Using the Linear Cash Taxes Paid Model in Accounting Research: Developing a Tax Model That Permits the Inclusion of Loss-Years

Roy Clemons
New Mexico State University

Yan Zhang
New Mexico State University

Accounting tax researchers generally do not use a linear tax function to test for corporate tax avoidance. Stemming from the cash ETR function from Edwards, Kubata, and Shevlin (2021) we develop the linear cash taxes paid model where cash taxes paid are regressed on an intercept and pretax income. We find that U.S. MNEs achieve greater levels of tax avoidance with regards to taxes that are a function of current pretax income; whereas, U.S. domestic corporations achieve greater levels of tax avoidance with regards to taxes that are independent of current pretax income arising from book-tax differences. Overall, our findings complement the findings of Edwards et al. (2021), Lampenius, Shevlin, and Stenzel (2021), and answers the call for the inclusion of loss years when analyzing corporate tax avoidance (Hanlon and Heitzman 2010).

Keywords: effective tax rate, corporate tax avoidance, linear corporate tax function, multinationals, loss years, corporate taxation

INTRODUCTION

This paper investigates the difference in tax rate avoidance and tax base avoidance between U.S. multinationals (MNEs) and U.S. domestic corporations. An example of tax rate avoidance is a reduction in a U.S. MNE's tax burden due to its shifting of income from the U.S. to a foreign country with a low statutory tax rate (e.g., a tax haven); which is commonly referred to as base erosion and profit shifting (Dharmapala 2014). In contrast, an example of tax base avoidance, in the context of our study, refers to the reduction in explicit taxes by reducing taxable income in the United States. For example, tax base avoidance is commonly achieved by accelerating expenses and deferring income to reduce taxable income. Informed by recent research, we believe that U.S. MNEs will benefit from greater tax rate avoidance opportunities; while, U.S. domestic corporations will benefit more from tax base avoidance opportunities.

Dyreng et al. (2017), using the cash effective tax rate (*cash ETR*) to estimate corporate tax avoidance, surprisingly find that U.S. MNEs do not achieve greater levels of tax rate avoidance than their domestic counterparts. However, Edwards et al. (2021) provide theoretical and empirical evidence suggesting that a linear tax function is descriptive and conclude that *cash ETRs* can be nondiagnostic about corporate tax avoidance. We reexamine Dyreng et al.'s (2017) unexpected findings by using the linear tax paid model to measure tax avoidance, $TXPD = \alpha + \beta PI$, where cash taxes paid (*TXPD*) are regressed on an intercept and

pretax income (*PI*). The intercept, α, represents tax effects that are independent of pretax income (*PI*), and βPI represents tax effects that are directly associated with current pretax income.

We find the following when measuring corporate tax avoidance with the linear tax paid model. First, the intercept is negative and significant for U.S. domestic firms; on the other hand, the intercept is positive and significant for U.S. MNEs. Consistent with our hypotheses, the findings suggest that U.S. domestic firms have a tax base avoidance advantage. Second and consistent with our hypotheses, the slope coefficient for *PI* is significantly smaller for U.S. MNEs, suggesting that MNEs have a tax rate avoidance advantage over their domestic counterparts in both the positive current pretax income and negative current pretax income subsamples. In summary, the findings suggest that U.S. MNEs have a tax rate advantage, and U.S. domestic firms have a tax base advantage with regards to corporate tax avoidance.

The linear tax paid model provides several advantages over the *cash ETR* when estimating corporate tax avoidance. First, the linear tax paid model is an appropriate model specification for estimating the corporate tax function. Second, it allows a direct comparison of estimates that are unrelated to *PI* versus estimates that are a function of *PI*. Finally, the linear tax paid model is the modeling choice that provides a flexible framework that allows researchers to determine the impact of loss-years on the estimation of tax avoidance for U.S. corporations.

This study makes the following contributions to the corporate tax avoidance literature. First, we show that the linear tax paid model provides an easily interpretable measure of corporate tax avoidance that is meaningful for all firm-year observations. Second, our findings suggest that U.S. MNEs have a tax rate avoidance advantage over their domestic counterparts. Third, with regards to tax base avoidance, U.S. domestic corporations have an advantage over U.S. MNEs. Fourth, this study presents a parsimonious model which future studies may use to examine the effect of loss years on corporate tax avoidance. Finally, using the linear tax paid model, this study provides a plausible alternative explanation for Dyreng et al.'s (2017) unexpected finding that U.S. MNEs do not achieve greater levels of tax rate avoidance than U.S. domestic corporations.

The remainder of the study proceeds as follows. The second section provides a literature review, and the third section develops our hypotheses. The fourth section explains the research design, and the fifth section provides the sample selection and descriptive statistics. The sixth section reports our empirical analysis and results. The seventh section concludes.

LITERATURE REVIEW

Going back to Surrey (1973), the academic literature has a long history of using *ETRs* to measure corporate tax avoidance. Initially, the numerator of the *ETR* was usually either a firm's generally accepted accounting principles (GAAP) or current tax expense for financial reporting purposes, and the denominator was equal to a firm's pretax income (*See* Callihan (1994) for a review of the *ETR* literature). More recently, Dyreng et al. (2008) develop the *cash ETR* based on a firm's ability to pay a low amount of cash taxes per dollar of pretax income. Specifically, the authors use cash taxes paid instead of GAAP or current tax expense in the numerator of the *cash ETR*. Although the *cash ETR* is intuitively appealing and widely used, we discuss the empirical challenges associated with using it as a measure of corporate tax avoidance.

The requirements necessary to produce interpretable *cash ETRs* can create empirical issues when measuring corporate tax avoidance. Specifically, it is a ratio that can have either negative or positive values; furthermore, the ratio can also exceed one. For *cash ETRs*, negative values reflect either refunds in periods of pretax profitability or payments in periods of pretax losses. Values in excess of one suggest payments that exceed pretax income or refunds that exceed pretax losses. Therefore, to generate interpretable *cash ETRs*, researchers discard observations when pretax income is negative. Additionally, researchers limit the *cash ETR* to fall within the range of zero and one, generally arguing that *cash ETRs* below zero and above one lack economic meaning. Any results estimated using the remaining sample must be interpreted as results for the subset of firm years with *cash ETRs* between zero and one and are not, without further assumptions, applicable to the sample of all firm years.

Furthermore, until a recent study by Edwards et al. (2021), the underlying functional form of the *cash ETR* has received limited attention. Prior research, not common in the current literature, has discussed the potential empirical issues that exist when researchers assume a proportional corporate tax function. Wilkie (1988), Wilkie and Limberg (1990, 1993), Shevlin and Porter (1992), and Gupta and Newberry (1997) highlight the importance of controlling for changes in a firm's pretax income when investigating changes in *ETRs*. For example, Shevlin and Porter (1992) argue that "a major problem in using *ETRs* to assess the impact of tax rule changes is that they can vary across firms and time not only because of changes in tax laws but also because of changes in income if book-tax differences are not proportionally related to book income." Subsequently, Gupta and Newberry (1997) state that to the extent that book-tax differences are not proportional to income, *ETRs* can change simply because of changes in pretax income. We next demonstrate the empirical issues associated with assuming a proportional corporate tax function when using the *cash ETR*, as discussed in Edwards et al. (2021). The *cash ETR* equals *TXPD* scaled by *PI*:

$$cash\ ETR = TXPD / PI$$

Defining tax avoidance as a reduction in *TXPD* per dollar of *PI* assumes that the *cash ETR* is a proportional tax function (Dyreng et al. 2008, 2017; Dyreng and Lindsey 2009; Hanlon and Heitzman 2010). Alternatively stated, the underlying assumption is that all changes in *TXPD* are proportional to current income:

$$TXPD = \beta PI$$

However, under U.S. GAAP, temporary book-tax differences create timing differences representing changes in *TXPD* that are unrelated to current *PI*. Additionally, permanent differences not proportionally related to current *PI* can also affect *TXPD*. Given the inclusion of both temporary and permanent book-tax differences not proportional to current *PI* suggest a linear corporate tax paid function:

$$TXPD = \alpha + \beta PI$$

where the intercept, α, captures tax effects that are independent of the current period's *PI*, and the product of the slope coefficient and *PI*, βPI, captures tax effects that are directly associated with current pretax income. The slope coefficient represents the marginal tax payment due to an additional dollar of current period pretax income (Helpman and Sadka 1978; Romer 1975). Note, for the remainder of the paper, we will refer to the 'marginal tax payment' defined above, as simply the 'tax rate'. The extent to which temporary/permanent book-tax differences relate proportionally/linearly to pretax income is the empirical question examined by Edwards et al. (2021).

Dyreng et al. (2017) find a decreasing trend in *cash ETRs* over the past 25 years and interpret it as an increasing trend in U.S. corporate tax avoidance. Edwards et al. (2021) argue that *cash ETRs* can change over time simply because of increases in *PI* to the extent that *TXPD* do not relate proportionally to *PI*. To illustrate this point, assuming a linear corporate tax paid function, $TXPD = \alpha + \beta PI$, and dividing through by *PI* will lead to the following *cash ETR* function: $cash\ ETR = TXPD/PI = \alpha/PI + \beta$. Consistent with their expectations, Edwards et al. (2021) find that, to the extent that the coefficients α and β in the linear tax paid function are constant over time, decreases ($\alpha > 0$) or increases ($\alpha < 0$) in *cash ETRs* will be driven simply by the growth in *PI* and thus will be unrelated to firms' tax avoidance activities. The authors' findings suggest that ignoring the growth in *PI* on the magnitude of the *cash ETRs* can result in misleading inferences regarding the assessment of firms' tax avoidance behavior. Overall, the authors find that a linear corporate tax paid function is descriptive, and the authors' findings suggest that it is important to control for changes in *PI* when using the *cash ETR* to measure corporate tax avoidance.

HYPOTHESIS DEVELOPMENT

It is widely believed that U.S. MNEs are experiencing a growing income tax advantage over their domestic counterparts (Gravelle 2009; Levin and McCain 2013; McIntyre, Phillips, and Baxandall 2015). Academic tax research supports this notion and suggest three reasons for the MNEs growing income tax advantage: 1) increasing importance of intangible assets (Grubert and Slemrod 1998; Kleinbard 2011); 2) effective cross-border tax planning techniques of MNEs (De Simone, Klassen, and Seidman 2017; Klassen, Lisowsky, and Mescall 2017); and, 3) multiple tax strategies that are simply unavailable to purely domestic firms, including strategies involving aggressive transfer pricing, hybrid entities, cost-sharing agreements, intra-company debt agreements, and the deferral of offshore earnings (De Simone 2016; De Simone and Sansing 2018; Hopland, Lisowsky, Mardan, and Schindler 2018). Overall, the literature suggests that U.S. MNEs are experiencing greater income tax savings than their domestic counterparts.

Dyreng et al. (2017), in an extensive empirical analysis, find that U.S. MNEs do not have a tax rate advantage over U.S. domestic firms. However, Lampenius et al. (2021) develop an approach to decompose tax avoidance into two separate components; tax rate avoidance and tax base avoidance. Comparing U.S. MNEs and U.S. domestic firms, the authors find that MNEs rely on tax rate avoidance, and domestic firms rely on tax base avoidance. We agree with the findings of Lampenius et al (2021). Therefore, our study reexamines the Dyreng et al. (2017) study regarding the differing tax avoidance of U.S. MNEs and their domestic counterparts by testing the following hypotheses.

Given the aforementioned income shifting opportunities for U.S. MNEs, we test the following hypothesis, stated in the alternative:

H1: *Ceteris paribus, U.S. MNEs achieve greater levels of tax rate avoidance than their domestic counterparts.*

In contrast to tax rate avoidance, firms also engage in tax base avoidance. For example, all taxes are not proportionally related to the current period's pretax book income, and temporary book-tax differences create timing differences representing changes in cash taxes paid that are unrelated to current pretax income. Also, permanent differences not proportionally related to current pretax income can affect cash taxes paid. Common examples of tax base avoidance include the acceleration of expenses and the deferral of revenues to decrease taxable income (Lisowsky 2010). Also, a study by Drake et al. (2020) examines the trend in *ETRs* using the reconciling items between statutory and GAAP tax rates from corporations' tax footnotes. The authors find that releases of the valuation allowance can explain the declining time trend in *cash ETRs*, especially for domestic firms. Therefore, we test the following hypothesis, stated in the alternative:

H2: *Ceteris paribus, U.S. domestic corporations achieve greater levels of tax base avoidance than their multinational counterparts.*

RESEARCH DESIGN

Edwards et al. (2021) state that α and β have the same economic interpretation in both the linear cash taxes paid model, $TXPD = \alpha + \beta PI$, and in the cash ETR model, $cash\ ETR = \alpha\ (1/PI) + \beta$. Edwards et al. (2021) use the $Cash\ ETR = \alpha\ (1/PI) + \beta$ model in their study; whereas, we use the linear corporate tax paid model for our sample with positive *PI* in our study:

$$TXPD_{i,t} = \alpha + \beta Pos\_PI_{i,t} + \varepsilon_{i,t} \quad (1)$$

where $TXPD_{i,t}$ is cash taxes paid for firm *i* in year *t* and $Pos\_PI_{i,t}$ is positive pretax income for firm *i* in year *t*.

We use α and β to measure corporate tax avoidance; where α represents changes in taxes paid unrelated to pretax income, and β represents taxes paid as a function of pretax income. Furthermore, to test whether

U.S. MNEs have a tax rate advantage relative to their domestic counterparts, we include the incremental effects of MNEs in the model. Specifically, we use the following model for our sample with positive *PI*:

$$TXPD_{it} = \alpha + \alpha_1 MNE_{it} + \beta Pos\_PI_{it} + \beta_1 Pos\_PI_{it} * MNE_{it} + \varepsilon_{i,t} \quad (2)$$

where $TXPD_{i,t}$ is cash taxes paid for firm *i* in year *t*, $MNE_{i,t}$ is an indicator for multinational corporations in year t, and $Pos\_PI_{i,t}$ is positive pretax income for firm *i* in year *t*.

Including Loss Year Observations

When the *cash ETR* is used to measure corporate tax avoidance the required dropping of loss years from the sample results in a significant discarding of the overall population. The discarding of loss years is troublesome for two primary reasons. First, loss years represent over 32 percent (25,889/79,984) of the firm years in our sample, and the inability to study loss years introduces a significant limitation on researchers' ability to understand this subset of firms as noted by Hanlon and Heitzman (2010): "we do not have a very good understanding of loss firms, the utilization and value of tax-loss carryforwards, and how the existence of losses affects behavior (e.g., tax and accounting reporting and 'real' decisions) of any of the involved parties." Second, the non-random deletion of loss years based on the value of the dependent variable generates a data truncation bias that can generate misleading results (Teoh and Zhang 2011). For example, the findings of extant research suggest that the data truncation bias caused by dropping loss years can lead researchers to overestimate the level of corporate tax avoidance (Henry and Sansing 2019).

The linear corporate tax paid model provides an opportunity to address the preceding issues; because it is not subject to the discarding of loss years required when estimating *cash ETRs*. However, due to the asymmetric treatment of income and loss years, the model becomes nonlinear when loss years are included in the model. For example, prior literature illustrates that there is a kink in predicted taxes when pretax income is less than zero, and dropping loss years removes this nonlinearity (Brock et al. 2019). Alternatively stated, a linear function is the appropriate model specification when the *cash ETR* is used to measure tax avoidance on the positive *PI* subsample, but if loss years are included in the sample the correct model specification is nonlinear. However, although including loss years produces a nonlinear function, it is composed of two separate linear functions. Specifically, the model will be linear in positive *PI* and linear in negative *PI* as well. Therefore, to address the nonlinearity that exist when including loss years in the sample, we use piecewise linear regression when estimating the linear corporate tax paid function as follows:

$$TXPD_{it} = \alpha + \alpha_1 MNE_{it} + \beta Pos_{PI\,it} + \beta_1 Pos_{PI\,it} * MNE_{it} + \delta Neg_{PI\,it} + \delta_1 Neg\_PI_{it} * MNE_{it} + \varepsilon_{i,t} \quad (3)$$

where $TXPD_{i,t}$ is cash taxes paid for firm *i* in year *t*, $MNE_{i,t}$ is an indicator for multinational corporations in year t, $Pos\_PI_{i,t}$ is positive pretax income for firm *i* in year *t*, and $Neg\_PI_{i,t}$ is negative pretax income for firm *i* in year *t*.

SAMPLE SELECTION AND DESCRIPTIZE STATISTICS

Table 1 provides our sample selection criterion. Table 1 is presented in two subsamples: the sample excluding loss year (i.e., the Dyreng et al. 2017 sample) and the sample that includes loss years. To make our first sample comparable to Dyreng et al. (2017), we follow Dyreng et al. (2017)'s sample selection criteria. Specifically, we start with all U.S. incorporated nonfinancial, nonutility observations with assets greater than $10 million and non-missing pretax income (*PI*) from 1988 and 2012, resulting in 108,531 total observations. We also delete observations with missing control variable as in Dyreng et al. (2017) (7,698 firm-years), observations with missing *TXPD* (12,136 observations), observations with negative or zero *PI* (25,967 observations), and observations for firms with less than five observations available (8,637

observations). Our final sample of firms that excludes loss years contains 4,655 unique firms and 54,095 firm-year observations, which is very close to the Dyreng et al. (2017) sample size of 54,028 observations. When loss years are included, the sample contains 6,394 unique firms and 79,984 firm-year observations.

TABLE 1
SAMPLE SELECTION

	Excluding Loss Years		**Including Loss Years**	
Criteria	Firms	Firm-years	Firms	Firm-years
All US incorporated nonfinancial, nonutilities, Compustat observations between 1988 and 2012 with assets greater than $10 million and pretax income (*PI*) to be non-missing	12,206	108,531	12,206	108,531
Require non-missing values of control variables as in Dyreng et al. (2017)	11,591	100,833	11,591	100,833
Require cash tax paid (*TXPD*) to be non-missing	10,163	88,697	10,163	88,697
Require pretax income (*PI*) to be positive	8,558	62,730		
Require each firm to have at least five observations	4,655	54,095	6,394	79,984

Table 2 presents descriptive statistics for our sample of 79,984 firm-year observations. Panel A presents the univariate statistics for the sample excluding loss years and for the sample including loss years. For the sample, excluding loss years, in Panel A the mean for MNEs is 51%. The maximum pretax income (*PI*) is $103,051 million, and the maximum cash taxes paid (*TXPD*) is $33,941 million. When we include loss years, Panel A shows that the mean for *MNEs* is 48%. The minimum *PI* is -$56,494 million, and the minimum *TXPD* is -$1,883 million. Panel B presents descriptive statistics of multinational firms and domestic firms. Panel B shows that both *PI* and *TXPD* in our sample are significantly higher (p-value <0.01) for multinational firms (mean = $422 million for *PI*, mean = $113 million for *TXPD*) compared to domestic firms (mean = $79 million for *PI*, mean = $20 million for *TXPD)*.

TABLE 2
DESCRIPTIVE STATISTICS

Panel A: Entire Sample

Variable	**N**	**Mean**	**Std Dev**	**Minimum**	**25th Pctl**	**Median**	**75th Pctl**	**Maximum**
Excluding Loss Years								
MNE	54,095	0.51	0.5	0	0	1	1	1
PI	54,095	254.21	1,530.12	0	6.38	25.09	103.6	103,051
TXPD	54,095	67.46	464.58	-1,883	0.99	5.54	25.6	33,941
Including Loss Years								
MNE	79,984	0.48	0.49	0	0	0	1	1
PI	79,984	149.39	1314.05	-56,493.80	-0.90	8.01	51.93	103,051
TXPD	79,984	47.12	386.84	-1,883	0.16	2.26	14.2	33,941

Panel B: Multinational Firms and Domestic Firms

	MNE=0		MNE=1		
Variable	**N**	**Mean (1)**	**N**	**Mean (2)**	**Diff (1)-(2)**
Excluding Loss Years					
PI	26,482	78.90	27,613	422.34	-343.40***
TXPD	26,482	20.21	27,613	112.77	-92.56***
Including Loss Years					
PI	41,260	35.86	38,724	270.38	-234.52***
TXPD	41,260	13.09	38,724	83.38	-70.29***

Table 2 Panel A presents descriptive statistics for our samples of 54,095 firm-year observations. *MNE* is an indicator for multinational firm-years and is equal to one if the absolute value of pretax foreign income (*PIFO*) is greater than zero or if the absolute value of foreign tax expense (*TXFO*) is greater than zero. PI is pretax income. *TXPD* is cash taxes paid. Panel A shows the univariate statistics for the entire sample. Panel B presents descriptive statistics of for multinational firms and domestic firms.

EMPIRICAL RESULTS

Our analysis focuses on the tax avoidance differences between U.S. MNEs and domestic corporations. To test our hypotheses, we compare estimates using variants of the corporate tax paid model. **Table 3** displays coefficient estimates for models (1), (2), and (3) in Columns (1), (2), and (3), respectively. Column (1) is the base model used to compare our results to prior research. Column (2) estimates indicate differences between the change in predicted cash taxes paid for U.S. MNEs and domestic firms, and Column (3) incorporates loss years into the model from Column (2).

TABLE 3
RESULTS ON *TXPD* FUNCTION ESTIMATION

VARIABLES	Pred. Sign		(1) $TXPD_{it}$	(2) $TXPD_{it}$	(3) $TXPD_{it}$
Constant		α	1.090***	-0.614**	-0.445**
			(5.242)	(-2.065)	(-2.527)
MNE		α_1		2.713***	3.040***
				(6.473)	(11.913)
Positive_PI	(+)	β	0.255***	0.271***	0.274***
			(816.043)	(233.583)	(301.388)
*Positive_PI * MNE*	(-)	β_1		- .017***	-0.021***
				(-14.107)	(-22.228)
Negative_PI	(-)	δ			-0.003***
					(-3.203)
*Negative_PI * MNE*	(-)	δ_1			-0.018***
					(-18.168)
Observations			53,554	53,554	79,184
Adjusted R^2			0.926	0.926	0.930

***, **, * Indicate p<0.01, p<0.05, and p<0.1, two-tailed, respectively.
Column (1), (2), and (3) variables are truncated using Least Trimmed Squares (LTS). Column (1) and (2) are estimated using ordinary least squares; whereas, column (3) is estimated using piecewise linear regression.
Models:
Column (1): $TXPD_{it} = \alpha + \beta Pos\_PI_{it} + \varepsilon_{i,t}$
Column (2): $TXPD_{it} = \alpha + \alpha_1 MNE_{it} + \beta Pos\_PI_{it} + \beta_1 Pos\_PI_{it} * MNE_{it} + \varepsilon_{i,t}$
Column (3): $TXPD_{it} = \alpha + \alpha_1 MNE_{it} + \beta Pos\_PI_{it} + \beta_1 Pos\_PI_{it} * MNE_{it} + \delta Neg\_PI_{it} + \delta_1 Neg\_PI_{it} * MNE_{it} + \varepsilon_{i,t}$

Following Kraft et al. (2006), we perform robustness regressions using Least Trimmed Squares (LTS), in which we exclude the 1% of the sample with the largest squared residuals. In Column (1) and Column (2), we first exclude 1% of the sample (541 firm-year observations) with the largest squared residuals, and we then fit least squares to the remaining observations (53,554 firm-years); In Column (3) we first exclude 1% of the sample (800 firm-year observations) with the largest squared residuals, and we then fit least squares to the remaining observations (79,184 firm-years).

Table 3 Column (1) shows that α is positive and significant at a 1% level, indicating that firms with zero income are expected to pay $1,090,000 in taxes. The positive intercept is consistent with the findings of Edwards et al. (2021) and indicates that cash taxes paid are not simply proportionally related to pre-tax income. Consistent with prior research, β is positive and significant. The results indicate that each additional $1 of current pretax income (*PI*) increases expected cash taxes paid (*TXPD*) by $0.255, representing tax effects that are directly associated with current pretax income. Overall, the findings are consistent with prior research.

Table 3 Column (2) shows that α is negative and significant, indicating that domestic firms with zero income are expected to receive a tax refund of $614,000. On the other hand, α_1 is positive and significant indicating that MNEs with zero income are expected to pay $2,713,000 in taxes. The coefficient on β is positive and significant at a 1% level (β=0.271), indicating that each additional $1 of current pretax income increases expected cash taxes paid for domestic corporations by $0.271. β_1 is negative and significant at a 1% level (β_1= - 0.017*)*, indicating that MNEs have a tax rate advantage over their domestic counterparts. That is, each $1 of MNEs current pretax income increases expected cash taxes paid by $0.254=$0.271-$0.017. Alternatively stated, MNEs are expected to pay $0.017 less in cash taxes for each $1 of current pretax income relative to domestic corporations.

The above findings suggest the following inferences. First, α is negative and significant for domestic firms; however, α_1 is positive and significant for MNEs. Consistent with hypothesis two, the findings suggest that domestic firms have a tax base avoidance advantage over MNEs. Second and consistent with hypothesis one, β is significantly lower for MNEs suggesting that they have a tax rate advantage over their domestic counterparts. Overall, the findings suggest that MNEs have a tax rate avoidance advantage while domestic firms have a tax base avoidance advantage.

Table 3 Column (3) displays coefficient estimates for the least square estimators when indicators for loss-years and interactions are included as shown in model (3). It is important to note that the relationship between cash taxes paid and current pretax income is not unconditionally linear but piecewise linear when loss years are included; therefore, valid estimates of the tax-advantages of MNEs can only be estimated when nonlinear relationships in the data are correctly addressed. Therefore, we use a piecewise linear regression to estimate the coefficients using least squares on the full sample that includes loss-years.

Table 3 Column (3) shows that α is negative and significant, indicating that domestic firms with zero income are expected to receive a tax refund of $445,000. On the other hand, α_1 is positive and significant indicating that MNEs with zero income are expected to pay $3,040,000 in taxes. β is positive and significant. The results indicate that each additional $1 of current pretax income increases expected cash taxes paid for domestic corporations by $0.274. Consistent with our hypothesis, β_1 and δ_1 are negative and significant indicating that MNE have a tax rate advantage. Specifically, the tax rate for MNEs is $0.021 less for the positive current pretax income subsample and $0.018 less for the negative current pretax income subsample relative to domestic firms.

The above findings suggest the following inferences. First, α is negative and significant for domestic firms; however, α_1 is positive and significant for MNEs. Consistent with hypothesis two, the findings suggest that domestic firms have a tax base avoidance advantage over MNEs. Second, consistent with our hypothesis one, β is significantly lower for MNEs, suggesting that MNEs have a tax rate advantage over their domestic counterparts in both the positive current pretax income and negative current pretax income subsamples. Overall, when loss-years are included, the findings suggest that MNEs have a tax rate avoidance advantage in both income and loss years, and domestic firms have a tax base avoidance advantage.

CONCLUSION

Informed by recent research, this study utilizes the linear tax paid model to measure corporate tax avoidance. The findings of this study suggest that the linear tax paid function is an appropriate functional form to use when measuring corporate tax avoidance, and this study makes the following contributions to the literature. First, the linear tax paid model provides an intuitively appealing measure of corporate tax avoidance that is meaningful for all firm year observations. Second, the findings suggest that U.S. MNEs have a tax rate avoidance advantage over U.S. domestic firms. Third, the findings also suggest that U.S. domestic corporations have a tax base avoidance advantage over their multinational counterparts. Fourth, this study presents a parsimonious model which future researchers may employ to examine the effect of loss years on corporate tax avoidance. Additionally, this study provides a plausible alternative explanation for Dyreng et al.'s (2017) unexpected finding that U.S. MNEs do not achieve greater levels of tax rate avoidance than their domestic counterparts.

ACKNOWLEDGEMENT

We thank Lisa De Simone, Terry Shevlin, and Anup Srivastava for reading earlier versions of our paper. We are grateful to the University of California, Irvine tax reading group for evaluating a version of our paper and for providing helpful suggestions. We greatly appreciate Andrew Leone, Miguel Minutti-Meza, and Ben Jann for their help with Stata Code to run our regression analysis. We also thank participants at the American Taxation Association midyear meeting and participants at the National Tax Association Annual Conference on Taxation. Finally, we appreciate the useful comments provided by Steven Utke.

REFERENCES

Brock, N., Clemons, R., & Nowak, A. (2019). Estimating corporate tax avoidance with accounting data. *Tax Notes*, *162*(8), 887–897.

Callihan, D. (1994). Corporate effective tax rates: A synthesis of the literature. *Journal of Accounting Literature*, *13*, 1–43.

De Simone, L. (2016). Does a common set of accounting standards affect tax- motivated income shifting for multinational firms? *Journal of Accounting & Economics*, *61*(1), 145–165.

De Simone, L., & Sansing, R.C. (2019). Income shifting using a cost-sharing arrangement. *The Journal of the American Taxation Association*, *41*(1), 123–136.

De Simone, L., Klassen, K., & Seidman, J. (2017). Unprofitable affiliates and income shifting behavior. *The Accounting Review*, *92*(3), 113–136.

Dharmapala, D. (2014). What do we know about base erosion and profit shifting? A review of the empirical literature. *Fisc. Stud.*, *35*, 421–448.

Drake, K., Hamilton, R., & Lusch, S.J. (2020). Are declining effective tax rates indicative of tax avoidance? Insight from effective tax rate reconciliations. *Journal of Accounting and Economics*, *70*(1), 101317.

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

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.

Dyreng, S., Hanlon, M., Maydew, E., & Thornock, J. (2017). Changes in corporateeffective tax rates over the past 25 years. *Journal of Financial Economics*, *124*(3), 441–463.

Edward, A., Kubata, A., & Shevlin, T. (2021). The decreasing trend in cash effective tax rates: The role of growth in pre-tax income. *The Accounting Review*, *96*(5), 233–261.

Gravelle, J. (2009). Tax havens: International tax avoidance and evasion. *National Tax Journal*, pp. 727–753.

Grubert, H., & Slemrod, J. (1998). The effect of taxes on investment and income shifting to Puerto Rico. *Review of Economics and Statistics*, *80*(3), 365–373.
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.
Hanlon, M., & Heitzman, S. (2010). A review of tax research. *Journal of Accounting and Economics*, *50*, 127–178.
Helpman, E., & Sadka, E. (1978). The optimal income tax. *Journal of Public Economics*, *9*, 383–393.
Henry, E., & Sansing, R. (2019). Corporate tax avoidance: data truncation and loss firms. *Rev Account Stud*, *23*, 1042–1070.
Hopland, A., Lisowsky, P., Mardan, M., & Schindler, D. (2018). Flexibility in income shifting under losses. *The Accounting Review*, *93*(3), 163–183.
Klassen, K., Lisowsky, P., & Mescall, D. (2017). Transfer pricing: Strategies, practices, and tax minimization. *Contemporary Accounting Research*, *34*(1), 455–493.
Kleinbard, E. (2011). Stateless income. *Florida Tax Review*, *11*, 699.
Kraft, A., Leone, A., & Wasley, C. (2006). An analysis of the theories and explanations offered for the mispricing of accruals and accrual components. *Journal of Accounting Research*, *44*(2), 297–339.
Lampenius, N., Shevlin, T., & Stenzel, A. (2021). Measuring corporate tax rate and tax base avoidance of U.S. domestic and U.S. multinational firms. *Journal of Accounting and Economics*, *72*(1).
Levin, C., & McCain, J. (2013). *Offshore profit shifting and the U.S. tax code part 2 (Apple Inc.)*. Memorandum (May 21). Washington, DC: U.S. Congress Permanent Subcommittee on Investigations.
Lisowsky, P. (2010). Seeking shelter: Empirically modeling tax shelters using financial statement information. *The Accounting Review*, *85*, 1693–1720. https://doi.org/10.2308/accr.2010.85.5.1693
McIntyre, R.S., Phillips, R., & Baxandall, P. (2015). *Offshore shell games 2015. The use of offshore tax havens by fortune 500 companies*. Washington, DC: U.S. Public Interest Research Group Education Fund and Citizens for Tax Justice.
Romer, T. (1975). Individual welfare, majority voting, and the properties of a linear income tax. *Journal of Public Economics*, *4*, 163–185.
Shevlin, T., & Porter, S. (1992). The corporate tax comeback in 1987: Some further evidence. *Journal of the American Taxation Association*, *14*(1), 58–79.
Surrey, S. (1973). *Pathways to Tax Reform*. Cambridge, MA: Harvard University Press.
Teoh, S., & Zhang, Y. (2011). Data truncation bias, loss firms, and accounting anomalies. *The Accounting Review*, *86*(4), 1445–1475.
Wilkie, P. (1988). Corporate average effective tax rates and inferences about relative tax preferences. *The Journal of the American Taxation Association*, pp. 75–88.
Wilkie, P., & Limberg, S. (1990). The relationship between firm size and effective tax rate: A reconciliation of Zimmerman [1983] and Porcano [1986]. *Journal of the American Taxation Association*, *11*, 76–91.
Wilkie, P., & Limberg, S. (1993). Measuring explicit tax (dis) advantage for corporate taxpayers: An alternative to average effective tax rates. *Journal of the American Taxation Association*, *15*, 46–71.