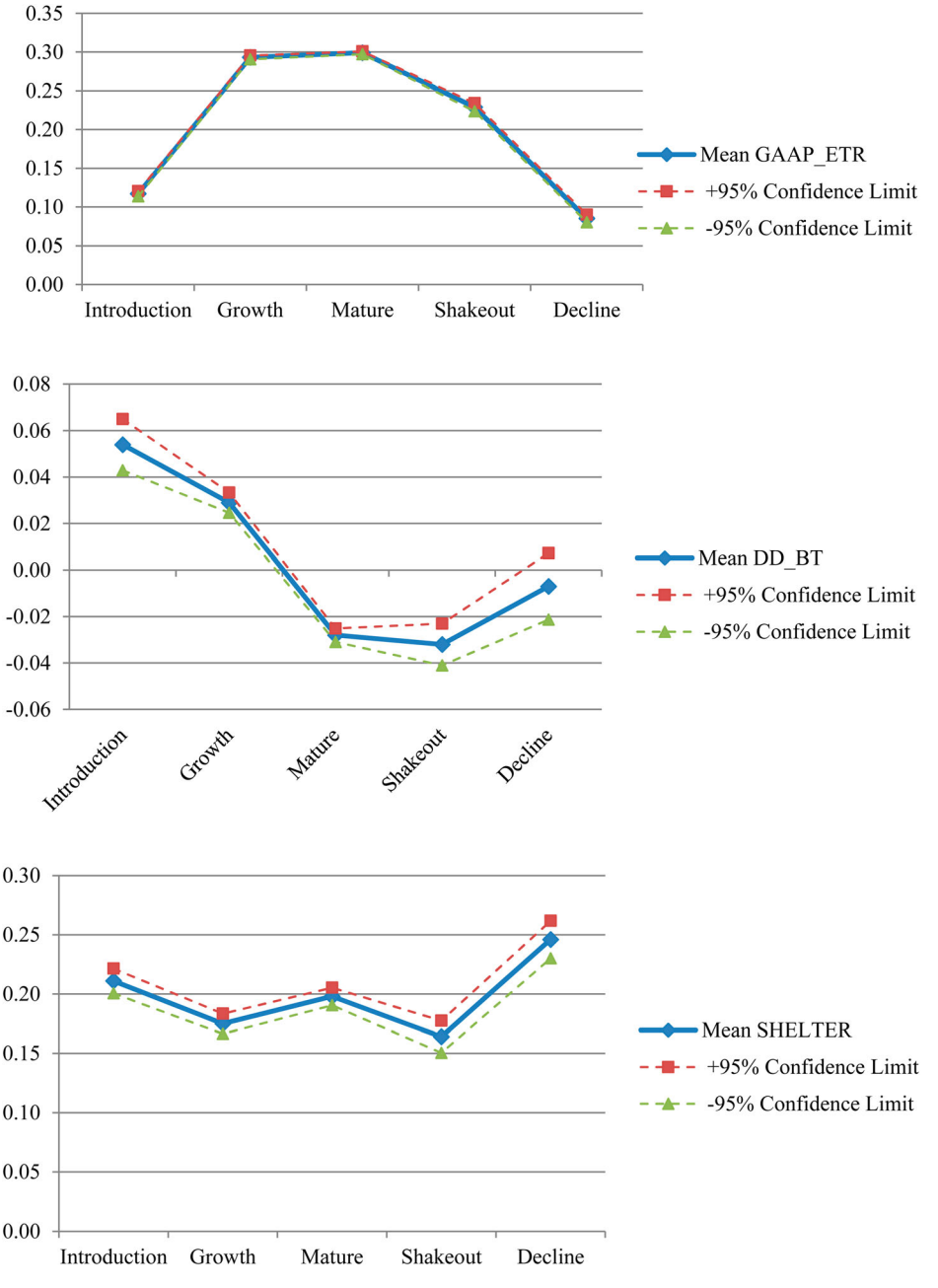

Figure 1. Graphical presentation of the mean tax avoidance proxy measures across the firm life cycle stages.

multicollinearity issues in our regression model, the shake-out stage, which is theoretically ambiguous (Dickinson, 2011), is omitted from the regression model.[20]

[20]Prior research by Hasan et al. (2015) and Habib and Hasan (2015) followed a similar approach in examining the association between firm life cycle and the cost of equity and risk-taking, respectively. However, in a robustness check

Table 4. Mean difference test of tax Avoidance – Dickinson's (2011) model of life cycle stages

Estimates	Tax avoidance (Stage 1)	Tax avoidance (Stage 2)	*t*-Statistics for differences	*p*-Values
	Introduction	Growth		
GAAP_ETR	0.117	0.293	82.541	.000
DD_BT	0.054	0.029	−4.089	.000
SHELTER	0.211	0.175	−7.434	.000
	Growth	Mature		
GAAP_ETR	0.293	0.298	3.245	.001
DD_BT	0.029	−0.028	−21.663	.000
SHELTER	0.175	0.199	5.739	.000
	Mature	Shake-out		
GAAP_ETR	0.298	0.229	−24.297	.000
DD_BT	−0.028	−0.032	0.736	.461
SHELTER	0.199	0.164	−4.807	.000
	Shake-out	Decline		
GAAP_ETR	0.229	0.085	−39.327	.000
DD_BT	−0.032	−0.007	2.851	.004
SHELTER	0.164	0.245	10.569	.000
	Introduction	Mature		
GAAP_ETR	0.117	0.298	91.090	.000
DD_BT	0.054	−0.028	−14.120	.000
SHELTER	0.211	0.199	−2.775	.005
	Introduction	Shake-out		
GAAP_ETR	0.117	0.229	34.923	.000
DD_BT	0.054	−0.032	−11.808	.000
SHELTER	0.211	0.164	−7.410	.000
	Introduction	Decline		
GAAP_ETR	0.117	0.085	−10.651	.000
DD_BT	0.054	−0.007	−6.659	.000
SHELTER	0.211	0.246	4.828	.000
	Growth	Shake-out		
GAAP_ETR	0.293	0.229	−21.747	.001
DD_BT	0.029	−0.032	−11.995	.000
SHELTER	0.175	0.164	−1.932	.055
	Growth	Decline		
GAAP_ETR	0.293	0.085	−74.764	.000
DD_BT	0.029	−0.007	−4.806	.000
SHELTER	0.175	0.246	10.984	.000

Notes: Variable definitions: Refer to Appendix A; and *p*-values are based on two-tailed tests.

Our regression results show that compared to the shake-out stage, the introduction and decline stages of firm life cycle are significantly positively associated with tax avoidance ($p < .05$ or better), whereas the growth and mature stages of firm life cycle are significantly negatively associated with tax avoidance ($p < .10$ or better). Model 1 shows that compared to the shake-out stage of a firm's life cycle, the introduction and decline stages have lower GAAP_ETRs of 2.1% and 2.9%, respectively, while the growth and mature stages have higher GAAP_ETRs of 0.6% and 0.3%, respectively. Variations in tax avoidance across the

(tabulated in the online supplemental material to this study), we also use the mature stage as the benchmark for our regression estimates and obtain qualitatively similar results.

various life cycle stages are therefore economically significant for GAAP_ETRs, especially in the introduction and decline stages. We also use DD_BT and SHELTER as additional proxy measures of tax avoidance in Models 2 and 3, respectively. The coefficients (and *t*-statistics) for the introduction stage of 0.256 and 0.162 (2.46 and 1.99), growth stage of −0.145 and −0.034 (−1.70 and −0.49), mature stage of −0.151 and −0.129 (−2.18 and −1.97) and decline stage of −0.049 and 0.349 (−0.43 and 3.88) are largely consistent with expectations. Model 2 shows that tax avoidance (DD_BT) is highest (lowest) in the introduction (decline) stage. For Model 3, compared to the shake-out stage of a firm's life cycle, the odds of a tax shelter (SHELTER) in the introduction stage is 17.58% higher and the odds of a tax shelter (SHELTER) in the growth and mature stages are 3.34% and 12.1% lower, respectively. We also find that several of our control variables are statistically significant. In particular, firms with higher levels of tax avoidance tend to be innovative and profitable, as evidenced by the significant coefficients between R&D, INTANG, PROFIT, NOL and ΔNOL and tax avoidance ($p < .05$ or better). Finally, given that the introduction and decline firms included in our sample are generally associated with NOLs, we also empirically test the robustness of our findings by excluding loss firms from our sample. Our additional regression results (tabulated in the online supplemental material) show that they are largely consistent with the main regression results reported in Table 5.[21]

In short, our findings are consistent with resource-based dependence theory in accounting for differences in tax avoidance across the firm life cycle stages. Specifically, after controlling for known determinants of tax avoidance and firm and year fixed effects, we find tax avoidance to be significantly negative in the growth and mature stages and significantly positive in the introduction and decline stages relative to the shake-out stage. Our regression results thus support the idea that firms in the introduction stage of their life cycle are faced with the need to maximize growth and secure innovations, but often have limited resources available to them to achieve those objectives. These firms are more likely to aggressively seek opportunities to manage cash flows that can be used to fund the innovations and investments necessary to ensure firm growth and increased shareholder returns, and they may also pursue tax avoidance strategies to maximize after-tax cash flows.

Continued earnings growth and the increased certainty of cash flow positions in the growth stage may provide management with the confidence to increase or maintain earnings without necessarily resorting to aggressive tax planning. Mature firms realize their full potential in terms of exploiting investment opportunities unless new innovations present themselves (Barclay & Smith, 2005; Dickinson, 2011). Certainty and reduced re-investment opportunities in the mature stage suggest that these firms have a lower propensity to aggressively pursue tax avoidance opportunities. However, with shrinking innovation, investment and cash flows in the decline phase, they are likely to engage in tax avoidance and related strategies to increase after-tax savings.

4.5. Additional Analysis

We also empirically test the interaction effects between each firm life cycle stage and the various tax avoidance determinants to ascertain whether any particular variable has additional significance in any given firm life cycle stage in explaining the variation in tax avoidance (i.e. GAAP_ETRs). The additional regression results are reported in Table 6.

[21]We also include the financial reporting quality measure (FINRQ) of Dechow and Dichev (2002) and the management ability score (MAS) of Demerjian et al. (2012) in our regression model as additional control variables as a further robust check. We find that the regression results (tabulated in our online supplementary material) are consistent with the main regression results reported in Table 5.

Table 5. Regression results – Dickinson's (2011) model of life cycle stages

	GAAP_ETR	DD_BT	SHELTER
	FFE	FFE	FX LOGIT
Dependent variable	Model 1	Model 2	Model 3
Intercept	0.248***	0.747	−0.044**
	(30.60)	(1.13)	(−2.17)
INTRODUCTION	−0.021***	0.256**	0.162**
	(−8.65)	(2.46)	(1.99)
GROWTH	0.006***	−0.145*	−0.034
	(2.77)	(−1.70)	(−0.49)
MATURE	0.003*	−0.151**	−0.129**
	(1.71)	(−2.18)	(−1.97)
DECLINE	−0.029***	−0.049	0.349***
	(−9.91)	(−0.43)	(3.88)
Control variables			
SIZE	0.018***	−0.148	0.085***
	(17.98)	(−1.16)	(2.60)
MTB	−0.000	0.008	0.045***
	(−0.73)	(1.16)	(12.26)
LEV	0.004***	0.511***	−0.188**
	(2.71)	(2.66)	(−2.34)
CASH	0.001	−0.386	0.312***
	(1.27)	(−0.97)	(5.62)
PROFIT	0.004***	2.363**	1.166***
	(3.99)	(2.19)	(37.29)
NOL	−0.064***	0.086	0.145**
	(−21.44)	(1.03)	(2.11)
ΔNOL	−0.002*	0.033*	0.162***
	(−1.89)	(1.65)	(22.94)
FI	0.085***	−1.229	12.908***
	(2.76)	(−0.99)	(15.06)
PPE	0.021***	−0.373***	0.803***
	(6.27)	(−2.75)	(6.44)
INTANG	−0.002*	−0.109	0.883***
	(−1.81)	(−1.55)	(8.88)
EQINC	0.009	−6.931	8.753*
	(0.06)	(−1.06)	(1.84)
R&D	−0.014**	0.209	0.363***
	(−1.97)	(0.27)	(4.26)
ΔSALES	0.001	0.027	0.204***
	(1.48)	(0.87)	(9.37)
EMP	0.002**	0.126	0.138***
	(2.30)	(1.04)	(5.02)
YEAR FE	Yes	Yes	Yes
FIRM FE	Yes	Yes	Yes
N	65,796	46,170	30,658
Adj. R^2/Pseudo R^2	0.586	0.171	0.459

Notes: Variable definitions: Refer to Appendix A; and the sample size in Model 1–3 are different as a result of the use of different tax avoidance proxy measures.
*Statistical significance at the 10% level (two-tailed tests).
**Statistical significance at the 5% level (two-tailed tests).
***Statistical significance at the 1% level (two-tailed tests).

In all of the regression models, firm life cycle stage remains significant, which reinforces the importance of the firm life cycle stages in explaining the relative variation in tax avoidance across each stage. The value of life cycle stage in explaining variations in tax avoidance is also evident by the significance of the coefficients in terms of the various life cycle stage dummy variables, tax avoidance determinants and tax avoidance-life cycle stage interaction terms. In addition, firms on average, tend to have less tax avoidance (i.e. have higher GAAP_ETRs) during the growth and mature stages ($p < .05$), whereas firms tend to avoid more tax (i.e. have lower GAAP_ETRs) during the introduction and decline stages ($p < .01$ and $p < .10$, respectively). The economic significance of these results can be observed based on the magnitude of the firm life cycle coefficients, which show that, on average, the GAAP_ETRs decrease during the introduction (−2.40%) and decline (−2.10%) stages, and increase during the growth (1.3%) and mature (1.2%) stages.

In addition, we examine whether the extant determinants of tax avoidance are sensitive to each of the stages of firm life cycle in explaining the variation in tax avoidance. Specifically, the coefficient for the size-life cycle stage interaction term (LCS*SIZE) is positive and statistically significant ($p < .05$ or better) during the introduction and decline stages, while this interaction term is negative and significant ($p < .05$ or better) during the growth and mature stages. These results generally show that smaller introduction and decline stage firms have higher levels of tax avoidance compared to their counterparts in those stages. Similarly, larger growth and mature stage firms have higher levels of tax avoidance compared to their counterparts in those stages. Thus, economies of scale in tax planning (Rego, 2003) operate throughout different life cycle stages which either enhance or suppress the level of tax avoidance during each stage.

The coefficient on the leverage-life cycle stage interaction term (LCS*LEV) is negative and significant for the growth and mature stages ($p < .10$ or better) and positive and significant in the introduction stage ($p < .01$). Lower leveraged introduction stage firms display higher levels of tax avoidance, whereas higher leveraged growth and mature stage firms exhibit lower levels of tax avoidance. A possible explanation for these results is that there may be a substitution effect between leverage levels where firms rely on the tax deductibility of interest expenditure and a firm's propensity to engage in tax avoidance (Graham & Tucker, 2006). The profitability interaction coefficient is negative (positive) and significant for the introduction (growth) stage of firm life cycle ($p < .01$). Higher profitable introduction stage firms have higher levels of tax avoidance, while higher profitable growth stage firms exhibit lower levels of tax avoidance. Firms perform relatively better in generating profits in the growth stage and management may be less reliant on sustaining profitability through tax strategies in that stage Further, it is possible that the profitable introduction stage firms are in the process of gaining market share, dealing effectively with resource constraints and competition, but in order to sustain this, they continue to focus on tax avoidance activities along with core operations to generate earnings. The coefficient on the NOL-life cycle stage interaction term (LCS*NOL) shows that net operating loss carry forwards reduces GAAP_ETRs during the introduction and decline stages ($p < .01$), whereas that interaction term increases GAAP_ETR during the growth and mature stages ($p < .01$). Finally, the introduction and decline stage firms with NOL have lower levels of tax avoidance. The coefficient on the FI-life cycle stage interaction term (LCS*FI) suggests that substantial foreign operations during the growth ($p < .05$) and mature ($p < .01$) stages facilitates tax avoidance, while the lack of substantial foreign operations during the introduction ($p < .01$) and decline ($p < .01$) stage firms leads to reduced levels of tax avoidance. Finally, we also repeat the regression analysis by employing the DD_BT and SHELTER proxy measures of tax avoidance. We find that the regression results (tabulated in the online supplemental material) are qualitatively similar to those reported in Table 6.

Table 6. Regression results – the interaction effects of firm life cycle and firm characteristics on tax avoidance

	INTRO	GROWTH	MATURE	DECLINE	SHAKE-OUT
	FFE	FFE	FFE	FFE	FFE
Dependent variable	Model 1	Model 2	Model 3	Model 4	Model 5
Intercept	0.271***	0.234***	0.237***	−0.274***	−0.269***
	(33.67)	(25.05)	(25.42)	(34.25)	(33.71)
LIFE CYCLE STAGE (LCS)	−0.024***	0.013**	0.012**	−0.021*	−0.011
	(−3.26)	(2.12)	(2.05)	(−1.79)	(−1.27)
Interaction variables					
LCS*SIZE	0.007***	−0.002**	−0.003***	0.004**	0.004**
	(5.51)	(−1.98)	(−2.75)	(2.40)	(2.54)
LCS*MTB	0.000*	−0.000	−0.001**	0.000	−0.001*
	(1.90)	(−0.22)	(−2.31)	(0.90)	(−1.87)
LCS*LEV	0.012***	−0.012***	−0.007*	0.004	0.006
	(5.59)	(−3.86)	(−1.66)	(1.63)	(1.43)
LCS*CASH	−0.001	−0.001	0.013*	0.002	0.010
	(−0.33)	(−0.22)	(1.80)	(0.35)	(1.19)
LCS*PROFIT	−0.004***	0.005***	0.000	−0.001	0.003
	(4.07)	(3.31)	(0.06)	(−0.78)	(1.47)
LCS*NOL	−0.032***	0.016***	0.021***	−0.027***	−0.010**
	(−6.57)	(5.67)	(7.32)	(−2.90)	(−2.07)
LCS*ΔNOL	0.011***	−0.002	−0.004	0.002	−0.006
	(7.27)	(−0.62)	(−0.71)	(1.07)	(−1.63)
LCS*FI	0.265***	−0.129**	−0.182***	0.467***	0.118
	(2.66)	(−2.50)	(−3.64)	(3.08)	(1.29)
LCS*PPE	−0.030***	0.007	0.006	−0.008	0.006
	(−5.08)	(1.52)	(1.11)	(−0.69)	(0.56)
LCS*INTANG	−0.002	0.002	−0.002	−0.001	0.001
	(−1.35)	(0.73)	(−0.43)	(−0.37)	(0.18)
LCS*EQINC	0.989***	−0.359	−1.193***	1.355***	0.567
	(2.75)	(−1.06)	(−3.82)	(2.77)	(1.07)
LCS*R&D	−0.011*	0.007	−0.024	0.034***	0.001
	(−1.86)	(0.48)	(−1.03)	(3.41)	(0.04)
LCS*ΔSALES	−0.002**	0.005**	0.003	0.001	−0.002
	(1.97)	(2.10)	(1.33)	(0.42)	(−1.03)
LCS*EMP	0.003***	−0.001	0.000	−0.004***	−0.002
	(2.78)	(−0.50)	(0.32)	(−2.78)	(−1.17)
Control variables					
SIZE	0.012***	0.013**	0.020***	0.012***	0.012***
	(12.33)	(2.12)	(14.03)	(12.05)	(12.72)
MTB	−0.000***	0.000	0.000***	−0.000**	−0.000
	(−3.23)	(0.91)	(3.38)	(−2.02)	(−1.18)
LEV	−0.008***	0.003*	0.002*	−0.003**	−0.002
	(−4.07)	(1.95)	(1.76)	(−2.39)	(−1.57)
CASH	0.005*	0.009***	0.000	0.005***	0.001**
	(1.76)	(5.84)	(1.54)	(2.93)	(2.24)
PROFIT	0.004***	0.002***	0.003***	0.002***	0.002***
	(6.15)	(4.98)	(6.91)	(5.20)	(4.77)
NOL	−0.057***	0.069***	−0.074***	−0.061***	−0.061***
	(−19.49)	(21.87)	(−22.13)	(−20.55)	(−20.55)
ΔNOL	−0.012***	−0.004***	−0.003***	−0.007***	−0.006***
	(−8.32)	(5.56)	(−4.93)	(−8.05)	(−7.69)

(*Continued*)

Table 6. Continued

	INTRO	GROWTH	MATURE	DECLINE	SHAKE-OUT
	FFE	FFE	FFE	FFE	FFE
Dependent variable	Model 1	Model 2	Model 3	Model 4	Model 5
FI	0.028	0.134***	0.176***	0.047	0.065
	(0.61)	(2.78)	(3.59)	(1.01)	(1.43)
PPE	0.026***	0.018***	0.024***	0.015***	0.018***
	(5.67)	(3.94)	(6.13)	(3.79)	(4.57)
INTANG	0.012***	−0.002*	−0.002	0.008*	−0.002
	(2.51)	(−1.91)	(−1.64)	(1.82)	(−1.55)
EQINC	−0.175	0.104	0.443**	−0.125	−0.036
	(−0.85)	(1.54)	(2.04)	(−0.66)	(−0.19)
R&D	0.000***	−0.027***	−0.017***	−0.053***	−0.043***
	(2.10)	(−4.05)	(2.68)	(−7.18)	(−6.39)
ΔSALES	0.001	0.000	0.001	−0.001	0.000
	(0.97)	(0.08)	(1.32)	(−1.01)	(0.74)
EMP	0.004***	0.002*	0.002*	0.004***	0.004***
	(4.23)	(1.86)	(1.72)	(4.31)	(4.41)
YEAR FE	Yes	Yes	Yes	Yes	Yes
FIRM FE	Yes	Yes	Yes	Yes	Yes
N	65,796	65,796	65,796	65,796	65,796
Adj. R^2	0.586	0.586	0.586	0.585	0.584

Notes: Variable definitions: Refer to Appendix A; and this table shows the results for the GAAP_ETR proxy measure of tax avoidance.
*Statistical significance at the 10% level (two-tailed tests).
**Statistical significance at the 5% level (two-tailed tests).
***Statistical significance at the 1% level (two-tailed tests).

4.6. Robustness Checks

4.6.1. Alternative proxy measures of tax avoidance

As a robustness check of our main regression results (see Table 5), we employ two alternative proxy measures of tax avoidance based on cash ETR (CASH_ETR) (Dyreng et al., 2010) and cash tax non-conformity divided by lagged total assets (Δ/TA) (Henry & Sansing, 2014) in our empirical analysis. As Dickinson's (2011) life cycle measure is based on cash flow, it is possible that CASH_ETR (i.e. cash taxes paid divided by cash flow from operations) could also be a suitable alternative proxy measure of tax avoidance.[22] Thus, we repeat our analysis employing CASH_ETR as a proxy measure of tax avoidance. Henry and Sansing (2014) also propose another alternative proxy measure of tax avoidance to address statistical sampling bias and measurement error in the study of tax avoidance.[23] They claim that the removal of loss firms leads to a data truncation bias in which a significant fraction of firms are removed leading to potentially spurious effects. For instance, this bias may occur with the truncation of ETRs between values of 0 and 1 with more firms incurring a zero ETR in the introduction and decline stages. We thus employ the cash tax non-conformity measure of Henry and Sansing (2014) (Δ/TA) (i.e. the difference between a firm's cash taxes paid and its *prima facie*

[22]In fact, the CASH_ETR measure may help to reduce any differences in financial reporting considerations across life cycle stages, which could possibly confound our empirical results (e.g. Dyreng et al., 2010).
[23]Indeed, many empirical tax avoidance studies either delete or winsorize observations for which the tax avoidance measure is not meaningful, especially in cases of firms exhibiting losses.

Table 7. Regression results – CASH_ETR and Δ/TA measures of tax avoidance

	CASH_ETR	Δ/TA
	FFE	FFE
Dependent variable	Model 1	Model 2
Intercept	0.318***	0.027**
	(10.40)	(2.41)
INTRODUCTION	−0.075***	−0.010***
	(−15.62)	(−2.66)
GROWTH	0.038***	0.010***
	(9.29)	(2.81)
MATURE	0.008**	0.004***
	(2.02)	(2.65)
DECLINE	−0.077***	0.002
	(−14.44)	(0.57)
Control variables	Yes	Yes
YEAR FE	Yes	Yes
FIRM FE	Yes	Yes
N	50,917	63,753
Adj. R^2	0.249	0.878

Notes: Variable definitions: Refer to Appendix A; the sample size in Models 1 and 2 are different as a result of the use of different tax avoidance proxy measures; and control variables are omitted for the sake of brevity.
**Statistical significance at the 5% level (two-tailed tests).
***Statistical significance at the 1% level (two-tailed tests).

income tax expense on accounting profit divided by total assets) in this study to ensure that our results are not significantly affected by a potential data truncation bias.

Table 7 presents our regression results for the CASH_ETR (Model 1) and Δ/TA (Model 2) proxy measures of tax avoidance. Our results in Table 7 (Model 1) show that the introduction and decline stage firms are negatively associated with CASH_ETR ($p < .01$), while the growth and mature stage firms are positively associated with CASH_ETR ($p < .05$ or better). Further, Δ/TA is negatively associated with the introduction stage of a firm's life cycle ($p < .01$), but positively associated with the growth and mature stages ($p < .01$). Hence, these particular set of regression results are broadly in line with our main regression results shown in Table 5. We also find that our empirical results based on the CASH_ETR and Δ/TA proxy measures of tax avoidance are economically significant. Compared to the shake-out stage of a firm's life cycle, the introduction (decline) stages have lower CASH_ETRs by 7.5% (7.7%), whereas the growth (mature) stages firms have CASH_ETRs that are 3.8% (0.8%) higher. Finally, compared to the shake-out stage of a firm's life cycle, the introduction stage has lower Δ/TA by 1.0%, while the growth (mature) stages firms have Δ/TA that are 1.0% (0.4%) higher.

4.6.2. Alternative proxy measure of firm life cycle

As an additional robustness check of our main regression results reported in Table 5, we employ the DeAngelo et al. (2006) firm life cycle model which uses retained earnings divided by total assets or total equity to measure the various stages of development in a firm's life cycle. DeAngelo et al. (2006) claim that the mix of earned/contributed capital (i.e. retained earnings (RE) divided by total assets (TA) or total equity (TE)) has a greater influence on a firm's decision

Table 8. Regression results – DeAngelo et al.'s (2006) model of firm life cycle stages

	GAAP_ETR	DD_BT	SHELTER
	FFE	FFE	FX LOGIT
Dependent variable	Model 1	Model 2	Model 3
Intercept	0.274***	0.391***	−0.093***
	(33.94)	(2.61)	(−5.31)
RE/TA	0.001***	−0.067***	−0.026***
	(3.25)	(−7.11)	(−3.98)
RE/TA^2	0.000***	0.001***	−0.001**
	(6.27)	(2.16)	(−2.00)
Control variables	Yes	Yes	Yes
YEAR FE	Yes	Yes	Yes
FIRM FE	Yes	Yes	Yes
N	65,796	46,170	30,658
Adj. R^2/Pseudo R^2	0.579	0.173	0.409

Notes: Variable definitions: Refer to Appendix A; the sample size in Models 1, 2 and 3 are different on account of the utilization of different tax avoidance proxy measures; and control variables are omitted for the sake of brevity.
**Statistical significance at the 5% level (two-tailed tests).
***Statistical significance at the 1% level (two-tailed tests).

to pay dividends, compared with the profitability or growth opportunities thus consistent with theoretical life cycle predictions.

Table 8 reports the regression results for the life cycle stage proxy measures developed by DeAngelo et al. (2006) and the different proxy measures of tax avoidance. The coefficients show that RE/TA is significantly associated with our various tax avoidance measures ($p <$ .01), indicating that tax avoidance decreases as RE/TA increases. In the regression model, we use both RE/TA and RE/TA^2 to examine whether the association between life cycle stages and tax avoidance is curvilinear. The regression results show that the association is essentially concave, implying that as RE/TA increases, tax avoidance decreases at an increasing rate.[24]

As a further robustness check of our main regression results (see Table 5), we follow prior research and modify the life cycle measure of DeAngelo et al. (2006) by partitioning the sample into three life cycle stages (e.g. Al-Hadi, Hasan, & Habib, 2016; Owen & Yawson, 2010). In particular, young firms are those belonging to the cohort with the lowest one-third of RE/TA values (i.e. life cycle stage 1), mature firms are those belonging to the cohort with the middle one-third of RE/TA values (i.e. life cycle stage 2) and old firms are those belonging to the cohort with the top RE/TA values (i.e. life cycle stage 3).[25] As presented in Table 9, our regression results show that compared to mature and old firms, young firms engage in significantly more tax avoidance activities ($p <$ .05 or better). In brief, these additional findings broadly confirm our main regression results presented in Table 5.

[24]We also test the association between firm life cycle stage and tax avoidance using the alternative RE/TE life cycle stage proxy measure developed by DeAngelo et al. (2006). Results tabulated in the online supplemental material are fairly similar in scope to the RE/TA life cycle stage proxy measure results reported in Table 8.
[25]Specifically, a high RE/TA implies a mature or older firm with declining investments, whereas a low RE/TA firm tends to be in an early and growing stage of development (DeAngelo et al., 2006).

Table 9. Regression results – Alternative measure of DeAngelo et al.'s (2006) firm life cycle stages

	GAAP_ETR			DD_BT			SHELTER		
	FFE	FFE	FFE	FFE	FFE	FFE	FX LOGIT	FX LOGIT	FX LOGIT
Dependent variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Intercept	0.292***	0.264***	0.268***	0.240**	0.101***	0.669***	−0.097***	−0.069***	−0.043***
	(36.42)	(32.75)	(33.61)	(2.02)	(3.94)	(4.64)	(−5.51)	(−3.95)	(−2.59)
RETA_Bottom Cohort	−0.060***			0.099**			0.315***		
	(−15.28)			(2.28)			(4.67)		
RETA_Middle Cohort		0.010***			−0.014***			−0.262***	
		(4.48)			(−2.71)			(−5.85)	
RETA_Top Cohort			0.019***			−0.067**			0.073
			(7.98)			(−2.26)			(1.15)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
YEAR FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FIRM FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	65,796	65,796	65,796	46,170	46,170	46,170	30,658	30,658	30,658
Adj. R^2/ Pseudo R^2	0.589	0.584	0.585	0.167	0.179	0.189	0.408	0.408	0.478

Notes: Variable definitions: Refer to Appendix A; the sample size from Models 1–9 are different because of the use of alternative tax avoidance proxy measures; and control variables are omitted for the sake of brevity.

**Statistical significance at the 5% level (two-tailed tests).

***Statistical significance at the 1% level (two-tailed tests).

4.6.3. Cash flow types and tax avoidance

In our main regression model (see Equation (1)), we follow Dickinson (2011) and employ cash flow from operating, financing and investment activities to proxy for stages in a firm's life cycle. To gain a better understanding about which particular cash flow component has a dominant effect on tax avoidance, we re-run Model 1 (see Table 5) with respect to each of the cash flow items. We estimate the following regression model:

$$\begin{aligned} \text{GAAP\_ETR}_{it} = {} & \alpha_{0it} + \beta_1 \text{CFO\_D}_{it} + \beta_2 \text{CFF\_D}_{it} + \beta_3 \text{CFI\_D}_{it} + \beta_4 \text{CFO\_D*CFF\_D}_{it} \\ & + \beta_5 \text{CFO\_D*CFI\_D}_{it} + \beta_6 \text{CFF\_D*CFI\_D}_{it} + \beta_7 \text{CFO\_D*CFF\_D*CFI\_D}_{it} \\ & + \beta_{8-21} \text{CONTROLS}_{it} + \text{YEAR}_{\text{DUMMIES}} + \alpha_i + \varepsilon_{it}, \end{aligned} \tag{2}$$

where, CFO_D = a dummy variable, coded as 1 if cash flow from operating activities is positive, and 0 otherwise, CFF_D = a dummy variable, coded as 1 if cash flow from financing activities is positive, and 0 otherwise, CFI_D, = a dummy variable, coded as 1 if cash flow from investment activities is positive, and 0 otherwise, and CFO_D*CFI_D, CFF_D*CFI_D and CFO_D*CFF_D*CFI_D = the interaction terms between the various cash flow dummy variables.

Our regression results (tabulated in our online supplemental material) show that when we include each of the cash flow proxy measures individually in the regression model, CFO_D is positively associated with GAAP_ETR ($p < .01$), while CFF_D and CFI_D are negatively associated with GAAP_ETR ($p < .05$ or better). Further, when we incorporate the various interaction terms between these dummy variables in the regression model, we find that the interaction terms between CFO_D and CFF_D (CFO_D*CFF_D), and CFO_D and CFI_D (CDO_D*CFI_D) are positive and significant with respect to GAAP_ETR ($p < .05$ or better). Our results show the dominant role of CFO in affecting tax avoidance. In addition, the interaction term between CFF_D and CFI_D (CFF_D*CFI_D) is negative and significant in terms of GAAP_ETR ($p < .01$), showing that GAAP_ETR is negatively associated with (positive) cash flows from financing and investment activities. Overall, these regression results are consistent with our main regression results (see Table 5) in that the variation in the different cash flow patterns arising from operating, financing and investment activities help to explain tax avoidance.

4.6.4. Potential influence of the 2001 and 2008 macroeconomic crises

It is also possible that there could have been a substantial shift in a firm's life cycle stage progression because of the two large macroeconomic crises centered around the 2001 and 2008 years. Thus, as a final robustness check of our main regression results reported in Table 5, and after restricting our sample to firms which existed in the 1990 year, we plot the proportions of firms in the five life cycle stages of Dickinson (2011) for the 1990–2013 period.

Our results (tabulated in the online supplemental material) show that more firms move toward the later stages of the life cycle over time and that these results are not affected by the two large macroeconomic crises. Our results are thus consistent with Dickinson (2011). Finally, to obtain additional support that our main regression results are not affected by the two large macroeconomic crises centered around the 2001 and 2008 years, we repeat our regression analysis after excluding data pertaining to both the 2001 and 2008 years (at the same time) from our sample. Our regression results (tabulated in the online supplemental material) are qualitatively similar to the main regression results shown in Table 5.

5. Conclusion

This study examines the association between firm life cycle stages and corporate tax avoidance. We find that that tax avoidance is significantly positively associated with the introduction and decline stages and significantly negatively associated with the growth and mature stages using the shake-out stage as a benchmark. We also observe a U-shaped pattern in tax avoidance outcomes across the various life cycle stages according to the predictions of dynamic resource-based theory. Our results are consistent using several robustness checks. Overall, our results show that a firm's life cycle stage is a major determinant of tax avoidance.

This study contributes to the growing body of literature focusing on the accounting and financial implications of a firm's life cycle. It also extends the literature on the tax avoidance practices of firms with specific reference to firm life cycle stages. In fact, there is a lack of research about the significance of a firm's life cycle for tax avoidance with most studies in this area considering the level of tax avoidance at a given point in time without paying particular attention to how differences in a firm's operating, investing and financing activities across its life cycle affects its propensity to engage in tax avoidance. This study is one of the first to present detailed empirical evidence of the association between a firm's life cycle stages and tax avoidance. We also contribute to the extant literature on resource-based dependence theory that provides the underlying theoretical framework for our study.

Future research could empirically examine the associations between management strategy, effective resource use and a firm's life cycle. Differences in managerial economies of scale across a firm's life cycle stages are likely to have flow-on impacts for financial management and the efficiency of capital market operations. Future research could also investigate corporate governance structures (e.g. board and committee structures and composition) across a firm's life cycle stages as differences in resource availability, competiveness, risk levels, expertise and reputational concerns are likely to vary across those stages.

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Disclosure Statement

No potential conflict of interest was reported by the authors.

Supplemental Material

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References

Ahmed, K., & Jinan, M. (2011). The association between research and development expenditure and firm performance: Testing a life cycle hypothesis. *International Journal of Accounting, Auditing and Performance Evaluation*, *7*(4), 267–286.

Akhtar, S. (2012). Capital structure and business cycles. *Accounting and Finance*, *52*(s-1), 25–48.

Al-Hadi, A., Hasan, M. M., & Habib, A. (2016). Risk committee, firm life cycle, and market risk disclosures. *Corporate Governance: An International Review*, *24*(2), 145–170.

Anthony, J. H., & Ramesh, K. (1992). Association between accounting performance measures and stock prices: A test of the life cycle hypothesis. *Journal of Accounting and Economics*, *15*(2 and 3), 203–227.

Audretsch, D., & Feldman, M. (1996). Innovative clusters and firm life cycle. *Review of Industrial Organization*, *11*(2), 253–273.

Austin, C. R., & Wilson, R. J. (2013). *Are reputational costs a determinant of tax avoidance?* Working paper. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2216879

Ayers, B., Seidman, J. K., & Towery, E. (2015). *Taxpayer behavior under audit certainty*. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2609134

Barclay, M., & Smith, C. (2005). The capital structure puzzle: The evidence revisited. *Journal of Applied Corporate Finance*, *17*(1), 8–17.

Bhattacharya, N., Black, E., Christensen, T., & Mergenthaler, R. (2004). Empirical evidence on recent trends in pro forma reporting. *Accounting Horizons*, *18*(1), 27–43.

Black, E. (1998). Life-cycle impacts on the incremental value-relevance of earnings and cash flow measures. *Journal of Financial Statement Analysis*, *4*, 40–57.

Bradshaw, M., Drake, M., Myers, J., & Myers, L. (2012). A re-examination of analysts' superiority over time-series forecasts of annual earnings. *Review of Accounting Studies*, *17*(4), 944–968.

Brondolo, J. (2009). *Collecting taxes during an economic crisis: challenges and policy options*. IMF Staff Position Note (SPN/09/17), 1–38. Retrieved from www.imf.org/external/pubs/ft/spn/2009/spn0917.pdf

Cai, H., & Liu, Q. (2009). Competition and corporate tax avoidance: Evidence from Chinese industrial firms. *The Economic Journal*, *119*(537), 764–795.

Campello, M., Giambona, E., Graham, J., & Harvey, C. (2011). Liquidity management and corporate investment during a financial crisis. *Review of Financial Studies*, *24*(6), 1944–1979.

Chen, S., DeFond, M., & Park, C. (2002). Voluntary disclosure of balance sheet information in quarterly earnings announcements. *Journal of Accounting and Economics*, *33*(2), 229–251.

Chen, Z., Dhaliwal, D. S., & Xie, H. (2010). Regulation fair value disclosure and the cost of equity capital. *Review of Accounting Studies*, *15*(1), 106–144.

Chou, H.-I., Li, H., & Yin, X. (2010). The effects of financial distress and capital structure on the work effort of outside directors. *Journal of Empirical Finance*, *17*(3), 300–312.

DeAngelo, H., DeAngelo, L., & Stulz, R. M. (2006). Dividend policy and the earned/contributed capital mix: A test of the life-cycle theory. *Journal of Financial Economics*, *81*(2), 227–254.

Dechow, P. M., & Dichev, I. D. (2002). The quality of accruals and earnings: The role of accrual estimation errors. *The Accounting Review*, *77*(s-1), 35–59.

Dechow, P. M., Sloan, R. G., & Sweeney, A. P. (1995). Detecting earnings management. *The Accounting Review*, *70*(2), 193–225.

Demerjian, P., Lev, B., & McVay, S. (2012). Quantifying managerial ability: A new measure and validity tests. *Management Science*, *58*(7), 1229–1248.

Desai, M. A. (2003). The divergence between book and tax income. *Tax Policy and the Economy*, *17*, 169–206.

Desai, M. A., & Dharmapala, D. (2006). Corporate tax avoidance and high-powered incentives. *Journal of Financial Economics*, *79*(1), 145–179.

Diamond, D. W. (1991). Monitoring and reputation: The choice between bank loans and directly placed debt. *Journal of Political Economy*, *99*(4), 689–721.

Dickinson, V. (2011). Cash flow patterns as a proxy for firm life cycle. *The Accounting Review*, *86*(6), 1969–1994.

Drake, K. (2015). *Does firm life cycle explain the relation between book-tax differences and earnings persistence?* Working Paper. Retrieved from https://oatd.org/oatd/record?record=oai%5C%3Aarizonastate%5C%3A15021

Drobetz, W., Halling, M., & Schroder, H. (2015). *Corporate life-cycle dynamics of cash holdings*. Working Paper. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2578315

Dyreng, S., Hanlon, M., & Maydew, E. (2008). Long-run corporate tax avoidance. *The Accounting Review*, *83*(1), 61–82.

Dyreng, S., Hanlon, M., & Maydew, E. (2010). The effects of executives on corporate tax avoidance. *The Accounting Review*, *85*(4), 1163–1189.

Dyreng, S., Hoopes, J. L., & Wilde, J. H. (2015). *Public pressure and corporate tax behavior*. Working Paper. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2474346

Dyreng, S., & Lindsey, B. (2009). Using financial accounting data to examine the effect of foreign operations located in tax havens and other countries on U.S. multinational firms' tax rates. *Journal of Accounting Research*, *47*(5), 1283–1316.

Edwards, A., Schwab, C., & Shevlin, T. (2016). Financial constraints and cash tax savings. *The Accounting Review*, *91*(3), 859–881.

Fairfield, P. M., & Yohn, T. L. (2001). Using asset turnover and profit margin to forecast changes in profitability. *Review of Accounting Studies*, *6*(4), 371–385.
Filatotchev, I., Toms, S., & Wright, M. (2006). The firm's strategic dynamics and corporate governance life-cycle. *International Journal of Managerial Finance*, *2*(4), 256–279.
Financial Accounting Standards Board. (1987). *Statement of cash flows*. Norwalk, CT: Author.
Frank, M. M., Lynch, J. L., & Rego, S. O. (2009). Are financial and tax reporting aggressiveness reflective of broader corporate policies? *The Accounting Review*, *84*(2), 467–496.
Gort, M., & Klepper, S. (1982). Time paths in the diffusion of product innovations. *Economic Journal*, *92*(367), 630–653.
Graham, J. R., Hanlon, M., Shevlin, T., & Shroff, N. (2014). Incentives for tax planning and avoidance: Evidence from the field. *The Accounting Review*, *89*(3), 991–1023.
Graham, J. R., Raedy, J. S., & Shackelford, D. A. (2012). Research in accounting for income taxes. *Journal of Accounting and Economics*, *53*(1 and 2), 412–434.
Graham, J. R., & Tucker, A. (2006). Tax shelters and corporate debt policy. *Journal of Financial Economics*, *81*, 563–594.
Guedhami, O., & Pittman, J. (2008). The importance of IRS monitoring to debt pricing in private firms. *Journal of Financial Economics*, *90*(1), 38–58.
Gupta, S., & Newberry, K. (1997). Determinants of the variability in corporate effective tax rates: Evidence from longitudinal data. *Journal of Accounting and Public Policy*, *16*(1), 1–34.
Habib, A., & Hasan, M. M. (2015). Firm life cycle, corporate risk-taking and investor sentiment. *Accounting & Finance*. doi:10.1111/acfi.12141
Hanlon, M., & Heitzman, S. (2010). A review of tax research. *Journal of Accounting and Economics*, *50*(2 and 3), 127–178.
Hanlon, M., Hoopes, J. L., & Shroff, N. (2014). The effect of tax authority monitoring and enforcement on financial reporting quality. *The Journal of the American Taxation Association*, *36*(2), 137–170.
Hanlon, M., & Slemrod, J. (2009). What does tax aggressiveness signal? Evidence from stock price reactions to news about tax shelter involvement. *Journal of Public Economics*, *93*, 126–141.
Hasan, M. M., Hossain, M., Cheung, A., & Habib, A. (2015). Corporate life cycle and cost of equity capital. *Journal of Contemporary Accounting & Economics*, *11*(1), 46–60.
Helfat, C. E., & Peteraf, M. A. (2003). The dynamic resource-based view: Capabilities lifecycles. *Strategic Management Journal*, *24*, 997–1010.
Henry, E., & Sansing, R. C. (2014). *Data truncation bias and the mismeasurement of corporate tax avoidance*. Working Paper. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2329694
Higgins, D., Omer, T., & Phillips, J. (2015). The influence of a firm's business strategy on its tax aggressiveness. *Contemporary Accounting Research*, *32*(2), 674–702.
Hoi, C. K., Wu, Q., & Zhang, H. (2013). Is corporate social responsibility (CSR) associated with tax avoidance? Evidence from irresponsible CSR activities. *The Accounting Review*, *88*(6), 2025–2059.
Hoopes, J. L., Mescall, D., & Pittman, J. A. (2012). Do IRS audits deter corporate tax avoidance? *The Accounting Review*, *87*(5), 1603–1639.
Huseynov, F., & Klamm, B. K. (2012). Tax avoidance, tax management and corporate social responsibility. *Journal of Corporate Finance*, *18*(4), 804–827.
Javanovic, B. (1982). Selection and evolution of industry. *Econometrica*, *50*(3), 649–670.
Jenkins, D., Kane, G., & Velury, U. (2004). The impact of the corporate life-cycle on the value-relevance of disaggregated earnings components. *Review of Accounting and Finance*, *3*(4), 5–20.
Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics*, *3*(4), 305–360.
Kim, J.-B., Li, Y., & Zhang, L. (2011). Corporate tax avoidance and stock price crash risk: Firm-level analysis. *Journal of Financial Economics*, *100*(3), 639–662.
Koester, A., Shevlin, T., & Wangerin, D. (2013). *Does operational efficiency spill over onto the tax return?* Working Paper. Retrieved from http://areas.kenan-flagler.unc.edu/Accounting/TaxCenter/taxsym2014/Documents/Wangerin-KSW%2020131209.pdf
Lisowsky, P., Robinson, L., & Schmidt, A. (2013). Do publicly disclosed tax reserves tell us about privately disclosed tax shelter activity? *Journal of Accounting Research*, *51*(3), 583–629.
Manzon, G., & Plesko, G. (2002). The relation between financial and tax reporting measures of income. *Tax Law Review*, *55*, 175–214.
McGuire S. T., Omer, T., & Wang, D. (2012). Tax avoidance: Does tax-specific industry expertise make a difference? *The Accounting Review*, *87*(3): 975–1003.

McGuire, S. T., Omer, T., & Wilde, J. H. (2013). Investment opportunity sets, operating uncertainty, and capital market pressure: Determinants of investments in tax shelter activities. *The Journal of the American Taxation Association*, *36*(1), 1–26.

Miller, D., & Friesen, P. (1984). A longitudinal study of the corporate life cycle. *Management Science*, *30*(10), 1161–1183.

Mills, L. F., Erickson, M., & Maydew, E. L. (1998). Investments in tax planning. *Journal of the American Taxation Association*, *20*(Spring), 1–19.

Mueller, D. C. (1972). A life cycle theory of the firm. *The Journal of Industrial Economics*, *20*(3), 199–219.

Myers, S. C., & Majluf, N. S. (1984). Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics*, *13*(2), 187–221.

O'Connor, T., & Byrne, J. (2015). Governance and the corporate life-cycle. *International Journal of Managerial Finance*, *11*(1), 23–43.

Owen, S., & Yawson, A. (2010). Corporate life cycle and M&A activity. *Journal of Banking & Finance*, *34*(2), 427–440.

Poterba, J. M., Rao, N., & Seidman, J. (2011). Deferred tax positions and incentives for corporate behavior around corporate tax changes. *National Tax Journal*, *64*(1), 27–57.

Ramaswamy, V., Ueng, J. C., & Carl, L. (2007). Corporate governance characteristics of growth companies: An empirical study. *Academy of Accounting and Financial Studies*, *12*(1), 21–33.

Rego, S. O. (2003). Tax-avoidance activities of U.S. multinational corporations. *Contemporary Accounting Research*, *20*(4), 805–833.

Rego, S. O., & Wilson, R. (2012). Equity risk and corporate tax aggressiveness. *Journal of Accounting Research*, *50*(3), 775–810.

Richardson, G., Lanis, R., & Taylor, G. (2015). Financial distress, outside directors and corporate tax aggressiveness spanning the global financial crisis: An empirical analysis. *Journal of Banking and Finance*, *52*, 112–129.

Robinson, J. R., Sikes, S. A., & Weaver, C. D. (2010). Performance measurement of corporate tax departments. *The Accounting Review*, *85*(3), 1035–1064.

Robinson, J. R., Xue, Y., & Zhang, M. H. (2012). *Tax planning and financial expertise in the audit committee.* Working Paper. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2146003

Slemrod, J., & Wilson, J. D. (2009). Tax competition with parasitic tax havens. *Journal of Public Economics*, *93*(11 and 12), 1261–1270.

Spence, M. (1977). Entry, capacity, investment, and oligopolistic pricing. *Bell Journal of Economics*, *8*(2), 534–544.

Spence, M. (1979). Investment strategy and growth in a new market. *Bell Journal of Economics*, *10*(1), 1–19.

Spence, M. (1981). The learning curve and competition. *Bell Journal of Economics*, *12*(1), 49–70.

Stanfield, J. W. (2011). *Cash liquidity, holdings, and performance as determinants of corporate tax avoidance* (Unpublished thesis). Purdue University. Retrieved from http://docs.lib.purdue.edu/dissertations/AAI3481156/

Waegenaere, A. D., Sansing, R. C., & Wielhouwer, J. L. (2013). Multinational taxation and R&D investments. *The Accounting Review*, *87*(4), 1197–1217.

Wilson, R. J. (2009). An examination of corporate tax shelter participants. *The Accounting Review*, *84*(3), 969–999.

Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data* (2nd ed.). Cambridge, MA: MIT Press.

Young, C. S., & Huang, C. (2004). The association between firm life-cycle stage, assets portfolio, and firm's future performance. *Commerce and Management Quarterly*, *5*(1), 49–71.

Appendix A. Variable definitions and measurement

Variables		Definition and measurement
Dependent variable		
GAAP_ETR	=	Total tax expense divided by pre-tax book income less special items for firm i in year t. $GAAP\_ETR_{it}$ is set as missing when the denominator is zero or negative. We truncate $GAAP\_ETR_{it}$ to the range 0–1 (e.g. McGuire et al., 2012).
DD_BT	=	Desai and Dharmapala (2006) discretionary book–tax difference (DD_BT) for firm *i*, year *t*. DD_BT is equal to , from the following firm fixed effects regression: $BT_{it} = \beta_1 TA_{it} + \mu_i + \varepsilon_{it}$, where BT_{it} is the Manzon and Plesko (2002) book–tax difference measure (described below); TA_{it} is Dechow, Sloan, and Sweeney (1995) total accruals measure for firm *i* in year *t*, divided by the lagged value of assets; is the average value of the residual for firm *i* over the sample period; and ε_{it} is the deviation of the residual in year t from firm i's average residual. BT is defined as (US domestic financial income – US domestic taxable income – income taxes (state) – income taxes (other) – equity in earnings) divided by lagged assets. Firms with zero or negative taxable income are assumed to have attenuated incentives, at the margin, to engage in tax sheltering activity.
SHELTER	=	Wilson's (2009) sheltering probability equation is summarized as follows: $SHELTER\_PROB_{it} = -4.86 + 5.20 \times BTD_{it} + 4.08 \times DA_{it} - 0.41 \times LEV_{it} + 0.76 \times AT_{it} + 3.51 \times ROA_{it} + 1.72 \times FOREIGN\ INCOME_{it} + 2.43 \times R\&D_{it}$ where: $SHELTER\_PROB_{it}$ is the sheltering probability for firm i in year t, BTD_{it} is a book–tax difference measure as defined by Kim et al. (2011), DA_{it} is discretionary accruals from the performance-adjusted modified cross-sectional Jones Model, LEV_{it} is firm leverage, AT_{it} is the log of total assets for firm *i* in year *t*, ROA_{it} is return on assets, $FOREIGN\ INCOME_{it}$ is a dummy variable, coded as 1 for firm years that report foreign income and 0 otherwise, and $R\&D_{it}$ is research and development expense divided by total asset. Following Kim et al. (2011), we define BTD as book income less taxable income divided by lagged assets. Book income is pre-tax income in year *t*. Taxable income is calculated by summing current federal tax expense and current foreign tax expense and dividing by the statutory tax rate and then subtracting the change in NOL carry forwards in year *t*. If current federal tax expense is missing, total current tax expense is calculated by subtracting deferred taxes, state income taxes and other income taxes from total income taxes in year *t*. Following Rego and Wilson (2012), we rank $SHELTER\_PROB_{it}$ each year and create a dummy variable to capture those firms that have a high sheltering probability. $SHELTER_{it}$ is a dummy variable, coded as 1 if the firm's estimated sheltering probability is in the top quintile in that year, and 0 otherwise.
CASH_ETR	=	Cash tax paid divided by cash flow from operations for firm *i* in year *t*.
Δ/TA	=	Cash tax non-conformity, which is defined as the difference between a firm's cash taxes paid and its *prima facie* income tax expense on accounting profit divided by total assets as per Henry and Sansing (2014).
Firm life cycle proxy measures		
FLC_DUM	=	A vector of dummy variables which capture the different stages in a firm's life cycle as per the Dickinson (2011) model.
RE/TA	=	Retained earnings divided by total assets in accordance with the DeAngelo et al. (2006) model.
RE/TE	=	Retained earnings divided by total equity in line with the DeAngelo et al. (2006) model.
Firm cash flow proxy measures		
CFO_D	=	A dummy variable, coded as 1 if cash flow from operating activities is positive, and 0 otherwise.

(*Continued*)

Appendix A. Continued

Variables		Definition and measurement
CFF_D	=	A dummy variable, coded as 1 if cash flow from financing activities is positive, and 0 otherwise.
CFI_D	=	A dummy variable, coded as 1 if cash flow from investment activities is positive, and 0 otherwise.
Control variables		
SIZE	=	Natural log of the market value of equity for firm i at the beginning of year *t*.
MTB	=	Market-to-book ratio for firm *i*, at the beginning of year *t*, measured as market value of equity divided by book value of equity.
LEV	=	Leverage for firm *i*, year *t*, measured as long-term debt divided by lagged assets.
CASH	=	Cash holding for firm *i*, year *t*, defined as cash and marketable securities divided by lagged assets.
PROFIT	=	Profitability of the firm, measured as operating income divided by lagged assets.
NOL	=	A dummy variable, coded as 1 if the loss carry forward is positive at the beginning of the year *t*, and 0 otherwise.
ΔNOL	=	Change in loss carries forward for firm *i*, year *t*, divided by lagged assets.
FI	=	Foreign income for firm *i*, year *t*, divided by lagged assets. Missing values are set to zero.
PPE	=	Property, plant, and equipment for firm *i*, year *t*, divided by lagged assets.
INTANG	=	Intangible assets for firm *i*, year *t*, divided by lagged assets.
EQINC	=	Equity income in earnings for firm *i*, year *t*, divided by lagged assets.
R&D	=	Research and development expense ratio for firm *i*, year *t*, measured as research and development expense divided by lagged assets. Missing values are set to zero.
ΔSALES	=	Changes in sales divided by lagged sales for firm *i*, year *t*.
EMP	=	The natural logarithm of the number of employees for firm *i*, year *t*.
YEAR	=	A vector of dummy variables to control for year effects.
α_i	=	Firm specific unobserved fixed effects.
Additional control variables for a robustness check		
FINRQ	=	The financial reporting quality measure of Dechow and Dichev (2002).
MAS	=	The management ability score of Demerjian, Lev, and McVay (2012).