Implications of Tax Loss Asymmetry for Owners of S-Corporations

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Online Appendix

A Additional information on data construction

We use administrative tax data to identify information about owners' firms (through the links implied by Form 1120S, Schedule K-1) and to follow owners over time. The administrative tax data contains only a subset of variables available in the SOI sample, which requires us to impose additional assumptions in certain situations.Therefore, we therefore pool passive and non-passive income together. Second, the unit of analysis is the base-year tax unit, which could be a single filer or a married couple filing jointly.[47] In years other than the base year, we aggregate income information from all tax returns that year on which the base-year primary filer or base-year secondary filer appears. We abstract from the complexities that arise from allocating NOLs at death, divorce, or marriage. Third, we do not observe the NOL deduction in the administrative tax data. Therefore, in years other than the base year, we approximate the NOL deduction as any negative amount reported as "other income."[48]

B Carrybacks

In this section, we provide more detail on how we take account of the imperfect takeup tof loss carrybacks by owners of S corporations. Loss carrybacks generate an immediate tax refund in the year they are used. If losses are not carried back, the loss must be carried forward to offset income in a future year, which tends to have a lower value (discounted to the present). Two potential reasons for low take-up are the complexity of amending a past return and the potential for the carryback to interact with other components of the tax system–by, for example, eliminating the ability to claim tax credits for those years, or pushing a taxpayer into a lower marginal rate bracket.

The extent to which S-corporate owners elect to carryback losses is an empirical question. To analyze this, we estimate the amount of income that could be carried back from year τ: this approximately equals the smaller of the amount of NOL generated at τ and the amount of positive income present in the carryback period. This is the "potential" carryback amount. We then confirm whether the owner received a refund during the carryback period using the admininstrative tax data. When we see a refund, we assume that an owner carried the eligible loss back.[49] This analysis is limited to losses generated in 2007 or later due to data limitations.

[47] We treat filers who are married filing separately analogously to single filers.

[48] In the SOI data, where we observe both the true NOL deduction and other income, we find that this appears to be a reasonable, if imperfect, approximation. In our sample, we estimate a yearly average of \$56b in true NOL deductions and \$68b in negative other income. A regression of log negative other income (plus 1000) on log true NOLD (plus 1000) yields a coefficient of 0.71 and an R^2 of 0.41.

[49] We make this approximation by dividing the value of the refund by the potential carryback amount. The 25th, 50th, and 75th percentiles of this average tax rate are approximately 21%, 31%, and 36%, respectively.

We find a positive relationship between the estimated carryback amount and the share of losses carried back. Appendix Figure O2 shows the carryback take-up rate as a function of the potential carryback amount. Here, we find that the take-up rate is close to zero for the smallest potential carryback amounts, and the take-up rate reaches roughly 70% for potential carrybacks in excess of $1,000,000. In light of this, we find that the *owner*-weighted take-up rate is quite low: approximately 17.5 percent of owners eligible to carry a loss back actually file for a carryback refund. At the same time, the *dollar*-weighted take-up rate is much higher: approximately 65 percent of potential carrybacks are in fact carried back. For comparison, the share of eligible owners is lower than that found by Zwick (2020) for C corporations (37 percent), but the dollar-weighted take-up rate for S corporate losses is higher than for C corporate losses (52 percent).

Include Figure O2 about here.

We model these estimated take-up rates for all of our dynamic analyses. In particular, we assign each owner/base-year ($i\tau$) observation a time-invariant take-up rate, $\gamma_{i\tau}$, based on the observed (dollar-weighted) take-up rate of owners with similar amounts of S corporation assets.[50] For each of our dynamic exercises, we require various vectors of tax liability $U_{i\tau}$. In regimes where carrybacks are allowed, we do so by computing the vector $U^0_{i\tau}$ under the assumption that $i\tau$ *never* takes up carrybacks and $U^1_{i\tau}$ under the assumption that $i\tau$ *always* takes up carrybacks. The final vector $U_{i\tau}$ is given by the convex combination: $U_{i\tau} = \gamma_{i\tau}U^1_{i\tau} + (1-\gamma_{i\tau})U^0_{i\tau}$.

C Computing the present value of tax losses

In this section, we describe additional details in the procedure to estimate the present value of the tax savings associated with a given loss. Let Δ_i^- denote the tax savings associated with the loss: that is, the increase in the present value of tax liability that would be realized if the loss were set to zero in the base year rather than equal to its true value. This term can be broken into two parts:

$$\Delta_i^- = \underbrace{W_i^-}_{\text{Changes in the panel}} + \underbrace{B_i^-}_{\text{Changes beyond the panel}} \tag{C.1}$$

Given the simulated path of taxable income, computing W_i^- is straightforward: we compute the year-by-year difference in simulated tax and apply the appropriate discount rate.

Estimating B_i^- requires additional assumptions, however. Essentially, this boils down to when the change in NOLs entering event time 11 (denote this change as N_i^-) gets taken into account in taxable income. We assume that this change of NOLs decays geometrically.[51]

[50] The time-invariance of this parameter is an admittedly unsatisfactory assumption, given that a firm might have a large loss in one period and a smaller loss in another period. However, this assumption is necessary for tractability. Appendix Figure O3 plots the mean takeup rate as a function of assets.

[51] We abstract away from the expiration of any NOLs.

That is, in each period, some share ψ^- of the remaining NOL change is used, where ψ^- is estimated empirically based on the observed aggregate use of the NOL change at event time 10. Finally, we apply a tax rate equal to the "contemporaneous average tax rate" in event time 10 – that is, the change in event time 10 tax liability divided by the change in event time 10 taxable income. We refer to this tax rate as θ^-. This leads to the following formula for b^-, the present value of each dollar change in NOLs:[52]

$$b^- = \frac{\theta^-}{(1+r)^{10}} \times \frac{\psi^-}{r+\psi^-} \tag{C.2}$$

Finally, we compute $B_i^- = b^- N_i^-$. The average tax rate on the loss is then equal to the ratio of Δ^- to the loss.

The procedure for calculating the average tax rate on gains is precisely analogous. We simulate the vector of tax liability under the counterfactual where the loss is set to zero and where the loss is flipped to a gain. And we value any changes in the NOL stock entering event time 11 in the same manner. The average tax rate on the gain is then equal to the ratio of the extra tax liability (Δ^+) to the amount of the gain.

D Estimating threshold probability of success for risky investment

In this section, we describe additional details in the procedure to estimate the threshold probability for engaging in a risky investment. The condition in Equation (1) can be written as follows.

$$\big(p_i^* - (1-p_i^*)\big)x_i = p_i^* \underbrace{(T_i^+ - T_i^0)}_{\Delta_i^{+,0}} - (1-p_i^*)\underbrace{(T_i^0 - T_i^-)}_{\Delta_i^{0,-}} \tag{D.1}$$

In this equation, $\Delta_i^{+,0}$ represents the additional tax liability when the project is successful, relative to when the project does not occur. Similarly, $\Delta_i^{0,-}$ represents the additional tax liability when the project does not occur, relative to when the project is not successful – or, equivalently, $\Delta_i^{0,-}$ represents the tax *savings* when the project fails relative to not engaging in the project.

Each of these terms can be split into a component that we measure over our thirteen-year panel (i.e., due to the change in tax liability that occurs in years -2 through 10) and into a component that reflects changes in tax liability in later years (i.e., because the NOL stock entering year 11 has been affected). That is, we can write the following equation (and an analogous one for $\Delta_i^{0,-}$):

$$\Delta_i^{+,0} = \underbrace{W_i^{+,0}}_{\text{Changes in the panel}} + \underbrace{B_i^{+,0}}_{\text{Changes beyond the panel}} \tag{D.2}$$

This problem is identical to the problem considered in Appendix C. Therefore, we use the

[52] Observe that when $r = 0$, b^- is simply equal to θ^-.

method described in that section in exactly the same manner to calculate $W_i^{+,0}$, $W_i^{0,-}$, $B_i^{+,0}$, and $B_i^{0,-}$. Once we calculate these objects, solving for p_i^* is a matter of trivial algebra.

E Calculation of effective tax rates

In this appendix, we describe how we calculate effective tax rates (ETR). We begin with the case of ETRs on tangible investment, which allows us to present the general formulation of how we approach this problem. Then, we report an analysis of the ETRs on a dollar of "other income," which is, analytically, a special case of the general formulation.

We are considering a $1 investment in tangible capital. We assume that the investment is seven-year MACRS property, which entails a series of deductions m_k from event time $k = 0$ through $k = 7$.[53] We assume that the investment produces gross income in proportion to those deductions, meaning that $y_{ik} = c_i \times m_k$ for some constant c_i that may vary by owner.[54] For this investment to be marginal after tax at some specified discount rate r, it must be the case that the present value of the income, $PV^I(c_i; r)$ equals the cost of the investment (one) plus the present value of the extra tax liability, $PV_i^T(c_i, r)$.[55] That is, c_i is pinned down by the following condition:

$$1 + PV_i^T(c_i, r) = PV^I(c_i, r) \tag{E.1}$$

Furthermore, c_i in turn pins down the effective tax rate: there is a one-to-one mapping between c_i and ρ_i, the equivalent pre-tax rate of return. The value ρ_i is defined such that the investment would be marginal at discount rate ρ_i in the absence of taxes. I.e., given c_i, ρ_i is set such that:

$$1 = PV^I(c_i, \rho_i) \tag{E.2}$$

Thus, the main objective is to solve for c_i for each owner.

The present value of the income simply equals $c_i \times \sum_{k=0}^{7} \frac{m_k}{(1+r)^k}$. It will be convenient to introduce matrix notation. Let R_n denote the vector (of length n) of $1, \frac{1}{1+r}, \frac{1}{(1+r)^2}, \ldots$ and let M denote the vector of the 8 values of m_k. Thus, this present value can be written as:

$$PV^I(c_i; r) = c_i \times R_8' M \tag{E.3}$$

Next, we turn our attention to the term $PV_i^T(c_i, r)$. In each of event times $k = 0$ through $k = 7$, the investment produces a change in net income equal to $y_{ik} - m_k = (c_i - 1)m_k$. For a owner with positive taxable income (and not bound by the 80%-of-income NOL limitation or the excess business loss limitations under post-TCJA law), this change in net income is reflected immediately in tax liability. More generally, however, a change in net income in

[53] These deductions are 14.29 cents, 24.49 cents, 17.49 cents, 12.49 cents, 8.93 cents, 8.92 cents, 8.93 cents, and 4.46 cents, respectively. For the purpose of this exercise describing the effect of loss asymmetry, we disregard bonus depreciation.

[54] For notational conciseness, we drop the τ (base year) subscript in this section. All references to an individual owner i should be understood to be to the combination of an individual and base year.

[55] Note that PV^T is indexed by i. This is precisely because loss carryovers will mean that this mapping will vary by owner.

event time k has an effect on tax liability in event times $j \geq k$. We separate this into two components: (1) the present value of tax liability incurred in event times $j \leq 10$ (i.e. during our period of data), and (2) the present value of the tax liability incurred in event time $j > 10$. We will denote the former as $PV_i^{TW}(c_i, r)$ (where "W" stands for "window") and the latter as $PV_i^{TB}(c_i, r)$ (where "B" stands for "beyond").

First, we consider liability incurred in event times $j \leq 10$. For $j \leq 10$, we can define an 11-by-8 matrix T_i, where the entry in $(j+1, k+1)$ corresponds to the tax liability incurred in j attributable to income earned in k. Thus, the investment produces a vector of tax liability equal to $T_i(c_i - 1)M$, and the present value of tax liability incurred through event time 10 can then be written as:

$$PV_i^{TW}(c_i, r) = (c_i - 1)R_{11}' T_i M \tag{E.4}$$

We compute this matrix T_i column by column. First, we compute the baseline tax liability of owner i in event times 0 through 10, denoted $U_{i,base}$. Next, we increase S corporation income by \$100 in event time 0 (and only in event time 0) and compute the vector of tax liability U_i^0; the first column of T_i is equal to $\frac{U_i^0 - U_{i,base}}{100}$.[56] We repeat this process for $k = 0, 1, \ldots, 8$ until we create the entire matrix T_i.

Next, we consider liability incurred in event times $j > 10$. If a dollar of earnings in event time k is not taken into account immediately (e.g., if the owner has a loss that year), then that dollar of earnings will usually cause a reduction in NOL carryforwards – either a reduction in NOLs generated in event time k, or an increase in absorption of NOL carryforwards generated in event time $l < k$. For each owner, we compute N_{ik}, the change in NOL stocks entering event time 11 attributable to one dollar of income earned in event time k.[57]

We assign a value to N_{ik} using the procedure described in Section C: that is, we assume a geometric decay of the remaining reduction NOL stock and apply the event time 10 contemporaneous average tax rate to it.[58] This procedure creates eight values b_k for $k = 0, \ldots, 8$, where b_k represents the present value of tax liability associated with a one dollar reduction in the NOL stock attributable to income in event time k.

This gives us the final result:

$$PV_i^{TB} = \sum_{k=0}^{7} \underbrace{(c_i - 1)m_k}_{\text{Net income earned in } k} \times \underbrace{N_{ik} b_k}_{\substack{\text{Change in tax liability beyond,} \\ \text{due to income earned in } k}} \tag{E.5}$$

Letting V_i denote the length-8 vector of $N_{ik}b_k$, we can now rewrite the marginality condition from (E.1):

$$1 + (c_i - 1)R_{11}' T_i M + (c_i - 1)V_i' M = c_i R_8' M \tag{E.6}$$

Note that $R_{11}' T_i M$, $V_i' M$, and $R_8' M$ are each scalars for a given owner i. Thus, once we calculate T_i and V_i for each owner, it is then a matter of trivial algebra to solve for c_i.

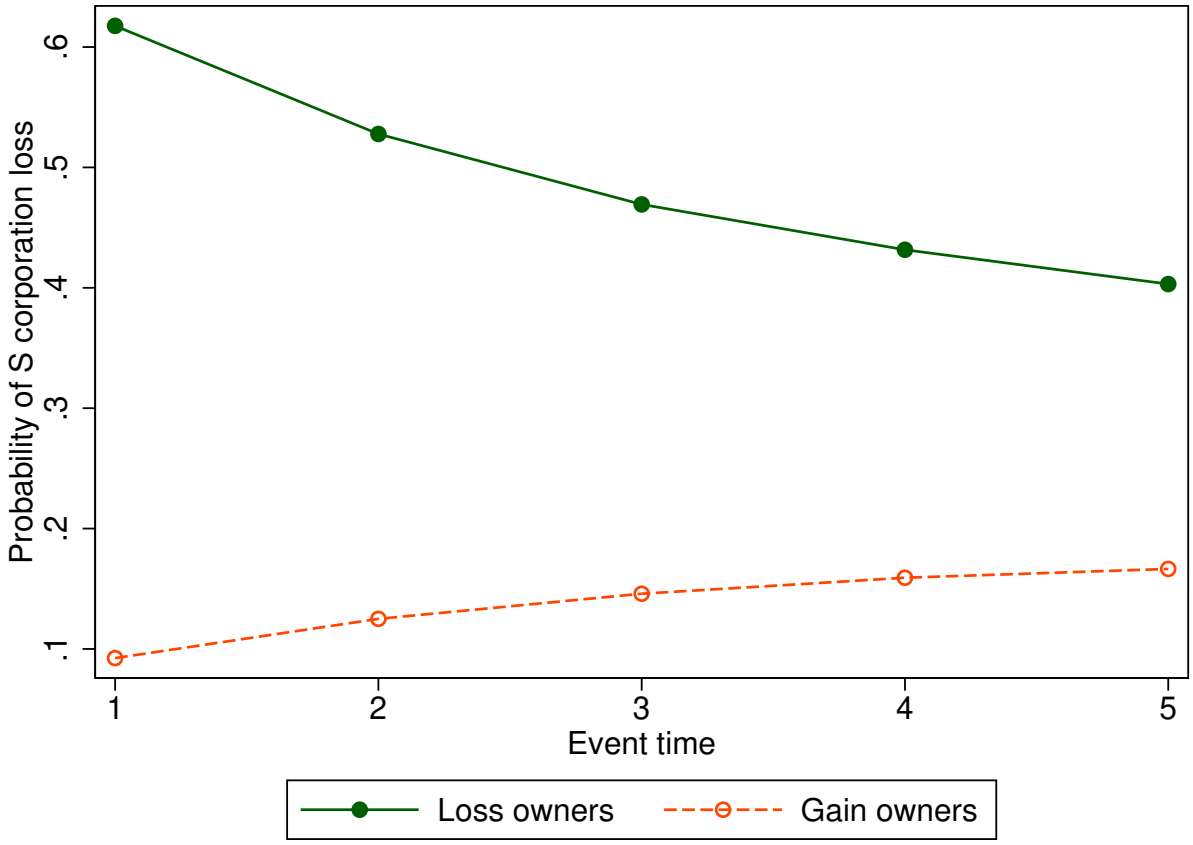
[56] We use an increment of \$100 instead of \$1 for numerical precision.

[57] We compute this in the same simulation that creates the matrix T_i.

[58] This procedure is equivalent to assuming that a marginal dollar of carryback will be absorbed with some memory-less probability in each year after event time 10.

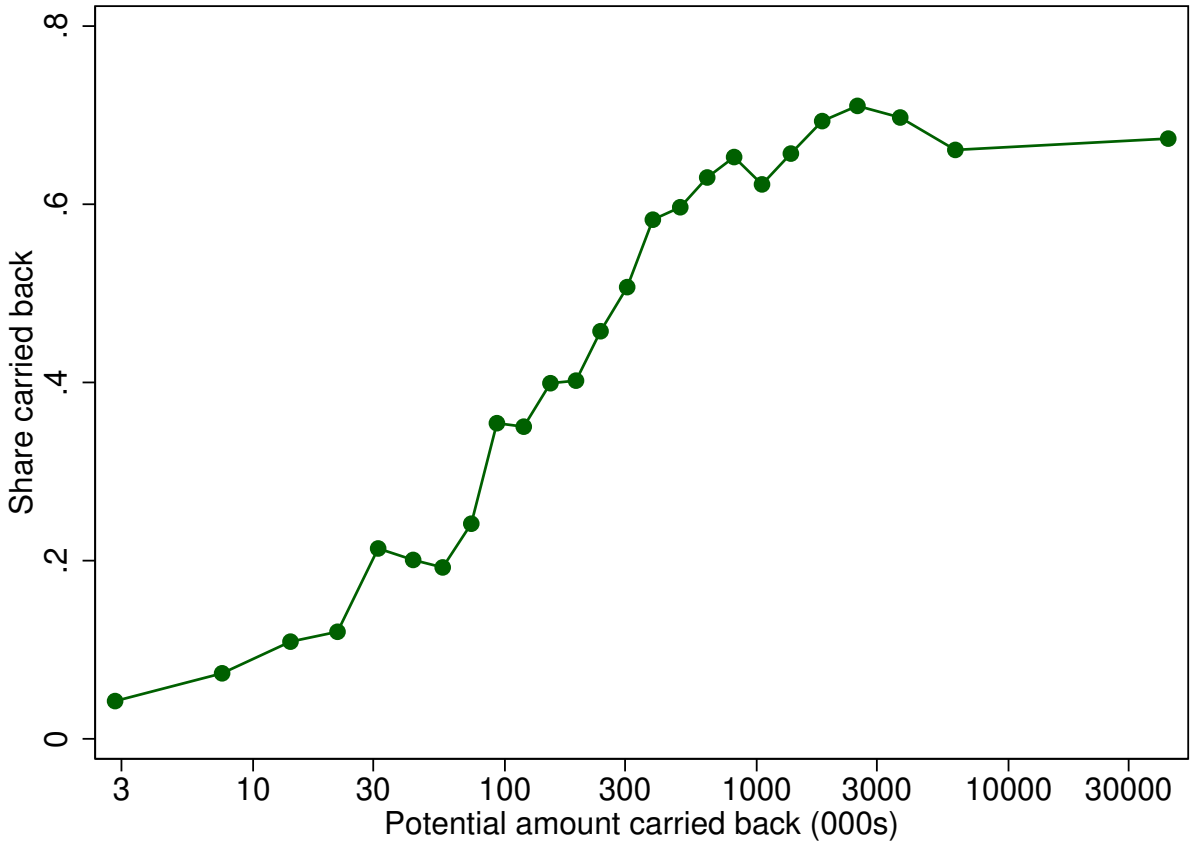
Online Appendix: Tables and Figures

Figure O1: Probably of having S corporation loss in future years



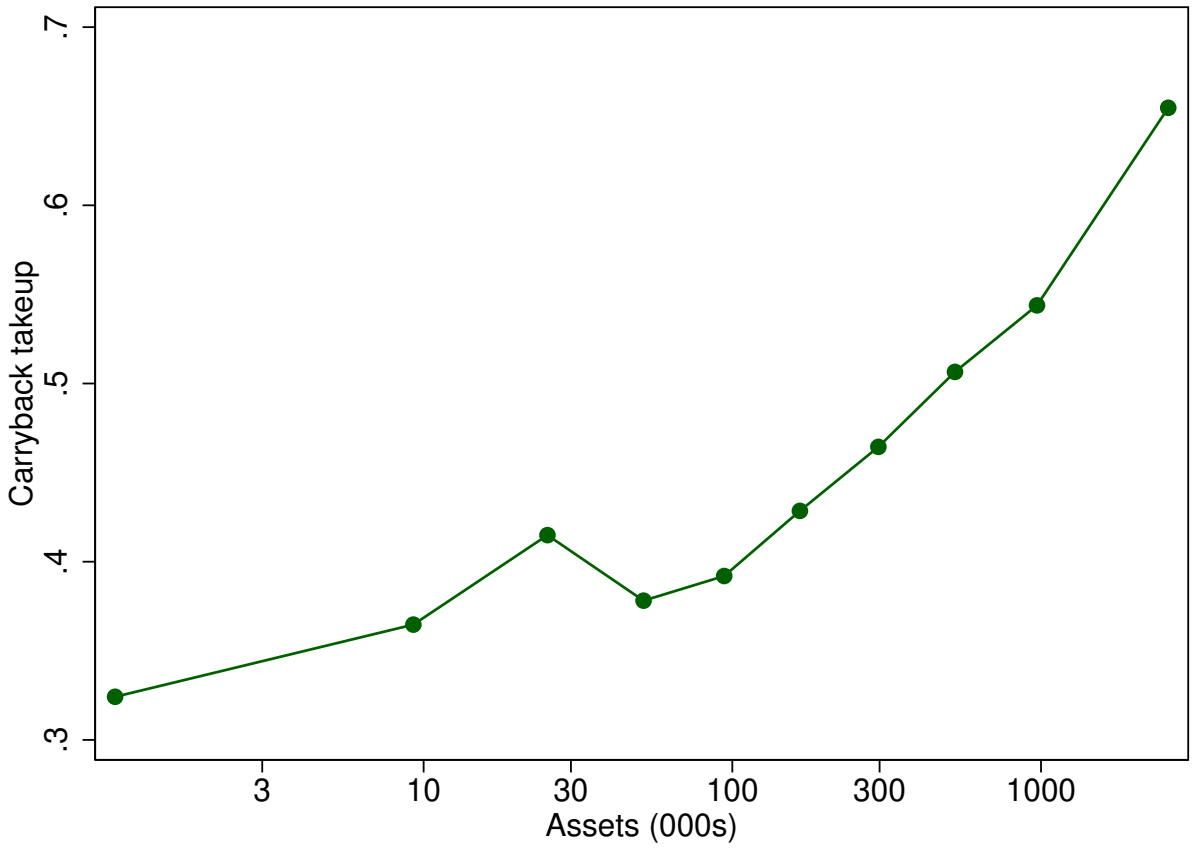
Notes: This figure plots the probability of having negative S corporation income, by event time, separately for owners with positive and negative S corporation income at event time zero. The sample includes owners from 2002-2012 and is weighted by the absolute value of the gain or loss at event time zero.

Figure O2: Share taking up carrybacks by amount eligible for carryback



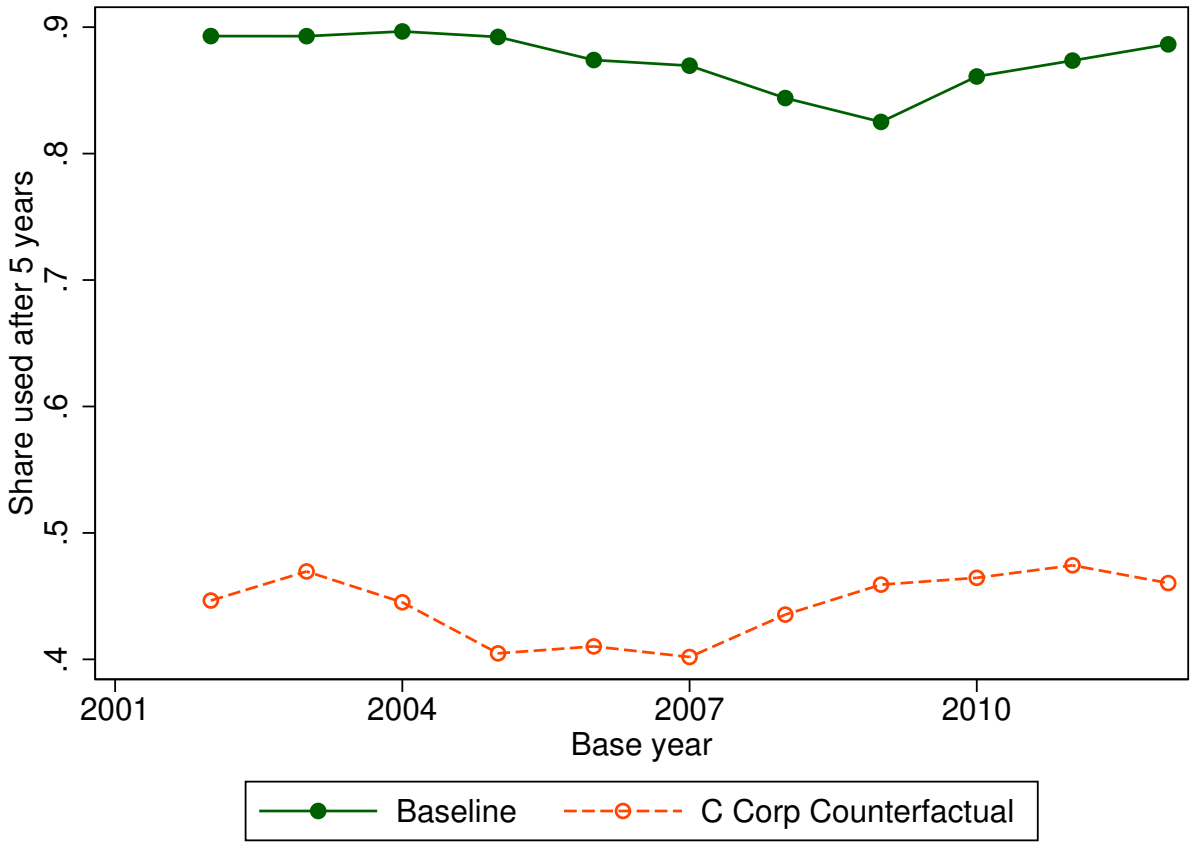
Notes: This figure plots the share of eligible carrybacks that are taken up, as a function of the carryback amount (in 2010 dollars). See section B for details on how we measure carryback use. The sample includes owners with positive simulated carrybacks attributable to losses generated in 2007-2017.

Figure O3: Share taking up carrybacks by amount of S corporation assets



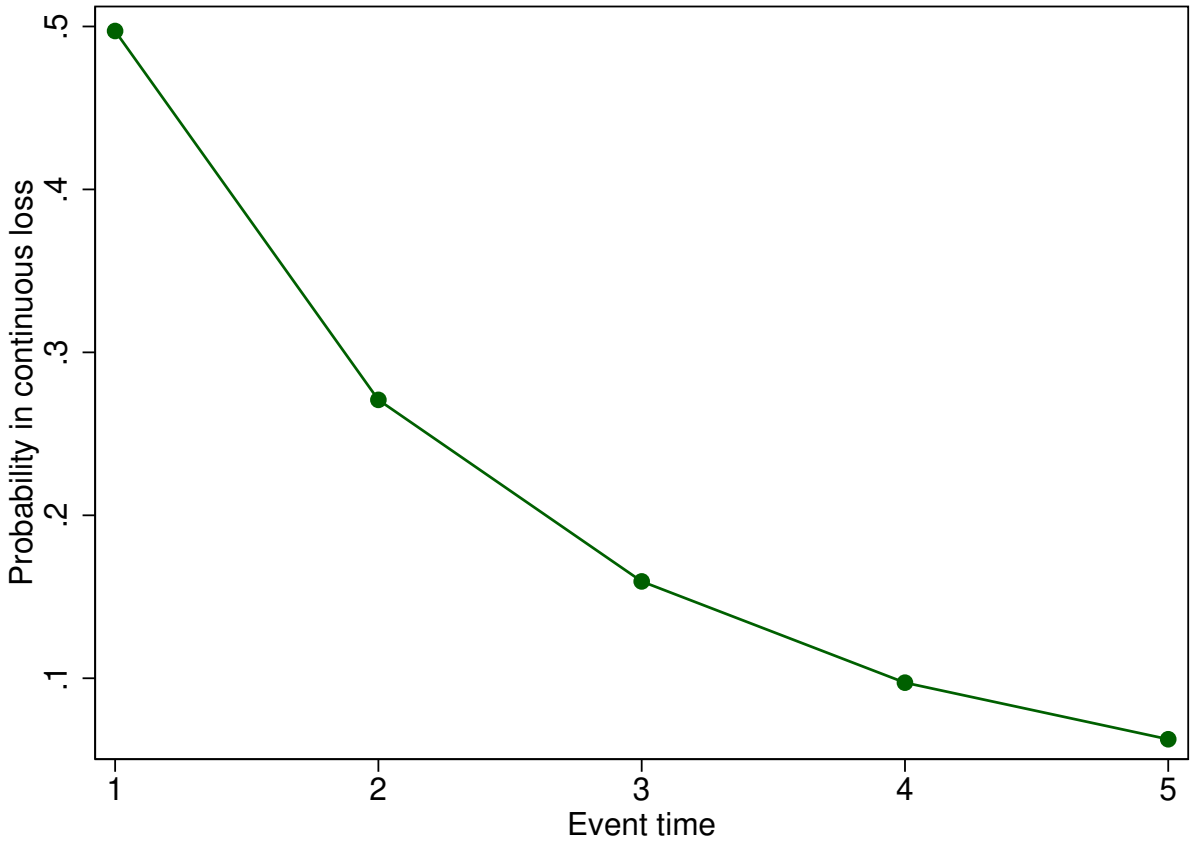
Notes: This figure plots the share of eligible carrybacks that are taken up, as a function of S corporation assets owned by an individual (equal to the assets reported on Form 1120S multiplied by each owner's ownership share). See section B for details on how we measure carryback use. The sample includes owners with positive simulated carrybacks attributable to losses generated in 2007-2017.

Figure O4: Loss use by base year



Notes: This figure plots the share of losses generated in each base year that are used within five years. The solid green series uses the baseline law (the law actually in effect during the sample period). The dashed orange series uses the C corporation counterfactual, in which S corporation loss can be used only to offset S corporation income in other years.

Figure O5: Probability of continuously having negative income among S corporation owners unable to use all of their losses contemporaneously



Notes: This figure plots the probability of having negative current income for each year from event time zero through event time t among S corporation owners with a loss who are unable to use all of their losses contemporaneously. Current income is defined as taxable income before subtracting NOL deductions, but not bound below at zero. The sample includes owners from 2002-2012 and is weighted by the absolute value of the gain or loss at event time zero.

Table O1: Loss use matrix, baseline

	Total Losses	**Loss use (billions)**								**Wasted**
	(billions)	$t-2$	$t-1$	t	$t+1$	$t+2$	$t+3$	$t+4$	$t+5$	
2002	44.3	2.7	0.6	30.0	1.9	2.2	1.1	0.7	0.4	3.3
2003	44.5	2.1	0.6	31.1	2.9	1.4	1.0	0.5	0.2	3.2
2004	42.7	1.8	0.4	31.5	2.0	1.3	0.7	0.3	0.2	3.0
2005	42.7	1.4	0.5	32.5	1.7	1.1	0.4	0.3	0.2	3.2
2006	50.4	2.0	0.6	37.8	1.6	0.7	0.6	0.5	0.4	3.7
2007	64.8	3.7	0.8	46.8	1.6	1.0	1.0	0.8	0.7	4.7
2008	78.0	7.9	1.4	46.7	2.9	2.2	1.8	1.7	1.2	6.0
2009	71.2	6.7	1.0	40.2	2.8	2.6	2.4	1.7	1.3	5.8
2010	55.7	2.8	0.6	36.4	2.6	2.4	1.4	1.0	0.8	4.0
2011	52.2	2.4	0.7	35.3	3.0	1.6	1.2	0.9	0.6	3.8
2012	45.1	1.7	0.6	32.5	2.0	1.4	0.9	0.5	0.3	3.1

Notes: The left-most column in this table reports the total amount of active S corporation loss reported by individuals (in nominal dollars). The remaining columns report the amount of loss we estimate to be used in each of event times -2 through +5 (in billions of nominal dollars). The right-most column reports the amount of loss wasted (in billions of nominal dollars). This table uses the baseline law (the law actually in effect during the sample period).

Table O2: Loss use matrix, C corporation counterfactual

	Total Losses	**Loss use (billions)**								**Wasted**
	(billions)	$t-2$	$t-1$	t	$t+1$	$t+2$	$t+3$	$t+4$	$t+5$	
2002	44.3	2.9	2.2	0.0	3.8	4.4	2.9	1.9	1.5	0.0
2003	44.5	3.8	1.9	0.0	5.1	4.0	2.7	2.0	1.5	0.0
2004	42.7	3.7	1.8	0.0	4.7	3.6	2.3	1.7	1.2	0.0
2005	42.7	3.2	1.8	0.0	4.1	2.9	2.1	1.8	1.3	0.0
2006	50.4	4.6	2.4	0.0	4.4	3.0	2.7	1.7	1.8	0.0
2007	64.8	7.1	2.6	0.0	4.6	3.9	2.8	2.9	2.1	0.0
2008	78.0	10.3	2.8	0.0	5.5	4.5	4.2	3.6	3.0	0.0
2009	71.2	8.3	2.7	0.0	5.8	5.3	4.5	3.6	2.6	0.0
2010	55.7	5.5	2.3	0.0	5.8	4.2	3.5	2.7	2.0	0.0
2011	52.2	5.0	2.1	0.0	6.3	4.1	3.3	2.2	1.7	0.0
2012	45.1	3.8	2.2	0.0	5.4	3.6	2.6	1.7	1.5	0.0

Notes: The left-most column in this table reports the total amount of active S corporation loss reported by individuals (in nominal dollars). The remaining columns report the amount of loss we estimate to be used in each of event times -2 through +5 (in billions of nominal dollars). The right-most column reports the amount of loss wasted (in billions of nominal dollars). This table uses C corporation counterfactual, in which S corporation loss can be used only to offset S corporation income in other years.

Table O3: Loss use matrix, post-TCJA

	Total Losses	**Loss use (billions)**								**Wasted**
	(billions)	$t-2$	$t-1$	t	$t+1$	$t+2$	$t+3$	$t+4$	$t+5$	
2002	44.3	0.0	0.0	23.2	7.6	3.9	2.3	1.2	0.6	2.5
2003	44.5	0.0	0.0	24.7	7.9	3.5	1.7	1.0	0.4	2.5
2004	42.7	0.0	0.0	23.9	7.9	3.1	1.4	0.7	0.4	2.3
2005	42.7	0.0	0.0	24.7	7.9	2.7	0.9	0.5	0.4	2.5
2006	50.4	0.0	0.0	27.9	9.7	2.0	1.2	0.9	0.7	2.9
2007	64.8	0.0	0.0	31.8	9.5	3.8	2.6	1.9	1.7	3.5
2008	78.0	0.0	0.0	34.3	10.6	6.6	4.3	3.2	2.1	4.5
2009	71.2	0.0	0.0	31.9	10.5	5.4	3.9	2.6	1.8	4.4
2010	55.7	0.0	0.0	27.3	9.6	4.9	2.5	1.6	1.1	2.8
2011	52.2	0.0	0.0	26.6	10.5	3.2	2.0	1.3	0.8	2.8
2012	45.1	0.0	0.0	23.6	7.9	3.5	1.8	1.0	0.7	2.1

Notes: The left-most column in this table reports the total amount of active S corporation loss reported by individuals (in nominal dollars). The remaining columns report the amount of loss we estimate to be used in each of event times -2 through +5 (in billions of nominal dollars). The right-most column reports the amount of loss wasted (in billions of nominal dollars). This table uses the model of law that incorporates the three TCJA provisions that restrict loss use, as discussed in section VI.

Table O4: Effective Tax Rate: Tangible Capital Investment, regression-adjusted

	Baseline		Counterfactual
	(1)	(2)	(3)
Gain owners	0.288	0.290	0.267
Loss owners	0.213	0.233	0.152
Difference	-0.075	-0.057	-0.115
	(0.002)	(0.002)	(0.002)
Mean ETR	✓		✓
Statutory Rate		✓	
Observations	266,800	266,800	266,800

Notes: This table reports estimated ETRs on a dollar of investment in tangible capital, adjusted for fixed effects for year interacted with 30 bins of income from sources other than S corporations. Cols. 1 and 2 reports results for owners of S corporations under our baseline analysis. Column (1) reports the mean ETR for owners with positive S income, negative S income, and the difference. The mean ETR for gain owners is repeated from Table 4. The difference between gain owners and loss owners is computed via a regression with the aforementioned fixed effects. The mean for loss owners is set equal to the main for gain owners plus the regression-estimated difference. See text for a discussion of the calculation of ETRs on investment. See also the notes to Table 4.

Table O5: Amount of investment distorted by loss asymmetry

	(1)
Equiv. geom. depr. rate (δ)	0.264
Counterfactual EMTR	0.269
Shifted investment per year	$ 680 million

Notes: This table reports the amount of investment (per year, in 2010 dollars) that we estimate to be distorted by loss asymmetry. Specifically, relative to the counterfactual where all owners face the EMTR given in the second row, loss owners engage in $680 million (as indicated in the third row) more investment and gain owners engage in $680 million less investment per year. The calculation uses a geometric depreciation rate, given in the first row, that is equivalent to the finite depreciation assumed in Section V in present value.