Net Operating Loss Carryforwards and Corporate Savings Policies

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Abstract

We examine the relation between tax net operating loss (NOL) carryforwards and corporate cash holdings. Corporate taxation of passive income increases the cost of holding liquid assets ("cash"), but NOLs can shield that income from tax. We test whether NOLs are associated with greater levels of cash. We develop a new proxy for worldwide NOL benefits from footnote disclosures that more precisely captures their worldwide value and demonstrate our proxy's superiority over common alternatives. Our empirical evidence suggests that that NOLs lead to greater cash holdings, mitigate the impact of repatriation taxes on cash holdings, and increase investor valuation of cash. Our paper provides new evidence of how corporate financial policies respond to taxation, considers interactions with other tax explanations, and demonstrates the value of proper NOL measurement.

Keywords: Net Operating Losses, Taxes, Debt, Equity, Cash

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1. Introduction

This paper studies the effects of NOL carryforwards (also referred to as "tax loss carryforwards" or "NOLs") on firms' savings policies. A central question in corporate finance is whether firms build liquidity reserves for precautionary reasons, such as in anticipation of high external financing costs or cash flow uncertainty (Opler, Pinkowitz, Stulz and Williamson 1999). While savings provide firms with necessary liquidity reserves, firms may incur taxes on returns earned on accumulated cash (Riddick and Whited 2009); thus, it is generally more tax-efficient for firms to distribute excess cash to shareholders than to generate passive investment income subject to double taxation (Smith and Warner 1979; Duchin, Gilbert, Harford, Hrdlicka 2017). An NOL carryforward directly lowers the tax cost of corporate savings by absorbing and reducing income otherwise subject to corporate tax. In this paper, we examine whether and to what extent NOL tax benefits are associated with greater cash holdings.

Economic theory predicts a role for these tax shields in firm savings decisions. For example, Riddick and Whited (2009) model these decisions and discuss how firms face a dynamic trade-off between taxes due on income earned from corporate savings versus external financing costs. By extension, managers should prefer corporate savings when NOLs absorb this tax cost. Despite this prediction and the extensive focus on firms' savings decisions in the corporate finance literature (Foley, Hartzell, Titman, and Twite 2007; Riddick and Whited 2009; Duchin et al. 2017), there is no empirical evidence of such relation. This is surprising given how economically significant NOLs are to firms and the government: in 2012, aggregate unused NOL carryforwards for U.S. corporations approached $2 *trillion* at the federal level alone (Treasury Inspector General for Tax Administration 2015), potentially reducing future U.S. corporate tax revenues by $700 billion

(using the 35% corporate tax rate in effect at that time).[1] The lack of evidence may be attributed to an assumption in prior literature that a relatively low proportion of firms report tax losses. However, using detail from the financial statements, we find that almost 90% of large U.S. public firms disclose NOL carryforwards in at least one jurisdiction (federal, state, or foreign), a seven-fold increase over the 13% rate between 1981 and 1995 (Auerbach and Poterba 1987; Mills, Newberry, and Novack 2003). We empirically demonstrate the relevance of NOLs in these important corporate savings decisions for a large and economically significant group of firms.

Although theory motivates the prediction that firm cash holdings are increasing in NOLs, there are several reasons that we may not find the expected relation. First, managers may simply ignore the tax consequences, possibly because the perceived tax savings are minimal. In this case, we would observe little to no relation between cash policies and measures of a firm's taxable status. Second, even if taxes are considered, other components of the tax system such as repatriation taxes (Foley et al., 2007) and uncertain tax benefits (Hanlon, Maydew, and Saavedra 2017) could dominate the importance of NOLs in firms' cash holdings decisions. Third, we may be unable to detect important variation in managers' assessments of firm NOLs, including the impact of statutory limitations and the allocation of taxable losses across jurisdictions. While we advance the measurement of NOL benefits to incorporate these features, we cannot perfectly observe a manager's private valuation of this tax asset. Consequently, the relation between savings policies and NOLs is an open empirical question.

We first examine the relation between NOLs and firm savings using worldwide measures of cash holdings and tax losses. Aside from studies that use proprietary IRS data (Graham and Mills

[1] By comparison, federal corporate income tax revenues averaged $240 billion per year between 2009 and 2015 (Office of Management and Budget, Historical Tables, Table 2.1).

2008; Cooper and Knittel 2010), prior research typically uses a readily-available but imperfect proxy from Compustat—data item *tlcf*—to measure tax losses (MacKie-Mason 1990; Graham 1996b; Plesko 2003).[2] Given concerns about the validity of this measure (Mills et al. 2003), we build a comprehensive panel of NOL carryforward data for a sample of large U.S. firms (S&P 1500) from 2010 through 2015 by collecting information on the magnitudes and jurisdictions of firms' NOL carryforwards from their financial statements. We then use these data to construct a measure of the expected tax benefits from utilization of these losses (the "NOL benefit").

We show that Compustat's *tlcf* has three shortcomings of importance to empirical researchers. First, it inaccurately captures a firm's tax status because it fails to identify the presence of NOLs in one out of four firm-years. Specifically, we identify 89 percent of the observations in our sample with an NOL carryforward, compared to just 67 percent based on Compustat. For the firms that Compustat fails to identify as having NOLs, we estimate NOL tax benefits averaging $213 million. Second, conditional on correctly identifying the existence of a tax loss, Compustat data fail to capture the accurate balance of carryforwards. We estimate gross NOL carryforwards approximately 28 percent larger than Compustat ($838.0 million of NOLs using our data as compared to $657.1 million using *tlcf*). Finally, Compustat data ignore the distinction in expected cash values arising from differences in tax rates, summing jurisdiction-specific pre-tax amounts into a single reported tax loss carryforward. For example, Compustat treats a firm with one dollar each of federal, state, and foreign NOLs as having three dollars in total NOLs, even though firms do not generate NOLs in constant proportions across geographical boundaries. Furthermore, the

[2] MacKie-Mason (1990), Graham (1996b), and Plesko (2003) acknowledge shortcomings of the Compustat variable, and Auerbach and Poterba (1987) and Mills et al. (2003) highlight the importance of jurisdictional detail that is not observed with the Compustat measure. Despite these shortcomings, over thirty papers have been published in top accounting journals since 2010 that use *tlcf* as an input to measure tax loss status (see Appendix A).

expected tax benefits depend on each jurisdiction's tax rate. Appendix B provides descriptive information to compare our measure to the Compustat-based one.

To address these issues, we derive an estimate of the undiscounted NOL value that weights each dollar of a firm's NOL carryforward by an estimated statutory tax rate for the jurisdiction in which the tax loss was generated. The "NOL benefit" proxy we construct is the undiscounted potential cash tax savings from existing NOLs carryforwards, applying location-specific tax rates, and scaled by total assets. We validate the NOL benefit measure by demonstrating that it correctly explains reductions in future cash taxes. Further, we show that it significantly outperforms a *tlcf*-based proxy.

To test our primary research question, we regress a measure of worldwide cash and cash equivalents on the NOL benefit measure and control variables that capture other determinants of a firm's cash holdings, including investment spending, payout obligations, and external financing activity. The results are consistent with our predictions: corporate cash holdings (cash and short-term investments) are increasing in the firm's NOL benefits. An increase in NOL benefits of 1% of total assets is associated with a 0.12% change in the cash-to-assets ratio. We also re-estimate the effects among domestic-only firms to more directly tie the effect of domestic tax losses on domestic cash holdings, thereby mitigating concerns that the effects are driven by other features of multinational firms. Among the subsample of domestic-only firms, we confirm the positive association and observe an even larger effect: an increase in NOL benefits of 1% of total assets is associated with a 0.21% change in the cash-to-assets ratio for this sub-sample.

We find that the positive association holds after controlling for other known tax factors that are associated with greater cash holdings, including repatriation taxes (Foley et al., 2007) and reserves for uncertain tax positions (Hanlon et al. 2017). In additional tests, we study the

interaction between NOLs and repatriation taxes in explaining cash holdings. The assertion that repatriation taxes lead to greater cash holdings is contingent on the firm facing incremental US taxes when earnings are repatriated from foreign subsidiaries (Foley et al. 2007). Indeed, among the sample of firms without NOLs, we observe the strong positive association between repatriation taxes and cash holdings as demonstrated by the prior literature. However, domestic NOLs should mitigate the trapped foreign cash problem by absorbing income associated with repatriated foreign cash. We find evidence consistent with this prediction; as a firm's NOLs increase, the sensitivity of cash holdings to repatriation taxes declines significantly. Further decomposition of the NOL benefit measure into its domestic and foreign components confirms that this attenuation is (as expected) attributable to domestic NOLs. This empirical result augments prior discussion that firms forego use of their NOL to absorb income associated with repatriations (Graham, Hanlon, and Shevlin 2010) and provides a possible explanation as to why approximately 30% of multinational firms repatriate each year despite the expected tax cost (Desai, Foley, and Hines 2001 and 2007).

We then study whether the presence of NOLs affects investors' responses to the increased cash holdings. If the positive sensitivity of cash holdings to NOL tax benefits is driven by higher after-tax returns on corporate investment income, investors' valuation of those cash holdings should also be increasing in NOL benefits. We test this prediction using the valuation-of-cash framework from Faulkender and Wang (2006). Specifically, we regress annual excess stock returns on the annual change in cash, the NOL benefit, and the interaction between them. Consistent with our expectations, we find that the coefficient on the change in cash is increasing in NOL benefits. The results confirm that investors place a significantly higher value on corporate liquidity when NOL carryforwards shield the income generated on these liquid assets from taxation. In an additional

test, we find evidence suggesting that NOL tax benefits cause managers to build these cash reserves from the proceeds of debt and equity issuances and from asset sales.

Finally, we examine whether alternative, more readily-available proxies would have produced similar results to those reported in this paper. We replace our NOL benefit proxy with one based on the Compustat *tlcf* measure, one based on simulated NOLs as in Blouin, Core, and Guay (2010), and the Graham (1996a) estimated after-tax marginal tax rate measure. Although none of these measures performs as well or consistently as ours, the *tlcf*- and simulation-based NOLs do explain some of the variation in cash holdings and valuation, but only within a smaller subsample of firms. The after-tax marginal tax rate, despite being an explicit estimate of the tax cost on the next dollar income, is unable to explain cash holdings or valuation. This appears consistent with survey evidence in Graham, Hanlon, Shevlin, and Shroff (2017) that managers rely more on simple heuristics for tax status (such as NOLs) rather than more sophisticated simulations.

Our study contributes to the literature in several ways. First, we consider a cost of cash holdings that has been explicitly suggested, but previously untested, by prior literature. In so doing, we add to the literature studying NOLs, which has primarily focused on studying actions taken to preserve the value of tax losses (Maydew 1997; Erickson and Heitzman 2010; Erickson, Heitzman, and Zhang 2013; Sikes, Tian, and Wilson 2014) and testing the role of NOLs in firm investment decisions (Devereux, Keen, and Schiantarelli 1994; Edgerton 2010; Langenmayr and Lester 2018). We demonstrate the role of these important tax assets in firms' savings and liquidity decisions.

Second, we address criticisms of the Compustat-based proxy for NOL carryforwards by showing that a measure that comprehensively identifies the tax benefits from *worldwide* NOL carryforwards, using data disclosed in firms' financial statements, better captures a firm's available tax loss shields. We accurately identify NOLs firms and further demonstrate the determinants and

characteristics of firms reporting these losses. Our NOL-based measure of tax benefits is a simpler and more direct heuristic of tax status that captures rich variation across firms; further, it does not require projections of future taxable income that may produce conflicting conclusions about a firm's future tax status (Graham 2000; Blouin et al. 2010). As such, it is more appropriately geared toward examining short-run corporate policy decisions and investor responses to those decisions.

Finally, this paper informs policy makers about the possible effects of changes in NOL policies. Prior to 2017, U.S. tax policies changed three times in 16 years to permit more generous tax loss offsets (Dobridge 2016). This trend reversed in 2017. The Tax Cuts and Jobs Act eliminates the option to carry back a tax loss for an immediate refund, limits the utilization of new NOL carryforwards to 80% of taxable income, and provides for an indefinite carryforward period. These changes should increase the incidence and magnitude of NOL carryforwards. However, because the value of an NOL carryforward also depends on the expected statutory tax rate, the reduction in the corporate tax rate decreases the government's expected revenue loss upon utilization of these tax losses. Early evidence of an NOL-based wealth transfer is suggested by the market reactions to the 2016 election and tax reform (Wagner, Zeckhauser, and Ziegler 2018). A more focused approach that exploits the rich information used here should provide researchers future opportunities to inform the discussion over corporate tax policies and NOLs in particular.

2. Sample, Descriptive Statistics, and Validation of NOL Benefit Proxy

2.1 Sample

Because our data must be hand-collected from the financial statement footnotes, we focus our sample selection on large, publicly-traded, U.S.-headquartered firms. We first sort all listed firms in Compustat based on an annual composite ranking of assets, sales, and market value of equity. We identify the largest 1,500 firms based on this ranking in any year between 2010 and 2015 for

a sample of 1,958 distinct firms. Using the tax footnote, we hand-collect data in every available year of our sample period, yielding an initial sample of 9,910 firm-years. We drop all regulated and financial firms (2,302 observations), as these firms are subject to different rules that may affect financing decisions and the calculation of taxable income, and we retain observations with sufficient accounting and market data. These steps result in a final sample of 6,884 firm-year observations, representing 1,410 distinct firms. Of this sample, we calculate a positive NOL benefit for 6,120 (88.9%) of the firm-year observations.

2.2 Construction of the NOL tax benefit measure

Our NOL benefit measure is a tax rate-weighted measure of NOL carryforwards. We capture gross carryforwards from the footnote disclosures (the pretax loss available to offset future income) and weight them using jurisdiction-specific tax rates based on the source of the NOL and an assumed tax rate based on sample characteristics. When gross carryforwards are not available, we rely on the deferred tax asset disclosures that are already adjusted for the tax rate. The resulting measure is then scaled by total assets. Appendix B provides a detailed description of this approach and a discussion of why we prioritize the gross carryforward over the deferred tax asset in estimating NOL benefits.[3]

Table 1, Panel A reports the average (median) unscaled NOL benefit for the 6,120 firm-years of $190.6 ($39.4) million, meaning that the average (median) firm could save $190.6 ($39.4) million in cash taxes by utilizing all of the firm's NOLs. For the subset of firms with jurisdiction-specific data, we find average federal, state, and foreign NOL benefits of $99.0 million, $18.0

[3] This methodology has three key advantages relative to using a *tlcf*-based measure, as seen in the Appendix B tables. First, it allows us to identify NOLs for approximately 20% of our sample that Compustat treats as having no tax losses (see Table B1, Panel A). Second, it exploits variation in the location of the NOL in determining the applicable tax rates, which is a key determinant of the NOL's realizable cash value (see Table B1, Panel B). Third, it incorporates a number of different data components on tax losses, ranging from specific dollar amounts for total losses disclosed by some firms to NOL deferred tax asset information (see Table B1, Panel C).

million, and $62.9 million, respectively.

Table 1, Panel B presents the trends in NOL benefits for a balanced panel of 770 firms with data available in every year of the sample period. We find that the unscaled dollar value of the NOL benefit is increasing over time. The NOL benefit is equivalent to approximately 2.2% to 2.5% of a firm's total assets, with the federal loss responsible for the majority of this tax asset. The scaled NOL benefit is slightly declining over the six-year window, attributable to faster growth in the book value of assets (the denominator) relative to the increase in NOLs.

Panel C presents the incidence and level of NOL benefits, relative to book assets, in the industries with the highest and lowest proportion of tax loss firms. Using Fama and French 48 industry definitions, we find that tax losses are most prevalent in the Communications, Pharmaceutical, Automotive, Computers, and Electronic Equipment industries – all of which are R&D and investment-intensive. The NOL benefits for these industries average 5.0 to 6.7 percent of total assets. In contrast, firms reporting the lowest level of NOL benefits are in Retail and Service industries. The relative under-reporting of NOLs within Compustat is observed across all of these industries, as seen by comparing percentages across the second and third columns.

2.3 Descriptive statistics

Table 2 provides descriptive statistics for the variables used in the empirical tests. We first present the average values for the full sample of 6,884 firm-years, followed by averages for each of five groups formed by sorting observations on levels of NOL benefits. The first group includes 764 firm-years with no evidence of NOL carryforwards in the financial statement footnotes. The remaining 6,120 observations are sorted into quartiles based on the amount of NOL benefits. By construction, NOL benefits are increasing across the quartiles, from 0.2 percent of assets in the bottom quartile to 11.0 percent of assets in the top quartile. Federal (state, foreign) tax losses

average 8.0 percent (0.9 percent, 1.7 percent) of total assets in the highest quartile, with 85.8% of the firms in this quartile providing these jurisdiction-specific details.

We also collected data on important statutory limitations (Section 382 of the Internal Revenue Code) and valuation allowances that suggest that some firms will be unable to fully use their tax losses.[4] The proportion of firms disclosing that their U.S. federal losses are subject to a statutory limitation under Internal Revenue Code Section 382 is increasing monotonically up to 36.5% in the top quartile. The valuation allowance is relatively flat: between 59% and 67% of firms with NOLs disclose a valuation allowance at least 50% of the firm's total deferred tax assets. These statistics demonstrate important variation in actual and expected utilization of tax losses that is otherwise undetected using the Compustat *tlcf* measure.

We report the incidence and amount of tax losses using a Compustat-based measure calculated as *tlcf**0.23, where 0.23 is determined based on sample descriptive statistics in Appendix B. Approximately 67.4 percent of the sample report a positive value in Compustat data item *tlcf*. A comparison to the 88.9% incidence of tax losses above demonstrates that Compustat fails to identify one-fourth of large firms that have net operating losses.[5]

[4] The statutory limitation is designed to eliminate "trafficking" in NOLs by discouraging profitable firms from acquiring NOL firms only for their tax benefits. Specifically, Section 382 of the U.S. Internal Revenue Code states that if ownership by 5 percent shareholders changes by more than 50 percent within a three-year period, the amount of U.S. federal NOLs that can be used in any given year is limited. This annual limitation is equal to the product of the firm's value (thus, for public firms, their market capitalization) and the long-term federal tax-exempt rate published monthly by the IRS. For example, assume an average firm in the sample with market capitalization of $10.8 billion (Table 2) and total tax losses of $820 million (Table B1, Panel B). If the firm is not subject to the statutory limitation, it could use the full $820 million to offset taxable income in future years. However, if the statutory limitation was triggered, the firm would be limited to using $271.1 million per year based on the January 2019 published long-term tax exempt rate of 2.51% ($10.8 billion x .0251 = $271.1 million). Some states and foreign countries also impose a limitation similar to Section 382.

[5] Mills et al. (2003) find that 3.3 percent of their sample exhibit classification error attributable to Compustat not reporting the existence of a tax loss. Their analyses compare Compustat data to federal losses reported on U.S. income tax returns between 1981 and 1995. Using a random sample of 1,050 observations between 1994 and 2014, Christensen, Kenchington, and Laux (2018) find that 31 percent of their sample exhibit classification error based on comparison of Compustat to the footnote disclosures.

Figure 1 depicts the potential measurement differences between our NOL benefit measure and one constructed from Compustat *tlcf*. First, we sort firms based on the ratio of *tlcf* to total assets and present the comparable Compustat NOL benefit range (5th to 95th percentile) for each group in the shaded boxes. By construction, these ranges do not overlap across quantiles. The corresponding dark lines represent the range (5th to 95th percentile) of our NOL benefit measure for the same observations. There are two key points worth noting here. First, the NOL benefit for firms where *tlcf* is zero or missing (the first group) ranges from zero to 8.0 percent of total assets. Second, relative to a *tlcf*-based measure, we find significant variation in the NOL benefit within each group. This is driven by our explicit accounting for the firm-specific variation in NOL location when available. Because of this variation, there is substantial overlap in the distributions of NOL benefits across *tlcf*-sorted groups. In summary, this figure graphically displays the measurement error inherent in using Compustat *tlcf* to identify both the presence of NOLs and their potential cash tax value.[6]

Table 2 also shows descriptive statistics for other tax measures. As expected, cash ETRs, cash

[6] In Heitzman and Lester (2019), we provide additional evidence that our methodology represents an improvement in estimation of worldwide tax loss benefits and apply it to understand market reactions to recent tax reforms. We also estimate the model using hand-collected data on the full population of public firms in Compustat in 2013 and confirm that the predictive model is successful in estimating prior year losses for all public firms (not just the larger publicly-traded firms that comprise our primary sample). However, we acknowledge that our approach still leaves room for future improvement. The economic benefit from tax loss carryforwards is a function of expected future profits, the expected year of profitability, the expected future tax rate, and the firm's discount rate. Our methodology specifically addresses estimation of the expected future tax rate. Shortcomings still exist due to the lack of data availability to further refine our estimates. First, we do not have access to internal forecasts of whether managers' expect to utilize their NOLs and over what period. While some information can be gleaned through the valuation allowance and the disclosure of statutory limitations, these sources provide only limited insight. Thus, our calculation of the tax benefit assumes that all NOLs disclosed will be used and provides an upper bound on the potential value of this tax asset. Second, there is typically no disclosure of the specific state or country jurisdictions the NOLs relate to; the state and foreign tax rates we apply to the NOLs are an approximation based on blended tax rates that we estimate. Third, because we generally do not know the specific state or country jurisdictions, we are unable to factor in variation in carryforward policies by location. To our knowledge, the only way to mitigate the second and third data issues would be to obtain tax return data for each jurisdiction in which a firm operates (federal, state, and foreign); however, we are unaware of any researcher who has obtained such data. In several tests, we address these shortcomings by performing analysis of domestic-only companies and demonstrate that our inferences hold within this sample.

taxes paid, current tax expense, and marginal tax rates all decline as NOL benefits increase. For example, the average cash taxes paid by firms with no evidence of NOL carryforwards is approximately 4.2 percent of total assets as compared to 0.7 percent of assets in the top quartile of NOL benefit firms. Because corporate tax avoidance measures are strongly affected by the presence of NOL carryforwards, tax avoidance research should carefully consider the accurate measurement and impact of NOL benefits on the interpretation of their results (Drake et al., 2018).

High NOL benefit firms report the lowest amount of pre-tax income, equivalent to 1.9 percent of total assets. While firms with NOL benefits are unsurprisingly poor-performing based on measures of profitability and financial constraints, the data reveal a more interesting picture. These are the smallest firms in the sample by both book and market value. However, our sample construction ensures they are still economically significant by conventional measures, averaging $5.1 billion in assets. High NOL firms also report the greatest levels of R&D expenditures (9.0 percent of sales) and have slightly higher market-to-book ratios than NOL firms in the other quartiles. Approximately 77.1 percent of firms with high NOL benefits have some foreign presence, a proportion higher than the subsample of firms without NOLs and similar to the low NOL benefit quartile. Because firms that report the largest NOL carryforwards appear to have substantive investment opportunities, they should also be more sensitive to factors that affect their cash holdings and other sources of internal financing.[7] Firms in the top quartile of NOL benefits hold 23.2% of assets in cash and report a 0.8% average change in this balance. These high-NOL-benefit firms report a 1.5% average excess return.

[7] The descriptive statistics on the other quartiles reveal that there is a non-monotonic relationship between the level of tax losses and several important firm characteristics. For example, the firms in the second quartile are the largest firms based on the book value of assets, and the second and third quartiles contain the highest proportion of firms with a foreign presence. In short, firms in the second and third quartiles of tax loss firms do not exhibit the common characteristics of poorly-performing, constrained firms and instead are large, profitable, multinational companies.

2.4 Is our NOL benefit measure a better proxy for tax shields?

Prior to testing the relation between cash holdings and our NOL benefit measure, we must first validate that this measure can more accurately predict reductions in future taxation. Thus, we first document our measure's ability to explain current tax expense and cash taxes paid in year $t + 1$ by estimating the following model:

$$Tax_{i,t+1} = \alpha_0 + \alpha_1 APTI_{i,t+1} + \alpha_2 NOL\ Benefit_{i,t} + \alpha_3 APTI_{i,t+1} \times NOL\ Benefit_{i,t} + e \quad (1)$$

where $Tax_{i,t+1}$ is current tax expense or cash taxes paid of firm i scaled by total assets in year $t+1$; $APTI_{i,\,t+1}$ is de-meaned pre-tax income (a proxy for taxable income), calculated as pre-tax income scaled by total assets in year $t + 1$, less the sample mean of 8%; and $NOL\ Benefit_{i,t}$ is measured at the end of year t and described in Section 2.2. We expect a positive sign for α_1, which captures the average current effective or cash tax rate in the sample. We de-mean *PTI* so that the coefficient on NOL benefits (α_2) can be interpreted as the average tax savings realized in year $t + 1$ per $1 of NOL benefits at the beginning of $t + 1$ for the average profitable firm in the sample; we predict a negative sign on α_2. We also expect a negative sign for the interaction term, α_3, which estimates the effect of an increase in a firm's NOL benefits on the firm's average tax rate. We exclude fixed effects from the model to measure the ability of two primary variables—profitability and NOLs—to explain the firm's tax obligations.[8] Standard errors are clustered at the firm level.

Table 3, Columns (1) through (3) present results using current tax expense in year $t + 1$ as the dependent variable. Columns (4) through (6) replace current tax expense with cash taxes paid. In Columns (1) and (4), we find a positive and statistically significant coefficient on *APTI*. The coefficient of 0.23 (0.21) can be interpreted as a GAAP current (cash) effective tax rate in that

[8] Results are unaffected if industry and year fixed effects are also included.

$0.23 ($0.21) of current tax expense (cash tax) will be accrued (paid) on $1 of pre-tax income in year t + 1. The coefficient on *NOL Benefit* (α_2) is significantly negative as predicted. In Column (4), for example, the coefficient of -0.08 implies that a $1 increase in a firm's NOL benefit at the end of year t generates $0.08 in cash tax savings in year t + 1 for the average profitable firm. Finally, the coefficients on the interaction terms *APTI*×*NOL Benefit* (α_3) are -0.77 and -0.80 in Columns (1) and (4) respectively. These amounts imply that a five percentage point increase in the NOL benefit (approximately one standard deviation) is associated with a 3.9% and 4.0% decrease in the current effective tax rate and cash tax rate, respectively.

While this measure performs as expected, a natural question is whether it performs significantly better than a readily-available measure based on Compustat *tlcf*. We perform two tests to address this question. First, in untabulated analysis, we re-estimate Eq. (1) and replace our NOL Benefit measure with a Compustat NOL benefit measure based on *tlcf*. We then compare the explanatory power of that model to the one tabulated at the top of Table 3. *p*-values obtained from Vuong tests on the models in Columns (1) and (4) are 0.012 and 0.050 (untabulated), indicating that the model using our measurement of NOL benefits significantly outperforms one based on *tlcf* alone. Second, we re-estimate Eq. (1), including both the NOL benefit proxy and the Compustat NOL benefit proxy and their corresponding interaction terms with *APTI* to the model. We present these results at the bottom of Table 3, Panel A. We find that only our NOL benefit proxy explains an economically and statistically significant reduction in current tax expense in year t + 1 (coeff. = -0.59, $p < 0.01$). Thus, our measure explains tax savings using current tax expense when the other proxy does not. When cash taxes paid is the dependent variable (Column 4), the Compustat-based proxy behaves closer to our more accurate tax shield proxy, although its smaller estimated effects suggest that it less precisely measures the magnitude of the tax effect.

Given the asymmetric payoff structure of NOL benefits and the fact that only firms with positive taxable income can use NOL carryforwards to reduce their tax payments, we partition the sample into firm-years with positive and negative pre-tax income in the other columns of Table 3, Panel A following prior research (Plesko 2003). As expected, we observe that the negative effect of NOL benefits on both current tax expense and cash taxes paid in year $t + 1$ is concentrated in firm-years with positive pre-tax income in Columns (2) and (5). In contrast, the coefficient on *APTI* is close to zero among the firms with losses in year $t + 1$ in Columns (3) and (6), reflecting the fact that these firms pay no tax or receive no refunds on their losses. The explanatory power of the model is also substantially higher in profit years (for example, 62.7% vs. 1.5% in Columns 2 and 3 at the top of Panel A). These patterns persist when replacing cash taxes paid as the dependent variable and in the second set of regressions at the bottom of the table that include the Compustat-based proxy. In additional analyses (untabulated), we re-estimate the models measuring *APTI* and *Tax* over the next subsequent year ($t + 2$) and find similar results across all specifications. That is, our measure of NOL benefits predicts future tax expense and cash tax savings over both one- and two-year horizons, and the effects are concentrated within profitable firm years.

The results in Panel A assume that the entire NOL carryforward is available for use in the following year. However, some firms have such a large pool of NOLs relative to future taxable income that some NOLs will expire unutilized. Inclusion of these "excess" NOLs in the results presented in Panel A produces a lower coefficient on *NOL Benefit* and its interaction with *APTI*, as α_2 and α_3 reflect the average tax savings realized on all NOLs for the sample. To refine the coefficient estimates, we partition the NOL benefit into a "usable" NOL component that estimates the NOL to be utilized in the near term, and an "excess" NOL component. We define *Usable NOL* as min(*NOL Benefit*, 0.05), which is the minimum of the firm's total NOL benefit (scaled by assets)

up to approximately one standard deviation in the NOL benefit.[9] *Excess NOL* is the remainder, or max(0, *NOL Benefit* – 0.05)

In Panel B of Table 3, we present the results from re-estimating Eq. (1) with these partitions of the NOL benefit. As in Panel A, we first present results from estimating Eq. (1) with only our NOL benefit measure in the top of the table and then include both our measure and the Compustat NOL benefit measure in the bottom of the table. As expected, we find that the coefficient on *NOL Benefit* is concentrated in the usable portion; the coefficient of -0.23 on *Usable NOL* in Column (1) suggests that a $1 increase is associated with $0.23 tax savings in year $t + 1$. In contrast, excess NOL benefits have no effect on taxes in $t + 1$. Turning to the interaction between *APTI* and *Usable NOL*, the coefficient of -4.07 is over five times the size estimated on the interaction in Panel A (-0.77) and implies that a 0.05 increase in NOL benefits is associated with a 20.4 percentage point decrease in the average tax rate. For example, given the average current effective tax rate of 27% in this sample (i.e., the coefficient on *APTI*, α_1), an increase in the NOL benefit from zero to 0.05 reduces the current effective tax rate by 75% (20.4% / 27%). The remaining columns generate qualitatively similar inferences. The bottom section of Panel B presents the results including the Compustat-based measure refined in a similar way. The hand-collected NOL benefit measure continues to dominate the Compustat-based one in explaining future tax expense and cash taxes paid. The differences between both the main effects and interactions are statistically significant for the usable NOL portion at the 0.01 level (untabulated).

In other untabulated tests, we repeat the tests in Panel B by partitioning the NOL on the existence of a large valuation allowance, meaning that the accounting reserve exceeds half of the

[9] In sensitivity tests, we find (consistent with expectations) that the coefficient estimate on usable NOLs increases as we decrease this upper bound usability threshold value.

NOL benefit. We also replicate the Panel B tests partitioning on whether firms are subject to U.S. federal statutory limitations on the future use of NOLs. Across both of these tests, we find that a firm's ability to convert NOLs into future tax savings is lower when the firm faces statutory limitations or has a large valuation allowance.

In Panel C, we test how the predictability of future tax liabilities varies based on the jurisdiction of the tax loss. For the sample of firms that either reported jurisdiction-specific NOL information or have no NOLs, we re-estimate Eq. (1) after decomposing *NOL Benefit* into its domestic (federal plus state) and foreign components. For a firm of average profitability (*PTI* of 8%), both domestic and foreign NOLs explain reductions in current tax expense and cash taxes in year $t + 1$ as seen in Columns (1) and (4). As expected, the impact of NOLs on the current effective and cash tax rates is also negative and significant for both domestic and foreign NOL sources. The remaining columns partition the sample into domestic-only and multinational sub-samples, where a domestic-only firm reports no foreign profits or taxes. We show that the results are generally robust across the location of the NOL and regardless of whether the firm has foreign operations. Collectively, the results in Table 3 validate our measure of NOL benefits, demonstrate that this measure often out-performs a *tlcf*-based proxy, and confirm that the measure works in predictable ways for profitable firms, firms with large pools of NOLs, and firms with differing geographic presence. We thus use this measure for our hypothesis tests.

3. Hypothesis Tests

3.1 NOL benefits and corporate savings decisions

To the extent managers consider taxes in determining the firm's financing policies (Graham 1996a; Blouin et al. 2010), it is natural to expect that taxes will also help determine the firm's level of savings and liquidity. Firms may optimally retain more cash within the firm to provide an

internal source of financing when external sources are costly or when future cash flows are uncertain (Opler et al. 1999; Denis and Sibilkov 2010). The corporate taxation of income earned on cash and liquid securities is viewed as an important cost of retaining cash in the firm, as it subjects the returns to double taxation that investors could otherwise avoid by investing on their own account (Riddick and Whited 2009). However, NOL carryforwards shield passive income from corporate tax, thereby lowering the cost of holding cash in the corporation and increasing optimal cash levels. We formally test whether NOL benefits are positively associated with cash holdings by estimating the following specification:

$$\begin{aligned} Cash_{i,t} = a_0 + \alpha_1 NOL\ Benefit_{i,t} + \alpha_2 Repat_{i,t} + \alpha_3 UTB_{i,t} + \alpha_4 \ln(BVA_{i,t}) + \alpha_5 NWC_{i,t} \\ + \alpha_6 MTB_{i,t} + \alpha_7 CFO_{i,t} + \alpha_8 R\&D_{i,t} + \alpha_9 Capex_{i,t} + \alpha_{10} Acquisitions_{i,t} \\ + a_{11} Dividend\ Payer_{i,t} + \alpha_{12} Leverage_{i,t} + \alpha_{13} NetDebt_{i,t} \\ + \alpha_{14} Industry\ CF\ Risk_{i,t} + e. \end{aligned} \tag{2}$$

$Cash_{i,t}$ is the log of the ratio of a firm's cash and short-term investments (*che*) to total assets (*at*) in year *t*; $NOL\ Benefit_{i,t}$ is as described in Section 2.2, and the control variables are discussed below. We predict a positive coefficient on α_1.

We include two variables that control for other tax incentives to hold cash; the firm's repatriation tax costs (Foley et al. 2007; Hanlon, Lester, and Verdi 2015; Blouin, Krull, and Robinson 2016) and the reserves for uncertain tax benefits (UTBs) (Hanlon et al. 2017). $Repat_{i,t}$ is constructed following Foley et al. (2007) and is calculated as a firm's pre-tax foreign income (*pifo*), times the U.S. statutory tax rate during the sample period of 35%. Foreign taxes (*txfo*) are then subtracted from this amount to approximate a firm's foreign tax credit. $Repat_{i,t}$ is the maximum of this amount or zero, scaled by a firm's total assets. $UTB_{i,t}$ is measured as the reserve for uncertain tax benefits as reported in the financial statements (*txtubend*), scaled by total assets.

Following prior literature, we expect that firms with higher repatriation tax liabilities, as well as firms with more uncertain tax benefits, hold more cash.

We control for a firm's size using the log of the book value of a firm's assets, $ln(BVA_{i,t})$, where the book value of assets (at) is expressed in 2010 dollars. We also control for a firm's net working capital, $NWC_{i,t}$, measured as non-cash current assets (*ca* - *che*), less current liabilities (*cl*). We control for a firm's growth opportunities with $Market\text{-}to\text{-}book_{i,t}$, which is measured as the market value of a firm's assets (*at – ceq + csho*prcc_f*), scaled by total assets (at). $CFO_{i,t}$ (*oancf* scaled by total assets) controls for a firm's internal source of financing. Investment demands are captured by $R\&D_{i,t}$ (R&D expense (*xrd*) scaled by revenues (sale)), $Capex_{i,t}$ (capital expenditures (*capx*) scaled by total assets), and $Acquisitions_{i,t}$ (*acq + acqcshi**(*prcc_f* + lag(*prcc_f*))/2) scaled by total assets). $Dividend\ Payer_{i,t}$ is an indicator variable equal to one if the firm pays dividends (*dvc* > 0) in year *t* and zero otherwise. $Leverage_{i,t}$ controls for a firm's existing external debt financing and is measured as total long-term debt (*dltt + dlc*), scaled by total assets. $Net\ Debt_{i,t}$ is debt issued less debt repaid during the year (*dltis – dltr*) divided by assets and controls for concurrent debt financing. $Industry\ CF\ Risk_{i,t}$ is the average standard deviation of earnings before depreciation (*oibdp*) scaled by assets over the past three years among firms in the same industry. Industry and year fixed effects are included in estimating Eq. (2), and standard errors are clustered by firm.

We present the results from estimating Eq. (2) in Table 4, Panel A. In Column (1), *NOL Benefit* exhibits a positive and significant association with the firm's cash holdings. The coefficient of 0.12 implies that increasing NOL benefits by 0.05 (approximately one standard deviation) is associated with a 0.6 percentage point increase in the cash-to-asset ratio. The control variables exhibit statistically significant relations with cash holdings consistent with prior research. Specifically, larger, dividend-paying firms with greater working capital, higher levels of capital

expenditures and debt, and more acquisition spending hold less cash. Firms with more growth opportunities, greater R&D spending, greater net debt issuances, and greater industry cash flow volatility also hold more cash. In Column (2), we include both *Repat* and *UTB* and find that the results hold. We continue to observe a positive and statistically significant coefficient on *NOL Benefit* of the same size as in Column (1). This provides evidence that the effects of the tax loss are incremental to these other previously documented tax motivations for cash holdings.

Column (3) and (4) present results after partitioning firms into domestic-only and multinational sub-samples. We conduct the test on these subsamples for two reasons. First, there is a stronger match between the jurisdiction of the NOL and cash within the domestic-only subsample, thereby improving identification of the effect by reducing measurement error that may be present in Column (2). Second, these tests permit us to compare effects across the two subsamples of firms to determine whether NOLs have a different role given a firm's geographic presence.

In Column (3), we find a coefficient of 0.21 for domestic-only firms, which implies that increasing NOL benefits by 0.05 (approximately one standard deviation) is associated with a 0.11 percentage point increase in the cash-to-asset ratio. In contrast, we observe no statistically significant result within the multinational firms when using our measure of a firm's total NOL benefit. Instead, repatriation tax costs, uncertain tax benefits, and other determinants explain these firms' cash holdings.

One potential reason that NOLs do not exhibit a significant association with cash holdings for multinational firms in Column (4) is that repatriation tax considerations dominate. If so, then the importance of NOLs for savings decisions should vary with the level of repatriation taxes. To test these effects, we re-estimate Eq. (2) after including the interaction term *NOL Benefit x Repat* and report these results in Panel B. The main effect of *NOL Benefit* tests whether NOLs affect cash

holdings in U.S. multinational firms when repatriation taxes are not a driver of a firm's cash holdings. After including the interaction term in Eq. (2), we find that that the main effect of *NOL Benefits* is positive and statistically significant. The coefficient of 0.12 in Column (1) implies that, for firms with no repatriation tax (*Repatriation tax cost* = 0), the effect is as large as that found in the full sample in Panel A.

The interaction tests whether a firm's NOLs mitigate repatriation tax frictions. Specifically, the NOL firm may have less trapped foreign cash if the US parent is willing to use domestic NOLs to absorb the U.S. tax due upon a repatriation. This use of domestic NOLs may explain why approximately 30% of multinational firms repatriate each year, despite presumably incurring U.S. taxes due to the relatively higher U.S. corporate income tax rate (Desai et al., 2001 and 2007). However, because firms would not obtain the full benefit of a U.S. tax loss (given that the loss would only absorb income subject to tax at a rate equal to the difference between the US tax rate and the foreign tax rate), we may find no association between NOL benefits and the sensitivity of cash holdings to repatriation taxes (Graham et al. 2010 and 2011).

In Panel B, Column (1), we find a negative and statistically significant coefficient on the interaction between NOLs and repatriation taxes. This result suggests that as repatriation taxes increase, firms with NOLs have more freedom to return foreign cash to the U.S parent, shielding the company from incremental U.S. tax due upon repatriation.

To confirm that the effects documented are indeed attributed to utilization of the U.S. federal NOL, we focus on the subsample of multinationals that disclose the location of the NOL (or have no NOL); on this smaller sample (n=4,336), we continue to observe similar effects in Column (2). We then bifurcate the *NOL Benefit* into a domestic and foreign component. In Column (3), we present results with the bifurcated measure of NOLs, excluding the interaction between NOLs and

repatriation taxes. We observe a positive but statistically insignificant relation between domestic NOLs and cash holdings, whereas foreign NOLs exhibit a negative relation. In Column (4), we interact the domestic and foreign NOL measures with *Repat* (as in Column (1)) and find that the effect of NOL benefits in mitigating the relation between repatriation taxes and cash holdings is indeed driven by the variation in US domestic NOLs. These results support the conclusion that NOLs provide a tax shield that enables firms to repatriate cash from their foreign subsidiaries at a relatively lower cost.

3.2 NOLs and the value of cash

If the incremental liquid assets associated with NOLs arise from a lower corporate tax cost on their returns, those higher after-tax returns should be reflected in a higher valuation by investors. We test the effect of NOL benefits on investors' valuation of cash using the specification from Faulkender and Wang (2006), adapted to include the net financing components as proposed by Halford, McConnell, Sibilkov, and Zaiats (2017) and used by Harford, Wang, and Zhang (2017).

As a brief background, the valuation-of-cash framework tests the theoretical prediction that one dollar of cash inside the firm should be valued at one dollar by investors. However, Faulkender and Wang (2006) show that investors of firms facing financing constraints place a higher value of an additional dollar of cash because internal funding allows managers to pursue positive net present value projects when external funding is otherwise too costly. In contrast, the value of cash decreases when managers operate in weaker monitoring environments (Dittmar and Mahrt-Smith 2007), implying that investors believe the additional dollar of cash will more likely be spent on projects providing private benefits to entrenched managers (Jensen 1986; Harford 1999).

To test the prediction that the cash holdings of NOL firms should be valued more highly by investors because of NOL-driven reductions in the corporate tax on investment income, we estimate the following model:

$$\begin{aligned} r_{i,t} - R^{B}_{i,t} = \; & \gamma_0 + \gamma_1 \Delta Cash_{i,t} + \gamma_2 NOL\ Benefit_{i,t-1} \\ & + \gamma_3 \Delta Cash_{i,t} \times NOL\ Benefit_{i,t-1} + \gamma_4 \Delta Earn._{i,t} + \gamma_5 \Delta Noncash\ assets_{i,t} \\ & + \gamma_6 \Delta R\&D_{i,t} + \gamma_7 \Delta Int._{i,t} + \gamma_8 \Delta Div._{i,t} + \gamma_9 Cash_{i,t-1} + \gamma_{10} Leverage_{i,t} \\ & + \gamma_{11} Stock\ issued_{i,t} + \gamma_{12} Stock\ repurchased_{i,t} \\ & + \gamma_{13} Net\ debt\ iss._{i,t} + \gamma_{13} Cash\ accum._{i,t} + \gamma_{14} Cash_{it-1} \times \Delta Cash_{i,t} \\ & + \gamma_{15} Leverage_{i,t} \times \Delta Cash_{i,t} + \varepsilon_{i,} \end{aligned} \tag{3}$$

where Δ denotes the change in the variable over the year. The dependent variable is the firm's excess stock return, where $r_{i,t}$ is the total return for firm *i* in year *t*, and $R^{B}_{i,t}$ is firm *i*'s benchmark return in year *t*. The benchmark return is constructed as the value-weighted return on a size and book-to-market matched portfolio (Fama and French 1993; Faulkender and Wang 2006).

$Cash_{i,t}$ is firm *i*'s cash holdings in year *t* and is defined as cash plus short-term investments (*che*). Both the change in cash holdings ($\Delta Cash_{i,t}$) and cash at the beginning of the year ($Cash_{i,t-1}$) are included in Eq. (3). $NOL\ Benefit_{i,t-1}$ is as described in Section 2.2, but for consistency with the other variables included in Eq. (3) is scaled by the beginning market value of equity. This proxy is measured at the beginning of the year to mitigate the information content of new tax loss carryforwards for current performance. To test whether NOLs are viewed as increasing the value of a marginal dollar of cash, we interact $\Delta Cash_{i,t}$ and $NOL\ Benefit_{i,t-1}$ and predict a positive coefficient on γ_3.

The model also includes changes in other firm-specific factors associated with stock returns: $\Delta Earnings_{i,t+1}$, calculated as earnings before extraordinary items (*ib*); $\Delta Noncash\ assets_{i,t+1}$, equal

to total assets less cash (*at* - *che*); $\Delta R\&D_{i,t+1}$ and $\Delta Interest_{i,t+1}$ to capture expenses for R&D activity (*xrd*, set equal to zero if missing) and debt financing costs; and $\Delta Dividends_{i,t+1}$ to reflect dividends paid to common shareholders. Following Halford et al. (2017), we decompose net financing into *Stock issued*$_{i,t}$, *Stock repurchased*$_{i,t}$, and *Net debt issued*$_{i,t}$ using information from the cash flow statement, and we include an indicator *Cash accumulation*$_{i,t}$ that equals one if cash holdings increased during the year and zero otherwise. All non-indicator variables are scaled by the firm's equity value at the beginning of the fiscal year, such that the coefficients can be interpreted as the dollar change in a firm's equity value associated with a one-dollar change in the corresponding independent variables. Finally, we also include *Market leverage*$_{i,t+1}$, calculated as total long-term debt plus debt in current liabilities (*dltt* + *dlc*), divided by the market value of assets. Table 2 provides descriptive statistics for these variables. As before, we include year and industry fixed effects when estimating Eq. (3) and cluster standard errors at the firm level.

Table 5 presents the regression results. We first replicate Faulkender and Wang (2006) in Column (1) and find that for our sample of firms, an extra dollar of cash is valued by shareholders at $0.59. The valuation at less than $1.00 could be attributed to a combination of agency conflicts (Dittmar and Mahrt-Smith 2007) and foreign cash holdings that are valued at a discount for the multinational firms in the sample (Harford et al. 2017).

Column (2) includes results from testing the sensitivity of cash valuation to NOL benefits in Column (2). We observe a positive and statistically significant coefficient on both the NOL variable, as well as the interaction term, supporting the view that that corporate savings linked to available NOL benefits are positively valued by investors.[10] The coefficient of 0.87 on the

[10] Some have argued that NOLs introduce agency problems, which would predict an opposite sign between NOLs and the value of cash. One specific channel through which tax loss benefits would be associated with weaker governance that may enable agency issues is through a shareholder rights plan ("poison pill") designed to prevent unfriendly takeovers by forcing dilution of the buyer's interest once their ownership stake comprises 15 or 20 percent (Ryngaert

interaction implies that a 0.05 increase in *NOL Benefit* is associated with a $0.04 increase in the marginal dollar of cash (0.05 × 0.87).

Columns (3) through (5) present results after partitioning firms into domestic-only and multinational subsamples. In Column (3), we observe that an extra dollar of cash is valued by shareholders at $0.75, which is equivalent to the value found in Table II, Column (1) of Faulkender and Wang (2006). This higher valuation for domestic-only firms is consistent with these firms not having trapped foreign cash that investors discount. The coefficient of 0.64 on the interaction term implies that a 0.05 increase in *NOL Benefit* is associated with a $0.03 increase in the value of the next dollar of cash.

Column (4) also demonstrates that, among multinational firms, NOLs are also viewed as increasing the value of a marginal dollar of cash, possibly due to the fact that domestic NOLs can absorb some of the repatriation tax liability. Consistent with this explanation, we find that the effects are attributable to domestic NOLs in Column (5) after bifurcating the NOL into its domestic and foreign components on the subsample of firms with available data. In short, investors' valuation of cash is higher when the cost of the savings can be offset with U.S. tax shields.[11]

4. Additional analyses

4.1 NOLs and the sources of cash

1988; Brickley, Coles, and Terry 1994; Comment and Schwert 1995; Coates 2000; Fich, Harford, and Yore 2018). Since 2005, dozens of firms have adopted poison pills that are triggered at a lower 5 percent ownership threshold (based on the statutory tax rules of Internal Revenue Code Section 382) to protect the firm's tax loss asset from inadvertent impairment. Erickson and Heitzman (2010) and Sikes et al. (2014) study these tax loss poison pills. While the Delaware Court ruled that the poison pill was an appropriate action to preserve the value of the tax loss asset, Sikes et al. (2014) find that the market reaction to announcements of these poison pills is negative, which suggests that investors view these plans as mechanisms to insulate management from the threat of takeover.

[11] Note that in each regression in Table 5, the coefficient on the main effect of *NOL Benefit* is positive and significant, suggesting that stock returns are increasing in NOL tax benefits independent of their association with cash valuation. This is consistent with NOLs having a mechanical leverage-like effect by increasing the covariance of after-tax cash flows with the market, thereby increasing systematic risk. For related discussions on the association between taxes and the firm's cost of capital, see Goh et al. (2016), Sikes and Verrecchia (2017), and Heitzman and Ogneva (2019).

In the prior section, we find that cash holdings and investor valuation of cash increase in NOL benefits. In this section, we provide additional evidence on the link between NOLs and managers' savings decisions. We adapt the sources of cash models from Duchin et al. (2017) and McClean (2011) and regress the change in cash holdings on operating cash flow, cash raised from debt and equity issuances, and cash from sales of assets. We then condition the sensitivity of cash to these sources on NOL benefits in the following model:

$$\begin{aligned}\Delta Cash_{it} = \ & \alpha_0 + \alpha_1 CFO_{it} + \alpha_2 Debt\ and\ Equity\ issues_{it} + \alpha_3 Asset\ sales_{it} \\ & + \alpha_4 NOL\ Benefit_{it-1} + \alpha_5 CFO_{it} \times NOL\ Benefit_{it-1} \\ & + \alpha_6 Debt\ and\ Equity\ issues_{it} \times NOL\ Benefit_{it-1} \\ & + \alpha_7 Asset\ sales_{it} \times NOL\ Benefit_{it-1} + e\end{aligned} \tag{4}$$

From the cash flow statement, *CFO* is operating cash flows (*oancf*), *Debt and Equity issues* is the sum of proceeds from issuing debt and equity (*dltis* + *sstk*), and *Asset sales* is the proceeds from the sale of PPE and other investments (*sppi* + *siv*). All variables are scaled by beginning assets. *NOL Benefit* is measured at the beginning of the year. The coefficients $\alpha_1 - \alpha_3$ can be interpreted as the average amount from each source of cash during the year that managers retain in cash reserves at the end of the year. α_1 is the average contribution of NOL benefits to cash holdings, independent of the sources of cash. The interaction coefficients $\alpha_5 - \alpha_7$ estimate the effect of NOL benefits on the manager's decision to retain cash from these various sources. Standard errors are clustered at the firm level.

In Column (1) of Table 6 we estimate a benchmark model that excludes *NOL Benefit* and its interactions for comparison to the prior literature. We find that firms save roughly $0.23 for every dollar of operating cash flow but only $0.05 of every dollar of external financing. These estimates are similar to those Duchin et al. (2017), confirming that our sample exhibits similar effects as in

this prior paper. We then ask whether NOLs affect the savings decision. In Column (2) we include the NOL benefit proxy and find that NOLs are associated with future growth in cash flows; $1 of NOL benefits converts to an approximately $0.24 in cash.

One interpretation of the evidence is that NOLs simply mechanically increase cash by reducing cash tax liabilities. However, consistent with our conceptual development, we argue that the impact of NOL benefits on cash should occur through the manager's decision to retain the cash generated rather than distribute or redeploy it. If so, then the sensitivity of cash to NOLs should operate primarily through the decision to retain cash out of non-tax cash sources. To test this, we estimate the full model in Eq. (4) above and interact NOLs with the proxies for operating, financing, and investing sources of cash.

The results, reported in Column (3), are generally consistent with our prediction. NOLs have a positive but insignificant effect on the retention of cash out of current operations. However, they do have a positive and significant effect on the decision to retain cash raised from external financing. For each $1 of debt or equity raised, a 0.05 increase in the NOL benefit is associated with $0.038 of additional cash (0.05 x 0.75). For each $1 of assets sold, that same increase in the NOL benefit is associated with $0.043 in additional cash (0.05 x 0.84). The results are similar if we exclude taxes paid from operating cash flows, are robust to controlling for total assets, and are not explained by financial constraints. These results provide further support for the proposition that NOL benefits play an active role in shaping managers' decisions to retain cash.

4.2 Alternative tax benefit proxies

Section 2 and Table 3 demonstrate how the NOL benefit measure constructed from hand-collected data performs relative to a Compustat-based measure in explaining future tax obligations. This section describes results from testing our main savings predictions using this Compustat-

based measure and two additional proxies: a simulated NOL benefit based on the approach for estimating NOL carryforwards in Shevlin (1990) and Blouin et al. (2010), and Graham's after-financing marginal tax rate. The marginal tax rate is a more sophisticated approach that uses the dynamics of the tax code and expectations of future taxable income to derive an expected tax rate on current income and deductions.

Recall that the Compustat-based NOL benefit measure is equal to Compustat *tlcf* multiplied by 0.23 (the median tax rate calculated from our data in Appendix Table B1, Panel B). To calculate the simulated NOL carryforward, we estimate taxable income each year (starting with the earliest year available or 1960, whichever is later) as pre-tax income (*pi*), less special items (*spi*), less grossed-up deferred tax expense (*txd*/top marginal tax rate). We assume that the firm starts with no NOL carryforwards and apply the corresponding carryback and carryforward rules each year to derive the simulated NOL carryforward at the end of each year. We assume firms use carrybacks when available and use the oldest carryforward first. We then multiply the simulated carryforward by 0.23 to calculate the simulated NOL benefit. The third measure is the after-financing marginal tax rate, which estimates the present value of tax on an additional dollar of taxable income from forecasted taxable income and *tlcf*. We obtain this measure from John Graham.

Table 7, Panel A summarizes the results for re-estimating Eq. (2) using each of these three measures. We also include a summary of the results from Tables 4 and 5 for comparison. In Column (1), we present the coefficient for the relation between a firm's cash holdings and one of the three alternative NOL benefit proxies. Although we do observe a positive effect for the simulated NOL benefit in Column (1), we fail to observe the larger and statistically significant effect among domestic-only firms in Column (2) using this measure. Instead, we observe that the Compustat NOL benefit measure generates a result consistent with ours from Table 4, suggesting

that *tlcf* has better explanatory power when jurisdictional complexity is minimal. For this measure, we also observe a negative and statistically significant effect on the interaction term in Column (4), but, inconsistent with our results, the main effect is not statistically significant. Further, neither of the other two measures produce results for the interaction term, suggesting that cash holdings exhibit a different relation with NOLs relative to simulated or marginal tax rates.

Panel B presents results from re-estimating Eq. (3) for the valuation-of-cash tests. We find that the effect of the tax benefit on the valuation of cash (the interaction term) is positive across all three measures, but is only statistically significant for the Compustat-based measure and the simulated NOL benefit. Further, the effect for the simulated NOL benefit is much smaller and weaker relative to the effect in Table 5.

Given that our measure appears to best capture NOL benefits relative to these other three measures (on the basis of predicting future tax obligations as shown in Table 3), the results presented in Tables 4 and 5 reflect economic significance and magnitude to which we can benchmark these results presented in Table 7. While the collective evidence is generally consistent, the *significance* of the effects and the *explanatory power* of these models vary based on the measure that is used. It is unsurprising that the Compustat-based measure generates some similar effects given that there are many firms for which *tlcf* and *NOL benefit* are similar. However, its weaknesses are revealed within the multinational sample, suggesting that – for these firms – we would have otherwise concluded no effect of the NOL on firm savings or the valuation of cash based on using only *tlcf*. Coupled with the evidence in Appendix B, the results demonstrate the importance of refining the measurement of NOLs beyond the information contained in *tlcf* to make accurate inferences and precisely quantify the effect of these tax assets on firm decisions.

In untabulated tests, we find that Compustat's failure to report a positive value for *tlcf* when the firm discloses it in the footnotes is more likely when the firm is larger, more profitable, has positive tax expense, no foreign operations, and no acquisitions. This suggests that reliance on *tlcf* could induce spurious correlations in other work due to systematic variation in Compustat errors. We conclude that use of these other measures would result in different interpretations and conclusions regarding magnitude and in some cases, the direction of effects, further reinforcing the importance of correctly measuring a firm's NOL benefit.

5. Conclusion

Using detailed data on the amounts and attributes of net operating loss carryforwards disclosed in firms' financial statements, we show that NOL carryforwards are much more prevalent than that suggested by Compustat and prior research, affecting nearly 90% of the large public firms in our sample. The large firms that claim these tax losses are important participants in the U.S. capital markets and large contributors to U.S. tax revenues in profitable years. They also derive substantial NOL benefits from state and foreign sources. Thus, understanding to what extent tax losses affect firms' decisions is important for academic researchers, firm managers, and policy makers.

In particular, the proper identification and measurement of NOL benefits is an extremely relevant issue for accounting and finance research. Commonly used proxies for marginal tax rates and tax avoidance are heavily influenced by NOLs. However, estimates of these NOLs employed in the vast majority of published tax research suffer from mismeasurement. While our approach is imperfect, we take an important step forward in showing that an estimate gleaned from the financial statement footnotes offers a more precise measure of tax shields.

We apply our measure to examine whether and to what extent the tax benefits from NOL carryforwards affect corporate savings policies. We find that cash holdings are increasing in the

NOL benefit. The strongest association is among domestic firms; however we find similar evidence in multinational firms that are subject to little repatriation tax. Moreover, the sensitivity of cash to repatriation taxes documented in prior studies is conditional on NOLs: domestic NOLs appear to reduce the trapped cash problem by absorbing repatriation taxes. Finally, investors place a higher value on their cash holdings when the available NOL benefits can shield passive investment income from corporate tax.

In addition to contributing knowledge about the population of tax loss firms and the amount of these important assets, we also add to the literature demonstrating why taxes matter. Prior studies of tax loss firms focus primarily on documenting the amount of these losses and studying how the losses affect investment incentives. This study offers an important step in considering additional effects of these tax losses on other important firm decisions.

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Appendix A– Tax Loss Variables in Prior Accounting Literature (2010-2017)

Journal name	# of Tax research papers (1)	# containing NOL Variable (2)	# measuring NOL status with *tlcf* (3)	# measuring NOL with other methodologies (4)
Journal of Accounting & Economics	22	10	9	1
Journal of Accounting Research	18	9	8	1
The Accounting Review	73	22	17	5
Total	113	41	34	7

This appendix provides a summary of tax research papers published in three academic Accounting journals in the period 2010 through 2017. We identify any papers with "tax" in the title or abstract and present the count of these papers, by journal, in Column (1). In Column (2), we provide the count of papers that use a net operating loss variable in the empirical specifications, either as a dependent variable, a control variable, or a partitioning variable. Columns (3) and (4) present counts of the number of papers constructing the NOL variable using either *tlcf* or other methodologies, respectively.

Appendix B – Supplemental descriptive data on hand-collected NOL carryforwards

Table B1 provides details on the data obtained from the tax footnotes. Panel A compares the frequency of NOL carryforwards in our hand-collected data to the frequency from Compustat data. Panel A also provides further details for the subsample of 6,120 firm-year observations that disclose an NOL carryforward.

Panel B provides further descriptive details on the reported NOLs. We first present statistics for the 4,076 observations disclosing the total pre-tax NOL carryforward by location. The average (median) tax loss carryforward of $823.4 ($206.9) million means that an average firm could offset nearly $1 billion of future taxable income with existing NOL carryforward. To evaluate the relative importance of this amount, which combines losses across jurisdictions, we report NOL carryforwards by location when disclosed. Of the 4,076 observations that report the NOLs' locations, 64.5% (2,627 observations) disclose federal NOL carryforwards averaging $473.8 million; 68.4% (2,790 observations) disclose state NOL carryforwards averaging $453.9 million; and 58.6% (2,390 observations) disclose foreign NOLs averaging $353.6 million. The average NOL carryforward reported in Compustat for these firms (*tlcf*) is $801 million (untabulated).[12] However, because *tlcf* represents the simple sum of pre-tax NOL carryforwards and does not reflect jurisdiction-specific details, we are precluded from identifying and comparing the jurisdictions and relative value of the NOLs across the two data sources.

Nearly all firms in the tax loss sample report a line-item for deferred tax assets related to NOL carryforwards (5,894 observations or 96.3% of positive NOL firms). A firm's deferred tax asset should equal the firm's gross tax loss carryforward multiplied by the applicable tax rate in the corresponding tax jurisdiction. The mean (median) gross deferred tax asset for NOL carryforwards is $221.4 ($45.6) million. Firms either provide an "uncontaminated" amount by reporting the deferred tax asset for the NOL on a distinct line in the deferred tax asset and liability section of the income tax footnote, or a "contaminated" amount that combines the NOL deferred tax asset with other tax attributes, such as tax credit carryforwards. For the 4,272 firm-years with uncontaminated NOL deferred tax assets, the mean (median) asset is $170.3 ($36.3); for the 1,622 firm-years reporting a contaminated amount, the mean (median) is higher at $356.0 ($70.0) million. Some firms also disclose location-specific NOL deferred tax assets. For these firms, the average gross deferred tax asset is $165.6 million at the federal level, $42.6 million at the state level, and $127.8 million at the foreign level. The distribution is skewed, with reported medians of $29.0, $12.3, and $21.0 million respectively.

Based on the subsample of firms that disclose both an NOL deferred tax asset and the total amount of loss carryforwards by jurisdiction, we estimate the applicable federal, state, and foreign income tax rates at 35.0 percent, 4.9 percent, and 26.6 percent respectively (i.e., the median income tax rates as shown in Table B1, Panel B). For firms that disclose only the total of both the NOL

[12] In comparing Compustat NOLs to U.S. NOLs reported on the tax return, Mills et al. (2003) find higher values for Compustat NOLs, primarily due to the fact that the U.S. tax returns do not include foreign losses or some NOLs acquired in M&A transactions.

carryforward and its deferred tax asset amounts, we estimate a blended median income tax rate of 22.7 percent.[13]

The estimated NOL benefits are reported in Panel C. First, for the two-thirds of the sample in which it is available, we use NOL carryforward data at the jurisdiction level (4,076 observations). We construct the NOL benefit as $\Sigma(NOL_{ij} \times \tau_j)$, where NOL_{ij} refers to the total reported losses carried forward for firm *i* in location *j* (federal, state or foreign), and τ_j is the applicable tax rate based on the median tax rates in Table B1, Panel B.[14] If the firm does not provide jurisdiction data but does disclose a total tax loss carryforward amount (NOL_i), we apply a blended rate of 22.7 percent (the median tax rate from Table B1, Panel B). This latter methodology is used to estimate NOL benefits for approximately 8.9 percent of the sample (543 observations).

For the remaining 24.4 percent of the firms, we rely on deferred tax asset disclosures to estimate the NOL benefit.[15] For these firms, we estimate NOL benefits first with jurisdiction-specific disclosures (722 observations), then with uncontaminated total NOL-specific deferred tax assets (471 observations), and finally with contaminated deferred tax assets (306 observations).

In Panel D, we compare our calculated NOL benefit to the *tlcf* amounts reported in Compustat. Of the 1,478 observations for which we identify an available NOL carryforward, but Compustat does not (i.e., *tlcf* is missing or zero), the average estimated NOL benefit is $213.1 million.[16] For

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[13] While 35% is the correct rate to apply for federal NOLs in our sample period, the rates used for state and foreign NOLs could be biased by our focus on the subsample of firms that disclose jurisdiction-specific deferred tax assets and loss carryforwards. In additional untabulated tests, we regress total NOL deferred tax assets on various measures of NOL carryforwards and interpret the coefficients as estimates of the average tax rates on the NOLs. These results support the estimated tax rates we derived.

[14] This methodology prioritizes information about pre-tax NOL carryforwards to estimate tax loss benefits. Alternative methodologies used in calculating the benefit, namely those that prioritize the deferred tax asset amount rather than the gross tax loss carryforward amount, yield similar results and are highly correlated ($\rho > 0.94$).

[15] While a firm's deferred tax asset for the loss carryforward should already reflect a rate-weighted methodology, there are several reasons why we do not rely primarily on deferred tax asset disclosures to construct our measure. First, a firm's deferred tax asset is shaped by accounting rules that could omit some tax loss carryforwards in determining the reported deferred tax asset. For example, the exercise of stock options generally creates a tax deduction. During most of our sample period, a portion of the stock option exercise deduction (the excess tax benefit) that increases tax loss carryforwards is reported "off book;" the correct and full amount of the tax loss carryforward is disclosed (including this stock option deduction), but the relevant deferred tax asset ignores it. Second, the deferred tax amount can be "contaminated" in that it can include other tax attributes such as credit carryforwards that result in overestimation of the potential tax loss benefits. In our sample, approximately 27 percent of firms that disclose a deferred tax asset for tax loss carryforwards combine this amount with other deferred tax items. Third, the gross deferred tax asset usually does not include detail on the underlying jurisdiction. Nonetheless, we use these data for the subset of firms for which measurement of tax losses would otherwise be unavailable due to nondisclosure of total tax loss carryforward amounts.

[16] One can partially infer the reason Compustat misses firm NOLs from the statistics presented in this panel – Compustat seems to miss firms that only report a tax loss via reporting a deferred tax asset (approximately two-thirds of this subsample). According to Compustat, the definition of *tlcf* is as follows:
"[tlcf] represents the portion of prior and current year losses applied as a reduction of taxable income in the next succeeding year or years. When available and applicable, this item is usually reported in the notes to financial statements. This item includes: 1) Amounts reported for financial purposes (also called "book value"), 2) Carry-over tax loss, 3) Carry-forward tax loss of both domestic and foreign consolidated subsidiaries, and 4) Carry-forward tax loss incurred prior to acquisition of a consolidated subsidiary (unless the company specifies that it does not expect to be able to utilize the amount). This item excludes: a) Amounts reported for tax purposes, 2) Capital loss carry-forward, 3) Carry-back tax loss, 4) Carry-forward tax loss of unconsolidated subsidiaries, 5) Investment tax credit carry-forward, 6) Tax credit carry-forward" (Compustat Online Manual).

3,630 observations (59.3 percent of the sample of loss firms) for which Compustat does report *tlcf* and for which the location of the NOL is disclosed, the average value of *tlcf* is $899.9 million and is driven by a few very large outliers. For these same firms, our estimated average pre-tax NOL carryforwards are $838 million. Importantly, we find that there is significant heterogeneity in the location, and hence the after-tax value, of the NOL carryforwards. Within our sample, federal NOLs average $306.2 million, while state and foreign NOLs average $317.1 million and $214.7 million, respectively. Thus, data that focuses only on U.S. federal NOLs (U.S. corporate income tax returns), or fails to distinguish the location of the NOLs (*tlcf*), may significantly misstate a firm's tax loss status.

Table B1– Descriptive statistics on NOL carryforwards and NOL benefits

This table reports summary statistics on net operating loss (NOL) carryforwards disclosed in firms' financial statements between 2010 and 2015. The sample includes firms that were in the top 1,500 publicly-traded firms by a combined ranking of book assets, market capitalization, and sales. If the firm is among the top 1,500 for any given year, we collect the tax loss data for all six years when available. We drop all firms in the financial and utilities industries and present statistics for the final sample of 6,884 firm-years used in the empirical tests. Panel A provides statistics on the percentage of firms reporting tax loss and other information. Panel B provides descriptive statistics on the amount of net operating losses and deferred tax assets disclosed in the financial statements. Panel C derives the NOL Benefit that is the primary measure in the empirical tests. Panel D compares dollar values for tax losses between the hand-collected and Compustat data.

Panel A: Number of firms disclosing NOL carryforwards

	2010 - 2015 (N = 6,884)	
	N	% sample
% firm-years disclosing NOL carryforwards > 0		
Per hand-collection	6,120	88.9%
Per Compustat (tlcf > 0)	4,642	67.4%
Of 6,120 firm-years with hand-collected NOL carryforwards > 0 , % disclosing		
Location and amount of NOL carryforward	4,076	66.6%
Location and amount of deferred tax asset for NOL carryforward	1,625	26.6%
Gross NOL carryforward	3,869	56.2%
Gross deferred tax asset for NOL carryforward	5,894	96.3%
Gross deferred tax asset amount includes other tax assets	1,643	26.8%
Disclosing existence of Sec. 382 limitation	1,366	22.3%
Positive valuation allowance for deferred tax asset	5,481	89.6%
Valuation allowance equal to at least 50% of estimated NOL tax benefit	3,838	62.7%

Table B1 (continued) - Descriptive statistics on NOL carryforwards and NOL benefits

Panel B: Disclosed NOL carryforward and Deferred tax asset amounts

	2010 - 2015 (N = 6,120)		
$ in millions	N	Mean	Median
Of firms disclosing NOL carryforward location:			
Σ(federal, state, foreign)	4,076	$823.4	$206.9
Federal NOL carryforward	2,627	473.8	98.9
State NOL carryforward	2,790	453.9	114.8
Foreign NOL carryforward	2,390	353.6	68.6
Of firms disclosing deferred tax assets for NOL carryforwards, amounts for:			
Total DTA (all)	5,894	$221.4	$45.6
Total DTA (uncontaminated)	4,272	170.3	36.3
Total DTA (mixed with other tax items)	1,622	356.0	70.0
Federal DTA	759	165.6	29.0
State DTA	1,040	42.6	12.3
Foreign DTA	912	127.8	21.0
Of firms disclosing both, the ratio of DTA / NOL carryforward			
Total (when disclosed)	4,423	24.6%	22.7%
Federal	386	34.1%	35.0%
State	379	9.9%	4.9%
Foreign	389	27.6%	26.6%

Panel C: Total inferred tax loss benefit (NOL benefit)

$ in millions	N	Mean	Median
NOL benefit (total)	6,120	$190.6	$39.4
Comprised of amounts calculated as follows:			
Jurisdiction-based NOLs ($\Sigma(NOL_j \times \tau_j)$)	4,076	$178.4	$40.0
Total NOLs ($NOL \times \tau$)	543	223.5	64.2
Jurisdiction-based DTA for NOLs (ΣDTA_j)	722	195.3	40.9
Total DTA for NOL (uncontaminated)	471	186.5	20.1
Total DTA for NOL (contaminated)	306	289.2	33.7

Panel D: NOL carryforwards, Hand-collected vs Compustat

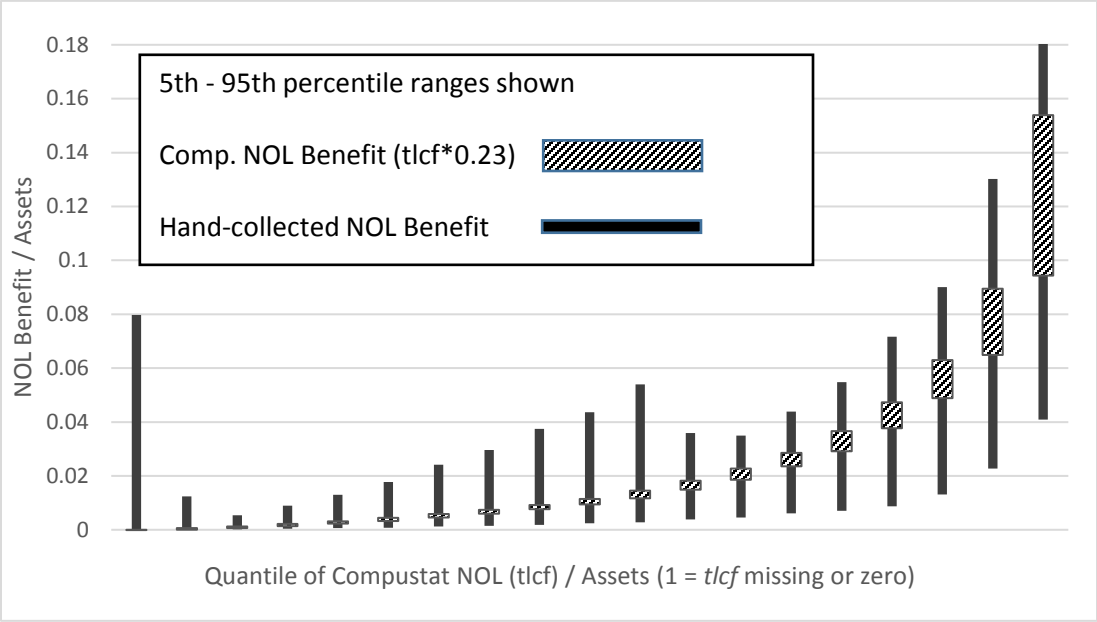
$ in millions	N	Mean	Median
Compustat NOL (tlcf) is missing:			
NOL Benefit	1,478	$213.1	$29.0
Total NOL DTA	1,434	266.2	33.4
Total NOL carryforward (ΣNOL_j, if location not reported then gross NOL)	484	715.6	214.6
Compustat NOL (tlcf) is available & NOL location available:			
Compustat NOL (*tlcf*)	3,630	$899.9	$202.0
Total NOL [Σ(federal, state, foreign)]	3,630	838.0	207.0
Federal NOL	3,630	306.2	21.5
State NOL	3,630	317.1	38.1
Foreign NOL	3,630	214.7	11.8

Appendix C: Variable Definitions

Variable	Definition
Hand-collected NOL variables	
NOL Benefit	Tax-rate weighted NOL carryforwards divided by total assets
Federal NOL Benefit	NOL benefit for carryforwards at the US federal level (when available) divided by total assets
State NOL Benefit	NOL benefit for carryforwards in US states (when available) divided by total assets
Foreign NOL Benefit	NOL benefit for carryforwards in foreign jurisdictions (when available) divided by total assets
Limited by 382	Indicator variable if footnote discloses NOL carryforwards are limited by Section 382
Valuation allowance > 50%	Indicator variable if valuation allowance exceeds 50% of NOL benefit
NOL Poison pill	Indicator variable for 382-based shareholder rights plan (source: SharkRepellent data from Factset)
Alternative tax/NOL variables	
Compustat NOL	Compustat NOL carryforward (*tlcf*) divided by total assets
Compustat NOL Benefit	Compustat NOL*0.23
Simulated NOL	Simulated NOL carryforward based on time-series of taxable income estimates [(*pi* – *spi* – *txd*)/top stat. rate]. Carryforward estimated using carryback and carryforward rules at the time, beginning with taxable income estimates in 1960. Divided by total assets.
Simulated NOL Benefit	Simulated NOL*0.23
Usable NOL	Min.(NOL Benefit, 0.05)
Excess NOL	NOL Benefit – Usable NOL
$MTR_{\text{after-fin (before-fin)}}$	Simulated marginal tax rate after (before) financing costs available from John Graham's website
Compustat tax variables	
Cash ETR	Cash paid for taxes (*txpd*) divided by pre-tax income (*pi* – *spi*)
Cash tax paid	Cash paid for taxes (*txpd*) divided by total assets (*at*)
Tax paid ≤ 0	Indicator variable if cash taxes paid (*txpd*) less than or equal to zero
Repatriation tax cost	Foreign pre-tax income (*pifo*) * 35% - foreign taxes (*txfo*) divided by total assets. Set equal to zero if negative
Perm. reinvested earnings	Permanently reinvested earnings (*pre*) divided by total assets
Uncertain tax benefits	Reserve for uncertain tax benefits (*txtubend*) divided by total assets
Non-tax firm characteristics	
PTI	Pre-tax income adjusted for special items (*pi* – *spi*) divided by total assets
APTI	PTI – 0.08
$\Sigma PTI_{t-2,t}$	Three-year sum of PTI ending in year *t*, divided by total assets in year *t*
Retained earnings ≤ 0	Indicator variable if retained earnings (*re*) less than or equal to zero
Foreign activity	Indicator variable equal to one if firm discloses non-zero pre-tax foreign income (*pifo*) or foreign taxes (*txdfo* or *txfo*)
Net working capital / Assets	Noncash current assets (*ca* - *che*) less current liabilities (*cl*)
Real book assets	Total assets (*at*) in 2010 dollars
Real market value of assets	Market value of assets (*at* - *ceq* + *prcc_f***csho*) in 2010 dollars
M/B Assets	Market value of assets divided by total assets

R&D	Research and development expense (*xrd*) divided by net sales (*sale*)
Tangibility	Property, plant and equipment, net (*ppent*) divided by total assets
Leverage	Total long-term debt (*dltt* + *dlc*) divided by total assets
Low external financing	Indicator variable if firm was not in top 40% on any single measure of external financing activity for the year (*dltis/at*, *dltr/at*, *sstk/at*, or *prstk/at*)
Low Z-score	Indicator variable if firm in bottom 40% of Altman's Z-score
Fin. constrained (WW)	Indicator variable if Whited-Wu index in top 40% of all firms
Fin. constrained (BGY)	Indicator variable if both low z-Score low external financing
ΔAssets	Change in total assets divided by beginning total assets
Capex	Capital expenditures (*capx*) divided by beginning total assets
Acquisitions	Cash (*cashacq*) and stock acquisitions (*acqcshi**(1/2)*(ending price + beginning price)/2)divided by beginning assets
Net financing	Net stock and debt issuances (*sstk* – *prstkc* + *dltis* – *dltr*) divided by beginning total assets
Net stock issued	Stock issued during the year (*sstk*) - stock repurchased during the year (*prstkc*) divided by beginning total assets
dSM	(ΔCommon shares outstanding (*csho*)*(End share price + Beg share price price)/2) divided by beginning total assets
dSB	(ΔShareholders equity (*seq*) – ΔRetained earnings (*re*)) / beginning total assets
Excess return	The annual return over the fiscal year divided by the return on a size and book-to-market matched portfolio
Valuation regression:	
ΔCash	The change in cash and marketable securities from the prior year divided by beginning market value of equity
NOL Benefits	Potential taxes avoided due to tax loss carryforwards at the beginning of the year, divided by beginning market value
ΔEarn	Change in earnings before extraordinary items (*ib*) divided by beginning market value
ΔNon-cash assets	Change in non-cash assets (*at* – *che*) divided by beginning market value
ΔR&D	Change in R&D expense (*xrd*) divided by beginning market value
ΔInterest	Change in interest expense (*xint*) divided by beginning market value
ΔDividends	Change in dividends (*dvc*) divided by beginning market value
Cash	Cash and marketable securities (*che*) at the beginning of the year divided by beginning market value
Leverage	Total debt (*dltt* + *dltc*) divided by the market value of assets at the end of the year
Stock issued	Stock issued during the year (*sstk*) divided by beginning market value
Stock repurchased	Stock repurchased during the year (*prstkc*) divided by beginning market value
Net debt issued	Debt issued less debt repaid during the year (*dltis* – *dltr*) divided by beginning market value
Accumulation (0,1)	Indicator variable equal to one if the change in cash and marketable securities (*che*) is positive
Debt and equity issued	Debt issued plus stock issued (*dltis* + *sstk*) divided by beginning assets
Asset sales	Cash from sale of PPE plus cash from sale of investments (*sppe* + *siv*) divided by beginning assets

Figure 1: Distribution of hand-collected NOL benefit estimates for US firms between 2010 and 2015, by quantile of Compustat NOL (*tlcf*) estimates



This figure graphs the range of NOL benefit estimates, from the 5th to the 95th percentile, within each quantile of Compustat NOL estimates (*tlcf* / *at*). The first quantile represent firms in which *tlcf* is zero or missing (2,242 observations). The remaining groups comprise 244 to 245 observations each. The highest quantile is excluded from this chart for visual purposes, but NOL benefit estimates (hand-collected) range from 0.166 to 0.342.

Table 1 - Descriptive statistics on NOL carryforwards and NOL benefits

This table reports summary statistics on net operating loss (NOL) carryforwards disclosed in firms' financial statements between 2010 and 2015. Panel A provides the NOL Benefit that is the primary measure in the empirical tests. Panel B provides trends in the average reported tax losses over time for a balanced panel of 770 firms. Panel C presents statistics for industries with the highest and lowest proportion of tax loss firms.

Panel A: Total inferred tax loss benefit (NOL benefit)

	2010 - 2015 (N = 6,120)		
$ in millions	N	Mean	Median
NOL benefit (total)	6,120	$190.6	$39.4
When jurisdiction information available:			
Total NOL Benefit	4,840	$179.8	$39.5
Federal NOL benefit	4,840	99.0	4.9
State NOL benefit	4,840	18.0	2.0
Foreign NOL benefit	4,840	62.9	2.8

Panel B: Trends over time for a balanced panel of 770 firms

	2010	2011	2012	2013	2014	2015
NOL Benefit ($ millions)	$159.7	$171.8	$183.8	$194.6	$194.1	$200.6
When jurisdiction disclosed:						
Federal NOL benefit	75.0	80.4	87.5	87.3	87.2	84.0
State NOL benefit	13.7	14.2	17.3	18.6	18.2	19.8
Foreign NOL benefit	49.6	55.3	59.9	72.9	71.5	77.8
NOL Benefit (scaled by Assets)	0.025	0.024	0.024	0.026	0.021	0.022
When jurisdiction disclosed:						
Federal NOL benefit	0.016	0.015	0.015	0.017	0.012	0.012
State NOL benefit	0.003	0.003	0.003	0.003	0.002	0.002
Foreign NOL benefit	0.005	0.005	0.006	0.008	0.006	0.007

Panel C: Highest and lowest NOL benefits by industry

$ in millions	Average NOL Benefit / Assets (%)	% NOL Benefits > 0	% Compustat NOL > 0
Highest NOL Benefit			
Communication	6.7%	99.2%	73.6%
Pharmaceutical	6.4%	92.6%	66.8%
Automobiles and Trucks	5.2%	87.5%	55.4%
Computers	5.1%	91.8%	78.7%
Electronic Equipment	5.0%	93.8%	73.0%
Lowest NOL Benefit			
Food	0.8%	79.1%	61.0%
Wholesale	0.9%	82.9%	62.6%
Restaurants, Hotels, Motels	0.9%	64.4%	37.0%
Retail	1.1%	77.5%	52.4%
Personal Services	1.2%	83.1%	56.8%

Table 2 – Descriptive statistics

This table reports the average values of key variables for 6,884 firm-year observations of non-financial, non-regulated firms between 2010 and 2015. Among firms reporting NOL carryforwards, firms are ranked into quartiles each year by NOL Benefit, which is the ratio of estimated tax loss benefits to total assets. Variable definitions are described in Appendix C. * denotes the smaller sample of 5,604 observations, comprised of 764 observations with no tax loss carryforwards and 4,840 observations that disclose jurisdiction-level detail on NOLs.

		By size of NOL Benefit				
	All	No NOL	1 - Low	2	3	4 - High
N =	6,884	764	1,529	1,529	1,533	1,529
Hand-collected tax loss variables						
NOL Benefit	0.031	0.000	0.002	0.007	0.020	0.110
Federal NOL Benefit*	0.021	0.000	0.000	0.002	0.009	0.080
State NOL Benefit*	0.003	0.000	0.000	0.002	0.003	0.009
Foreign NOL Benefit*	0.007	0.000	0.001	0.003	0.008	0.017
Detail on jurisdiction (0,1)	0.814	0.000	0.740	0.758	0.807	0.858
Limited by 382 (0,1)	0.198	0.000	0.146	0.148	0.234	0.365
Valuation allowance > 50% (0,1)	0.557	0.000	0.627	0.672	0.596	0.614
Other tax variables						
NOL poison pill (0,1)	0.010	0.000	0.002	0.005	0.001	0.037
Compustat *tlcf* > 0 (0,1)	0.674	0.007	0.673	0.733	0.800	0.824
Compustat NOL Benefit	0.030	0.000	0.006	0.015	0.020	0.096
Cash ETR (*N* = 6,188)	0.232	0.285	0.254	0.247	0.213	0.165
Cash tax paid	0.023	0.042	0.030	0.025	0.018	0.007
Current tax expense	0.023	0.042	0.030	0.026	0.019	0.007
Repatriation tax	0.004	0.002	0.004	0.004	0.004	0.003
Permanently reinvested earnings	0.096	0.040	0.090	0.118	0.117	0.086
Uncertain tax benefits	0.010	0.006	0.007	0.010	0.013	0.010
$MTR_{after\text{-}fin}$ (*N* = 4,242)	0.149	0.336	0.157	0.132	0.108	0.092
$MTR_{before\text{-}fin}$ (*N* = 3,764)	0.322	0.342	0.337	0.335	0.319	0.267
Non-tax variables						
PTI_{t+1}	0.086	0.145	0.113	0.102	0.080	0.019
CFO_t	0.104	0.140	0.114	0.112	0.101	0.071
Foreign activity (0,1)	0.774	0.543	0.783	0.846	0.844	0.771
Market-to-book	1.989	2.346	1.983	1.962	1.813	2.020
R&D	0.043	0.015	0.027	0.035	0.033	0.090
Tangibility	0.265	0.334	0.237	0.238	0.268	0.284
Leverage	0.260	0.182	0.235	0.249	0.265	0.329
Book value of assets ($bn)	8.309	6.923	9.293	12.121	7.406	5.111
Market value of assets ($bn)	10.838	12.913	12.634	16.715	8.619	4.352
Dividend payer	0.552	0.664	0.577	0.639	0.586	0.351
Industry cash flow risk	0.043	0.042	0.039	0.042	0.042	0.048
Financially Constrained (BGY) (0,1)	0.064	0.010	0.024	0.034	0.063	0.160

Table 2 (continued) – Descriptive statistics

		By size of NOL Benefit				
	All	No NOL	1 - Low	2	3	4 - High
N =	6,884	764	1,529	1,529	1,533	1,529
***Cash valuation model variables* (scaled by MVE_t):**						
NOL $Benefit_t$	0.053	0.000	0.002	0.008	0.033	0.198
Excess $Return_{t+1}$	0.014	0.041	0.018	0.014	-0.006	0.015
$\Delta Cash_{t,t+1}$	0.005	-0.000	0.007	0.007	0.002	0.008
$\Delta Earn_{t,t+1}$	0.003	0.003	-0.006	-0.001	-0.005	0.022
$\Delta Noncash\_assets_{t,t+1}$	0.056	0.070	0.077	0.047	0.055	0.037
$\Delta R\&D_{t,t+1}$	0.001	0.001	0.001	0.001	0.001	0.002
$\Delta Interest_{t,t+1}$	0.001	0.000	0.001	0.001	0.002	0.002
$\Delta Dividends_{t,t+1}$	0.001	0.002	0.001	0.001	0.001	0.000
$Cash_t$	0.152	0.105	0.122	0.126	0.150	0.232
Market $leverage_t$	0.186	0.117	0.163	0.171	0.195	0.249
Stock $issued_t$	0.026	0.026	0.030	0.030	0.025	0.019
Stock $repurchased_t$	0.015	0.008	0.011	0.009	0.014	0.028
Net debt $issued_t$	0.027	0.011	0.028	0.023	0.029	0.039
Cash $accumulation_t$ (0,1)	0.538	0.514	0.544	0.548	0.544	0.526
***Cash sources model variables* (scaled by $Assets_t$):**						
$\Delta Cash_{t,t+1}$	0.011	0.007	0.009	0.009	0.008	0.023
Operating cash $flow_{t+1}$	0.112	0.151	0.122	0.118	0.107	0.081
Debt and equity $issues_{t+1}$	0.178	0.134	0.179	0.172	0.180	0.202
Asset $sales_{t+1}$	0.040	0.042	0.039	0.037	0.034	0.048

Table 3 – Relative performance of NOL benefit proxies

This table reports the results from comparing the relative power of NOL benefit proxies in explaining future tax obligations. Panel A reports results using Current tax expense$_{t+1}$ (Columns 1 – 3) and Cash taxes paid $_{t+1}$ (Columns 4 – 6). Columns (1) and (4) reflect results for the full sample; Columns (2) and (5) report results for firm-years with positive pre-tax income; and Columns (3) and (6) report results for firm-years with negative or zero pre-tax income. APTI$_{t+1}$ is the firm's pre-tax income, de-meaned to amount of pre-tax income to facilitate interpretation of the coefficients; specifically, is the ratio of pre-tax income to total assets, less the average PTI$_{i,t+1}$ for the sample. NOL benefit is the amount calculated using the methodology in Table 1. Panel B presents results after decomposing the amount of NOL into "usable" and "excess" portions. Panel C presents results after decomposing the NOL into domestic and foreign components and based on the firm's geographic presence (domestic-only vs. multinational). All variables are defined in Appendix C. ***, **, and * indicate significance at the 0.01, 0.05 and 0.10 levels based on robust Z-statistics (in parentheses) using standard errors clustered at the firm level.

Panel A: Comparing tax shield performance for hand-collected vs. Compustat data

Dependent variable =	Current tax expense$_{t+1}$			Cash taxes paid$_{t+1}$		
Sample =	All Firms	PTI$_{t+1}$ > 0	PTI$_{t+1}$ ≤ 0	All Firms	PTI$_{t+1}$ > 0	PTI$_{t+1}$ ≤ 0
N =	6,884	6,108	776	6,884	6,108	776
	(1)	(2)	(3)	(4)	(5)	(6)
Hand-collected NOL						
APTI$_{t+1}$	0.23***	0.29***	0.01**	0.21***	0.27***	0.01***
	(25.81)	(31.01)	(2.40)	(29.70)	(42.37)	(3.59)
NOL Benefit$_t$	-0.06***	-0.05***	0.00	-0.08***	-0.06***	-0.00
	(-6.29)	(-6.07)	(0.57)	(-10.10)	(-10.47)	(-0.71)
APTI$_{t+1}$ × NOL Ben.$_t$	-0.77***	-0.71***	-0.00	-0.80***	-0.89***	-0.01
	(-11.21)	(-5.66)	(-0.25)	(-13.78)	(-7.07)	(-0.34)
R-squared	0.565	0.627	0.015	0.603	0.670	0.022
Hand-collected vs. Compustat NOL						
APTI$_{t+1}$	0.23***	0.29***	0.01**	0.21***	0.27***	0.01***
	(25.82)	(30.91)	(2.40)	(29.69)	(41.89)	(3.65)
NOL Benefit$_t$	-0.06***	-0.05***	0.00	-0.06***	-0.05***	-0.01
	(-4.60)	(-4.53)	(0.03)	(-5.25)	(-5.65)	(-1.15)
Compustat NOL Benefit$_t$	-0.01	-0.00	0.00	-0.03***	-0.02**	0.01
	(-0.85)	(-0.10)	(0.37)	(-3.32)	(-2.43)	(0.80)
APTI$_{t+1}$ × NOL Ben.$_t$	-0.59***	-0.60***	-0.01	-0.62***	-0.53***	-0.01
	(-6.60)	(-3.54)	(-0.35)	(-6.48)	(-3.04)	(-0.41)
APTI$_{t+1}$ × Comp. NOL Ben.$_t$	-0.12	-0.17	0.01	-0.25***	-0.58***	0.00
	(-1.05)	(-0.77)	(0.23)	(-2.67)	(-3.18)	(0.80)
R-squared	0.565	0.628	0.015	0.605	0.673	0.024

Table 3 (continued) – Relative performance of NOL benefit proxies

Panel B: Comparing tax shield performance after decomposing available vs. excess NOL

Dependent variable =	Current tax expense $_{t+1}$			Cash taxes paid$_{t+1}$		
Sample =	All Firms	$PTI_{t+1} > 0$	$PTI_{t+1} \leq 0$	All Firms	$PTI_{t+1} > 0$	$PTI_{t+1} \leq 0$
N =	6,884	6,108	776	6,884	6,108	776
	(1)	(2)	(3)	(4)	(5)	(6)
Hand-collected NOL						
$APTI_{t+1}$	0.27***	0.30***	0.01	0.25***	0.28***	0.02***
	(24.52)	(25.08)	(1.28)	(31.03)	(34.83)	(3.80)
NOL Benefit$_t$						
Usable NOL	-0.23***	-0.19***	-0.02	-0.25***	-0.20***	-0.11***
	(-7.85)	(-8.79)	(-0.37)	(-9.63)	(-10.85)	(-3.10)
Excess NOL	-0.00	0.00	0.01	-0.02*	-0.01**	0.01*
	(-0.05)	(0.04)	(0.93)	(-1.92)	(-2.02)	(1.68)
$APTI_{t+1}$ × NOL Ben.$_t$						
Usable NOL	-4.07***	-2.29***	-0.15	-3.98***	-2.64***	-0.34***
	(-10.37)	(-3.32)	(-0.59)	(-12.10)	(-4.62)	(-2.66)
Excess NOL	-0.07	-0.30*	0.01	-0.11*	-0.44***	0.04**
	(-0.94)	(-1.73)	(0.48)	(-1.80)	(-2.80)	(2.11)
R-squared	0.606	0.637	0.016	0.649	0.682	0.040
Hand-collected vs. Compustat NOL						
$APTI_{t+1}$	0.27***	0.30***	0.01	0.25***	0.28***	0.02***
	(24.35)	(24.68)	(1.27)	(30.80)	(34.38)	(3.79)
NOL Benefit$_t$						
Usable NOL	-0.21***	-0.18***	-0.02	-0.22***	-0.19***	-0.09***
	(-6.28)	(-6.95)	(-0.33)	(-7.41)	(-8.54)	(-2.70)
Excess NOL	-0.01	-0.00	0.00	-0.00	-0.01	0.01
	(-0.30)	(-0.31)	(0.15)	(-0.33)	(-0.51)	(0.59)
Compustat NOL Benefit$_t$						
Usable NOL	-0.02	-0.01	0.00	-0.03	-0.01	-0.01
	(-0.73)	(-0.37)	(0.00)	(-1.15)	(-0.64)	(-0.42)
Excess NOL	0.01	0.01	0.00	-0.02*	-0.02*	0.00
	(0.35)	(0.37)	(0.30)	(-1.80)	(-1.85)	(0.37)
$APTI_{t+1}$ × NOL Ben.$_t$						
Usable NOL	-3.62***	-1.96**	-0.13	-3.27***	-1.82***	-0.18
	(-6.75)	(-2.57)	(-0.48)	(-6.81)	(-2.67)	(-1.12)
Excess NOL	-0.13	-0.35	-0.00	-0.12	-0.30	0.01
	(-0.92)	(-1.48)	(-0.01)	(-0.90)	(-1.27)	(0.30)
$APTI_{t+1}$ × Comp. NOL Ben.$_t$						
Usable NOL	-0.58	-0.44	-0.02	-0.88*	-0.95	-0.17
	(-1.10)	(-0.67)	(-0.15)	(-1.85)	(-1.56)	(-1.56)
Excess NOL	-0.08	0.10	0.01	-0.02	-0.28	0.03
	(0.56)	(0.40)	(0.27)	(-0.13)	(-1.40)	(0.81)
R-squared	0.606	0.661	0.137	0.651	0.684	0.043

Table 3 (continued) – Relative performance of NOL benefit proxies

Panel C: Comparing tax shield performance using jurisdiction data on NOLs

Dependent variable =	Current tax expense $_{t+1}$			Cash taxes paid$_{t+1}$		
Sample =	Avail. NOL Jurisdiction	Domestic-only Firms	MNCs	Avail. NOL Jurisdiction	Domestic-only firms	MNCs
N =	5,604	1,268	4,336	5,604	1,268	4,336
	(1)	(2)	(3)	(4)	(5)	(6)
$APTI_{t+1}$	0.23***	0.23***	0.23***	0.21***	0.21***	0.21***
	(23.02)	(14.50)	(18.73)	(25.90)	(13.77)	(23.82)
Domestic NOL Benefit$_t$	-0.06***	-0.12***	-0.04***	-0.09***	-0.14***	-0.07***
	(-5.15)	(-4.50)	(-3.05)	(-9.45)	(-8.83)	(-6.43)
Foreign NOL Benefit$_t$	-0.12***		-0.12***	-0.04*		-0.03
	(-3.77)		(-3.81)	(-1.65)		(-1.40)
$APTI_{t+1}$ × Dom. NOL Ben.$_t$	-0.82***	-1.06***	-0.71***	-0.87***	-1.07***	-0.79***
	(-10.16)	(-5.31)	(-8.50)	(-12.65)	(-7.04)	(-10.66)
$APTI_{t+1}$ × For. NOL Ben.$_t$	-1.44***		-1.47***	-1.23**		-1.28**
	(-2.69)		(-2.65)	(-2.42)		(-2.52)
R-squared	0.562	0.644	0.532	0.601	0.637	0.591

Table 4 – NOL benefits and cash holdings

This table presents the results from regressions of cash holdings on tax loss benefits for a sample of non-financial and non-regulated firms between 2010 and 2015. Panel A reports results for all firms in the sample and partitioned by multinational status in columns (3) and (4). Panel B reports the results for multinational firms including interactions with repatriation tax cost and jurisdiction-specific NOL benefits when available. The dependent variable is the natural log of the ratio of cash and short-term investments to total assets. All variables are defined in Appendix C. The specification includes industry and year fixed effects. ***, **, and * indicate significance at the 0.01, 0.05 and 0.10 levels and reflect standard errors clustered at the firm level.

Panel A: NOLs the cash holding decision

	Dependent variable = ln($Cash_t$/$Assets_t$)			
	All	All	Domestic only	MNC only
	(1)	(2)	(3)	(4)
NOL $Benefit_t$	0.12***	0.12**	0.21***	0.05
	(2.62)	(2.40)	(2.92)	(0.94)
Repatriation tax $cost_t$		2.59***		2.56***
		(7.11)		(7.02)
Uncertain tax $benefits_t$ (UTB)		0.32*	0.60	0.33*
		(1.81)	(1.29)	(1.91)
ln(BVA_t)	-0.01***	-0.02***	-0.02***	-0.01***
	(-6.60)	(-8.65)	(-6.12)	(-6.73)
Net working $capital_t$	-0.24***	-0.25***	-0.30***	-0.23***
	(-12.14)	(-12.55)	(-8.39)	(-10.06)
Market-to-$book_t$	0.02***	0.02***	0.01***	0.02***
	(8.38)	(8.10)	(3.49)	(7.62)
CFO_t	0.18***	0.11***	0.14***	0.13***
	(4.93)	(3.31)	(2.85)	(3.59)
R&D_t	0.09**	0.09**	0.05**	0.08**
	(2.12)	(2.16)	(2.00)	(1.99)
$Capex_t$	-0.32***	-0.29***	-0.30***	-0.24***
	(-10.22)	(-9.47)	(-6.50)	(-6.06)
Cash $acquisitions_t$	-0.27***	-0.26***	-0.17***	-0.29***
	(-15.02)	(-15.11)	(-4.68)	(-14.29)
Dividend $payer_t$	-0.02***	-0.02***	-0.00	-0.02***
	(-4.29)	(-4.02)	(-0.24)	(-4.33)
$Leverage_{t-1}$	-0.15***	-0.14***	-0.13***	-0.15***
	(-13.15)	(-13.04)	(-7.90)	(-11.42)
Net debt $issue_{t-1}$	0.17***	0.16***	0.08***	0.17***
	(10.30)	(10.23)	(2.98)	(9.67)
Industry cash flow $risk_t$	0.51***	0.46***	0.52***	0.40***
	(5.42)	(5.16)	(4.05)	(3.29)
N	6,884	6,884	1,460	5,424
R-squared	0.546	0.566	0.680	0.556

Table 4 (continued) – NOL benefits and cash holdings

Panel B: Multinational firms, NOL source, and cash holdings

Sample	Dependent variable = ln($Cash_t$/$Assets_t$)			
	All MNC	MNC w/ NOL jurisdiction		
	Total NOL w/ Repat. tax cost interaction	Total NOL w/ Repat. tax cost interaction	NOL jurisdiction w/o interaction	NOL jurisdiction + w/ Repat. tax cost interaction
	(1)	(2)	(3)	(4)
NOL $Benefit_t$				
All NOLs	0.12**	0.11*		
	(2.22)	(1.87)		
Domestic NOLs			0.10	0.17**
			(1.49)	(2.32)
Foreign NOLs			-0.28*	-0.18
			(1.91)	(-1.11)
Repatriation tax $cost_t$	3.09***	2.87***	2.39***	2.92***
	(7.91)	(6.63)	(5.88)	(6.52)
Uncertain tax $benefits_t$ (UTB)	0.31*	0.45**	0.50***	0.48**
	(1.82)	(2.34)	(2.63)	(2.49)
NOL $Benefit_t$ × Repat.tax $cost_t$				
All NOLs	-17.43***	-14.62**		
	(-2.88)	(-2.21)		
Domestic NOLs				-14.10*
				(-1.63)
Foreign NOLs				-21.59
				(-1.17)
Control variables	Yes	Yes	Yes	Yes
N	5,424	4,336	4,336	4,336
R-squared	0.560	0.577	0.569	0.571

Table 5 - NOL benefits and the valuation of cash

This table reports the regressions of excess stock returns between 2011 and 2016 on the change in cash, NOL benefit as of the beginning of the year, and the interaction between the two, as well as control variables for 6,884 firm-year observations. The explanatory variables following Faulkender and Wang (2006). All variables except leverage are scaled by beginning market value of equity. All variables are defined in Appendix C. The specification includes industry and year fixed effects. ***, **, and * indicate significance at the 0.01, 0.05 and 0.10 levels and reflect standard errors clustered at the firm level.

	Dependent Variable = Excess Returns$_{t+1}$				
	All	All	Domestic only	MNC only	MNC w/ NOL juris.
	(1)	(2)	(3)	(4)	(5)
ΔCash$_{t,t+1}$	0.59***	0.59***	0.75***	0.60***	0.60***
	(3.31)	(3.51)	(2.77)	(4.72)	(4.48)
NOL Benefits$_t$					
Total		0.26***	0.36***	0.18***	
		(4.65)	(3.59)	(2.75)	
Domestic					0.16***
					(2.04)
Foreign					0.30
					(1.34)
ΔCash$_{t,t+1}$ × NOL Benefits$_t$					
Total		0.87***	0.64**	0.81**	
		(4.38)	(2.56)	(2.54)	
Domestic					0.62*
					(1.66)
Foreign					0.57
					(0.30)
ΔEarn$_{t,t+1}$	0.32***	0.30***	0.21***	0.37***	0.39***
	(7.40)	(6.83)	(3.18)	(6.87)	(6.80)
ΔNoncash_assets$_{t,t+1}$	0.10***	0.11***	0.09***	0.14***	0.13***
	(5.08)	(5.32)	(3.33)	(5.21)	(4.60)
ΔR&D$_{t,t+1}$	1.72**	1.78**	3.91**	1.12	1.07
	(2.38)	(2.51)	(2.28)	(1.46)	(1.30)
ΔInterest$_{t,t+1}$	-1.64**	-1.57**	-2.54***	-0.59	-0.65
	(-2.42)	(-2.42)	(-2.91)	(-0.57)	(-0.93)
ΔDividends$_{t,t+1}$	0.36	0.40	0.52	0.50	0.51
	(1.31)	(1.48)	(1.13)	(1.58)	(1.45)
Cash$_{t,}$	0.12***	0.06	0.03	0.13***	0.14**
	(2.79)	(1.56)	(0.59)	(2.76)	(2.36)
Market leverage$_t$	-0.37***	-0.44***	-0.53***	-0.43***	-0.43***
	(-11.45)	(-12.43)	(-7.35)	(-10.06)	(-9.08)
Stock issued$_t$	0.55***	0.47***	0.20	0.68***	0.66***
	(3.94)	(3.61)	(1.12)	(3.94)	(3.66)
Stock repurchased$_t$	0.28**	0.33***	0.17	0.44***	0.44***
	(2.48)	(2.95)	(0.63)	(3.60)	(3.22)
Net debt issued$_t$	-0.08	-0.07	0.03	-0.19***	-0.16**
	(-1.60)	(-1.47)	(0.55)	(-2.92)	(-2.42)
Cash accumulation$_t$ (0,1)	0.03***	0.03***	0.03	0.04***	0.04***
	(2.90)	(3.02)	(1.12)	(3.56)	(3.45)
ΔCash$_{t,t+1}$ × Cash$_t$	-0.07	-0.21***	-0.18**	-0.13	-0.24
	(-0.97)	(-2.54)	(-2.29)	(-1.14)	(-1.59)
[ΔCash/lag(MVE)] x [Debt/MV	-0.59	-0.80**	-1.06**	-0.59	-0.25
Assets]	(-1.42)	(-2.15)	(-2.49)	(-1.39)	(-0.63)
N / *R*-squared	6,884 / 0.152	6,884 / 0.170	1,460 / 0.225	5,424 / 0.173	4,336 / 0.178

Table 6 - NOL benefits and the source of cash

This table reports the regressions of annual changes in cash between 2011 and 2016 on the operating cash flows, debt and equity issuances, sales of assets (PPE and investments), and NOL benefits as of the beginning of the year for 6,884 firm-year observations. The explanatory variables follow Duchin et al. (2017). All variables are scaled by beginning total assets. All variables are defined in Appendix C. The specification includes industry and year fixed effects. ***, **, and * indicate significance at the 0.01, 0.05 and 0.10 levels form standard errors clustered at the firm level and reported in parentheses.

	Dependent Variable = $\Delta Cash_{t,t+1}$		
	(1)	(2)	(3)
Operating cash flow$_{t+1}$	0.23***	0.26***	0.24***
	(7.49)	(8.49)	(9.60)
Debt and equity issues$_{t+1}$	0.05***	0.05***	0.02
	(5.09)	(4.94)	(1.47)
Asset sales$_{t+1}$	0.08***	0.08***	0.03
	(3.17)	(3.15)	(1.30)
NOL Benefits$_t$		0.24***	-0.03
		(5.40)	(-0.67)
Operating cash flow$_{t+1}$ × NOL Benefits$_t$			0.60
			(1.46)
Debt and equity issues$_{t+1}$× NOL Benefits$_t$			0.75***
			(3.62)
Asset sales$_{t+1}$ × NOL Benefits$_t$			0.84***
			(3.10)
N	6,884	6,884	6,884
R-squared	0.081	0.105	0.149

Table 7 - Alternative tax benefit proxies: Compustat NOL, simulated NOL, and marginal tax rates

This table reports the results from replicating the cash holdings and cash valuation regressions with alternative measures of tax benefits. The alternative measures include: 1) Compustat NOL benefit equal to 0.23**tlcf*, 2) a simulated NOL benefit equal to the simulated NOL described in the text times 0.23, and 3) Graham's after-financing marginal tax rate, multiplied by -1. All control variables are included. Variables are defined in Appendix C. ***, **, and * indicate significance at the 0.01, 0.05 and 0.10 levels using *Z*-statistics based on standard errors clustered at the firm level. Industry and year fixed effects are included.

Panel A: Determinants of cash with alternative tax benefit proxies

	Dependent variable = ln($Cash_t$/$Assets_t$)			
	All	Domestic only	MNC only	MNC w/ Repat. Interaction
	(1)	(2)	(3)	(4)
Benchmark results from Table 4				
NOL Benefit (hand-coll.)	0.12***	0.21***	0.05	0.12**
NOL Ben. × Repat.				-17.43***
N / R-sq	6,884 / 0.55	6,884 / 0.68	5,424 / 0.56	5,424 / 0.56
Results from alternative tax proxies				
Compustat NOL Ben.	0.08	0.25***	0.00	0.06
Comp. NOL × Repat.				-13.09**
N / R-sq	6,884 / 0.56	1,460 / 0.68	5,424 / 0.56	5,424 / 0.56
Sim. NOL Ben.	0.27***	0.08	0.23***	0.24***
Sim. NOL × Repat.				-6.45
N / R-sq	6,884 / 0.56	1,460 / 0.68	5,424 / 0.56	5,424 / 0.56
-1*MTR (after-tax)	0.00	-0.05	-0.01	0.00
-1*MTR × Repat.				1.96
N / R-sq	4,242 / 0.59	788 / 0.76	3,454 / 0.57	3,454 / 0.57

Table 7 (continued) - Alternative tax benefit proxies: Compustat NOL, simulated NOL, and marginal tax rates

Panel B: Valuation of cash across alternative tax benefit proxies

	Dependent variable = Excess Returns$_{t+1}$		
	All	Domestic only	MNC only
	(1)	(2)	(3)
Benchmark results from Table 5			
ΔCash$_{t,t+1}$	0.59***	0.75**	0.60***
NOL Benefit (Hand-coll.)	0.26***	0.36***	0.18***
ΔCash$_{t,t+1}$ × NOL Ben.	0.87***	0.64**	0.81**
N / R-sq	6,884 / 0.16	1,460 / 0.23	5,424 / 0.17
Results from alternative tax proxies			
ΔCash$_{t,t+1}$	0.55***	0.67**	0.63***
Compustat NOL Ben.	0.24***	0.44***	0.10
ΔCash$_{t,t+1}$ × Comp. NOL	0.89***	0.68**	0.59
N / R-sq	6,884 / 0.16	1,460 / 0.23	5,424 / 0.17
ΔCash$_{t,t+1}$	0.60***	0.72***	0.62***
Simulated NOL Ben.	0.00	-0.00	0.02
ΔCash$_{t,t+1}$ × Sim. NOL	0.24	0.60*	-0.07
N / R-sq	6,884 / 0.16	1,460 / 0.21	5,424 / 0.17
ΔCash$_{t,t+1}$	0.70***	1.51*	0.56***
-1*MTR (after-tax)	0.06**	0.17*	0.04
ΔCash$_{t,t+1}$ × -1*MTR	0.59	0.73	0.43
N / R-sq	4,242 / 0.17	788 / 0.30	3,454 / 0.16