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THE IMPLICATIONS OF TAX ASYMMETRY FOR U.S. CORPORATIONS

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This paper examines the implications of the asymmetric treatment of tax losses for U.S. corporations for 1993–2004. We find that partial refunding of tax losses reduces their real values by approximately one-half and produces modest effective tax rate differentials between taxable and non-taxable firms. However, if firms use debt financing or utilize an investment tax credit, then rate differentials can be significant. We also find that certain industries and younger firms disproportionately bear the negative consequences of partial refunding, due to either delayed realization or the inability to use tax losses to offset prior or future profits.

Keywords: corporate income tax, business tax, marginal effective tax rate, investment

JEL Codes: H25, H21

I. INTRODUCTION

The asymmetric treatment of gains and losses is a universal feature of corporate income tax systems. Corporations incur tax liability if profitable, but they generally do not receive a commensurate refund if they report a tax loss. Corporations must carry tax losses backward or forward in time to offset prior payments (immediately) or reduce future tax liability. Because most corporations carry tax losses forward, they receive only a partial refund of their real tax loss. Moreover, loss carryforward firms can experience lengthy non-taxable spells that create effective tax rate disparities between those firms and their taxable counterparts. This potential outcome is highly relevant for researchers interested in the corporate investment process because loss and loss carryforward firms undertake significant investment. For example, in 2004, tax data reveal that these firms reported nearly 70 percent of total corporate investment.

The significance of tax asymmetry for tax status and investment is underscored by the extensive literature that explores this issue. Cordes and Sheffrin (1983) find that tax asymmetry contributes to significant variation in the marginal cost of debt across

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industries. Auerbach and Poterba (1987) and Mintz (1988) find that loss carryforwards can have a dramatic effect on investment incentives in cyclical industries. Altshuler and Auerbach (1990) show that partial refunding increases the persistence of non-taxable status and creates effective tax rate disparities between taxable and non-taxable firms. Devereux, Keen and Schiantarelli (1994) find that tax asymmetry causes considerable cross-sectional and intertemporal variation in the cost of capital for UK manufacturing firms, although the explicit modeling of tax asymmetry did not improve the explanatory power of their investment equations. By contrast, Cummins, Hassett and Hubbard (1995) show that U.S. firms with no loss carryforwards are responsive to changes in the user cost of capital, but loss carryfoward firms are not. Most recently, Gendron, Anderson and Mintz (2003) find that the investment behavior of Canadian firms is sensitive to tax status.

We extend this literature by examining the implications of tax asymmetry for U.S. corporations for 1993–2004. Compared to prior studies, we employ a much larger dataset that captures the majority of tax losses reported by corporations for the period analyzed. Another unique feature of our dataset is that it includes new firms and firms that terminate operations. These attributes allow us to compare the implications of tax asymmetry for new firms relative to older, established firms. We can also quantify the magnitude of tax losses that are never used by expired firms. Overall, we find that partial refunding erodes the real value of tax losses by slightly more than one-half. Our results show that the negative consequences of tax asymmetry are not borne uniformly, as service industries and new firms are penalized disproportionately. On average, such firms endure relatively long delays in realizing losses, and in many cases are simply unable to use losses as an offset against taxable income. We also find that tax asymmetry produces modest effective tax rate differentials between taxable and non-taxable firms within and across industries. For equipment investment, tax rate differentials increase significantly if firms use debt financing or utilize an investment tax credit.

Section II begins our analysis with a brief overview of the partial tax loss refund system. Section III presents our dataset and the methodologies we use for this analysis. Section IV examines the erosion of real tax losses across all firms and nine industry groups for selected tax years. Section V computes transition probabilities and steady state distributions of firms across various tax states. We use those results to compute the impact of tax asymmetry on effective tax rates across our nine industry groups for taxable and non-taxable firms. Section VI summarizes our findings.

II. THE PARTIAL REFUNDING OF NET OPERATING LOSSES

Tax law provides two options to subchapter C corporations that report a net operating loss (NOL). If a firm has outstanding tax liability from the prior two tax years, then a firm may carry the NOL back to offset that liability.[1] If a firm is unable to exhaust the

[1] Firms may elect to relinquish the entire carryback period for any tax year. Once made, this election is irrevocable for that tax year.

NOL through carryback, it then carries the NOL forward to be used as a net operating loss deduction (NOLD) against future taxable income. Net operating losses may be carried forward up to 20 years, at which time they expire.[2] Net operating losses acquired through mergers or acquisitions face certain restrictions that impede their use and make it unlikely that a firm could immediately utilize all such NOLs.[3]

Currently, no OECD country that levies a corporate income tax allows full NOL refundability or even pays interest to maintain their real values.[4] Despite this universal treatment, the inherent flaws of the partial refund system are well-known. In broad terms, the system suffers from three shortcomings that are related to a firm's inability to use NOLs immediately. The most conspicuous deficiency is the real NOL erosion caused by delays in claiming carryforward deductions. Mintz (1988) finds that tax asymmetry produced significant erosion and dispersion in the real value of tax losses recouped by Canadian firms; while most real taxes losses were recouped by retail trade firms (86 cents per dollar) and utilities (83 cents), manufacturers recouped little more than half (61 cents), and resource firms (e.g., mining) recouped less than one quarter (24 cents). Both Mintz and Auerbach and Poterba (1987) find that partial refunding penalizes cyclical industries more heavily due to such delays.

A less transparent flaw of partial refunding is the potential for marginal effective tax rate disparities between taxable and non-taxable firms. Because non-taxable firms might face higher or lower effective tax rates than their taxable counterparts, partial refunding might encourage or discourage investment depending on a firm's tax attributes, tax-life of investment and prospects for future profitability. For example, non-taxable firms might face lower effective tax rates because loss carryforwards temporarily shield income generated by new investment. Such income is effectively taxed in a future year as the incremental income from the new investment reduces the stock of loss carryforwards. However, the positive effects of this tax shield might be (more than) offset by the simultaneous delay of depreciation and interest deductions.

A third flaw of partial refunding is that it discriminates against risky investments, new firms, and undiversified firms. A firm choosing between two projects with equal expected (pre-tax) returns will opt for the less risky project due to the potential reduc-

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[2] For tax years ending prior to August 6, 1997, firms could carry NOLs back three tax years and forward 15 years.

[3] Sections 381 and 382 of the Internal Revenue Code contain rules for NOLs acquired through mergers and acquisitions. A successor corporation is allowed to carry over any NOLs and certain other items of its predecessor under specified conditions. After an ownership change, the amount of income that a corporation may offset each year by acquired NOL carryforwards is limited to an amount determined by multiplying the value of the equity of the corporation just prior to the ownership change by the federal long-term tax-exempt rate in effect on the date of change. Any unused limitation amounts may be carried forward and added to the next year's limitation.

[4] All OECD countries allow firms to carry tax losses forward in time; approximately two-thirds allow a five to ten year carryforward, the remainder allow indefinite carryforward. By contrast, only eight OECD countries (including the United States) allow firms to carry losses back to offset prior payments. For countries that allow carryback, tax losses may be carried back between one and three tax years.

tion in the real value of any tax loss that might be incurred and carried forward. New firms face higher expected effective tax rates because the taxing authority does not share in the loss if the firm fails, yet levies tax if the firm is profitable. Small, undiversified firms might also face higher tax rates if they cannot use a NOL to offset taxable income from other investments.[5]

At the same time, tax asymmetry confers a number of valuable benefits to the taxing authority. An important implication of partial refunding is the ceiling imposed on fraud and abuse. Under full refundability, firms would enjoy unlimited and immediate benefits from the overstatement of tax losses. Because firms must use NOLs to offset profits, partial refunding limits fraud to actual tax liability. Other benefits include reduced revenue volatility and enhanced real tax receipts. Partial refunding stabilizes revenues because it acts as an imperfect income averaging mechanism. Real receipts are enhanced because many corporations never utilize NOLs or claim them after substantial delay. For tax years 1993–2003, Cooper and Knittel (2006) find that full loss refundability would have reduced U.S. corporate income tax revenues by approximately one-third, whereas actual loss carryforward deductions and carryback refunds reduced revenues by only 15 percent during that time period.

In the analysis that follows, we use two metrics to gauge how partial refunding affects C corporations: real NOL erosion and effective tax rates. We do not attempt to address or quantify the many other ways that tax asymmetry might impact corporations. For example, loss considerations might have sufficient import so that a firm opts for S-corporation status to allow the pass-through of any tax loss, thereby imposing a limit on the number and type of entities that can be shareholders of the firm. Alternatively, tax asymmetry might compel non-taxable firms to use complex leasing arrangements, whereas they would simply purchase the asset under full refunding. We also disregard other attributes that might affect our analysis, such as tax credits. The inclusion of tax credits would greatly increase the complexity of the analysis and distract from analyzing issues related solely to the partial refunding of NOLs.

III. DATA AND METHODOLOGY

The dataset for this analysis is a combination of two Internal Revenue Service (IRS) data files. The primary data source is the IRS annual corporate samples for tax years 1993–2004. The stratified annual samples include detailed tax return data for 60,000–80,000 C corporations from a total population of approximately 2.1 million firms. The second data source is the CORTAX data file, which contains all post-filing amendments and adjustments initiated by firms or the IRS. For our purposes, CORTAX provides two useful pieces of information. CORTAX records when a firm applies for a carryback refund, the tax year to which the loss is applied, and the dollar amount of the refund. CORTAX also provides information regarding the status of firms that exit the annual corporate sample. If a firm does not file a tax return because it no longer

[5] For a more complete discussion of these issues and illustrative examples, see Mintz (1991).

conducts business under its former taxpayer identification number, then CORTAX retains that number for up to 10 years, but leaves all other fields blank. By contrast, certain fields will contain values if the firm filed a return, but was not included in the annual sample. We use this indicator to distinguish between firms that simply leave the annual sample for a given year from firms that no longer exist. The latter case occurs when a firm terminates operations or is acquired by another firm.

Our final dataset can be sub-divided into three distinct groups. The primary group includes firms that are present for all tax years 1993–2004. This group generates most of the activity we observe. The second group includes firms that first appear in the annual sample between tax year 1994 and tax year 2001 and appear every year thereafter. The third group includes firms that appear for at least three consecutive tax years, but then subsequently cease to file a return under that taxpayer identification number due to termination or acquisition. The data do not allow us to differentiate between those two outcomes. Therefore, if we cease to observe a firm in our dataset, then we assume that the firm's stock of unused NOLs will never be used. This assumption understates NOL utilization because it is possible that some portion of any acquired NOL stock will be used during our study period. However, due to the restrictions placed on acquired NOLs, any understatement should be modest.

A. Corporate Dataset

Our dataset captures nearly three-quarters of total NOLs and loss carryforward deductions reported by all corporations during our study period (Table 1). The (unweighted) dataset begins with 46,700 firms in tax year 1993, peaks at 67,600 in tax year 2001, and then declines to 52,800 by 2004. This trend is attributable to the fact that we capture new additions to the annual corporate sample only through tax year 2001, but we allow terminations and acquisitions through 2004.[6]

Because small firms are not fully sampled, our unweighted dataset underrepresents small loss firms. The average loss for our dataset is $8.4 million, compared to $0.2 million for the corporate population. Although we cannot quantify how this omission affects our results, we surmise that small loss firms would experience similar or stronger negative repercussions from partial refunding due to their less diversified operations and more limited ability to carryback losses. Because we capture a relatively high proportion of total reported NOLs, we do not attempt to control for firms omitted from our dataset.

Our study period covers a full business cycle, so we observe a dramatic increase, then decline, in reported NOLs for the corporate population and our dataset. From 1993 to 2001, total tax losses increased from $127 billion to $440 billion, then declined to $273

[6] In addition, there is a large increase in the number of firms in our dataset from 1997–1999. During that time, the annual corporate sample increased from approximately 62,000 to 82,000 firms. The larger sample includes all mid-sized firms with assets between $10 million to $50 million or gross proceeds between $2.5 million to $10 million. Previously, those firms were sampled at a rate between 0.4–10 percent.

Table 1

Corporate Population and Dataset
(Thousands of Firms, $ Billion)

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Number of firms												
Corporate population	2,194	2,311	2,312	2,318	2,248	2,250	2,199	2,173	2,137	2,100	2,048	2,028
Dataset[1]	47	51	54	51	52	61	63	66	68	65	59	53
Number of loss firms												
Corporate population	999	1,038	1,050	1,034	1,009	1,010	999	1,028	1,049	1,100	1,056	1,038
Dataset	13	14	16	15	15	19	21	24	27	26	23	20
Share of firms reporting loss												
Corporate population	0.46	0.45	0.45	0.45	0.45	0.45	0.45	0.47	0.49	0.52	0.52	0.51
Dataset	0.29	0.28	0.29	0.29	0.29	0.31	0.33	0.36	0.40	0.41	0.39	0.38
Reported tax loss												
Corporate population	127	128	127	140	158	205	248	342	440	419	323	273
Dataset	71	64	73	81	97	142	181	245	370	366	243	188
Average tax loss (millions)												
Corporate population	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.4	0.4	0.3	0.3
Dataset	5.3	4.5	4.6	5.5	6.5	7.6	8.8	10.4	13.7	13.8	10.6	9.5
Loss carryforward deductions												
Corporate population	45	49	57	55	60	53	65	77	65	66	70	101
Dataset	27	31	41	37	43	36	49	61	45	50	52	76

(1) Figures represent unweighted amounts.
Source: Corporate population data are from IRS *Publication 16, Corporation Income Tax Returns*. Tabulations for dataset are from selected corporate tax returns contained in IRS Statistics of Income Division annual stratified samples.

billion for tax year 2004.[7] The tabulations from Table 1 show that most NOLs were not used during that interval. For tax years 1993–2004, reported NOLs totaled $2.9 trillion, whereas carryback refunds and loss carryforward deductions totaled $1.2 trillion. We examine the implications of this fact below.

B. Definitions and Methodology

For the purposes of this analysis, we define a net operating loss as the excess of allowable deductions (including the dividends received deduction) over total income. The NOLs we examine are operating losses; they do not include capital losses.[8] Carryback refunds are NOLs used to offset tax liability from a prior tax year. Net operating loss deductions are loss carryforwards from prior tax years that are used as a deduction against current year income. Finally, we define a non-taxable firm as a loss firm that does not immediately carry all losses back (full carryback firms are taxable at the margin) or a firm that uses loss carryforwards to eliminate at least 95 percent of current year tax liability.[9]

We track how firms use NOLs beginning with tax year 1993 because it corresponds to the first year that corporations reported NOL stocks on their tax return. The NOL stock is the cumulative amount of unused tax losses that firms carry forward into the tax year. If a firm reports a NOL stock carried into 1993, we require that the firm exhaust that stock prior to the utilization of any new NOLs. For each successive tax year, we re-compute the NOL stock brought forward by adding reported losses and deducting any carryback refunds or carryforward deductions from the original stock reported by the firm. We use CORTAX data to attribute carryback refunds to the loss year from which they originate. The attribution of loss carryforward deductions to a specific loss year is more complicated. For that purpose, we vintage and track a firm's NOL stock and attribute claimed loss carryforward deductions to the oldest NOLs carried in that inventory. This stacking order reflects utilization patterns because NOLs will expire if unused.

In certain instances, firms will claim a loss carryforward deduction that exceeds our computed NOL stock carried into the tax year. These unexplained deductions may arise due to unobserved adjustments made to the original tax return (i.e., an amended tax return or audit) or if a firm acquires NOLs through a merger or acquisition. In either

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[7] For tax year 2005, NOLs decreased to $217 billion, then increased to $228 billion (2006) and $314 billion (2007).

[8] Capital losses can only offset capital gains. If the corporation cannot deduct a capital loss in the current tax year, it must carry the loss to other tax years and deduct it from any net capital gains that occur in those years.

[9] We do not require that firms eliminate all tax liability because we observe a number of instances where firms leave a small amount of taxable income on their tax return, even though it appears they could eliminate all of it based on the size of their NOL carryforward stock. We are unsure why this outcome occurs. The elimination of this threshold has only a minor impact on our results. It is possible that these firms will in fact eliminate all taxable income when they file an amended return once the audit process is complete.

case, we cannot identify the tax year from which the loss deduction originates. We label these deductions "unexplained NOLDs" because it appears that the firm had insufficient stock to claim them. Unexplained NOLDs are held separate and are not included in our analysis; they comprise approximately one-tenth of all loss deductions we observe.[10] To the extent that unexplained NOLDs are attributable to the acquisition of a firm previously included in our dataset (hence we include their tax loss in our tabulations), we will understate NOL utilization. Otherwise, the omission of these deductions does not impact our results.

IV. THE EROSION OF REAL NET OPERATING LOSSES

We begin our analysis with an examination of the effect of tax asymmetry on the real value of tax losses. To quantify any erosion that occurs, we track how quickly firms use NOLs. We classify NOLs into one of three groups based on their ultimate disposition: (1) NOL used as a carryback refund or loss carryforward deduction (which may indicate that a portion of a NOL was used or the entire amount), (2) NOL lost, due to a termination or merger/acquisition, and (3) NOL remains to be used at a future time. Table 2 reports these outcomes and the number of years that transpire before firms in our dataset used NOLs.

Tax year 1993 is the first year that our methodology can be used to attribute carryback refunds and carryforward deductions to the tax year from which they originate. For 1993, firms in our dataset had eleven years to utilize $71 billion of reported tax losses. We find that slightly more than one-half of those NOLs were used as a carryback refund or carryforward deduction ($38 billion), slightly less than one-third were lost ($21 billion) and 16 percent ($11 billion) remain unused by the end of our study period. For later tax years, the share of NOLs used or lost generally declines over time, while the share unused increases due to the progressively shorter utilization window.

At the bottom of Table 2, we track the usage of any pre-existing NOL stocks that firms reported in the first year they appear in our dataset. For these amounts, we cannot identify the tax year from which loss carryforward deductions originate and we do not know the exact number of years that transpired before NOLs were used. The first case relates to firms present in 1993 that reported $263 billion of NOL stock carried into that year. From 1993–2004, we find those firms used $153 billion (58 percent) as a carryforward deduction, $92 billion (35 percent) was lost due to termination or acquisition, and $18 billion (7 percent) remains to be used by the end of tax year 2004. It is likely that much of this final amount will expire unused. The second case relates to firms that first appear between tax years 1994–2001 and report a NOL stock carried into the year we first observe them. Those firms reported $163 billion of NOL stock. We find that $73 billion (45 percent) of that stock was used as a carryforward deduction, $47 billion (29 percent) was lost, and $43 billion (26 percent) remains to be used.

[10] By comparison, Altshuler and Auerbach (1987) find an underprediction rate of approximately 6 percent per year.

Table 2

Disposition of Net Operating Losses
($ Billion)

Tax		Carryback	NOL Used as Carryforward Deduction, Number of Years Until Used												Final NOL Disposition		
Year	NOL	Refund	1	2	3	4	5	6	7	8	9	10	11	12	Used [1]	Lost [2]	Remain
1993	71.0	10.4	2.8	6.4	3.7	5.4	2.3	1.7	2.2	1.2	0.8	0.6	0.9		38.3	21.3	11.4
1994	64.4	11.7	3.9	2.5	3.1	2.5	1.8	1.9	1.4	1.1	0.7	1.0			31.8	19.0	13.6
1995	73.3	12.1	2.1	3.0	2.0	2.3	1.7	2.2	1.4	1.4	1.3				29.5	26.5	17.2
1996	80.5	12.9	2.1	2.6	3.1	3.7	1.9	1.8	1.5	1.8					31.2	31.4	17.9
1997	97.1	15.7	2.6	3.2	5.3	2.2	1.9	1.6	1.5						34.0	39.4	23.6
1998	141.9	18.9	5.8	7.9	3.7	3.2	3.9	3.5							46.8	53.3	41.7
1999	180.6	20.8	11.1	5.6	3.9	5.4	6.8								53.6	55.8	71.2
2000	245.5	26.0	5.4	5.4	5.9	8.8									51.6	67.4	126.5
2001	370.3	88.1	8.0	8.3	7.6										112.0	66.3	192.0
2002	365.9	66.3	5.1	11.4											82.7	57.7	225.4
2003	243.1	28.0	5.6												33.6	17.2	192.4
2004	188.3	13.7													13.7	0.0	174.6
Utilization of pre-existing NOL stocks																	
Pre-1993[3]	262.7		27.3	25.3	25.7	19.6	17.7	11.1	9.0	7.0	4.7	2.5	1.8	1.5	153.2	91.6	17.9
New firms[4]	162.7		14.0	16.5	11.9	13.1	7.0	4.8	2.7	2.0	0.7	0.5	0.2	0.0	73.4	46.7	42.6

(1) Used NOLs equal to the sum of carryback refunds and loss carryforward deductions.
(2) Lost NOLs are stocks of NOLs that disappear due to firm termination or a merger/acquisition.
(3) Pre-existing NOL stock brought forward into tax year 1993. Carryback refunds are not observable.
(4) Pre-existing NOL stock for firms that first appear in our dataset after tax year 1993. Carryback refunds are not observable.
Source: Authors' calculations as explained in text.

The tabulations from Table 2 reveal that firms typically carried back 12–15 percent of their tax loss to offset liability from prior tax years.[11] We note that actual carryback potential appears considerably higher, but some firms may have opted to forgo carryback to avoid displacing a credit that was claimed previously.[12] Carryback refunds spiked in 2001–02 due to the Jobs Creation and Worker Assistance Act of 2002 and adverse economic conditions. The Jobs Creation Act temporarily extends the loss carryback window from two to five years for NOLs generated in those years.

Although the utilization patterns from Table 2 suggest that most NOLs eventually claimed are used within three to four years of the tax loss, the table also shows that some firms endure lengthy delays. For example, firms claimed nearly one billion of carryforward deductions in 2004 that were attributable to tax year 1993. Such delays cause significant erosion, but unused NOLs have a much greater impact on real values because a large share are never used and have no value. A simple extrapolation of our results illustrates this point. For tax years 1993–95, firms could carry NOLs forward fifteen years. If one assumes that the declining utilization patterns for those years continue over the NOL's remaining tax life, then our results suggest that approximately two-fifths of NOLs generated in those years would never be used.[13]

A. NOL Utilization by Industry

We divide our dataset into nine industry groups to more closely examine the implications of tax asymmetry across sectors for three tax years: 1993, 1996 and 1999. To facilitate comparisons across those years, we restrict the NOL utilization window to eight years. That is, we compare the share of losses claimed (i.e., the utilization rate) and the speed of those claims across sectors for up to eight years after the NOL was reported.[14]

Table 3 presents our industry results. Across all firms, the share of NOLs utilized during the eight-year window declines from 51 to 40 percent. This result holds generally across all sectors, although utilities and financials are exceptions. We find considerable

[11] Glenday and Mintz (1991) find that Canadian firms carried back, on average, 13 percent of NOLs for losses incurred between 1978–85. The authors find considerable variation in carryback percentages across industries.

[12] Because loss carrybacks must be used prior to the application of any tax credits, firms might displace a foreign tax credit or general business tax credit if the loss carryback offsets taxable income and tax liability that was originally offset by a credit. Firms may carry displaced credits back one year or forward based on the remaining tax life of the displaced credit at the time it was originally claimed. Therefore, it is possible that firms might need to file multiple amended returns due to loss carryback.

[13] To compute this percentage, we assume that 85 percent of NOLs we classify as "lost" for 1993–95 are, in fact, never used, while the residual losses are eventually claimed by an acquiring firm.

[14] For tax year 1999, we observe NOL utilization for five years only. For that year, we make projections of total loss carryforward deductions claimed at the industry level for our dataset for tax years 2005–07 based on actual industry tax data for 2005–07 for the corporate population. We then project the share of those loss carryforward deductions attributable to 1999 losses based on industry-specific utilization patterns though 2004. Because our results suggest that approximately 75–80 percent of NOLs eventually used are claimed within five years of the tax year incurred, our results should not be sensitive to these projections.

Table 3

Industry Utilization of Net Operating Losses
($ Billion)

	Reported Tax Loss			Share Used[1]			Average Vintage[2]		
Industry	1993	1996	1999	1993	1996	1999	1993	1996	1999
All firms	71.0	80.5	180.6	0.51	0.39	0.40	2.6	2.4	3.0
Non-durable mfg.	7.3	7.5	16.8	0.66	0.64	0.53	2.6	2.1	3.1
Durable mfg.	11.6	12.7	30.4	0.62	0.50	0.44	3.2	2.1	3.0
Wholesale-retail	7.4	12.7	21.3	0.53	0.32	0.29	3.1	3.0	3.4
Information	5.0	9.3	40.6	0.76	0.50	0.40	3.4	3.0	2.7
Financial	19.0	15.4	26.8	0.39	0.30	0.50	1.4	1.6	3.2
Professional services	1.7	4.0	13.7	0.30	0.30	0.16	3.0	2.8	4.4
Utilities	2.2	2.6	3.0	0.36	0.54	0.75	0.7	2.8	1.5
Transportation	4.6	2.5	4.3	0.50	0.26	0.45	3.2	2.0	2.5
All other[3]	12.1	13.8	23.7	0.44	0.25	0.30	2.0	3.0	2.9

(1) Percentage of NOLs used during eight-year window that follows tax loss.
(2) Average age of NOLs used during eight-year window that follows tax loss.
(3) Includes Health, Accommodation and Food Services, Other Services, Agriculture, Mining and Construction.
Source: Authors' calculations as explained in text.

dispersion in utilization rates across sectors; rates range from 16 percent (the professional service sector for 1999) to 76 percent (the information sector for 1993).[15] The two sectors reporting the largest relative increase in NOLs (information and professional services) also experienced the largest relative decline in utilization rates. These sectors comprised 9 percent of NOLs for 1993 but nearly one-third for 1999. During that time, utilization rates fell by nearly half.

The final three columns of Table 3 show the average number of years that transpired before firms claimed NOLs. For this computation, we assume that carryback refunds are claimed immediately (i.e., in year zero). Across all firms, the average vintage of NOLs ranged from 2.4–3.0 years. In general, the financial and utility sectors claimed NOLs faster than the all-firm average, while the professional service sector was somewhat slower. We note that these average vintages relate only to NOLs claimed during our eight-year window. Had we extended our analysis to the full carryforward period, then we project that the average vintage would likely increase by 1.0–1.5 years.

B. NOL Utilization by New Firms

Several researchers, such as Mintz (1991) and Poddar (1991), have surmised that tax asymmetry penalizes new firms disproportionately because they have limited or no ability to carry losses back and suffer higher failure rates than established firms. To test this hypothesis, we separate new firms from their older counterparts and reproduce the tabulations from Table 3. We define a new firm as a firm that is not more than five years old based on the date of incorporation reported on the tax return for each of the three years we examine. We define old firms as all other firms.

Table 4 presents our new and old firm results. Across all sectors, the share of NOLs reported by new firms nearly doubled from 1993 (14 percent) to 1999 (27 percent). This trend was especially noticeable for the information and professional service sectors. Across the three years we examine, the average utilization rate for new firms was 17 percentage points lower than for old firms, with the largest difference recorded by the information sector (42 percentage points). The average NOL vintage for new firms was 1.4 years higher, with the information sector (2.7 years) again recording the largest difference.

C. Summary

Based on average utilization rates and vintages, our results imply that partial refunding causes significant NOL erosion. A simple method to quantify this erosion is the computation of average refundabilities or net present values. The final three columns of Table 4

[15] The professional service sector includes the following sub-sectors: legal, accounting, architectural and engineering, and computer systems design and related services. The information sector includes the following sub-sectors: publishing, motion picture and sound recording, broadcasting, internet publishing, telecommunications and internet service providers.

Table 4

New Versus Old Firm Net Operating Loss Utilization

	Net Operating Loss ($ billion)						Average Utilization Rate, Vintage and Refundability						
	1993		1996		1999		Utilization[1]		Vintage [2]		Refundability[3]		
Industry	new	old	new	old	new	old	new	old	new	old	new	old	all
All firms	9.9	61.1	13.9	66.6	48.6	132.1	0.30	0.47	3.9	2.5	0.30	0.50	0.46
Non-durable mfg.	1.6	5.7	1.6	5.9	3.9	13.0	0.49	0.64	3.8	2.4	0.48	0.70	0.65
Durable mfg.	1.6	10.0	1.8	10.9	5.6	24.8	0.39	0.54	3.8	2.6	0.39	0.58	0.55
Wholesale-retail	1.6	5.8	2.7	10.0	7.1	14.3	0.21	0.44	4.0	3.0	0.21	0.46	0.39
Information	0.5	4.5	3.0	6.3	15.0	25.5	0.24	0.66	5.4	2.7	0.22	0.70	0.58
Financial	1.2	17.8	1.3	14.1	5.6	21.2	0.37	0.40	3.0	2.0	0.38	0.45	0.44
Professional services	0.4	1.4	0.8	3.2	4.7	9.0	0.23	0.26	3.6	3.4	0.23	0.26	0.26
Utilities	0.3	1.9	0.1	2.5	0.4	2.6	0.36	0.58	2.4	1.7	0.39	0.66	0.62
Transportation	0.2	4.3	0.3	2.3	0.7	3.7	0.54	0.39	2.5	2.6	0.58	0.42	0.43
All other	2.4	9.7	2.4	11.5	5.7	18.1	0.25	0.35	3.9	2.4	0.25	0.38	0.35

(1) Average share of NOLs used during eight-year window that follows tax loss for tax years 1993, 1996 and 1999.
(2) Average vintage of NOLs used during eight-year window that follows tax loss for tax years 1993, 1996 and 1999.
(3) Projected real value of NOL recouped per dollar of loss. Calculations assume a discount rate of 6 percent.
Source: Authors' calculations as explained in text.

show these amounts. Using a discount rate of 6 percent, average NOL refundability is 85 cents per dollar based on the 2.7 years that all firms required, on average, to claim NOLs. However, this figure significantly understates erosion because it disregards any carryforward deductions claimed outside our eight-year window as well as NOLs never used. To incorporate those omissions, we assume that if we had lengthened the utilization window to capture the full NOL tax life, then average vintages would increase by 1.25 years. We also gross-up our average utilization rates from Table 4 by 25 percent to capture additional NOLs used in years nine through fifteen (1993 and 1996) or years nine through twenty (1999), as well as NOLs eventually used but acquired through mergers or acquisitions, which we generally count as lost. This gross-up increases the all-firm average utilization rate to 57 percent, and we assume that the residual share is never used and has no value. These two adjustments reduce average refundability to 46 cents per dollar across all firms. Non-durable manufacturers (65 cents) and utilities (62 cents) had the highest average refundability, while the professional service sector recouped the lowest amount (26 cents). Applying these same adjustments against our new firm results, average refundability across all firms was considerably lower (30 cents), ranging from 58 cents (in the transportation sector) to 21–22 cents (in the wholesale-retail and information sectors) per dollar of tax loss.

The decline in NOL utilization rates shown in Table 3 suggests that the negative repercussions of tax asymmetry may have intensified over time. Yet, two factors might prove that trend to be transient. We find that losses reported by new firms increased nearly four-fold between 1993–1999 and those firms had considerably lower NOL utilization rates. It is unclear whether the corporate sector will continue to experience such a large influx of new loss firms in future years. Adverse economic conditions in 2001–02 also had a negative impact on utilization rates for 1999 NOLs. For these reasons, it is premature to speculate on whether the cumulative effect of tax asymmetry has grown over time due to an ever-increasing stock of unused NOLs. It is possible that the time period we examine is atypical. We would expect a similar decline in utilization rates for recent NOLs due to the 2008–09 recession.[16]

One final interesting result from the tabulations in this section is the relatively high utilization rate (58 percent) associated with the $263 billion of NOL stock brought forward into tax year 1993 (Table 2). Although that stock is an amalgam of losses that could potentially come from tax years 1981–1992, our dataset suggests that approximately three-quarters of that amount is attributable to carryforwards from the 1990–92 recession and recovery years, since those NOLs were largely unused by 1993. Although we do not explicitly calculate utilization rates for 1990–92 NOLs, if we apply plausible assumptions based on our results from this section, then we project an average utiliza-

[16] The Worker, Homeownership and Business Assistance Act of 2009 opens the loss carryback window from two to five years for NOLs generated in tax years 2008 or 2009. Firms that received infusions under the Troubled Asset Relief Program do not qualify for the extended carryback period, nor does the Federal National Mortgage Association or the Federal Home Loan Mortgage Corporation.

tion rate of roughly 66 percent for 1990–92 NOLs, somewhat higher than the adjusted average utilization rate we use to compute average refundabilities across all firms (57 percent). This result might suggest that NOL utilization rates are related to the business cycle. Net operating losses generated during recession years might have higher utilization rates because the recession is an exogenous demand shock to firms that are typically profitable. Those firms soon regain their taxable status and utilize NOLs. By contrast, NOLs reported in recovery or boom years might be attributable to less efficient firms unable to use them quickly (or ever). Unfortunately, the time period we examine does not allow a more rigorous test of this hypothesis, because it covers only a few years after the 2001–02 recession. Moreover, the temporary opening of the carryback window for 2001–02 NOLs makes comparisons difficult since the tax law is not held constant.

V. THE IMPLICATIONS OF TAX ASYMMETRY FOR EFFECTIVE TAX RATES

As noted previously, the implications of tax asymmetry for the investment decision are not immediately clear. Partial refunding might raise or lower the marginal effective tax rate on investment, depending on a firm's current tax characteristics, future tax status, method of finance, and the tax life of the investment. Non-taxable firms might face effective tax rates that are quite different than their taxable counterparts if they are unable to quickly regain their taxable status. In order to assess the implications of tax asymmetry for investment, we first examine how rapidly firms transition between taxable and non-taxable status. We then use those transition probabilities to compute the expected present value of tax payments, pre- and post-tax internal rates of return, and effective tax rates for taxable and non-taxable firms.

A. Persistence of Tax Status

The tabulations from Table 1 reveal that approximately one-third of firms in our dataset report a NOL in a typical year. Because loss firms are generally smaller than their profitable counterparts, our unweighted dataset overstates their relative importance for average transition probability and effective tax rate computations. Therefore, we re-weight all firms using total income.[17] Total income is equal to the sum of gross receipts, rents, royalties, dividends, interest, capital gains and other income reported by firms on the corporate income tax return. This re-weighting scheme reduces the number of non-taxable firms by approximately one third. For ease of exposition, we continue to refer to the number of firms that transition between taxable and non-taxable status, as opposed to the share of total income, as is implied by our re-weighting scheme.

[17] Previous studies used total assets as a weighting factor (Auerbach and Poterba, 1987; Altshuler and Auerbach, 1990). We do not use total assets because some firms may neglect to report those amounts for certain years. We also find that total income is a better proxy than total assets for investment and tax liability generally.

Following Auerbach and Poterba (1987) and Altshuler and Auerbach (1990), we compute transition probabilities using a simple second-order Markov process to generate a firm's expected tax status, where the current and prior year status contain all the information needed to determine a firm's transition prospects for the following year. The second-order process has eight possible outcomes. In two outcomes, a firm maintains its original status through year three as a persistently taxable (TTT) or non-taxable (NNN) firm. The remaining six outcomes are a mixture of the taxable and non-taxable states. Because we use this simple process to compute transition probabilities, we assume that the marginal investment project is not large enough to affect future tax status. Thus, we assume that future tax status is independent of marginal investment decisions, and is not known with certainty. Rather, it is determined by a firm's stochastic income stream, which is a function of the return to prior investments.

In Table 5, we present (weighted) transition probabilities for firms that are persistently taxable and non-taxable. The column headings denote the first year of the three-year period we examine. Over time, we find that taxable and non-taxable persistence were relatively stable, although we do observe an increase in non-taxable persistence and a corresponding decline in taxable persistence for 1999, where the 2001 recession year is the third "outcome" year. We also find modest differences in average persistence across industries. Compared to the 1993–2002 average for all firms (in the final column), the financial sector (–6.4 percentage points) exhibits less non-taxable persistence while the information (7.5 percentage points) and professional service (6.3 percentage points) sectors exhibit more. For taxable persistence, only the transportation sector (–6.8 percentage points) was noticeably different from the all-firm average.[18]

B. Transition Paths to Steady State Distributions

We use our average transition probabilities to determine when a firm currently taxable or non-taxable could be expected to remit a future accrued tax liability. Once we compute the distribution of expected tax payments associated with each accrued tax liability over the life of a marginal investment, we can then compute effective tax rates to compare the impact of tax asymmetry on taxable and non-taxable firms.

Following the methodology and notation used by Auerbach and Poterba (1987), we define the term $\Pi^{t\ s}_{N\ T}$ as the probability that a firm that is non-taxable in year t regains taxable status in year $t + s$. For example, Π^{1}_{NNNT} is the probability that a firm non-taxable in year 1 will be non-taxable for two more years before transitioning to taxable status. We use the term q^{t}_{ij} to represent the probability that a firm is in one of four possible states based on its prior and current year tax status: *TT, TN, NT* and *NN*. For a firm that

[18] Our non-taxable persistence results are generally comparable to previous studies of U.S. corporations. Using tax data, Altshuler and Auerbach (1990) find that firms that are non-taxable (due to losses and credits) in the prior two years have a 0.78 likelihood of maintaining that status in the third year. Using Compustat data, Auerbach and Poterba (1987) find that firms with loss carryforward in the prior two years have a 0.83 likelihood of reporting a loss carryforward in the third year.

Table 5

Second-Order Markov Transition Probabilities

	Non-Taxable Persistence (NNN) [1]										
Industry	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Average
All firms	0.772	0.859	0.839	0.860	0.831	0.816	0.893	0.846	0.874	0.845	0.844
Non-durable mfg.	0.758	0.806	0.914	0.846	0.809	0.780	0.857	0.864	0.853	0.748	0.823
Durable mfg.	0.732	0.905	0.773	0.846	0.802	0.672	0.945	0.741	0.907	0.913	0.824
Wholesale-retail	0.827	0.885	0.860	0.854	0.826	0.881	0.905	0.867	0.874	0.857	0.863
Information	0.898	0.956	0.790	0.975	0.824	0.924	0.973	0.983	0.960	0.910	0.919
Financial	0.708	0.716	0.901	0.818	0.779	0.870	0.795	0.767	0.739	0.711	0.780
Professional services	0.865	0.907	0.955	0.749	0.928	0.923	0.935	0.934	0.932	0.939	0.907
Utilities	0.767	0.929	0.803	0.951	0.826	0.793	0.949	0.948	0.886	0.775	0.863
Transportation	0.804	0.834	0.741	0.755	0.916	0.903	0.907	0.849	0.921	0.942	0.857
All other	0.787	0.903	0.837	0.872	0.920	0.839	0.863	0.927	0.911	0.891	0.875
	Taxable Persistence (TTT) [2]										
Industry	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Average
All firms	0.921	0.949	0.947	0.924	0.931	0.905	0.878	0.895	0.910	0.951	0.921
Non-durable mfg.	0.978	0.956	0.972	0.900	0.956	0.915	0.922	0.892	0.954	0.982	0.943
Durable mfg.	0.827	0.950	0.967	0.900	0.923	0.924	0.743	0.886	0.818	0.962	0.890
Wholesale-retail	0.896	0.932	0.943	0.952	0.922	0.891	0.934	0.912	0.911	0.953	0.925
Information	0.960	0.976	0.932	0.979	0.874	0.916	0.952	0.958	0.941	0.953	0.944
Financial	0.950	0.961	0.931	0.932	0.946	0.910	0.901	0.929	0.956	0.978	0.939
Professional services	0.912	0.894	0.891	0.906	0.908	0.920	0.845	0.899	0.908	0.835	0.892
Utilities	0.977	0.978	0.971	0.914	0.986	0.944	0.854	0.790	0.797	0.812	0.902
Transportation	0.903	0.909	0.789	0.878	0.958	0.708	0.693	0.833	0.905	0.958	0.853
All other	0.892	0.923	0.927	0.856	0.885	0.932	0.909	0.864	0.902	0.896	0.899

(1) Average probability that a firm non-taxable (N) for two consecutive years remains non-taxable in the third year. Column headings represent first year.
(2) Average probability that a firm taxable (T) for two consecutive years remains taxable in the third year. Column headings represent first year.
Source: Authors' calculations as explained in text.

is non-taxable in the previous year and the year of investment (year 0), $q^{0}_{NN} = 1$ and $q^{0}_{NT} = q^{0}_{TN} = q^{0}_{TT} = 0$. The probability that a firm will be taxable in year 1 is then equal to the probability of the firm being in one of two states:

$$(1) \qquad \pi^{1}_{T} = q^{1}_{NT} + q^{1}_{TT} = (q^{0}_{NN} P_{NNT} + q^{0}_{TN} P_{TNT}) + (q^{0}_{TT} P_{TTT} + q^{0}_{NT} P_{NTT}),$$

where P_{TTT} represents the probability that a firm that is taxable for two years will maintain that status in the third year, and P_{TTN} represents the probability that the firm will transition to non-taxable status in the third year. Using this equation, the distribution of future states (q^{t}_{ij}) and probability of taxable status can be built up recursively based on the initial state in year 0 and the relevant transition probabilities. For example, the probability that a firm carries its taxes from the investment year forward exactly one year is equal *to* $\Pi^{0}_{NT} = q^{0}_{TN} P_{TNT} + q^{0}_{NN} P_{NNT}$. The unconditional probability of carrying taxes forward two years or more is $\Pi^{0}_{NN} = q^{0}_{TN} P_{TNN} + q^{0}_{NN} P_{NNN}$ and the probability of remaining non-taxable for exactly two years is $\Pi^{0}_{NNT} = \Pi^{0}_{NN} P_{NNT}$. In this manner, the probabilities associated with longer non-taxable spells can be computed recursively. We can then distribute an accrued tax liability that would be paid in year *t* if the firm were taxable over all future years, based on the probability that a firm that is non-taxable in year *t* will first transition to the taxable state and remit any tax due.

In the steady state, given that q_{NT} must equal q_{TN} and that the probabilities of the four possible states must sum to one, the steady state distribution of firms implied by our computed transition probabilities can be computed as follows: $q_{NN} = q_{NT} * (1 - P_{TNT}) / P_{NNT;}$ $q_{NT} = q_{TN} = 1 / (2 + P_{NTT} / (1 - P_{TTT}) + (1 - P_{TNT}) / P_{NNT})$, and $q_{TT} = q_{TN} * P_{NTT} / (1 - P_{TTT})$. In Table 6, we show the average transition probabilities used to compute the steady state distribution of firms across possible states. We note that these average transition probabilities reflect a full business cycle and that each of the ten three-year periods we examine (see Table 5) receives equal weight. Across all firms, our computations show that 30 percent of firms will be non-taxable in the steady state (*NN* plus *TN*), with nearly half of the professional service sector in that state, but less than one-fifth of the financial sector. These non-taxable shares are somewhat higher than the shares we actually observe in our re-weighted dataset, as the average share of non-taxable firms across all years is approximately 23 percent. This discrepancy occurs because our transition probabilities overstate long-term, non-taxable persistence since they do not capture the fact that persistently non-taxable firms are more likely to fail and will not continue in that state forever.[19] Despite this difference, we use the implied transition paths to steady state distributions for our analysis because they are consistent with our computed transition probabilities.

[19] However, it is unclear how we should treat firms that eventually expire or merge. For the purpose of our transition probability computations, we only require that firms be present for the three years we examine. If we had required that firms be present for all years of our study, then our average non-taxable persistence results (*NNN*) would generally decrease by 5 percentage points, and taxable persistence (*TTT*) would largely remain unchanged.

Table 6

Transition Probabilities and Steady State Distributions

	Average Transition Probabilities				Steady State Distributions			
Industry - all firms	NNN[1]	TNN	NTT	TTT	NN[2]	TN	NT	TT
All firms	0.841	0.575	0.766	0.921	0.236	0.065	0.065	0.634
Non-durable mfg.	0.823	0.570	0.788	0.943	0.170	0.053	0.053	0.725
Durable mfg.	0.814	0.669	0.767	0.890	0.286	0.080	0.080	0.555
Wholesale-retail	0.863	0.598	0.743	0.925	0.270	0.062	0.062	0.607
Information	0.919	0.590	0.813	0.944	0.307	0.042	0.042	0.609
Financial	0.780	0.437	0.777	0.939	0.118	0.060	0.060	0.762
Professional services	0.907	0.604	0.762	0.892	0.417	0.064	0.064	0.454
Utilities	0.851	0.678	0.686	0.902	0.336	0.074	0.074	0.517
Transportation	0.857	0.525	0.798	0.853	0.330	0.090	0.090	0.490
All Other	0.875	0.618	0.747	0.899	0.345	0.070	0.070	0.515
	Average Transition Probabilities				Steady State Distributions			
Industry - new firms only	NNN	TNN	NTT	TTT	NN	NT	TN	TT
All firms	0.924	0.695	0.824	0.892	0.488	0.053	0.053	0.405
Non-durable mfg.	0.950	0.753	0.923	0.864	0.631	0.042	0.042	0.285
Durable mfg.	0.912	0.729	0.887	0.841	0.523	0.063	0.063	0.351
Wholesale-retail	0.892	0.669	0.790	0.898	0.389	0.063	0.063	0.486
Information	0.969	0.756	0.826	0.949	0.575	0.023	0.023	0.378
Financial	0.833	0.473	0.794	0.833	0.296	0.104	0.104	0.496
Professional services	0.961	0.616	0.723	0.875	0.670	0.042	0.042	0.245
Utilities	0.928	0.690	0.678	0.961	0.329	0.035	0.035	0.601
Transportation	0.911	0.390	0.474	0.917	0.362	0.083	0.083	0.472
All other	0.941	0.737	0.780	0.909	0.540	0.043	0.043	0.373

(1) Average probability that a firm non-taxable (N) for two consecutive years remains non-taxable in the third year.
(2) Computed steady-state distribution of firms that are non-taxable (N) for two consecutive years.
Source: Authors' calculations as explained in text.

At the bottom of Table 6, we show computations for new firms. As expected, new firms generally exhibit more non-taxable persistence and less taxable persistence. Those results are reflected in the much higher share of new firms that are non-taxable in our computed steady state (54 percent). Especially notable is the large share of firms in that state for the professional service sector (71 percent).

C. Derivation of Effective Tax Rates

We define the effective tax rate as the difference between the internal rate of return for expected pre-tax cash flows (ρ) and expected post-tax cash flows (r) divided by the internal rate of return for expected pre-tax cash flows:

$$(2) \quad ETR = (\rho - r) / \rho .$$

If an asset has an economic depreciation rate equal to δ, then an investment made in year 0 would yield a gross return in year t equal to $(\rho + \delta)\ (1 - \delta)^{t-1}$ per dollar of investment. Assuming that the investment is equity financed and generates no income in the year of investment, the firm's tax liability in year 0 (B_0) would equal the tax depreciation allowance multiplied by the statutory tax rate (a negative tax liability) and for years after the investment, the accrued tax liability for each year t would equal:

$$(3) \quad B_t = \tau[(\rho + \delta)\,(1 - \delta)^{t-1} - D_t\,(1 - i)^t],$$

where τ is the statutory corporate tax rate, D_t is the nominal depreciation allowance and i is the rate of inflation.[20]

If losses were fully refundable, then accrued tax payments would equal actual tax payments as depicted by (3). The marginal project's post-tax internal rate of return (r) would then be defined by the following:

$$(4) \quad T(r) = \sum_{t=1}^{\infty} (1+r)^{-t}\,[(\rho + \delta)\,(1 - \delta)^{t-1}] - 1$$

where $T(r)$ represents the present value of tax payments (including those made in year 0). For the marginal investment, (4) shows that the net present value of income less the initial cash outlay must equal the net present value of taxes, so that the firm just "breaks even" on the investment.

If the tax system does not allow for the immediate refund of losses, then actual tax payments will differ from (3), and (4) must be amended before effective tax rates can be computed. Under this scenario, each accrued tax liability gives rise to a distribution of expected tax payments because a firm may not be taxable when the tax liability

[20] For these computations, we disregard shareholder level taxes. Inclusion of shareholder taxes does not alter our basic results.

attributable to the new investment accrues. For example, consider a non-taxable firm in year zero that does not transition to taxable status until year five. We have assumed that the marginal investment does not affect future tax status. In this example, the change in taxable income in years zero to four is not effectively realized until year five. For years zero to four, the incremental change to taxable income in each year merely reduces or augments the firm's carryforward stock dollar-for-dollar so that the incremental taxable income for each year would be effectively taxed in the year when the firm transitions to taxable status, which also corresponds to the year the firm exhausts any loss carryforward stock.

For each sector, we use our computed transition probabilities to project when a firm beginning from a particular state could be expected to pay an accrued tax liability. For illustrative purposes, consider a firm that is non-taxable for the current and prior year (*NN*). In Table 7, we show how accrued tax liabilities are spread forward over time for this firm based on our computed transition probabilities.[21] These figures depict the pattern of firms' first transition to taxable status from year zero. For example, the "all firms" column shows that non-taxable firms will remit none of the accrued tax liability from year zero during that year, 15.6 percent (P_{NNT}) will be remitted in year one, and 13.2 percent ($(1 - P_{NNT})*P_{NNT}$) in year two. By the end of year four, the probability that a firm will transition to taxable status and remit tax is approximately one-half. Corresponding figures for new firms are shown on the bottom half of the table. For new firms in certain industries (information and professional services), non-taxable persistence is so high as to delay more than one half of tax payments by 15 years or more.

The transition patterns from Table 7 are only relevant for tax liability attributable to year zero, the year of investment. For all future periods, we must also account for the fact that the distribution of firms among our four possible states (*NN, NT, TN* and *TT*) changes as the originally taxable or non-taxable firm in a future accrual period may be in any one of those four states. Therefore, in order to transform tax accruals after year zero into expected tax payments, we use the contemporaneous distribution of firms among the four states to determine the probability of future taxable status. We then use the incremental transition of firms from non-taxable to taxable status from that year forward to spread expected tax payments.

To this point, we have only accounted for delays in tax payments due to losses or the elimination of tax liability via loss carryforwards. We have not explicitly accounted for the interaction between projected future tax payments and loss carrybacks. When carrybacks are allowed, then each future tax payment increases a firm's ability to carry back future tax losses, thereby reducing tax liability. Following Auerbach and Poterba (1987), we use the term v_{ts} to represent the shadow value of incremental tax payments made in year $t + s$ attributable to their possible use as an offset against future losses. A more detailed explanation of the v_{ts} term is provided in the appendix. This term is gen-

[21] We truncate transition probabilities at year 20. For that year, we assume that all remaining non-taxable firms transition to taxable status. For our effective tax rate computations, we truncate accrued tax liabilities and projected income at year 40. These truncations have very minor implications for effective tax rates.

Table 7

Distribution of Years Until First Passage to Taxable Status

	All Firms: Non-Taxable Current and Prior Year									
Year	All Firms	Non-Durable Mfg.	Durable Mfg.	Wholesale and Retail	Information	Finance	Professional Services	Utilities	Transport	Other
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.156	0.177	0.176	0.137	0.081	0.220	0.093	0.147	0.153	0.125
2	0.132	0.145	0.145	0.118	0.074	0.171	0.085	0.126	0.129	0.109
3	0.111	0.120	0.120	0.102	0.068	0.134	0.077	0.107	0.110	0.096
4	0.094	0.099	0.099	0.088	0.063	0.104	0.070	0.091	0.093	0.084
5	0.079	0.081	0.081	0.076	0.058	0.081	0.063	0.078	0.079	0.073
6–10	0.245	0.235	0.235	0.250	0.225	0.206	0.237	0.248	0.246	0.250
11–15	0.104	0.089	0.089	0.120	0.148	0.060	0.145	0.112	0.107	0.128
16–20[1]	0.078	0.054	0.054	0.111	0.284	0.024	0.230	0.091	0.083	0.135
	New Firms: Non-Taxable Current and Prior Year									
Year	All Firms	Non-Durable Mfg.	Durable Mfg.	Wholesale and Retail	Information	Finance	Professional Services	Utilities	Transport	Other
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.076	0.050	0.088	0.108	0.031	0.167	0.039	0.072	0.089	0.059
2	0.070	0.048	0.080	0.096	0.030	0.139	0.037	0.067	0.081	0.056
3	0.065	0.045	0.073	0.086	0.029	0.116	0.036	0.062	0.074	0.052
4	0.060	0.043	0.067	0.077	0.028	0.096	0.035	0.058	0.067	0.049
5	0.055	0.041	0.061	0.068	0.027	0.080	0.033	0.054	0.061	0.046
6–10	0.220	0.176	0.233	0.246	0.124	0.240	0.148	0.215	0.234	0.194
11–15	0.148	0.136	0.147	0.139	0.106	0.097	0.121	0.148	0.147	0.143
16–20[1]	0.306	0.462	0.253	0.181	0.625	0.065	0.551	0.324	0.247	0.400

(1) All firms that remain non-taxable in year 20 are assumed to transition to taxable status in that year.
Source: Authors' calculations as explained in text.

erally modest, ranging from 0.05–0.10 for most sectors, because most loss carrybacks would have eventually been used as a carryforward deduction, so that the net effect of allowing future carrybacks is relatively small.

With this modification, the expected present value of tax payments is:

$$(5) \quad T(r) = \sum_{t=0}^{\infty} B_t (1+r)^{-t} \left[\sum_{s=0}^{\infty} ((1-i)/(1+r))^s \prod_{N^S T}^{t} (1-v_{ts}) \right]$$

The second part of (5) represents the expected present value of a one dollar tax accrual in year t. $T(r)$ is defined by (5) which is then substituted into (4) to compute effective tax rates.

D. Empirical Results

Table 8 presents our marginal effective tax rate computations. We consider two types of investment. The first investment represents general industrial equipment with a seven-year tax life (MACRS depreciation, mid-year convention) and an economic depreciation rate of 12.25 percent, based on Hulten and Wykoff (1981). We set the rate of inflation equal to 3 percent, the statutory tax rate to 35 percent, the pre-tax return to 6 percent and the real discount rate equal to 3 percent for purposes of computing the shadow value of carrybacks (v_{ts}). The second investment represents industrial buildings with a 39.5-year tax life (MACRS depreciation, mid-year convention) and economic depreciation of 3.61 percent. Finally, we assume that investments are equity financed and risk free so that the income produced by the investments is known with certainty. Only the firm's future tax status is uncertain.

For our computations, we examine three types of firms: (1) a hypothetical firm under full loss offset, (2) a firm that is non-taxable in the prior and current year (*NN*), and (3) a firm that is taxable in the prior and current year (*TT*). Under full loss offset, the effective tax rate on equipment (25.4 percent) is less than the statutory rate because tax depreciation is more generous than economic depreciation (i.e., it has a higher net present value given our inflation assumption) and this tax rate is the same across all sectors. Under partial refunding, the effective tax rate falls by approximately 1 percentage point for non-taxable firms and 5.6 percentage points for taxable firms. The non-taxable firm faces a higher rate because the delay from realizing depreciation deductions more than offsets the benefit from delaying payment of tax on incremental income. Across sectors, rates fall most dramatically for industries where partial refunding imposes the longest non-taxable spells (information and professional services). We find an inter-industry difference of approximately 7.5 percentage points for both taxable and non-taxable firms, and a maximum differential of 11.9 percentage points between non-taxable firms in the financial sector (26.7 percent) and taxable firms in the professional service sector (14.8 percent).

For structures, the effective tax rate (48.2 percent) under full loss offset exceeds the statutory rate because tax depreciation is less generous than economic depreciation.

Table 8

Marginal Effective Tax Rates

	Equipment			Structures		
Industry	Full Refund[1]	State NN[2]	State TT[3]	Full Refund	State NN	State TT
All firms	0.254	0.243	0.198	0.482	0.396	0.430
Non-durable mfg.	0.254	0.257	0.215	0.482	0.416	0.447
Durable mfg.	0.254	0.232	0.183	0.482	0.391	0.414
Wholesale-retail	0.254	0.233	0.189	0.482	0.380	0.422
Information	0.254	0.207	0.184	0.482	0.337	0.418
Financial	0.254	0.267	0.226	0.482	0.435	0.456
Professional services	0.254	0.195	0.148	0.482	0.327	0.382
Utilities	0.254	0.225	0.175	0.482	0.374	0.408
Transportation	0.254	0.236	0.187	0.482	0.393	0.418
All other	0.254	0.217	0.168	0.482	0.360	0.401
Variants for all firms						
With 50% debt finance	0.076	0.120	0.037	0.335	0.277	0.298
With 10% ITC	–0.072	0.072	–0.121	0.482	0.396	0.430
With 6% inflation	0.321	0.284	0.244	0.538	0.416	0.461

(1) Marginal effective tax rates under a system where tax losses are fully refunded.
(2) Marginal effective tax rates for firms non-taxable in current and prior year.
(3) Marginal effective tax rates for firms taxable in current and prior year.
Source: Authors' calculations as explained in text.

Under partial refunding, effective tax rates fall and the average rate for non-taxable firms (39.6 percent) is lower than the average rate for taxable firms (43.0 percent). For structure investments, non-taxable firms benefit relatively more from tax asymmetry because the gain from delaying payment of tax on incremental income exceeds the disadvantage from the inability to immediately use depreciation allowances. In general, we obtain that result for investments where tax depreciation is less generous than economic depreciation, given the other assumptions that we make. We find inter-industry differentials of 10.8 percentage points for non-taxable firms and 7.4 percentage points for taxable firms, and a maximum differential of 13.0 percentage points between taxable firms in the financial sector (45.6 percent) and non-taxable firms in the professional service sector (32.7 percent).

Although we derive modest effective tax rate differentials for equity-financed investments, we derive larger differentials if equipment investment is partially debt financed and significant differentials if firms can utilize an investment tax credit (ITC) that allows carryforwards. If the investment is 50 percent debt financed, then the effective tax rate

differential between taxable and non-taxable firms increases to 8.3 percentage points for equipment but falls to 2.0 percentage points for structures across all firms (bottom of Table 8).[22] Under a 10 percent ITC with a 50 percent basis offset, we derive a 19.3 percentage point differential in effective tax rates for equipment investment between taxable and non-taxable firms. Partial refunding penalizes non-taxable firms because the ITC benefit is front-loaded in the investment year. Finally, if we double our assumed rate of inflation from 3 to 6 percent, then effective tax rates increase for the hypothetical firm under full loss offset because deprecation allowances are further eroded. Effective rates increase somewhat less for taxable and non-taxable firms under partial refunding because the present value of future expected tax payments is also eroded.

We do not derive effective tax rates for new firms because the simple model we employ is not sufficiently complex to capture the unique characteristics of those firms. Had we simply extended our methodology to new firms and used the results from Tables 6 and 7, we would derive lower effective tax rates across all industries for equipment and structures investment because new firms are closer to existing in a perpetual non-taxable state. Our simple modeling does not capture the fact that a much higher proportion of new firms will likely fail, as opposed to enduring very long non-taxable spells, and it is unclear how we should treat that outcome in our computations. Moreover, our modeling does not allow for the fact that similar investment projects could be much riskier (i.e., uncertain) for new firms compared to established firms. When we allow for greater uncertainty, it is no longer known if the firm will survive and remit any tax. Under that scenario, the taxing authority will not share in any tax loss and so firms will face considerably higher expected effective tax rates.

A simple example illustrates this point. Assume a new firm invests in a "standalone" investment. That is, the firm has no other investments so that any loss incurred cannot be used until a future year when the firm becomes profitable. Assume further that if the investment is not profitable, then the firm fails and any tax losses are never effectively used. Finally, assume that the firm expects two possible outcomes that are equally likely: a pre-tax return of 15 percent and –5 percent. In this simple example, the firm's expected return is 5 percent and if the firm pays tax at 35 percent, its expected tax is $2.63 on a $100 investment, an expected tax rate of 53 percent. Our stylized model would not reflect that outcome because we assume that future income streams are known and that firms do not expire with unused tax losses. When we allow for the possibility of unprofitable investments and firm failure, much higher expected effective tax rates would result.

VI. CONCLUSION

Using a large, unbalanced panel of tax returns for 1993–2004, we examine the implications of tax asymmetry for U.S. corporations. Due to our limited time horizon, we look at NOL utilization over an eight-year window for tax years 1993, 1996 and 1999. For those years, we find an average NOL utilization rate of 47 percent across all

[22] This calculation assumes a nominal interest rate of 6 percent for interest payments on outstanding debt.

firms. If we adjust for NOLs used outside our eight-year window and merger/acquisition NOLs, then we project that average utilization rates were likely closer to 55–60 percent. For reasons we note, it is possible that the time period used for this analysis might be unusual, so that "typical" NOL utilization rates might be somewhat higher.

Due to the inability to use NOLs, as well as delays in claiming them, the average firm in our dataset recouped somewhat less than one-half of the real value of their tax loss. We find considerable dispersion in NOL utilization rates and average refundabilities across sectors. Across all firms, we find an average refundability of 46 cents per dollar of tax loss, ranging from 26 cents (professional services) to 65 cents (non-durable manufacturing). In general, sectors with modest start-up costs (e.g., professional services, information, other services) had low utilization rates and experienced greater NOL erosion due to a large influx of new loss firms. By contrast, sectors dominated by large, established firms (e.g., manufacturing and utilities) reported higher NOL utilization rates and experienced less erosion.

We divide our dataset between old and new firms to examine whether new firms bear the burden of tax asymmetry disproportionately. For the time period we examine, we find that new firms have lower NOL utilization rates, higher NOL vintages and lower average refundability compared to their older counterparts. We estimate that average NOL refundability was 30 cents per dollar of tax loss for new firms and 50 cents for established firms.

To examine the implications of these results for investment decisions, we compute transition probabilities using a second-order Markov process to generate a firm's expected tax status, and we use those probabilities to compute effective tax rates. We find modest effective tax rate differentials between taxable and non-taxable firms within our 9 industry sectors but somewhat larger differentials between sectors. Effective tax rate differentials increase further when we allow for debt financing and investment tax credits. Due to limitations in our modeling technique, we do not compute effective tax rates for new firms. However, due to their higher likelihood of failure and greater uncertainty of outcomes, it is likely that new firms face considerably higher expected effective tax rates for new investment projects compared to established firms.

Our results confirm that certain firms and industries bear the negative repercussions of tax asymmetry disproportionately. In order to alleviate this disparity, policymakers might consider two changes to the tax code. First, interest could be paid on NOLs to preserve their real value over time. This approach was recommended, in the context of a business cash flow tax, in the report of the President's Advisory Panel on Federal Tax Reform (2005). As noted in the report, the provision of interest on NOL carryforwards mitigates the negative effects of partial refunding, especially for firms undertaking projects expected to have negative cash flows for several years. The payment of interest prevents the erosion of any depreciation or interest deductions that cannot be claimed immediately, thereby preserving their value and reducing effective tax rates. However, we note that this proposal could have non-trivial revenue implications, given that recent corporate tax data show that firms carried an NOL stock of $1.3 trillion into tax year 2006. Methods to mitigate the revenue cost of such treatment might include providing interest on NOLs on a prospective basis only and the reduction of the carryforward

window from 20 to 15 years. Our results suggest that only a very small fraction of NOLs are ever used in years 16–20, when the effect of interest compounding would be greatest.

Another method of increasing NOL utilization is to allow firms to carryback NOLs without credit displacement. Currently, firms that carry NOLs back might displace a tax credit because loss carrybacks must be claimed prior to the application of any tax credits. Displaced credits can be carried back one year from the displacement year, but if they are not carried back, then they must be carried forward and the firm might need to recompute credits and file amended returns for various tax years. Under this proposal, firms would be allowed to carryback NOLs to offset any remaining final tax liability post-credits and would not need to displace credits. We observe many instances in our dataset where large firms appear to forgo NOL carryback when it is available. Many of those firms claimed significant general business and/or foreign tax credits. Although the data do not allow us to test whether the presence of a credit caused firms to forgo carryback, it seems to be a plausible explanation in these cases.

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APPENDIX: INCORPORATION OF LOSS CARRYBACKS FOR EFFECTIVE TAX RATE COMPUTATIONS

Following the methodology and notation used by Auerbach and Poterba (1987), this appendix describes the procedure used to account for loss carrybacks in our effective tax rate computations. When a firm makes a tax payment, that payment has value to the firm because it can be used to offset losses reported in the following two tax years. The current value to the firm is less than the present value of any such refunds because some portion (on average) of the carryback would have been used eventually as a carryforward deduction.

Define v_{TT} as the expected carryback value of a one dollar tax payment made in the second year for a firm in state *TT*. Define v_{NT} in a similar fashion. Let ω_{TN} represent the present value of the future deductions foregone when a NOL is realized (i.e., carried back). The value of v_{TT} is the expected present value of the carrybacks associated with a one dollar tax payment and is equal to:

$$\text{(A1)} \quad v_{TT} = [\beta P_{TTN} + \beta^2 P_{TTT} P_{TTN}](1-\omega_{TN}) = \beta P_{TTN}(1+\beta P_{TTT})(1-\omega_{TN}),$$

where $\beta = (1 - i) / (1 + r)$ denotes the discount factor applied when shifting a tax payment one year into the future. In a similar manner, define v_{NT} as:

$$\text{(A2)} \quad v_{NT} = [\beta P_{NTN} + \beta^2 P_{NTT} P_{TTN}](1-\omega_{TN})$$

for taxable firms that were non-taxable in the previous year. Finally, ω_{TN} is equal to:

(A3) $$\omega_{TN} = P_{TNT}\,\beta(1-v_{NT}) + P_{TNN}\,P_{NNT}\,\beta^2(1-v_{NT}) + \ldots + P_{TNN}\,P_{NNN}^{N-2}\,P_{NNT}\,\beta^N(1-v_{NT}),$$

where N represents the maximum number of carryforward periods (20). Solving these three equations yields the following:

(A4) $$v_{TT} = [\alpha_{TT}(1-\alpha_{TN})]/(1-\alpha_{NT}\,\alpha_{TN})$$

(A5) $$v_{NT} = [\alpha_{NT}(1-\alpha_{TN})]/(1-\alpha_{NT}\,\alpha_{TN})$$

(A6) $$\omega_{TN} = [\alpha_{TN}(1-\alpha_{NT})]/(1-\alpha_{NT}\,\alpha_{TN}).$$

where $\alpha_{TT} = \beta\,P_{TTN}\,(1 + \beta P_{TTT})$, $\alpha_{NT} = \beta\,P_{NTN} + \beta^2\,P_{NTT}\,P_{TTN}$ and $\alpha_{TN} = \beta P_{TNT} + \beta^2 P_{TNN}\,P_{NNT} + \ldots + \beta^N P_{TNN}\,P^{N-2}_{NNN}\,P_{NNT}$.

We use these shadow values to compute the expected present value of tax liabilities. To account for firms' ability to carry back NOLs, we multiply each of the expected tax payments generated by the no-carryback scenario by either $(1 - v_{TT})$ or $(1 - v_{NT})$, depending on the firm's tax status. When a firm accrues a tax liability with a distribution of expected tax payments over many periods, the contemporaneous value of q_{TT} determines the fraction of the expected tax payment which will be paid immediately in a state following a taxable year. This amount is multiplied by $(1 - v_{TT})$. All of the remaining components associated with this accrued tax liability are multiplied by $(1 - v_{NT})$, since they occur in states where the firm will have just re-entered taxable status. In the notation from the paper, this implies the following:

(A7) $$v_{ts} = v_{NT} \qquad \text{for } s > t$$

(A8) $$v_{ts} = (q^t_{TT}\,v_{TT} + q^t_{NT}\,v_{NT})/(q^t_{TT} + q^t_{NT}) \qquad \text{for } s = t$$

These equalities can be substituted into (5) to evaluate the internal rate of return, r, and the effective tax rate.