Net Operating Loss Carryforwards and Corporate Financial Policies

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Abstract

We examine the relation between net operating loss (NOL) carryforwards and external financing and liquidity decisions using hand-collected data that more precisely measure the expected value of these tax shields. NOL carryforwards drive variation in corporate tax status and are a key input into proxies such as simulated tax rates. Despite their importance, it is widely recognized that the readily-available proxy for NOLs from Compustat suffers from considerable measurement error. We first show that a measure constructed from our data can better predict cash tax shields on future profits relative to the Compustat measure. NOL benefits are positively associated with equity financing, consistent with NOL firms substituting from debt to equity when NOLs reduce the present value of interest deductions. Furthermore, this positive association between NOLs and equity issuances occurs within firms that are less sensitive to statutory limitations on NOL utilization triggered by changes in equity ownership. NOL benefits are also associated with larger corporate cash balances, consistent with NOLs lowering the tax cost of holding cash and liquid investments. These results inform the academic literature by quantifying the improvement in NOL measurement using data directly from the financial statement footnotes and documenting important firm decisions associated with a firm's NOLs. Furthermore, the results inform the current policy debate regarding whether to alter the U.S. tax loss rules.

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

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1. Introduction

Central questions in corporate finance concern whether and to what extent taxes influence firms' financial policies, including the mix between debt and equity, as well as how much cash to retain inside the company. Prior literature suggests that firms facing high tax rates should issue more debt and hold less cash. Specifically, the tax deductibility of interest payments, but not of dividends, provides a tax advantage to issuing debt that is increasing in the firm's marginal tax rate (DeAngelo and Masulis 1980; MacKie-Mason 1990; Graham 1996b). Similarly, the taxation of corporate income earned on passive investments is an important cost associated with the firm's retention and investment of cash (Riddick and Whited 2009; Duchin et al. 2017). Prior research has focused on refining the measurement of a firm's tax status to better identify and study these financing decisions (Shevlin, 1990; Graham, 1996a; Graham, Lemmon and Schallheim, 1998; Blouin, Core and Guay, 2010; Heider and Ljungqvist, 2015; Faulkender and Smith, 2016). However, relatively few studies address the mismeasurement in a primary driver of corporate tax status—a firm's net operating loss (NOL) carryforward. In this paper, we ask two broad questions: 1) does a more precise measure of the benefits from NOL carryforwards, obtained from financial statement disclosures, offer a material improvement in the measurement of corporate tax status, and if so, 2) are these NOL benefits associated with firms' financing and savings policies?

Net operating loss carryforwards are options to reduce future cash tax obligations owed to taxing authorities in profitable years and are economically significant to both 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 corporate tax revenues by $700 billion (assuming a 35% tax rate).[1] These losses are not confined to small firms; our data reveal that nearly 90% of large U.S. public firms report NOL carryforwards in at least one jurisdiction, largely from U.S. Federal losses. Given their increasing importance on corporate balance sheets, tax loss carryforwards are likely to influence important firm decisions.

We develop a new measure, based on hand-collected data, which more accurately reflects the variation in worldwide NOL benefits. Aside from the few studies using proprietary IRS data (Graham and Mills 2008; Cooper and Knittel 2010), prior research relies almost exclusively on a readily-available, but highly imperfect proxy from Compustat (data item *tlcf*) to identify the amount of NOL carryforwards (MacKie-Mason 1990; Graham 1996b).[2] Key shortcomings of *tlcf*, discussed as early as Auerbach and Poterba (1987) and more recently by Mills, Newberry and Novack (2003), include the failure to identify the presence of NOLs and to distinguish the jurisdictions in which they were generated. To address these concerns, we develop an alternative measure of expected NOL benefits based on the firm's total worldwide tax losses, as disclosed in the notes to a firm's financial statements. We show that our measure of NOL benefits is superior to the summary measure provided in Compustat by quantifying the incorrect incidence of tax losses based on *tlcf* and by showing that our measure can better predict future cash tax savings relative to *tlcf*. We then use our more accurate proxy to empirically test the association between these NOL benefits and firm financing and savings policies.

Prior literature motivates our predictions for the relation between NOLs and firm financing policies. Under the tradeoff theory of capital structure, non-debt corporate tax shields—such as

[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)
[2] These authors acknowledge these shortcomings of using *tlcf* in their studies.

tax loss carryforwards—significantly reduce the marginal tax benefits of debt (DeAngelo and Masulis, 1980; Graham, 1996). While debt is a key source of external funding, NOL carryforwards increase the after-tax cost of debt financing by crowding out and thus reducing the present value of interest deductions.[3] Thus, if firms require external financing, and if managers respond to the relative after-tax costs of debt and equity in choosing the type of external financing, we predict that firms with greater NOL benefits should choose to issue less debt and/or more equity than firms with fewer (or no) NOL carryforwards. That is, we expect a negative (positive) association between NOL benefits and debt (equity) issuances.

A related decision is whether firms build liquidity reserves for precautionary purposes, such as in anticipation of high external financing costs or cash flow uncertainty. In addition to agency conflicts that reduce investors' valuation of cash reserves (Dittmar and Mahrt-Smith 2007), corporate taxes are also recognized as a potential cost of accumulating excess cash (Riddick and Whited 2009). This is because it is generally more tax-efficient for the firm to distribute excess cash to shareholders than for the company to retain it and generate passive investment income subject to double taxation (Smith and Warner 1979; Duchin et al. 2017, Appendix C). However, an NOL carryforward directly lowers the tax cost of corporate savings by shielding the investment income from corporate tax. Thus, if NOLs reduce the tax cost of corporate savings, we expect a positive association between NOL benefits and cash holdings.

To test our predictions, we first construct a comprehensive panel of NOL carryforward data for a large sample of U.S. firms from 2010 to 2015 using hand-collected information from firms' publicly-available financial statements. We show that Compustat understates the frequency of

[3] Specifically, firms that have existing tax losses may not be able to immediately deduct interest expense paid on borrowing; instead, the interest deductions will add to the existing tax loss and be carried forward. Thus, an interest deduction may not be used until a future period if/when the company reports taxable income.

firms with NOL carryforwards: 89 percent of the observations in our sample report an NOL carryforward in the footnotes, whereas Compustat identifies just 67 percent among the same observations based on data item *tlcf*. One-quarter of our NOL observations are missing a value for *tlcf*, yet the estimated NOL tax benefits for these firms average $213 million. When *tlcf* is available, estimated NOL carryforwards are approximately 27.5 percent higher than the figure reported by Compustat ($838.0 million from our data compared to $657.1 million using *tlcf*).

Our hand-collected NOL data not only allow us to more accurately identify which firms have NOL carryforwards, they permit us to more precisely measure the total dollar amount and worldwide distribution of these tax attributes. Using these data, we derive an estimate of the NOLs' undiscounted value that weights each dollar of a firm's pre-tax NOL carryforward by an estimated statutory tax rate for the jurisdiction in which the NOL was generated (the "NOL benefit").[4] Based on the 67% of NOL firms that disclose the location of the carryforward, the $838 million in average total NOL carryforwards is comprised of 37.8% in state NOLs ($317 million) and 25.6% in foreign NOLs ($214.7 million).[5] The primary measure used in the empirical tests is the NOL benefit, calculated as the maximum potential cash tax savings from existing tax loss carryforwards reflecting location-specific rates, scaled by total assets.

A suitable proxy for NOL benefits should predict reductions in future tax payments. Therefore, we validate our measure by comparing its ability to explain future cash tax savings to that of the commonly-used Compustat-based measure. Conditional on having positive pretax income in year *t*+1 (more likely to generate cash tax savings from utilization of an NOL carryforward), we find

[4] Our calculation assumes that the entire pool of NOLs is immediately available for use, and therefore our estimates of NOL benefits should be viewed as upper bounds on the potential value of the NOL asset.

[5] Compustat-based measures ignore this obvious distinction in potential cash value, blending jurisdiction-specific pre-tax amounts into a single reported tax loss carryforward (*tlcf*). Compustat treats a firm with one dollar of Federal NOLs and one dollar of state NOLs as having two dollars in total NOLs, even though firms do not generate their NOLs in the same proportions across geographical boundaries even though tax rates vary across major jurisdictions.

the expected result the cash tax paid per dollar of pretax income in year $t+1$ is negatively associated with the NOL benefit available at the beginning of year $t+1$. Moving from the bottom to the top quartile of NOL benefits is associated with approximately a ten percentage point decline in the average cash effective tax rate. Importantly, our proxy for NOL benefits outperforms a *tlcf*-based measure: the association between a *tlcf*-based measure and cash tax savings on future pretax profits is statistically insignificant when the rival proxies are both included in the model.

We next provide evidence on the factors correlated with NOL benefits to study the types of firms reporting losses and, more specifically, to assess if NOL benefits are simply another signal of financial distress. As expected, prior cumulative pre-tax losses explain a significant portion of firms' NOL benefit. However, NOL benefits are also positively associated with market-to-book ratios, R&D expenditures, and foreign operations, reflective of firms with significant investment opportunities. To confirm the existence of growth opportunities among NOL firms, which likely affect the demand for external financing, we test and find that the NOL benefit is positively and significantly associated with future growth in total assets, capital expenditures, and R&D.

Having shown that our hand-collected NOL data perform better at predicting future tax shields, we then test our predictions on the association between NOL benefits and future external financing decisions. External financing activity from all sources is positively associated with the NOL tax benefit, consistent with these firms seeking capital to fund firms' asset growth. We then show, consistent with our predictions, that NOL benefits have a differential relation with debt and equity issuances. Adjusting for the growth in cash, we find the expected negative association between NOL benefits and future net debt issuances (debt issued less debt repaid); a ten percentage point increase in NOL benefits is associated with a decrease in net debt issuances of 0.9% of assets. We observe a significantly positive relation between NOL benefits and new equity financing,

consistent with firms choosing to issue equity when borrowing is otherwise relatively costly in the presence of NOL carryforwards. Our estimates suggest that an increase in NOL benefits of ten percentage points is associated with additional net equity issuances (stock issued less stock repurchased) of 1.2% of assets. These results are robust to alternative measures of equity financing and including only intentional financing decisions (greater than 2% of assets), as well as discrete choice models of seasoned offerings and large financing issuances.

Next, we extend these findings by asking whether NOL carryforwards can impose a cost on accessing external equity. Specifically, new equity issuances, trades in secondary markets, and even some repurchases can sufficiently change the composition of equity ownership in a way that triggers statutory limitations on the firm's ability to use its US NOL carryforwards in future periods.[6] Consequently, NOL carryforwards can indirectly increase the cost of equity financing if accessing equity raises the probability of triggering this future limitation. Consequently, we predict that the positive relation between NOL benefits and equity issuances will be attenuated when an equity issuance increases the risk of triggering this U.S. limitation. We obtain data on these limitations and find that, in our sample, 22% of the firms with tax losses have previously triggered this limitation and therefore may less discouraged from issuing equity. Consistent with our prediction, we find that the positive relation between NOL benefits and equity issuances is reduced and largely disappears for firms that face an elevated risk of a future limitation on their NOL benefits.

[6] In short, if ownership by 5 percent shareholders changes by more than 50 percent within a three-year period, the amount of tax losses that can be used in future years is subject to a statutory limitation under IRC Section 382. While this U.S. rule was implemented to discourage firms from acquiring tax loss firms only for the expected future tax benefits, this limitation can affect any firm that crosses the 50 percent ownership change threshold. That is, the limitation can be triggered even without an acquisition of controlling interest by any single party. In response to the threat of the potential limitation on NOLs, hundreds of firms have adopted "NOL Poison Pills", mechanisms that preclude 5% block acquisitions without board approval (Erickson and Heitzman 2010; Sikes et al. 2014).

Turning to the liquidity decision, we find that corporate cash is positively associated with the firm's NOL benefits, consistent with NOLs shielding investment income from corporate taxation and reflecting a potential tax incentive to save excess cash in the corporation. These results are robust to controlling for other tax-related determinants of cash holdings, such as repatriation taxes (Foley et al. 2007) and reserves for uncertain tax positions (Hanlon, Maydew and Saavedra 2017). In additional tests that consider the interactions between NOLs, repatriation taxes, and tax planning, we find that NOL benefits relax the trapped cash problem by shielding the firm from repatriation taxes and reducing the need to reserve cash for future settlements with tax authorities.[7]

We next test whether the NOL-driven increase in cash holdings is value-increasing. If the larger cash balances held by NOL firms are driven by a corporate tax advantage to savings that increases after-tax returns to investors, investor valuation of corporate cash should also be increasing in NOL benefits. To test this, we follow Faulkender and Wang (2006) and examine the valuation of cash holdings by regressing annual excess stock returns on the annual change in cash. The results are consistent with our prediction that investors place a significantly higher value on corporate cash when NOL benefits shield investment returns from corporate taxation.

We conduct several additional robustness tests. First, we address concerns that the NOL benefit is simply a proxy for non-tax financial constraints. We control for traditional measures of

[7] Although corporate taxes play a key conceptual role in many recent studies, the empirical evidence directly linking corporate taxes to cash holding decisions is limited, with the exception of the literature on repatriation taxes (e.g. Foley et al. 2007; Hanlon et al., 2015; Nessa, 2017; Harford et al., 2017; De Simone et al., 2017; De Simone and Lester, 2017). US firms that generate profits in low-tax foreign subsidiaries are taxed again when the earnings are repatriated to the US parent. This tax can be avoided by leaving the earnings in the foreign subsidiary, leading to a "trapped cash" problem. We acknowledge that these repatriation taxes are an important first order determinant of cash holdings and thus attempt to control for this factor in all of our tests of cash holdings by including the *REPAT* variable from these prior studies. Furthermore, we note that the firm's NOLs–specifically those generated in the US—can be used to offset this tax to the extent that firms choose to repatriate. To the extent NOLs relax this repatriation tax constraint, we expect that the impact of repatriation taxes on cash holdings should be mitigated when the firm has domestic NOLs. In additional analyses, we also test and find this expected result: U.S. MNCs' domestic NOLs appear to shield the foreign profits from incremental US tax.

financial constraints in our financing, cash holdings, and cash valuation regressions and find that our results continue to hold. Second, we also address whether a firm's simulated marginal tax rate should better capture the relevant information because it also incorporates forecasts of future pretax income. We find that an alternative measure of tax status based on simulated rates does not explain cash tax savings, financing, or cash holdings decisions.

Our study contributes to the literature several ways. First, we address the well-known criticisms of the Compustat-based proxy for NOL carryforwards by showing that a measure that comprehensively identifies NOLs reported in the footnotes, and incorporates information about their location and limitations, can explain financial policies when other proxies cannot. Our approach offers a material improvement in the identification of potential NOL tax benefits and suggests an avenue for future improvements in simulated tax rates following a recent literature that develops alternative methodologies for forecasting taxable income (Blouin, Core, and Guay 2010) or incorporating multinational tax exposure (Faulkender and Smith 2016).

Second, this paper adds to the corporate finance literature by studying how managers respond to a key tax shield, NOL carryforwards. We find that NOL benefits affect external financing and cash savings, consistent with traditional tax predictions. Moreover, we are (to our knowledge) the first paper to show that the threat of statutory limitations on NOLs in the US can mitigate incentives to shift to equity financing when tax benefits from interest deductions on corporate borrowing are low. Our results also add to the literature on repatriation taxes and cash holdings (Foley et al. 2007) by showing that domestic NOLs may mitigate the trapped cash problem. Finally, our results appear consistent with survey evidence in Graham et al. (2017), who find that managers appear more likely to base their decisions on relatively simple tax heuristics such as the statutory or effective tax rate. If managers treat the firm with persistent NOL carryforwards to be "temporarily

tax exempt" as suggested by Auerbach and Poterba (1987), this offers one explanation for our findings that financial policies are correlated with the tax benefits from NOL carryforwards.

Third, we contribute to the literature studying loss firms generally (e.g., Denis and Mckeon, 2016) and tax loss firms in particular (e.g., Dyreng, Lewellen, and Lindsey 2017) by providing analysis of the determinants of NOL carryforwards. Approximately 89 percent of the large publicly-traded firms in our sample report NOLs. While high NOL benefit firms have performed poorly in the past and appear financially constrained, they are also high growth firms that generate substantial accounting losses in their early years as they invest in risky projects critical for economic growth. These firms persist in the sample despite, or possibly because of, the NOL benefits that generate cash tax savings in future periods.

Finally, this paper informs policy makers about the mechanisms by which tax losses can affect important firm decisions. NOL carryforwards are the result of policies that determine the government's risk sharing rule, potentially altering firms' investment, financing and savings decisions. In the past sixteen years, U.S. tax loss rules have changed three times to permit more generous tax loss offsets (Dobridge 2016). While these statutory extensions illustrate policy makers' use of tax losses to achieve certain fiscal policy goals, they are also likely have nuanced or indirect effects on investor welfare; we show that NOL carryforwards appear to be important through their impact on financing and savings decisions. NOLs are also sensitive to variation in corporate tax rates, as the cash value of the carryforward depends critically on the statutory tax rate a firm expects to face. Our evidence suggests that accounting for these rate differences matters. Finally, tax rules that determine carrybacks and carryforwards vary widely across countries and states and are likely to shape how firms interact with their subsidiaries at home and abroad. Evidence on their economic consequences should remain a high priority for future research.

2. Sample and Descriptive Statistics

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 that we observe 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 firm valuation and the calculation of taxable income, and we retain observations with at least three years of accounting and market data. These steps result in a final sample of 6,884 firm-year observations.

Table 1 provides details on the data obtained from the tax footnotes. Panel A compares the frequency of tax loss carryforwards in the hand collected data to Compustat data. We show that 6,120 firms, or 88.9 percent of the sample, report some amount of tax loss carryforward, either through disclosure of a gross tax loss carryforward (the full amount of the loss available to offset future income) or through a deferred tax asset (the tax-effected amount of the loss carryforward) in the firm's income tax footnote. This figure is significantly higher than the 67.4 percent carryforward rate from Compustat data item *tlcf*.

Panel A also provides further details for the subsample of 6,120 firm-year observations that disclose a tax loss carryforward. Approximately 66.6 percent (4,076 observations) of these loss firms disclose the location of the NOL carryforwards, and 22.3 percent of the tax loss sample

disclose statutory limitations on the use of existing NOLs under Section 382 of the US Internal Revenue Code. We also find that 62.7 percent of tax loss firms report a large accounting valuation allowance to reduce the gross amount of deferred tax assets recorded on the firm's balance sheet.[8]

Panel B provides further descriptive details on the losses reported. 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 carryforwards. 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 disclosing the NOLs' location, 64.5% report Federal NOL carryforwards averaging $473.8 million; 68.4% disclose state NOLs averaging $453.9 million; and 58.6% disclose foreign NOLs averaging $353.6 million. The average NOL carryforward reported in Compustat for these firms (*tlcf*) is $631 million, suggesting that even when Compustat identifies the existence of the NOL, it only reports about 76% of the carryforwards disclosed ($631/$823.4). However, because Compustat data represent the simple sum of pretax NOL carryforwards and do not include jurisdiction-specific details, we are precluded from identifying and comparing the sources and relative value of the NOLs.

Nearly all firms in the tax loss sample also disclose a deferred tax asset for NOLs (5,894 observations or 96.3% of positive NOL firms). A firm's deferred tax asset should equal the firm's gross tax loss carryforwards, multiplied by the applicable tax rate in the corresponding tax jurisdiction. The mean (median) gross deferred tax asset for tax loss carryforwards is $221.4

[8] Firms generally report the valuation allowance in total, as opposed to reporting the amount of the valuation allowance specific to each deferred tax asset (such as the deferred tax asset related to tax loss carryforwards). While these allowances are often related to tax net operating losses, they can apply to any deferred tax asset. Because the valuation allowance can relate to many items, we report both the proportion of firms that have any valuation allowance (89.6 percent), as well as the proportion of firms with a large valuation allowance equal to at least 50% of the estimated NOL tax benefit (62.7 percent) to attempt to identify whether the valuation allowance likely relates to the tax loss.

($45.6) million. However, firms either provide an "uncontaminated" amount by reporting the tax loss benefit amount on a distinct line in the deferred tax asset and liability section of the income tax footnote, or combine the NOL tax asset with other tax attributes, such as tax credit carryforwards. For the 4,272 firm-years that separately report the deferred tax asset for NOL carryforward, the mean (median) asset is $170.3 ($36.3); for the 1,622 that blend the reported NOL carryforward asset with other items, the mean (median) is higher at $356.0 ($70.0) million. Some firms also disclose the location of the NOL in the deferred tax asset. For these firms, the average gross deferred tax asset is $165.6 million at the Federal level, $42.6 million at state levels, and $127.8 million across foreign jurisdictions. The distribution is skewed, with reported medians at $29.0, $12.3, and $21.0 million respectively.

Based on the subsample sample of firms that disclose both the deferred tax asset and the total amount of loss carryforwards by jurisdiction, we estimate the applicable U.S. Federal, state, and foreign rates at 35.0 percent, 4.9 percent, and 26.6 percent respectively (i.e., the median tax rates as shown in Table 1, Panel B). For firms that disclose only the total amount of both the deferred tax asset and tax loss carryforward, we estimate a blended median tax rate of 22.7 percent.

2.2 Construction of the NOL tax benefit measure

Our proxy for NOL tax benefit is a tax rate-weighted measure of tax loss carryforwards.[9] We prioritize information about the gross (not tax-effected) NOL carryforward in calculating this

[9] While this methodology represents an improvement in estimation of tax loss benefits, we acknowledge that this approach is still imperfect. 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 by measuring NOLs by jurisdiction and then applying the relevant estimated tax rate for that jurisdiction. We also capture data on valuation allowances and other statutory limitations that may otherwise limit future utilization. However, we note that shortcomings still exist, largely due to the lack of data availability to further refine our estimate. First, there are no data on how long it will take for the firm to use its NOLs; thus, our calculation of tax benefit assumes that all NOLs disclosed will be used. However, our amounts reflect managements' estimation of the likelihood of utilization because we collect and incorporate estimates of NOL-specific valuation allowances and statutory limitations. Second, there is no disclosure of specific state or country jurisdictions, such that our state and foreign tax rates are an approximation based on tax rates that we estimate

measure and present these amounts in Panel C of Table 1.[10] To construct the measure, we first use tax loss carryforward data at the jurisdictional level, as disclosed by two-thirds of the sample (4,076 observations). We construct the NOL benefit amount 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 1, Panel B. If the firm does not provide jurisdictional data but does provide the total tax losses carried forward (NOL_i), we apply a blended rate of 22.7 percent (also the median tax rate from Table 1, 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 with NOLs, we use deferred tax asset disclosures to estimate the NOL benefit.[11] For firms that disclose the deferred tax asset amount, but not the carryforward amount, we estimate NOL benefits based first on jurisdiction specific disclosures (722 observations), then uncontaminated deferred tax assets (471 observations), and finally

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from firms who provide jurisdiction-specific disclosures (discussed further below). Third, because we do not know the specific state or country jurisdictions, we are unable to factor in variation in carryforward limitations 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 perform analysis of domestic-only companies to address these concerns. While we still cannot perfectly observe the state jurisdictions in which these firms operate, these tests mitigate some of the issues outlined above by limiting the number of jurisdiction-specific rules to consider. We discuss these results in a later section.

[10] Alternative methodologies used in calculating the benefit, namely those that prioritize the deferred tax asset amount rather than the gross tax loss carryforward amount in the estimation of tax loss benefits, yield similar results and are highly correlated ($\rho > 0.94$).

[11] 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. 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 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.

contaminated deferred tax assets (306 observations). Panel C of Table 2 provides the values for NOL benefits constructed using this methodology. The average (median) firm has NOL benefits of $178.4 ($40.0) million.

In Panel D, we compare our amounts to those 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), carryforwards average $715.6 million and the average estimated NOL tax benefit is $213.1 million. For 3,630 observations (59.3 percent) for which Compustat does report *tlcf*, the average NOL carryforwards are $657.1 million. For these same firms, our estimated average NOL carryforwards are $838 million, a value that is 27.5 percent higher. Perhaps as important, we find that there is significant heterogeneity in the location, and hence after-tax value, of the NOL carryforwards. Within our sample, Federal NOLs average $306 million while state and foreign NOLs average $317 million and $215 million, respectively.

Panel E present 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, consistent with Cooper and Knittel (2010) who show that NOL utilization rates are fairly low. However, the ratio of the NOL benefit to total assets is slightly declining over time, likely due to the faster growth in the denominator.

Panel F presents the incidence and level of tax loss benefits by Fama and French 48 industry definitions. 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 tax losses for these industries average 5.0 to 6.7 percent of total assets. In contrast, firms reporting the lowest level of tax benefits are in Retail and Service industries. The relative under-

reporting of NOLs within Compustat is observed across all of these industries, suggesting systematic misreporting as opposed to concentration within a limited set or type of firm.

2.3 Descriptive Statistics

Table 2 provides descriptive statistics for the variables used in validating the tax loss benefit measure and testing the determinants of tax losses. In Panel A, we present the average values for the full sample, followed by averages for each of five groups formed by sorting observations on the level of NOL benefits as a percentage of total assets. The first group includes the 764 firm-years with no evidence NOL carryforwards. The remaining observations are sorted into quartiles of NOL benefits. By construction, NOL benefits are increasing across the quartiles, from 0.2 percent of assets in the bottom quartile to 10.4 percent of assets in the top quartile. Among firms reporting tax losses, the percentage of firm-year observations subject to statutory U.S. IRC Section 382 limitations on these losses increases monotonically, from 14.6 percent of firms in the bottom quartile to 36.5 percent in the top quartile. Even among firms in the top quartile of tax loss assets, Compustat fails to identify nearly one in every five firms with NOL carryforwards. As expected, marginal tax rates, cash ETRs, and cash taxes paid all decline monotonically as NOL benefits increase. For example, the average cash taxes paid by firms with no NOL carryforwards is approximately 4.2 percent of total assets, whereas this amount falls to 0.7 percent of assets in the top quartile of tax loss benefits.

High tax loss firms report the lowest amount of pre-tax ROA (2.7 percent) and have the highest leverage ratios (32.9 percent). While firms with high tax loss carryforwards 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, but they are still large by conventional measures (in part due to sample construction), averaging

$5.1 billion in assets. Furthermore, high tax loss firms report the greatest levels of R&D expenditures (9.0 percent of sales) and capital investment (5.7 percent of assets), and they have higher market-to-book ratios than tax loss firms in the other quartiles. Approximately 77.3 percent of firms with high tax losses have some foreign presence, a proportion higher than the subsample of firms without tax losses and similar to the low-tax-loss quartile. In addition, high tax loss firms also report high sales growth during the year, averaging 16.2 percent. Because firms that report the largest tax loss carryforwards appear to have substantive growth opportunities and are responsible for considerable investment activity, they should also be more sensitive to factors that affect their access to financing.[12]

Table 2, Panels B through D provide additional descriptive statistics on firm characteristics over time; in each panel, we partition the sample into five subgroups based on NOL benefits in 2010 and then report the average NOL benefit over future periods. In Panel B, we study the persistence of tax losses and observe that, for all groups except the high-tax-loss firms, NOL benefits increases slightly over the sample period. For example, firms in the third quartile of tax loss firms report a small increase in NOL benefits, from 2.3 to 2.5 percent of assets. By comparison, firms reporting the highest level of tax losses experience a decline over the sample period, from 11.9 percent of total assets in 2010 to 7.1 percent in 2015.

In Panel C, we examine the ratio of cash taxes paid to total assets. We find that cash taxes paid increase over time, and that this increase is most pronounced among the highest two quartiles of NOL benefits (increases of 4% and 5%, respectively). Panel D shows that the highest proportion

[12] 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.

of constrained firms are within the high-NOL-benefit quartile, but we note that the proportion of constrained firms fluctuates within each group across the six-year sample period.

2.4 Does our NOL tax benefit proxy better capture tax shields?

A proxy for NOL benefits should predict future tax savings if it correctly identifies firms' ability to shield future income from tax. To validate the information content of our measure, we compare the ability of our NOL benefit measure with a Compustat-based measure to explain future cash tax payments. Specifically, to test the performance of these two measures in capturing future tax savings, we estimate the following model:

$$Tax\,paid_{i,t+1} = \alpha_0 + \alpha_1 PTI_{i,t+1} + \alpha_2 NOL\ benefit_{i,t} + \alpha_3 PTI_{i,t+1} \times NOL\ benefit_{i,t} + e \quad (1)$$

where $Tax\ paid_{i,\,t+1}$ is the amount of cash taxes paid scaled by total assets by firm i in year $t+1$, $PTI_{i,\,t+1}$ is pre-tax income scaled by total assets of firm i in year $t+1$, and $NOL\ benefit_{i,t}$ is described in Sections 2.1 through 2.3. We expect $PTI_{i,\,t+1}$ to be positively associated with $Tax\ paid_{i,\,t+1}$; the coefficient α_1 reflects the average cash tax rate in the sample. We expect α_2 to be negatively associated with future cash tax payments to the extent book pretax income estimates taxable income with error. For the coefficient of interest, α_3, we expect a negative coefficient, as it captures the extent to which the NOL benefit reduces the average cash tax rate on pretax earnings by shielding that future income from cash taxes due.

The results are presented in Table 3. In each column, we present results from three sets of regressions. First, we estimate Eq. (1) as outlined above. Below that, we re-estimate Eq. (1), replacing $NOL\ benefit_{i,t}$ with the Compustat-based estimate ($Compustat\ NOL\ benefit_{i,t} = 0.23*tlcf$). In the final regression, at the bottom of each column, we include both measures to test their relative

explanatory power.[13] In the first set of results in Column (1) we find a negative and significant coefficient on the interaction between NOL benefit and pretax income. The coefficient estimate of -0.912 implies that approximately a ten percentage point increase in the NOL benefit (moving from the lowest to the highest quintile), is associated with a 9.1% decrease in the average cash tax rate. While the *tlcf*-based NOL benefit estimate is significant in the second set of results presented in Column (1), the coefficient of -0.247 predicts a reduction just one-fourth as large as that estimated using $NOL\ benefit_{i,t}$. Interestingly, when we include both proxies and their corresponding interaction terms in the model in the third set of results, we find that only our NOL benefit proxy constructed from detail in the footnotes can explain an economically and statistically significant reduction in future cash taxes (coeff. = 0.905, $p < 0.01$).

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 next partition the sample into firm-years with positive and negative pre-tax income (Columns (2) and (3), respectively). Consistent with expectations, we observe that the negative effect of the NOL benefit proxy on future cash tax payments is concentrated within firm-years with positive pre-tax income, similar to the results using Compustat data reported by Dyreng, Lewellen, and Lindsey (2017). The coefficient on $PTI_{i,\ t+1}$ is much smaller among loss firms, reflecting the fact that NOL carryforwards provide little value for a firm with current year losses. The explanatory power of the model is also substantially higher in profit years (67 percent R-squared in Column (2) as compared to 2 percent R-squared in Column (3)). In Columns (4) through (6), we re-estimate Eq. (1), measuring both *Tax_paid* and *PTI* over the following two years and find similar results across all specifications. That is, NOL benefits predict future cash tax savings over both one and two year

[13] The correlation between the two proxies is approximately 0.35.

horizons and are concentrated within profitable firm years. In untabulated results, we obtain similar inferences replacing cash taxes paid with current tax expense.

In Panel B, we partition the sample based on whether the firm is multinational (Columns (1) and (2)) and whether the NOLs are subject to existing statutory limitations (Columns (3) and (4)). We find that the coefficient on α_3 is similar for both domestic and multinational firms across all specifications (-0.974 and -0.924, respectively). Furthermore, among domestic firms only, NOL benefits are able to explain future tax reductions independent of the variation in pretax income. The estimate of -0.078 suggests that, for each dollar of NOL tax benefit, the firm realized approximately $0.08 in tax savings the following year, in addition to the savings correlated with pretax profitability. In Columns (3) and (4) we find that statutory limitations on the utilization of existing NOLs appear to reduce their effectiveness as tax shields. The coefficient on the interaction between pretax income and NOL benefits is -1.11 for firms without Sec. 382 limitations, and approximately half of that magnitude (coefficient = -0.597) for those facing Sec. 382 limitations.

2.5 What determines the NOL benefits?

In Table 4, we provide evidence on the determinants of firms' NOL benefits. Our purpose here is threefold. First, we confirm the basic intuition that the primary driver of NOL benefits is prior reported losses, and that the relation between NOLs and profitability is strongest among firms with cumulative losses. Second, to show that these book losses do not appear to be the only driver of the firm's NOL carryforwards, we include a variety of firm attributes that further explain the variation in NOL benefits. Third, although we conclude that our NOL benefit measure is superior to that reported by Compustat, we realize that subsequent research is unlikely to replicate efforts to collect these data until technologies like XBRL are able to consistently record these values. To

that end, our parameter estimates can be used to refine the estimate of NOL benefits available in Compustat.

Our analysis begins by regressing $NOL\ benefit_{i,t}$ on prior profitability, measured as pretax income accumulated over the five years preceding measurement of the NOL ($\Sigma PTI_{i,\ t-4,t}$). The results in Column (1) confirm that past profitability is the primary determinant of the balance of NOLs: the negative and significant coefficient on $\Sigma PTI_{i,\ t-4,t}$ means that NOL benefits are increasing (decreasing) in cumulative losses (profits) over the recent period. The explanatory power of the model with no other controls or fixed effects is 22 percent. In Column (2), we split pretax income into two variables based on the sign of pretax income over the period. As expected, NOL benefits are more sensitive to past losses than past profits.[14]

In Columns (3) and (4), we include additional control variables that may affect the level of a firm's NOL carryforward. Foreign activity is positively associated with NOL benefits. Firms with more valuable growth opportunities, captured with the market-to-book ratio, and more investment in intangible assets, captured by R&D, also report higher NOL benefits. Asset tangibility, a proxy for depreciation deductions, is not associated with NOL benefits, while a balance in the goodwill account, as a proxy for historical acquisition activity, suggest that acquired NOLs are not likely to be a first-order driver of the NOL benefits we observe. Leverage is associated with higher NOL benefits, a result likely attributable to the endogeneity of tax status to leverage. Large firms have lower NOL benefits. We note that, while adding both additional variables in Column (3) and industry and fixed effects in Column (4), the R-squared climbs modestly to 32 percent and 37

[14]Conditioning the NOL-PTI sensitivity on the sign of retained earnings at the beginning of the five-year period yields little additional explanatory power.

percent, respectively. Thus, several fundamental factors are important in explaining NOL benefits, but pre-tax losses are still the primary input.

In Columns (5) and (6), we split the sample into domestic and multinational firms. We find a stark difference in the explanatory power of the model across these sub-samples: for purely domestic firms, the model explains 59 percent of the variation in the NOL benefit, whereas for multinationals (Col. (6)), it explains only 31 percent. This difference suggests that consolidated profitability is best able to explain NOLs for firms that operate in fewer jurisdictions.

2.6 Are NOL firms growing?

Table 4 suggests that firms with high NOL benefits have more growth opportunities. In Table 5, we explicitly test the association between tax losses and future investment spending, given that growth opportunities should then predict external financing activity when investment cannot otherwise be funded by internal cash flows. Panel A provides descriptive statistics on the variables used in these tests; the average firm in the sample spends 5.6 percent of total assets and 2.9 percent of total sales on capital expenditures and R&D, respectively. In Panel B, we provide the results from regressing future investment spending on the NOL tax benefit and control variables that capture growth opportunities (market-to-book), potential internal financing sources (operating cash flows), and both leverage and size, that is:

$$Investment_{i,t+1} = a_0 + a_1 NOL\ Benefit_{i,t} + a_2 Market\_to\_book_{i,t} + a_3 CFO_{i,t} + a_4 Leverage_{i,t} + \mathrm{a}_5 \ln\left(MVA_{i,t}\right) + e \quad (2)$$

The NOL benefit is positively and significantly associated with investment spending as measured by total asset growth, capital expenditures and R&D spending. The coefficient estimates from the first column of Panel B suggest that a 10% increase in the NOL benefits is associated with 2.9%

more growth in total assets. To the extent NOL firms need external capital to fund this investment, we expect to observe stronger financing activity.

3. Hypothesis Tests

3.1 NOL benefits and financing decisions

In this section, we test our predictions on the association between NOL benefits and financing decisions. If NOL benefits increase the relative after-tax cost of debt by reducing the value of interest deductibility, then we expect a negative association with debt financing and a positive association with equity financing. To test these predictions, we follow Balakrishnan, Core and Verdi (2014) and model the financing decision as a function of investment opportunities, cash flows, cash holdings, leverage, size, and asset tangibility:

$$\begin{aligned} Ext\ Fin._{t+1} = a_0 + a_1 NOL\ Ben._t + a_2 Market\_to\_Book_t + a_3 CFO_t \\ + a_4 Leverage_t + \mathrm{a}_5 \ln(MVA_t) + a_6 Tangibility_t + e \end{aligned} \tag{3}$$

where the dependent variable is a measure of external financing activity in year *t+1*, and the independent variables reflect firm attributes in year *t*. The variables are as defined previously, except that we now include $Tangibility_{i,t}$ to proxy for debt capacity that arises when assets have higher collateral value. We include industry and year fixed effects and calculate significance levels based on standard errors clustered by firm.

The dependent variable, $Ext\ Fin_{i,t+1}$ is measured several ways. We first use net external financing, defined as the sum of net equity and net debt financing based on cash paid and received from financing activities disclosed on the Statement of Cash Flows. Specifically, net equity financing is cash raised from equity sales (sstk) less cash paid to repurchase stock (prstkc). Net debt is cash from debt issued (dltis) less cash paid to retire debt (dltr). As an alternative measure

of debt financing, we subtract the change in cash holdings (che) from net debt. We use two additional measures of equity issuances from Fama and French (2005) to use of equity financing that does not strictly rely on cash flow data. The first measure, dSM, is calculated as the change in common shares outstanding, times the firm's average share price over the year, scaled by beginning total assets. The second measure, dSB, is calculated as the change in shareholders' equity (net of the change in retained earnings), scaled by beginning total assets. Additionally, we consider whether the firm conducts a seasoned equity offering using data from the Securities Data Corporation (SDC).

Table 6, Panel A presents the distribution of the primary external financing measures. The average firm in our sample obtains external financing, with net external debt and equity issues totaling 1.7% of beginning assets. However, the average firm appears to have net cash outflows from equity financing of 1.9% of assets and net cash inflows from debt financing of 3.5% of assets. In contrast, the dSM and dSB measures from Fama and French (2005), suggest that the average firm's shareholders' equity is increasing by 1.1% of total assets, primarily based on the growth in shares outstanding (dSM).

We present the main results from estimating Eq. (2) in Panel B. The evidence is consistent with NOLs playing a role in financing decisions. In Column (1), external financing activity is significantly increasing in the available NOL benefits. We then partition the financing decision into equity (Columns (2) through (4)) and debt issuances (Columns (5) and (6)). As expected, we observe a positive and statistically significant relation between NOL benefits and equity issuances; this result holds across all three measures of external equity financing. In Column (2), the

coefficient of 0.116 suggests that increasing NOL benefits by 0.1 is associated with larger equity issues equivalent to 1.2% of beginning assets.

In Columns (5) and (6), we focus on debt financing decisions. The results in Column (5) indicate no statistically significant relation; NOL benefits do not seem to be associated with future debt issuances. However, after controlling for the change in internal cash holdings, which arguably better approximates the economic notion of leverage, we do observe a negative and statistically significant coefficient, albeit at the 10% level. The coefficient of -0.092 on cash-adjusted net debt issues suggests that a ten percentage point increase in the ratio of NOL benefits to assets is associated with a reduction in the proceeds from debt issuances by approximately 0.9% of total assets. NOL firms may not issue more debt, but when they do they tend to retain more of the proceeds in cash, Collectively, our results are consistent with tax losses firms shifting to equity for their incremental financing decisions.

One potential concern is that small changes in equity and debt arise because of artifacts in the data unrelated to intentional capital structure decisions (Graham, 1996b). To mitigate this concern, Panel C presents results that focus on intentional financing decisions defined as debt or equity issues that exceed 2% of the firm's beginning assets (in absolute value). After imposing this restriction, our results hold and suggest even larger magnitudes for equity issues. The impact of a 0.1 change in the ratio of NOL benefits to assets on future net equity issues rises from 1.2% of assets to 2.1%. The impact on debt financing appears qualitatively similar.

In Panel D, we use a discrete choice model to explain external financing. In this regression, we re-estimate Eq. (2) using a logistic model in which we replace the dependent variable with an indicator variable equal to one if the firm has large external financing activity, and zero otherwise. The dependent variables in Columns (1) through (4) are equal to one if the firm engaged in large

equity change; if the firm announced an equity offering based on data from SDC; if the firm had a large stock issue; or if the firm reported a large stock repurchase. In Column (5), the dependent variable is equal to one if the firm had a large debt issue (net of the change in cash), or zero otherwise. For all variables (other than in Column (2)), large issues are those that fall within the top 20% of the full Compustat sample. We continue to observe consistent results; the NOL benefit is positively associated with the probability of a large equity change or large stock issue, but negative associated with the shares repurchase and large (net) debt issues.

Collectively, the results in these tables confirm our predictions: NOL benefits reduce the present value of interest deductions, thus discouraging firms from issuing debt and motivating them to instead issue equity.

3.2 Equity issuances and statutory limitations on NOL utilization

Some jurisdictions impose limitations on the future use of NOLs if the ownership of the tax loss firm changes significantly. These laws were designed to eliminate "trafficking" in NOLs by discouraging profitable firms from acquiring NOL firms only for their tax benefits. In the U.S., these limitations arise largely from Section 382 of the Internal Revenue Code and states that if ownership by 5 percent shareholders changes by more than 50 percent within a three-year period, the amount of US NOLs that can be used in any given year is limited to the product of the firm's market capitalization and the long-term federal tax exempt rate. 382 is not limited to control transactions and can be triggered by combinations of transactions between the firm and shareholders or between shareholders in the secondary market. To the extent managers view Section 382 limitations as important, their preference for equity issuances should be mitigated when the required equity financing risks impairing the NOL benefits by triggering 382. To proxy

for this risk, we classify firms based on the disclosed existence of a limitation in the footnotes and argue that those without a limitation face a higher marginal cost of issuing equity.

In Table 7 we test this prediction. Specifically, we estimate the coefficient on NOL benefits separately for firms that have and have not previously triggered and disclosed a Section 382 limitation.[15] We find that the positive association between tax losses and equity issuances is concentrated within the firms that have a pre-existing statutory limitation; that is, these firms have already triggered the limitation and thus are less constrained by this rule when accessing equity. In contrast, when firms have not previously triggered a Section 382 limitation, we observe little relation between tax loss benefits and external equity financing. The threat of triggering a future limitation appears sufficiently costly to discourage firms from issuing equity.

In Panel B, we further bifurcate the NOL benefit into a domestic component and a foreign component, and split the domestic component according to the existence of limitations. The purpose of this test is to isolate the effect of the U.S. rules on the particular U.S. tax losses to which they apply.[16] The sample size for this test is slightly smaller given that we drop observations that do not disclose the location of the NOL; that is, the regression is estimated using observations that either disclose the location of the NOL or disclose no NOLs at all. We continue to observe that the equity result holds within the sample of firms that have previously triggered a Section 382 limitation. However, after removing foreign NOL benefits, we now also observe that firms not currently subject to this limitation, and thus facing higher costs of issuing equity in the future, appear to issue *more* debt as indicated in Column (5). Thus, the results suggest that, while NOL

[15] Our hand-collected ata permit this analysis because these data are not otherwise summarized or reported in Compustat.

[16] In this test, domestic includes both US Federal and state. Some states impose a limitation similar to Section 382. Furthermore, foreign countries also frequently have ownership-based limitations, but we expect that these would have a more limited effect given that our firms are headquartered in the US and that the majority of sample losses are domestic.

benefits can push firms away from issuing debt when interest deductibility has less value (as shown in Table 6), this results is attenuated when an equity issue threatens to impair the future value of the NOL benefits.

3.3 Do NOL firms hold more cash?

Tables 6 and 7 suggest that NOL benefits affect the manager's external financing decisions, and by extension, the relative cost of debt and equity. If managers respond to taxes in deciding the firm's financing policies, it is natural to expect them to also consider taxes when determining the level of liquidity and savings. 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, 2009). 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 investor could otherwise avoid by investing on their own account. However, NOL carryforwards shield passive income from corporate tax, thereby lowering the cost of holding cash in the corporation and increasing optimal cash levels. Consequently, we predict a positive association between NOL benefits and cash holdings.

We test this prediction and present results in Table 8. We regress the log of the ratio of total cash holdings to total assets on several variables prior research has shown to influence cash holdings. Consistent with prior research, we find in Column (1) that 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, higher ROA, and greater net debt issuances hold more cash. Firms with lower foreign taxes, as well as firms with more uncertain tax benefits from tax planning, also hold more cash.

In Column (2), we include the NOL benefit. The NOL benefit exhibits a positive and significant association with the firm's cash holdings; the coefficient of 0.10 implies that increasing the ratio of NOL benefits to assets by 0.1 is associated with a 1 percentage point increase cash holdings. This result is robust to controlling for other tax incentives to hold cash discussed in prior literature, including reserves for uncertain tax benefit settlements (UTBs) (Hanlon et al. 2017) and the repatriation tax cost due when foreign profits are repatriated to the US parent (Foley et al. 2007; Hanlon et al. 2015; Blouin et al. 2017).

In Panel B, we study whether interactions between NOL benefits, repatriation tax costs, and uncertain tax benefits can further explain cash holdings. The motivation for these tests is to understand whether a firm's NOLs can mitigate frictions such as the repatriation tax. To the extent the firm has domestic NOLs that can shelter dividends from foreign subsidiaries otherwise subject to the U.S. repatriation tax, we should observe an attenuated relation between repatriation taxes and cash holdings. We find results consistent with this prediction in Column 2 of Panel B. Among the multinational firms in our sample, we observe a positive and statistically significant coefficient on the main effect for both NOL benefits and repatriation tax cost, but a negative and statistically significant coefficient on the interaction term, suggesting that NOLs allow firms to more freely repatriate foreign profits by shielding the incremental U.S. tax due upon repatriation. Consistent with this interpretation, we find that the effect of NOL benefits in mitigating the relation between repatriation taxes and cash holdings is driven by the variation in Federal NOLs (Column (3)).

The results in this table also suggest that NOL benefits reduce the need to retain cash when the firm takes uncertain tax positions, a result that holds for both domestic and multinational firms. One explanation is that the tax planning that generates UTBs does not reduce current cash tax paid when firms are in NOL positions. While firms with NOLs may be less likely to have their positions

challenged in an audit, even if the positions are challenged, the increase in tax liability can be offset by the NOL and require no cash outlay. As a result, firms with high NOL benefits are less likely to save cash in anticipation of a challenge of items for which they have reserved a liability. The results are consistent with this conjecture.

3.4 Are the additional cash holdings value-increasing?

Holding investors' after-tax discount rate constant, the cash held by high NOL benefit firms should generate higher after-tax returns on passive investments and should thus be valued more highly by investors. We test the impact of NOL benefits on cash valuation using the regression specification from Faulkender and Wang (2006), adapted to include the components of net financing as proposed by Halford et al. (2016) and used by Harford, Wang and Zhang (2017). [17] Specifically, we estimate the following:

$$\begin{aligned} r_{i,t} - R^{B}_{i,t} = {} & \gamma_0 + \gamma_1 \Delta Cash_{i,t} + \gamma_2 NOL\ Ben_{i,t-1} + \gamma_3 \Delta Cash_{i,t} \times NOL\ Ben_{i,t-1} + \gamma_4 \Delta Earn._{i,t} \\ & + \gamma_5 \Delta Non-cash\ assets_{i,t} + \gamma_6 \Delta R\&D_{i,t} + \gamma_7 \Delta Int._{i,t} + \gamma_8 \Delta Div._{i,t} + \gamma_9 Cash_{i,t-1} \\ & + \gamma_{10} Leverage_{i,t} + \gamma_{11} Stock\ issues_{i,t} \\ & + \gamma_{12} Stock\ repurchased_{i,t} + \gamma_{13} Net\ debt\ iss._{i,t} + \gamma_{13} Cash\ accum._{i,t} + \gamma_{14} Cash_{it-1} \\ & \times \Delta Cash_{i,t} + \gamma_{15} Leverage_{i,t} \times \Delta Cash_{i,t} + \varepsilon_{i,} \end{aligned} \tag{4}$$

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

[17] Faulkender and Wang (2006) show that the value of an additional dollar of cash is greater when firms face financing constraints because internal funding allows managers to pursue positive net present value projects when external funding is costly. In contrast, the value of cash appears to fall when managers operate in weaker monitoring environments (Dittmar and Mahrt-Smith, 2007), suggesting that an additional dollar of cash is more likely to be spent on projects providing private benefits to entrenched managers (Jensen, 1986; Harford, 1999). Thus, these cash valuation models provide a simple and intuitive empirical framework in which to investigate the economic consequences of a variety of firm attributes.

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 is the firm *i*'s cash holdings and is defined as cash plus marketable securities. 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* is our proxy for tax loss benefits, taken at the beginning of the year to mitigate the information content of new tax loss carryforwards for current performance, and scaled by beginning market value of equity.[18]

The model also includes other firm-specific factors associated with stock returns: firm *i*'s earnings, calculated as earnings before extraordinary items; net assets, equal to total assets less cash; R&D and interest expenses; dividends paid to common shareholders; and market leverage, calculated as total long-term debt plus debt in current liabilities, divided by the market value of assets. Following Halford et al. (2016), we decompose net financing into stock issues, stock repurchases, and net debt issues using information from the cash flow statement, and include indicator equal to one if cash holdings increased during the year. R&D is set equal to zero if missing. All variables (other than market leverage) 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.

The coefficient γ_1 estimates the marginal value of a dollar of cash and theoretically should be equal to $1.00. To test the effect of NOL benefits on the valuation of cash, we interact it with the

[18] The ending tax loss carryforward is comprised of the beginning carryforward plus the change in carryforwards during the year. A primary source of changes in carryforwards is firm profits, which reduce the carryforward, or firm losses, which increase it. In unreported tests, we include the change in the tax loss carryforward in Eq. (1) and find that increases in carryforwards are associated with lower stock returns, consistent with the change in carryforward being driven by an underlying tax loss.

change in cash and present results in Table 9. Panel A provides descriptive statistics for the variables used in the test; Panel B present the regression results. We replicate Faulkender and Wang (2006) in Column (1) and test the sensitivity of cash valuation to NOL benefits in Column (2). We observe a positive and statistically significant coefficient on the interaction, supporting the view that that corporate savings linked to available NOL benefits are positively valued by investors.[19]

3.5 Additional analyses

In robustness tests, we explore whether the connections between NOL benefits, financing, and cash savings are driven by a financial constraints explanation; that is, we test whether the NOL benefit is simply capturing constrained firms. We first examine univariate statistics based on several measures of financial constraints. NOL firms appear more constrained under common indexes like Kaplan and Zingales (1997) and Whited and Wu (2006) and more distressed using Altman's Z-score, in large part because the measure is a function of poor profitability and the lack of dividend payments. We then re-estimate the main specifications, including various proxies for financial constraints, including indices based on Kaplan and Zingales (1997), Whited and Wu (2006), vanBinsbergen, Graham and Yang (2010), and other variables correlated with constraints, such as those based on firm size, dividend policy, and debt ratings. We find that the statistically

[19] 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, 1988; Brickley et al., 1994; Comment and Schwert, 1995; Coates, 2000; Fich et al., 2016). 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 a mechanism to insulate management from the threat of takeover in the market for corporate control.

significant association between the NOL benefit and external financing continues to hold; our measure contains incremental information content beyond traditional measures of constraint.

Another potential concern is that a firm's simulated marginal tax rate should better capture the information contained in both *tlcf* and our hand-collected measure by incorporating forecasts of future pretax income. For completeness, we re-estimate our validity tests as well as our marginal financing analyses, controlling for the firm's marginal tax rate when available. We find that marginal tax rate estimates do not explain short-run tax savings when NOL benefits are included, a result that should not be surprising given the long-run forecasts of profitability that the marginal tax rate estimates are based on. We note that this relative lack of explanatory power could arise because estimates of marginal tax rates use *tlcf* as the starting value for tax shields in the marginal tax rate simulation (Graham 1996b; Blouin, Core and Guay 2010). In additional tests, we also find that the firm's marginal tax rate does not appear to explain external financing or cash holding decisions. Thus, the measure we construct better predicts cash taxes due in the short run and exhibits important economic and statistically significant relations with key firm decisions.

4. Conclusion

Using detailed data on the amounts and attributes of net operating loss carryforwards disclosed in firms' financial statements, we show that the population of firms with tax loss carryforwards appears much greater than what has been suggested by prior work, encompassing nearly 90% of the firms in our sample. These losses, and the firms that claim them, are important to the economy.

We study if and to what extent tax benefits from NOL carryforwards affect external financing decisions and corporate liquidity. We find that NOL benefits are (weakly) negatively associated with debt issuances, but positively associated with equity issuances. However, the relative tax

advantage of equity disappears when a firm risks impairing the NOL benefits by transacting in equity markets in ways that could trigger statutory limitations under IRC Section 382. We then test and find that cash holdings are increasing in the NOL benefit and that investors place a higher value on cash holdings when the available NOL benefits are greater.

In addition to contributing knowledge about the population of tax loss firms and the amount of these important assets, we 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 firm decisions.

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Appendix – Variable Definitions

Variable	Definition
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	Dummy variable if footnote discloses NOL carryforwards are limited by Section 382
Valuation allowance > 50%	Dummy variable if valuation allowance exceeds 50% of NOL benefit
NOL Poison pill (0,1)	Dummy variable for 382-based shareholder rights plan (source: SharkRepellent data from Factset)
Compustat NOL benefit > 0	Dummy variable if Compustat tax loss carryforwards (tlcf) is positive
Compustat NOL benefit	Compustat tax loss carryforwards (tlcf)*0.23 divided by total assets
$MTR_{\text{after-fin (before-fin)}}$	Simulated marginal tax rate after (before) financing costs available from John Graham's website
Cash ETR	Cash paid for taxes (txpd) divided by pretax income
Cash tax paid	Cash paid for taxes (txpd) divided by total assets
Repatriation tax cost	Foreign pretax 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
PTI	Pretax income adjusted for special items (pi – spi) divided by total assets
PTI ($\Sigma_{t-5,t}$)	Five-year sum of PTI ending in year t, divided by total assets in year t
Foreign activity (0,1)	Dummy variable equal to one if firm discloses non-zero pretax foreign income (pifo) or foreign taxes (txdfo or txfo)
Net working capital / Assets	Nonc0ash 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
Goodwill > 0	Dummy variable if firm reported positive goodwill (gdw)
Leverage	Total long-term debt (dltt + dlc) divided by total assets
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
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
ΔAssets	Change in total assets divided by beginning total assets
Capex	Capital expenditures (capx) divided by beginning total assets
Acquisitions	Sum of 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

Figure 1: Frequency of NOLs for US firms in Compustat

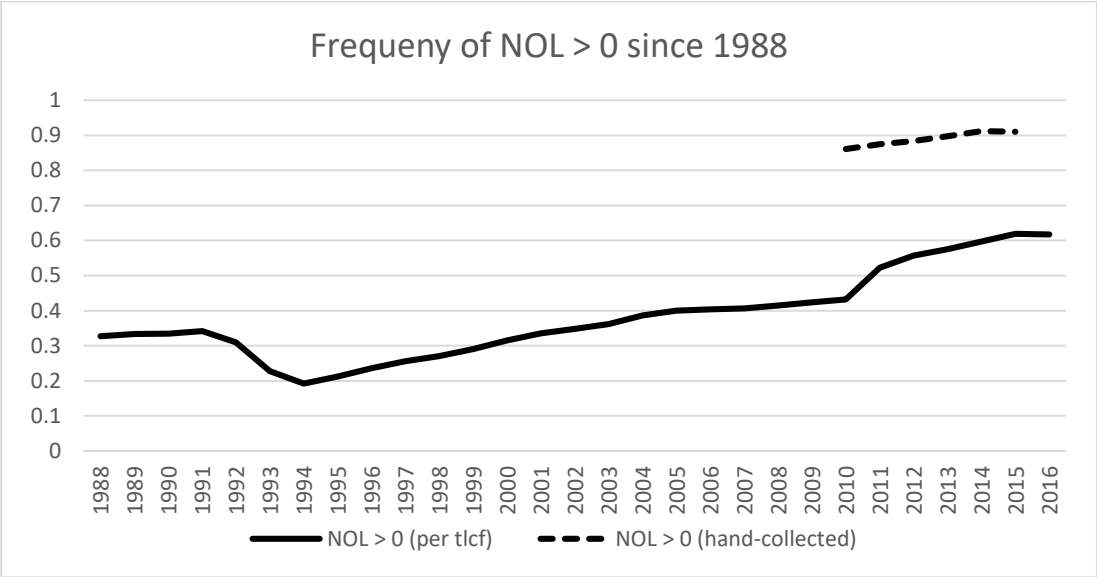

Table 1– Descriptive statistics on NOL carryforwards and construction of NOL benefits

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. Panel C derives the Tax Loss Benefit amount used as the primary measure in the empirical tests. Panel D compares dollar values for tax losses between the hand-collected and Compustat data. Panel E provides trends in the average reported tax losses over time, and Panel F presents industry statistics on high and low tax loss firms.

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 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 1 (cont'd) - Descriptive statistics on NOLs

Panel B: NOL carryforward and NOL Tax Benefit amounts (in $millions) disclosed

	2010 - 2015 (N = 6,120)		
	N > 0	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)

	N > 0	Mean	Median
NOL benefit (total)	6,120	$190.6	$39.4
Comprised of amounts calculated as follows:			
$\Sigma(NOL_j \times \tau_j)$	4,076	178.4	40.0
$NOL_j \times \tau_j$	543	223.5	64.2
ΣDTA_j	722	195.3	40.9
Total DTA (uncontaminated)	471	186.5	20.1
Total DTA (contaminated)	306	289.2	33.7
When jurisdiction information available:			
Total NOL Benefit	4,840	179.8	39.5
Domestic (Federal + State) NOL Benefit	4,840	117.0	15.4
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

Table 1 (cont'd) - Descriptive statistics on NOLs

Panel D: NOL carryforwards, Hand-collected vs Compustat ($mm)

	N > 0	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 unavailable:			
Compustat NOL (tlcf)	1,012	541.8	99.4
Total NOL	1,012	491.8	0.3
Compustat NOL (tlcf) is available & NOL location available:			
Compustat NOL (tlcf)	3,630	657.1	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

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

	2010	2011	2012	2013	2014	2015
NOL Benefit (Total $mm)	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 / Assets	0.025	0.024	0.024	0.026	0.021	0.022
When jurisdiction disclosed:						
Federal NOL benefit / Assets	0.016	0.015	0.015	0.017	0.012	0.012
State NOL benefit / Assets	0.003	0.003	0.003	0.003	0.002	0.002
Foreign NOL benefit / Assets	0.005	0.005	0.006	0.008	0.006	0.007

Panel F: Highest and NOL benefits by industry

	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 the ratio estimated tax loss benefits to total assets. Variable definitions are described in the Appendix. The symbols * indicate amounts estimated based on 4,840 observations with jurisdiction data; ** indicate $MTR_{after\text{-}fin}$ ($MTR_{before\text{-}fin}$) amounts estimated on 3,739 (3,283) observations; and *** indicates amount estimated with 5,431 observations.

Panel A: Descriptive statistics

		By size of NOL Benefit / Assets				
	All	None	1 - Low	2	3	4 - High
N =	6,884	764	1,529	1,529	1,533	1,529
NOL Benefit	0.029	0.000	0.002	0.007	0.020	0.104
Federal NOL Benefit*	0.023	0.000	0.001	0.002	0.009	0.074
State NOL Benefit*	0.004	0.000	0.001	0.002	0.003	0.009
Foreign NOL Benefit*	0.007	0.000	0.001	0.003	0.008	0.015
Detail on jurisdiction (0,1)	0.791	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
NOL poison pill (0,1)	0.010	0.000	0.002	0.005	0.001	0.037
Compustat NOL Benefit > 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
$MTR_{after\text{-}fin}$**	0.149	0.336	0.157	0.132	0.108	0.092
$MTR_{before\text{-}fin}$**	0.322	0.342	0.337	0.335	0.319	0.267
Cash ETR***	0.232	0.285	0.254	0.247	0.213	0.165
Cash tax paid (t + 1)	0.023	0.042	0.030	0.025	0.018	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
PTI (t+1)	0.091	0.159	0.118	0.106	0.082	0.027
PTI ($\Sigma_{t\text{-}5,t}$)	0.374	0.612	0.476	0.452	0.368	0.071
Foreign activity (0,1)	0.788	0.543	0.787	0.860	0.854	0.773
Market-to-book	1.989	2.346	1.983	1.962	1.813	2.020
R&D	0.042	0.015	0.027	0.035	0.033	0.090
Tangibility	0.265	0.334	0.237	0.238	0.268	0.284
Goodwill > 0 (0,1)	0.858	0.751	0.910	0.931	0.879	0.759
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
No dividend	0.447	0.336	0.423	0.360	0.413	0.649
Financially Constrained (WW) (0,1)	0.108	0.115	0.080	0.058	0.091	0.202
Financially Constrained (BGY) (0,1)	0.064	0.010	0.024	0.034	0.063	0.160
Low external financing activity (0,1)	0.353	0.373	0.323	0.339	0.347	0.394
High Z-score (0,1)	0.154	0.031	0.052	0.072	0.142	0.409

Table 2 (cont'd) – Descriptive statistics

Panel B: Average future NOL Benefits of firms sorted by NOL Benefit in 2010

	NOL Benefit / Assets					
	2010	2011	2012	2013	2014	2015
0 - No NOL Benefit in 2010	0.000	0.001	0.001	0.003	0.006	0.006
1 - Low NOL Benefit in 2010	0.002	0.004	0.005	0.006	0.007	0.007
2	0.007	0.009	0.012	0.011	0.012	0.012
3	0.021	0.023	0.025	0.025	0.025	0.025
4 - High NOL Benefit in 2010	0.119	0.112	0.105	0.097	0.086	0.071

Panel C: NOLs and future tax status

Average future Cash tax paid / Assets for portfolios sorted on NOL Benefit / Assets in 2010

	Cash tax paid / Assets					
	2010	2011	2012	2013	2014	2015
0 - No NOL Benefit in 2010	0.040	0.038	0.040	0.039	0.041	0.041
1 - Low NOL Benefit in 2010	0.028	0.028	0.027	0.028	0.029	0.027
2	0.024	0.023	0.025	0.024	0.025	0.025
3	0.016	0.018	0.020	0.020	0.022	0.022
4 - High NOL Benefit in 2010	0.004	0.008	0.009	0.010	0.010	0.013

% firms with tax paid < 0.5% of assets

	Cash tax paid / Assets < 0.5%					
	2010	2011	2012	2013	2014	2015
0 - No NOL Benefit in 2010	0.094	0.110	0.103	0.118	0.067	0.106
1 - Low NOL Benefit in 2010	0.159	0.195	0.165	0.149	0.131	0.130
2	0.205	0.192	0.159	0.153	0.171	0.113
3	0.383	0.313	0.287	0.288	0.253	0.218
4 - High NOL Benefit in 2010	0.633	0.582	0.557	0.547	0.505	0.442

Panel D: NOL benefits and financial constraints

Average fraction of firms considered constrained in the future (Whited and Wu)

	Financially constrained (WW)					
By NOL Benefit in 2010	2010	2011	2012	2013	2014	2015
0 - No NOL Benefit in 2010	0.118	0.116	0.103	0.145	0.121	0.089
1 - Low NOL Benefit in 2010	0.072	0.073	0.068	0.066	0.059	0.054
2	0.061	0.059	0.055	0.057	0.060	0.040
3	0.091	0.082	0.089	0.089	0.105	0.112
4 - High NOL Benefit in 2010	0.186	0.180	0.235	0.252	0.216	0.174

Average fraction of firms considered constrained in the future (Z-score & van Binsbergen, Graham and Yang)

	Financially constrained (Z × BGY)					
By NOL Benefit in 2010	2010	2011	2012	2013	2014	2015
0 - No NOL Benefit in 2010	0.012	0.018	0.006	0.020	0.007	0.035
1 - Low NOL Benefit in 2010	0.042	0.042	0.028	0.037	0.034	0.027
2	0.053	0.047	0.042	0.070	0.069	0.062
3	0.061	0.035	0.069	0.059	0.081	0.029
4 - High NOL Benefit in 2010	0.136	0.160	0.135	0.122	0.122	0.100

Table 3 – Relative performance of NOL benefit proxies

This table reports the results from tests comparing the relative power of NOL benefit proxies in explaining future tax payments. Panel A reports results using cash taxes paid in one future year, as well as the sum of taxes due over the following two years. Columns (1) and (4) reflect results for the full sample. Due to the asymmetric nature of NOL benefits on tax savings, the coefficients are estimated separately for profit and loss years; Columns (2) and (5) present results for firms with positive pre-tax income; and Columns (3) and (6) present results for firms with negative pre-tax income. Panel B presents results for different sub-samples of firms based on geographic footprint and statutory limitations imposed on the future utilization of the tax loss benefit. Regressions include year and industry fixed effects. *p*-values are based on standard errors clustered at the firm level.

Panel A: Explaining future cash tax payments

	Dependent variable = Cash tax paid$_{t+k}$					
	One year ahead (t + 1)			Two years ahead [Σ(t+1,t+2)]		
	All	PTI > 0	PTI ≤ 0	All	PTI > 0	PTI ≤ 0
N=	6,884	6,108	776	6,452	5,847	605
	(1)	(2)	(3)	(4)	(5)	(6)
PTI_{t+k}	0.211***	0.273***	0.009***	0.196***	0.213***	0.044***
PTI_{t+k} × NOL Ben.$_t$	-0.912***	-1.038***	-0.002	-0.821***	-0.786***	-0.105
NOL Ben.$_t$	-0.022**	0.009	0.004	-0.039***	-0.041*	-0.009
R-squared	0.60	0.67	0.02	0.59	0.60	0.14
PTI_{t+k}	0.193***	0.257***	0.009***	0.177***	0.204***	0.032***
PTI_{t+k} × Comp. NOL Ben.$_t$	-0.247***	-0.489***	0.001	-0.212***	-0.155	-0.001
Comp. NOL Ben.$_t$	0.009	0.038**	0.000	0.019	0.011	-0.004
R-squared	0.55	0.64	0.02	0.54	0.57	0.13
PTI_{t+k}	0.211***	0.273***	0.001***	0.196***	0.214***	0.043***
PTI_{t+k} × NOL Ben.$_t$	-0.905***	-0.949***	0.006	-0.869***	-0.824***	-0.093
PTI_{t+k} × Comp. NOL Ben.$_t$	-0.010	-0.110	0.004	0.042	0.139	-0.032
NOL Ben.$_t$	-0.020*	0.002	-0.005	-0.026**	-0.028	-0.013
Comp. NOL Ben.$_t$	-0.003	0.008	0.004	-0.012	-0.021	0.002
R-squared	0.60	0.67	0.02	0.59	0.60	0.14

Table 3 (cont'd) – Relative performance of NOL benefit proxies

Panel B: Comparing NOL proxies, multinational vs domestic and existing 382 limitation

	Dependent variable = Cash tax paid$_{t+1}$			
	Domestic only	Multi-national	Existing 382 limit	No 382 limit
N=	1,460	5,426	1,366	5,520
	(1)	(2)	(3)	(4)
PTI_{t+1}	0.197***	0.219***	0.173***	0.219***
PTI_{t+1} × NOL Ben.$_t$	-0.974***	-0.924***	-0.597***	-1.111***
NOL Ben. $_t$	-0.078***	0.000	-0.015	-0.020**
R-squared	0.62	0.61	0.55	0.61
PTI_{t+1}	0.177***	0.218***	0.153***	0.204***
PTI_{t+1} × Comp. NOL Ben.$_t$	-0.378***	-0.261***	-0.215***	-0.399***
Comp. NOL Ben.$_t$	-0.056***	0.015**	-0.013*	0.029***
R-squared	0.54	0.57	0.51	0.56
PTI_{t+k}	0.197***	0.219***	0.174***	0.219***
PTI_{t+k} × NOL Ben.$_t$	-1.036***	-0.894***	-0.510***	-1.095***
PTI_{t+k} × Comp. NOL Ben.$_t$	0.056	-0.026	-0.059*	-0.019
NOL Ben.$_t$	-0.084***	0.001	-0.014	-0.018*
Comp. NOL Ben.$_t$	0.008	-0.002	-0.003	-0.002
R-squared	0.62	0.61	0.56	0.61

Table 4 – The determinants of tax loss carryforward benefits

This table reports the results from regressing the NOL Benefit on pre-tax income and other variables that may contribute to the tax loss. The regressions are estimated on the 6,406 observations with pretax income available five years. All variables are defined in Appendix A. ***, **, and * indicate significance at the 0.01, 0.05 and 0.10 levels and reflect standard errors clustered at the firm level.

	Dependent var. = NOL Benefit$_t$					
	All Firms (1)	All Firms (2)	All Firms (3)	All Firms (4)	Domestic-only (5)	Multi-Nationals (6)
Intercept	0.060***	0.044***	0.064**	0.041**	0.039**	0.058***
$\sum PTI_{t-4,\,t}$	-0.072***					
$PTI_{t-4,\,t}$ (≤ 0)		-0.143***	-0.107***	-0.110***	-0.086***	-0.097***
$PTI_{t-4,\,t}$ (> 0)		-0.048***	-0.061***	-0.057***	-0.047***	-0.055***
Foreign activity			0.009***	0.008***		
R&D			0.023**	0.013**	0.001	0.019***
Market-to-book			0.008**	0.007***	0.008***	0.006***
Tangibility			-0.006	0.007	-0.024**	0.022**
Goodwill > 0			-0.009**	-0.010***	-0.009**	-0.012**
Leverage			0.029***	0.026***	0.054***	0.020**
ln(Real book assets)			-0.004***	-0.004***	-0.003*	-0.005***
Industry & Year FE	No	No	No	Yes	Yes	Yes
N	6,406	6,406	6,406	6,406	1,337	5,069
R-squared	0.22	0.27	0.32	0.37	0.59	0.31

Table 5 – NOL benefits and asset growth

This table presents the results from estimating the relation between investment spending and tax loss benefits. Panel A includes descriptive statistics; Panel B includes the regression results. Investment spending is measured with the change in total assets (Column (1)), capital expenditures (Column (2)), research and development (Column (3)), and acquisition spending (Column (4)). All variables are defined in the Appendix. ***, **, and * indicate significance at the 0.01, 0.05 and 0.10 levels and reflect standard errors clustered at the firm level. Industry and year fixed effects are included.

Panel A: Distribution of investment growth year *t* + 1

	Mean	Std. Dev	25th	50th	75th
$\Delta Assets_{t,t+1}$	0.100	0.284	-0.019	0.048	0.134
$Capex_{t+1}$	0.056	0.064	0.020	0.036	0.065
$R\&D_{\backslash t+1}$	0.029	0.061	0.000	0.000	0.029
$Acquisitions_{t+1}$	0.049	0.126	0.000	0.001	0.032

Panel B: NOL benefits and future asset growth

	Dependent variable = $Investment_{t+1}$			
	$\Delta Assets_{t,t+1}$	$Capex_{t+1}$	$R\&D_{t+1}$	$Acquisitions_{t+1}$
	(1)	(2)	(3)	(4)
NOL $Benefit_t$	0.289^{***}	0.036^{**}	0.213^{***}	-0.030
Market-to-Book $_t$	0.044^{***}	0.004^{***}	0.017^{***}	0.004^{**}
CFO_t	0.334^{***}	0.168^{***}	-0.101^{***}	0.024
$Leverage_t$	-0.097^{***}	0.011	-0.042^{***}	-0.028^{**}
$\ln(MVA_t)$	-0.024^{***}	-0.005^{***}	-0.002^{**}	-0.011^{***}
N	6,884	6,884	6,884	6,884
R-squared	0.11	0.42	0.54	0.04

Table 6 – NOL benefits and financing

This table presents the results from testing the relation between NOL benefits and external financing. Panel A includes descriptive statistics, and Panel B presents results from estimating Eq. (1). Panel C includes results including only large, intentional external financing (issuances of greater than 2% of beginning assets), and Panel D includes a discrete choice model The dependent variables represent financing activity in year *t+1*;net financing is the sum of net equity and net debt. Net equity issued is cash raised from equity sales, less cash paid to repurchase stock. Net debt is cash from debt issued less cash paid to retire debt . Net debt adjusted for cash subtracts the change in cash holdings from net debt. dSM and dSB measure the growth in equity following Fama and French (2005). All financing variables are scaled by total assets at the beginning of the period. The explanatory variables include the NOL benefit scaled by assets, market-to-book, operating cash flows scaled by assets, book leverage, the market value of the firm's assets, and asset tangibility. All variables are defined in the Appendix. ***, **, and * indicate significance at the 0.01, 0.05 and 0.10 levels and reflect standard errors clustered at the firm level. Industry and year fixed effects are included.

Panel A: Distribution of financing activity in year t + 1

	Mean	Std. Dev	25th	50th	75th
Net external financing	0.017	0.171	-0.048	-0.010	0.027
Net equity financing	-0.019	0.093	-0.041	0.005	0.001
dSM	0.011	0.163	-0.028	0.001	0.012
dSB	0.015	0.150	-0.018	0.003	0.014
Net debt financing	0.035	0.117	-0.011	0.000	0.045
Net debt - ΔCash	0.023	0.138	-0.037	0.004	0.059

Panel B: NOL benefits and external financing decisions

	Dependent variable = External financing$_{t+1}$					
	Total	Equity Issuances			Debt Issuances	
	Net external financing (1)	Net equity issued (2)	dSM (3)	dSB (4)	Net debt issued (5)	Net debt - ΔCash (6)
NOL Benefit$_t$	0.174***	0.116***	0.369***	0.249***	0.027	-0.092*
Market-to-Book$_t$	0.020***	0.010***	0.040***	0.030***	0.010***	-0.007**
CFO$_t$	-0.419***	-0.395***	-0.548***	-0.351**	0.009	0.067
Leverage$_t$	-0.012	0.002	0.001	-0.012	-0.002	0.018**
ln(MVA$_t$)	-0.017***	-0.011***	-0.015***	-0.014***	-0.005***	-0.002
Tangibility$_t$	0.031	0.027*	0.025	0.008	0.003	-0.008
N	6,884	6,884	6,884	6,884	6,884	6,884
R-squared	0.10	0.19	0.19	0.12	0.03	0.02

Table 6 (cont'd) – NOL benefits and financing

Panel C: NOL benefits and external financing decisions, large changes only (> 2% of beginning assets)

	Dependent variable = External financing $_{t+1}$					
	Total	Equity Issuances			Debt Issuances	
	Net external financing (1)	Net equity issued (2)	dSM (3)	dSB (4)	Net debt issued (5)	Net debt - ΔCash (6)
NOL Benefit$_t$	0.225**	0.209**	0.530***	0.302***	0.084	-0.114*
Controls	Yes	Yes	Yes	Yes	Yes	Yes
N	4,797	3,087	3,371	3,041	3,560	5,179
R-squared	0.13	0.28	0.25	0.18	0.11	0.03

Panel D: NOL benefits and external financing decisions, discrete choice models

	Dependent variable = pr(External financing$_{t+1}$ = 1)				
	Large equity change (dSM) (1)	Equity offering (SDC) (2)	Large stock issue (sstk) (3)	Large stock repurchase (prstk) (4)	Large net debt issue (5)
NOL Benefit$_t$	2.515***	0.161	1.505*	-4.045**	-6.17***
Controls	Yes	Yes	Yes	Yes	Yes
Pr(financing = 1)	12.7%	8.1%	6.5%	6.4%	22.6%
N	6,884	6,884	6,884	6,884	6,884
Pseudo R-squared	0.20	0.11	0.17	0.41	0.10

Table 7 – NOL benefits and financing: Exposure to statutory limitations

This table presents the results from testing how the relation between NOL benefits and external financing varies based on statutory limitations on future NOL utilization. Panel A presents results from estimating Eq. (1), including separate indicator variables of interest for whether the firm has an existing limitation under Section 382 of the U.S. Internal Revenue Code. All variables are defined in the Appendix. ***, **, and * indicate significance at the 0.01, 0.05 and 0.10 levels and reflect standard errors clustered at the firm level. Industry and year fixed effects are included.

Panel A: Existing 382-based NOL limitations and financing decisions

	Dependent variable = External financing$_{t+1}$					
	Total	Equity Issuances			Debt Issuances	
	Net external financing (1)	Net equity issued (2)	dSM (3)	dSB (4)	Net debt issued (5)	Net debt - ΔCash (6)
NOL Benefit$_t$						
Existing 382 limit = 0	0.080	0.054	0.155**	0.060	0.026	-0.030
Existing 382 limit = 1	0.201**	0.147**	0.476***	0.341***	0.007	-0.146*
Difference	0.122	0.093	0.321	0.281**	-0.019	0.116
Controls	Yes	Yes	Yes	Yes	Yes	Yes
N	6,884	6,884	6,884	6,884	6,884	6,884
R-squared	0.10	0.19	0.19	0.13	0.03	0.02

Panel B: NOL location, 382-based limitations, and financing decisions

	Dependent variable = External financing$_{t+1}$					
	Total	Equity Issuances			Debt Issuances	
	Net external financing (1)	Net equity issued (2)	dSM (3)	dSB (4)	Net debt issued (5)	Net debt - ΔCash (6)
NOL Benefit$_t$						
Domestic NOL Ben.						
Existing 382 limit = 0	0.173*	0.051	0.122	0.050	0.101*	0.021
Existing 382 limit = 1	0.373***	0.229**	0.661***	0.474***	0.071	-0.122
Limit – No Limit	0.200	0.178	0.539**	0.424***	-0.039	-0.143
Foreign NOL Ben.	-0.754***	-0.170	-0.547***	-0.322***	-0.431***	-0.391***
Controls	Yes	Yes	Yes	Yes	Yes	Yes
N	5,604	5,604	5,604	5,604	5,604	5,604
R-squared	0.11	0.19	0.20	0.14	0.04	0.03

Table 8 – 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. The dependent variable is the natural log of the ratio of cash and short-term investments to total assets. In Panel A, we estimate the regression on the full sample with the total NOL benefit included. In Panel B, we interact NOL benefit with the repatriation tax cost and uncertain tax benefits. The regressions are estimated for multinational firms only (col. 2), domestic firms only (col. 3), and by defining the NOL benefit as either the Federal (col. 4), state (col. 5), or foreign (col. 6) benefit among firms that disclose location information. Standard errors clustered at the firm level. Industry and year fixed effects are included. Other variables are defined in the Appendix.

Panel A: Cash holdings and NOL benefits

	Dependent variable = ln($Cash_t$/$Assets_t$)		
	(1)	(2)	(3)
NOL $Benefit_{tt}$		0.10^{**}	0.10^{**}
Repatriation tax $cost_t$	2.56^{***}	2.59^{***}	
Permanently reinvested $earnings_t$			0.11^{***}
Uncertain tax $benefits_t$ (UTB)	0.38^{***}	0.32^{*}	0.38^{**}
ln(real book $assets_t$)	-0.02^{***}	-0.02^{***}	-0.02^{***}
Net working $capital_t$	-0.25^{***}	-0.25^{***}	-0.25^{***}
Market-to-$book_t$	0.02^{***}	0.02^{***}	0.02^{***}
CFO_t	0.09^{**}	0.11^{**}	0.14^{***}
$R\&D_t$	0.09^{**}	0.09^{**}	0.09^{**}
$Capex_t$	-0.28^{***}	-0.29^{***}	-0.30^{***}
Cash $acquisitions_t$	-0.26^{***}	-0.26^{***}	-0.26^{***}
Dividend $dummy_t$	-0.02^{***}	-0.02^{***}	-0.02^{***}
$Leverage_{t-1}$	-0.14^{***}	-0.14^{***}	-0.14^{***}
Net debt $issue_{t-1}$	0.16^{***}	0.16^{***}	0.16^{***}
Industry cash flow $risk_t$	0.48^{***}	0.47^{***}	0.48^{***}
N	6,884	6,884	6,884
R-squared	0.56	0.57	0.56

Panel B: Impact of NOL benefits on trapped cash and cash held to satisfy tax challenges

				NOL Benefit =		
	All	MNC	Domestic	Federal	State	Foreign
	(1)	(2)	(3)	(4)	(5)	(6)
NOL $Benefit_t$	0.25^{***}	0.20^{***}	0.26^{***}	0.29^{***}	1.04^{**}	0.10
Repatriation tax $cost_t$	3.09^{***}	3.01^{***}		2.73^{***}	2.65^{***}	2.58^{***}
UTB_t	0.55^{***}	0.52^{**}	1.03^{**}	0.66^{***}	0.57^{***}	0.76^{***}
NOL Ben. x Repat. tax cost	-20.46^{***}	-17.85^{***}		-19.09^{**}	-85.55	-23.78
NOL Ben. x UTB	-4.70^{***}	-4.14^{**}	-7.72^{**}	-4.81^{**}	-7.41	-18.57^{*}
Controls	Yes	Yes	Yes	Yes	Yes	Yes
N	6,884	5,423	1,461	5,604	5,604	5,604
R-Squared	0.57	0.56	0.58	0.57	0.57	0.57

Table 9 - 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, beginning NOL benefits, and the interaction between the two, including control variables for 6,884 firm-year observations. Panel A reports descriptive statistics for the model variables results for all firms. Panel B reports the results from regressions of excess stock returns on explanatory variables. The baseline regression is in column (1). In column (2), the valuation of cash is conditioned on the ratio of NOL benefits to beginning market value of equity. All variables except leverage, are scaled by beginning market value of equity. Standard errors clustered at the firm level. Industry and year fixed effects are included.

Panel A: Descriptive statistics for cash valuation model

	Mean	Std. Dev	Q1	Median	Q3
NOL Benefits$_t$	0.050	0.120	0.001	0.008	0.035
Excess Return$_{t+1}$	0.014	0.347	-0.190	-0.009	0.175
ΔCash$_{t,t+1}$	0.005	0.103	-0.020	0.002	0.026
ΔEarn$_{t,t+1}$	0.003	0.178	-0.013	0.004	0.018
ΔNet assets$_{t,t+1}$	0.056	0.415	-0.017	0.026	0.097
ΔR&D$_{t,t+1}$	0.001	0.008	0.000	0.000	0.001
ΔInterest$_{t,t+1}$	0.001	0.013	-0.001	0.000	0.002
ΔDividends$_{t,t+1}$	0.001	0.018	0.000	0.000	0.002
Cash$_t$	0.152	0.231	0.041	0.095	0.185
Market leverage$_t$	0.186	0.162	0.063	0.149	0.267
Stock issued$_t$	0.015	0.064	0.000	0.003	0.008
Stock repurchased$_t$	0.026	0.037	0.000	0.010	0.038
Net debt issued$_t$	0.027	0.153	-0.011	0.000	0.041
Cash accumulation$_t$ (0,1)	0.538	0.499	0.000	1.000	1.000

Panel B: The relation between tax loss benefits and the valuation of the marginal dollar of cash

	Dependent Variable: Excess Returns$_{t+1}$	
	(1)	(2)
ΔCash$_{t,t+1}$	0.65***	0.56***
NOL Benefits$_t$		0.33***
ΔCash$_{t,t+1}$ × NOL Benefits$_t$		1.02***
ΔEarn$_{t,t+1}$	0.31***	0.29***
ΔNet assets$_{t,t+1}$	0.11***	0.11***
ΔR&D$_{t,t+1}$	1.72***	1.68**
ΔInterest$_{t,t+1}$	-1.56***	-1.58**
ΔDividends$_{t,t+1}$	0.34	0.40
Cash$_{t,}$	0.13***	0.07*
Market leverage$_t$	-0.37***	-0.45***
Stock issued$_t$	0.22*	0.48***
Stock repurchased$_t$	0.33***	0.33***
Net debt issued$_t$	-0.07***	-0.07
Cash accumulation$_t$ (0,1)	0.03***	0.03***
ΔCash $_{t,t+1}$ × Cash$_t$	-0.10	-0.18**
[ΔCash/lag(MVE)] x [Debt/MV Assets]	-0.58	-0.78**
R-squared	0.15	0.17