Crisis Relief Through the Tax Code: Effects of Corporate Loss Refunds on Firms and Workers *

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Governments undertake large expenditures to keep firms alive and workers employed during crises. However, directing that support to viable but financially constrained firms is often difficult. This paper asks whether tax loss carrybacks, which give firms with a history of profits a refund for prior taxes paid, can reach productive firms and preserve jobs at low net cost to the government. We study Australia's 2020 carryback using the universe of business tax returns linked to monthly payroll records. Eligible firms were more likely than other loss-making firms to return to profitability; among them, more financially constrained firms were more likely to claim. Comparing corporations to similar pass-through businesses, which were ineligible, we find that the average potential refund reduced closures within two years by 0.25 percentage points, about 4 percent of the closures that would otherwise have occurred. Each dollar of potential refund raised payroll by 77 cents over sixteen months, mainly by retaining existing workers. Following workers across employers, we estimate that 35 percent of this is earnings workers would otherwise have lost. We find that 52 percent of the losses eligible for refunds would otherwise have been deducted against profits within seven years. Combining our estimates of survival, workers' earnings, and forgone deductions, we estimate a marginal value of public funds of 2.26. Workers' preserved earnings account for most of the benefit, and the government's net cost is 40 cents per refund dollar.

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1 Introduction

Governments absorb a wide range of economic risks. They insure workers against job loss, guarantee banks and lending to small businesses, and through the corporate income tax they share in the profits of firms. In crises, governments extend this role by transferring cash to firms, because many viable firms fail for lack of liquidity rather than lack of solvency (Gourinchas et al., 2025), and because workers who lose their jobs suffer earnings losses that persist for years (Jacobson et al., 1993; Davis and von Wachter, 2011). The central difficulty for policymakers is reaching the firms that are viable but short of cash, where easing liquidity constraints would preserve productive employment matches, while limiting expenditures both to firms that are unlikely to recover and to those that do not require support. A government that must act quickly has little opportunity to overcome this challenge. Crisis programs typically give up targeting to gain coverage and speed (Granja et al., 2022; Bartik et al., 2020), making crisis relief very costly. This paper asks whether features of the corporate tax system can deliver effective relief to firms in need, and in turn to their workers, at a lower net cost. Our setting is the introduction of loss refunds in Australia during the COVID-19 pandemic, and we study this question using administrative tax data covering every firm and worker in the country.

As a claimant on profits through the corporate tax system, the government typically shares in firms' risk in only one direction. Profits are taxed as they accrue, but in most countries a firm with a tax loss receives no refund: it can only *carry forward* the loss and deduct it against profits it has yet to earn. The government's claim therefore pays most in good states and least in bad ones, the opposite of the position it takes as an insurer. Relief from carried-forward losses requires the firm to return to profit, meaning that it is lost if the firm does not survive and the firm accrues no interest on the asset in the meantime. As a result, in a downturn the tax system withholds relief from firms at exactly the moment the government is trying to supply it. We study the introduction of tax loss carrybacks, which make the taxation of profits and losses more symmetric. As the name suggests, a carryback

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lets a firm *carry back* a current loss, deducting it against profits reported in earlier years and recovering tax already paid in the past via an immediate refund. For a firm, the refund converts an illiquid carryforward deduction into cash: the firm receives the money sooner, regardless of whether or not it ever returns to profit.

Across developed economies, refunds of past tax payments are rare as permanent features of tax systems but common as crisis policy. For example, the United States extended its carryback provision in each of the last three major downturns, in 2002, 2009 and 2020, at a cost on the order of a tenth of annual corporate tax receipts in each episode. Governments across the developed world have introduced or expanded similar measures during the global financial crisis and the pandemic.[1] Figure 1 shows both patterns: of the 190 countries that tax corporate income, only 12 have had a permanent carryback at some point since 2000. Meanwhile 18 countries introduced or extended one as crisis policy between 2001 and 2022, 8 of them with no permanent provision to extend.

Whether carrybacks are an effective crisis policy for insuring workers and supporting firms depends primarily on two factors. The first is the actual effect of these refunds on firm survival and behavior, as well as their insurance effect on employment and workers' earnings. In a crisis, a firm's current losses may say less than usual about whether it will be viable once the crisis passes (Hanson et al., 2020), but its tax history predates the crisis. If the firms that were profitable before a crisis are those whose losses are transitory, the refund reaches viable firms that are short of cash. However, past profits may be an imperfect predictor of future ones, especially in a crisis that permanently shrinks some activities, and a refund that reaches a firm in permanent decline may keep alive a business whose exit would be no loss, at the expense of healthier competitors and of the reallocation of workers and capital to better uses (Caballero et al., 2008; Bethmann et al., 2018). Even a well-targeted refund would preserve jobs only if the firm uses the funds to keep its workers employed while staying open, as opposed to retaining the cash within the firm or paying it out to shareholders. The second factor relates to the effective cost of the refund for the government. A firm that has been refunded for a loss can no longer deduct it, so the government collects tax on later profits the loss would have sheltered, recouping part of its outlay automatically in a way that bailouts, forgiven loans and cash transfers do not. In this way, a carryback refund is no more expensive than an outright cash transfer to a firm, but has the potential to be much

[1] For example, the United Kingdom extended its one-year window to three years in both 2009 and 2021; Germany raised the limit on its one-year carryback provision from EUR 1 million to EUR 10 million for losses incurred in 2020 and 2021; France allowed 2020 losses to be carried back without the usual maximums; Japan temporarily expanded eligibility for its carryback refund from companies with capital below 100 million yen to those below 1 billion yen; New Zealand, Norway and Singapore, each of which ordinarily allow no refunding of past tax, introduced temporary or enhanced carryback schemes in 2020.

more cost effective if the government succeeds in providing it to firms that will recover.

Credible evidence on the causal effects of carrybacks as a crisis instrument is scarce. Because eligibility depends on the firm's own history of profits and losses, eligible loss-making firms can differ from ineligible ones in exactly the ways that determine their future outcomes. Furthermore, claiming is elective, so claimants differ from non-claimants in ways that reflect their current financial state. Recent work has documented take-up patterns and the use of marginal refund dollars during normal economic times: most eligible American firms leave refunds unclaimed (Zwick, 2021), and the effects of refund dollars are concentrated among financially constrained firms (Dobridge, 2021; Bethmann et al., 2018). To the best of our knowledge, prior work has not studied the temporary introduction of carrybacks into a corporate tax system that only allows carrying losses forward. We also lack evidence on how easing corporate tax asymmetry in this way affects not just firms themselves but the workers they employ, whom the government is trying to insure.

Australia during the COVID-19 pandemic offers an unusually clean setting to study these important questions. The country has no permanent provision for refunding past tax, so the introduction of a carryback in 2020 was a sudden and discrete change in the treatment of losses. We study this policy using the universe of business tax returns from 2001-02 through 2022-23, linked to payroll records that, from 2019-20, report every employer's workforce and payroll monthly. Because those records are filed for each employee, we link them to the workers themselves, allowing us to see both the refunds and the outcomes they were meant to affect, for every employer in the economy and for each of its workers.

We first present descriptive evidence suggesting that carrybacks did indeed flow to viable firms. Relative to the set of loss-making firms, carryback-eligible firms were more likely to recover from the loss: two years out, 37 percent had returned to positive taxable income, against 21 percent of loss-making firms as a whole. While only 30 percent of eligible firms claimed, these firms account for 57 percent of the total refund dollars that were available. Holding the size of the potential refund fixed, firms with low or falling earnings and rising debt were more likely to claim, suggesting a strong role for financial constraints in driving claiming behavior.

Our empirical approach begins by measuring the causal effects of the carryback refunds on employment. To do so, we compare eligible corporations with similar businesses organized as pass-throughs, which the statute excluded from carrying losses back. This comparison follows a tradition in public finance of using legal form to identify the effects of corporate taxation (Yagan, 2015; Kennedy et al., 2026). We reconstruct, from the statutory refund formula and each firm's filing history, the potential carryback refund available to every firm. For each pass-through we compute the refund it could have claimed had it been incorporated.

We then match each carryback-eligible corporation to a pass-through in the same two-digit industry, revenue decile and per-employee pay decile, to facilitate a comparison across similar firms.

The refunds kept firms open and kept workers on their payrolls. At the average potential refund level, a corporation was 0.25 percentage points more likely to be operating two years after the refund, against a two-year exit rate of 5.7 percent, so that the refund prevented about 4 percent of the closures that would otherwise have occurred. The effect does not narrow between the first and second years, suggesting that the refunds did not merely postpone closures. In monthly event studies around the arrival of the refund, the payroll of corporations rises relative to that of pass-throughs with the same potential carryback; cumulated over sixteen months, a dollar of potential refund raised payroll by about 77 cents. We find a similar path for total employment, while average pay per employee does not change. When we split each firm's payroll by worker tenure, payroll paid to retained workers closely matches the total payroll response we estimate, while the flow of payroll to new hires is estimated as a precise zero.

The results on firm payroll indicate that Australia's carryback policy succeeded in keeping workers earning at their current jobs. However, recessions can also move workers from less to more productive firms or employment matches (Caballero and Hammour, 1994; Foster et al., 2016), and Barrero et al. (2020) argue that tying pandemic support to job retention could slow this reallocation. The effect on payroll retained at a corporation we estimate may overstate what workers gained if they would have found similar work elsewhere. To address this, we run the same analysis at the worker level, tracking each worker's total income across employers and non-employment states. This allows us to estimate the direct impact of the refunds on workers' earnings net of reallocation. We find that workers' total earnings do rise after the refund by about 27 cents per dollar of potential refund. This implies that 35 percent of the payroll that corporations kept paying their incumbent workers is earnings those workers would otherwise have lost, the counterpart of the earnings losses of displaced workers (Jacobson et al., 1993; Davis and von Wachter, 2011; Schmieder et al., 2023).

Having addressed how carrybacks supported workers, we next turn to the question of measuring the effective cost of the refunds for the government. This requires a second counterfactual: the deductions their recipients would have taken had no carryback existed. A firm that claims a carryback refund gives up the right to deduct the refunded loss against later profits. In this way, a refund dollar can be an advance that the government recovers as those later profits are taxed. If the firm does not return to profit, however, the carryback refund becomes a pure transfer out of the tax system, increasing the government's costs. Which of these stories holds for any given firm depends on how much of the refunded loss

would otherwise have been deducted. Importantly, recipients' own returns cannot reveal this, because the refund removed the loss from their books and may have changed their later income, and because only a few years have passed since the policy was implemented. To estimate the fiscal cost of the carrybacks, we instead look at earlier firms that would have qualified under the 2020-21 rules but faced losses when only carryforwards were available. For each firm, we track how its unused losses would have been drawn down with and without the loss a refund would have removed, and we reweight these earlier firms to resemble those eligible in 2020-21. We find that 52 percent of refunded loss dollars would have been deducted within seven years of the loss, or 47 percent when relying exclusively on the loss cohorts around the Great Recession to discipline the calculation.

Putting these results together, we find that, net of what the government recovers, the carryback was an inexpensive way to support workers' earnings during the pandemic in Australia. Counting the deductions recipients could no longer take, the company tax remitted by firms the refund kept open, and the income tax on workers' additional earnings, the government recovered 60 cents of each refund dollar. A dollar of refunds therefore cost the government 40 cents, and a dollar of earnings that workers would otherwise have lost cost 85 cents. For comparison, each euro of short-time work transferred to workers in Italy cost the government about 1.38 euros (Giupponi and Landais, 2023). We estimate a marginal value of public funds of 2.26, with earnings that workers would otherwise have lost accounting for 93 percent of the surplus and the company tax of firms the refund kept open for the remaining 7 percent. The recovered deductions are what lift the ratio above 2: a cash grant with the same effects on survival and earnings displaces no deductions and would have a marginal value of public funds of 1.57. A refund may also be worth more to a firm than it costs the government, because the refund arrives in the year of the loss, when cash is scarce for the firm, while the deductions the firm gives up would have paid off only in years in which the firm was profitable. Our estimate credits firms with nothing for receiving cash early, and the ratio rises to 2.37 if a dollar in the loss year is worth 1.10 dollars to the firm.

Put together, our findings suggest that the corporate tax system holds both information that can target crisis relief as well as a means of recovering its cost. In Australia, tax payments made before the COVID-19 pandemic identified, if imperfectly, the firms more likely to recover from their losses. Allowing losses to be carried back therefore directed cash towards liquidity constrained firms, without needing any additional assessment of their prospects. These firms, in turn, used the funds to retain their workers providing valuable insurance both to workers and firms.

Related Literature Our study adds to a long literature on the asymmetric taxation of profits and losses. Theoretical work shows that the asymmetry raises effective tax rates and discourages investment and risk-taking (Auerbach, 1986; Auerbach and Poterba, 1987; Altshuler and Auerbach, 1990), and empirical work has documented the scale of unused losses (Cooper and Knittel, 2006; Altshuler et al., 2009) and traced the asymmetry's effects on investment and risk-taking (Edgerton, 2010; Dreßler and Overesch, 2013; Ljungqvist et al., 2017; Langenmayr and Lester, 2018; Goodman et al., 2023; Hillmann and Jacob, 2025). We study what happens when the asymmetry is relaxed during a crisis, using data that include the private and small firms where losses concentrate, and, novel to this literature, we follow the effects of the policy beyond investment to firm exit, employment and the earnings of individual workers.

Our analysis is closely related to work on loss refunds themselves. Koch et al. (2023) find that generous loss offsets stabilize equity values in crises, Langenmayr and Lester (2018) link longer refund windows to greater risk-taking, and Shi (2024), using changes in state carryback rules in the United States, finds that longer carryback periods raised investment, employment and business creation while longer carryforward periods had no effect. Our design improves on existing work in important ways. Prior estimates have mainly come from comparing claimants to non-claimants, or from variation in loss offset rules across countries and states. To the best of our knowledge, we are the first to compare firms with the same hypothetical potential refund that differ only in whether the law allowed them to claim it. Our take-up results also show that the low claiming Zwick (2021) documents in the United States is not specific to normal times: even in a crisis, with no cap on the refund, many eligible Australian firms did not claim. However, we go on to show that the size of the refund and financial constraints are key determinants of take-up, in addition to corporate tax complexity.

We also contribute to the evaluation of crisis support for firms. Much of this work concerns the Paycheck Protection Program, finding that its funds did not flow to the regions most affected by the pandemic (Granja et al., 2022), that routing loans through banks bought speed at some cost in targeting (Bartik et al., 2020), and that the program raised employment and survival at small businesses (Hubbard and Strain, 2020), though at USD 169,000 to 258,000 per year of employment retained and with most of its money going to owners and other claimants rather than workers (Autor et al., 2022a,b). Chodorow-Reich et al. (2022) find little evidence that its largest loans, which made up about half of its budgetary cost, preserved employment. Studies of short-time work find that it preserves jobs during temporary shocks but draws in less productive firms and pays some that would have kept their workers anyway (Giupponi and Landais, 2023; Cahuc et al., 2021; Giupponi

et al., 2022). We study a form of support delivered through the tax system that was much more cost effective in comparison.

Our framework also connects the tax treatment of losses to core issues in corporate finance. A carried-forward loss is a tax asset that pays off only when the firm earns taxable income, which gives it the payoff structure of an option (Green and Talmor, 1985; Favilukis et al., 2025). This asset's expected use changes a loss-making firm's effective tax rate and thus its incentive to borrow (Graham, 1996; Graham and Kim, 2009). We measure what firms do when presented with the opportunity to liquidate this asset at its par value, removing the asset's risk. This connects directly to the risk-sharing role of the corporate tax documented by Ljungqvist et al. (2017). Our evidence supports prior work that finds that financing frictions constrain employment (Chodorow-Reich, 2014; Benmelech et al., 2021); whereas that work studies shocks to credit, our results are driven by liquidity provided by the tax system.

The remainder of the paper is structured as follows: Section 2 describes the Australian setting and the data. Section 3 documents which firms the carryback reached and which claimed it, Section 4 sets out the comparison of corporations with pass-throughs, and Section 5 reports its estimates for firms and workers. Section 6 combines the estimates into a welfare evaluation, developing a framework for valuing and costing the refunds. Section 7 concludes.

2 Institutional Setting and Data

Business taxation in Australia Australian businesses can be organized as companies, partnerships, trusts, or sole traders. Companies pay corporate income tax on profits as they are earned, while shareholders pay personal income tax when profits are distributed.[2] The other three forms are pass-through entities and do not pay corporate income tax. Partnerships allocate income to their partners, trusts distribute income to beneficiaries, and sole traders report business income on their personal returns. In each case, business income is taxed at the owners' personal marginal rates.

Companies pay a flat corporate tax on taxable income, typically at a rate of 30 percent. Smaller companies, however, may qualify for a reduced rate. Since 2018-19, this rate has applied to base rate entities, defined as companies with aggregated turnover (or revenue) below AUD 50 million and no more than 80 percent of assessable income from passive sources.[3] The reduced rate was 27.5 percent through 2019-20, fell to 26 percent in 2020-21,

[2]An Australian company is comparable to a C corporation in the United States. We use company and corporation interchangeably.

[3]Passive income includes dividends and attached franking credits, royalties, rent, interest, and net capital gains. Before 2017-18, eligibility for the reduced rate depended on small business entity status and a lower

and fell again to 25 percent in 2021-22.

Australia integrates corporate and personal income taxes through a system of dividend imputation, which removes the double taxation of corporate income when it is distributed to shareholders. This system is called franking in Australia. The system works by crediting all firm-level corporate tax payments to a company's franking account. When the company pays a franked dividend, it attaches credits for tax already paid and reduces the account balance by $\tau/(1-\tau)$ per dollar of dividend. Shareholders that receive franked dividends include both the dividend itself and the franking credit in taxable income, then use the credit to offset their personal income tax liability, with any excess credit being completely refundable to individual shareholders. Distributed profits are therefore effectively taxed at the shareholder's marginal rate, with corporate tax acting as a withholding tax. The company's franking account balance therefore records all corporate tax paid that has not yet been passed on to shareholders as credits. From the perspective of the tax authority, when franking credits are distributed to shareholders, it is as if the firm had no longer paid this tax, and the franking account is debited. As a result, the franking account balance limits how much the company can receive as a carryback refund. For example, two firms may have the exact same history of past profits and current losses, but may be eligible for different carryback refunds due to their dividend policy. Because dividend policy may correlate with our outcomes of interest, we do not use this for identifying variation.

Treatment of losses in Australia, and the 2020 loss carryback An Australian company that incurs a tax loss generally cannot obtain an immediate refund of tax paid in earlier years. Instead, it carries the loss forward to deduct against future taxable income. Losses can be carried forward indefinitely, subject to a continuity of ownership test or a similar business test.

Australia has used loss carrybacks only temporarily, introducing them twice in response to economic crises. The first followed the global financial crisis and applied only in 2012-13. Firms could carry back up to AUD 1 million in losses, giving a maximum refund of AUD 300,000 at the prevailing 30 percent tax rate. The provision was repealed in 2014.[4] We study the second carryback, announced in the 2020-21 Budget on 6 October 2020 and legislated

turnover threshold. Before 2015-16, all companies paid 30 percent. Table B.5 in the appendix lists the full schedule.

[4]The provision was announced in the 2012-13 Budget and legislated as Division 160 of the Income Tax Assessment Act 1997. It was intended to establish a permanent two-year carryback, with a one-year transitional period. In 2012-13, losses could therefore be carried back only to 2011-12. Refunds were capped at the prior year's income tax liability and the firm's franking account balance. The provision was repealed alongside the minerals resource rent tax, effective from 2013-14.

within days.[5]

The 2020 carryback was available only to firms that were corporate tax entities in the loss year, the year to which the loss was carried back, and every intervening year. Partnerships, trusts, and sole traders – all forms of pass-through entities – were ineligible. Firms also needed aggregated turnover below AUD 5 billion in the loss year, which excluded only a handful of the country's largest firms. To claim, a firm had to have an income tax liability in the year to which it carried the loss back and to have lodged tax returns for the claim year and the preceding five years.[6]

The refund is calculated by subtracting net exempt income in the earlier year from the loss carried back, then multiplying by the corporate tax rate in the loss year. It is capped at the earlier year's income tax liability. Total refunds are also capped at the firm's franking account surplus at the end of the claim year. If F is the closing surplus and $\tilde{R}$ is the refund available before applying this cap, the firm can therefore receive $\min\left\{\tilde{R}, F\right\}$ as a refund. This prevents a firm's corporate tax payment from simultaneously generating both a credit for shareholders and a refund for the company. In other words, once a company distributes a franked dividend, the tax payment on those profits now belongs entirely to its shareholders, and the company cannot carry a loss back against it.

Firms could claim the carryback as a refundable tax offset on their 2020-21, 2021-22, or 2022-23 returns. A firm with losses in 2019-20 therefore had to wait until it lodged its 2020-21 return to receive a refund. As a result, firms affected early in the pandemic faced a substantial delay before receiving support.

Description of data We use administrative data from the Business Longitudinal Analysis Data Environment (BLADE), maintained by the Australian Bureau of Statistics (ABS). BLADE links the national business register to Australian Taxation Office records, including business income tax returns and business activity statements. The data cover all businesses in Australia, defined as any entity that lodges a tax return, submits a business activity statement, or reports positive payroll. Our panel spans the 2001-02 through 2022-23 financial years.

The firms in BLADE are identified both as tax-filing entities and as economic units, which group the filing entities belonging to the same enterprise. In particular, a large business may have separate business numbers and tax returns for different operating divisions, properties,

[5]The carryback was part of the JobMaker Plan, enacted through the Treasury Laws Amendment (A Tax Plan for the COVID-19 Economic Recovery) Act 2020.

[6]Firms also met the filing requirement if they had been assessed or were not required to lodge returns in the relevant years. Only revenue losses were eligible. Capital losses, losses arising from the conversion of excess franking offsets, and losses transferred in by head companies of consolidated groups or by foreign banking groups could not be carried back.

or franchised outlets. We use the annual concordances provided by BLADE to aggregate filing entities to economic units, meaning we study the largest entity that holds all subsidiary firms. We refer to these economic units as firms, the unit of observation in our study. We aggregate observations within a firm by summing flows and stocks across each firm's filing entities, and calculate ratios using the resulting totals where appropriate. For categorical variables such as industry, legal form, and state, we use the value reported by the constituent entity with the largest average income across all years. We exclude filing entities assigned to multiple economic units in the same year, non-profit institutions, and government entities.

We obtain industry, legal form, institutional sector, and state from the business register, and construct firm age using the year of commencement recorded in a separate birth date file. Business activity statements, lodged quarterly by businesses registered for the goods and services tax, report sales and wages. We rely on annual payroll records for annual headcounts and full-time-equivalent employment from 2001-02 to 2022-23. In addition, from 2019-20 on, the earliest year it is available, we use monthly payroll data containing employment, gross pay, and tax withheld at the firm level. Our main source for firms' financial information is annual income tax returns, which have separate forms for companies, individuals, partnerships, and trusts. We homogenize variables as appropriate to facilitate adequate comparisons across organizational forms; full details are available in Appendix B.

In particular, company tax returns include an itemized income statement and an abbreviated balance sheet reporting current and total assets and liabilities, total debt, and shareholders' funds. They also reconcile accounting profit with taxable income, reporting exempt income, losses deducted in the current year, and losses carried forward.

The returns also report tax charged on taxable income, offsets applied, and the net amount due or refundable at lodgment. We observe franked and unfranked dividends paid, franking credits received from other companies, and opening and closing franking account balances. We can therefore measure the balance that caps carryback refunds directly. Pass-through returns contain less detail, but report comparable measures of income, expenses, and net income.

Company returns for 2020-21 through 2022-23 include additional items for carryback claims. For each combination of a loss year and an earlier profitable year, we observe the loss carried back, the loss-year corporate tax rate, the earlier year's net exempt income and income tax liability, and the resulting refundable offset. These items allow us to measure actual claims separately for each pair of years.

In most cases, the tax data do not directly report each firm's statutory tax rate. Instead, we calculate it by dividing tax charged on taxable income by taxable income. This ratio usually matches a statutory Australian tax rate exactly. However, the ratio is naturally

unavailable for firms without positive taxable income, and can sometimes fall outside the statutory range for entities taxed under special schedules. In these cases, we impute the rate from the published schedule, using a firm's aggregated turnover and reported small-business and reduced-rate status. We express all dollar amounts in 2023 Australian dollars. Appendix B provides details on variable construction.

Potential carrybacks and the analysis sample We restrict the estimation sample to firms that employ at least five people in two consecutive years and that report revenue above AUD 150,000, in 2023 dollars, in two consecutive years. This allows us to focus on employer firms while omitting individuals conducting personal business under the organization of a firm. Because the business register includes many entities with little operating activity, such as shell companies, holding vehicles, single-property trusts, and one-person service entities, this is critical for our analysis. We require firms to meet the thresholds in consecutive years to reduce selection based on temporary changes in employment or revenue; we do not impose a stricter definition with more consecutive years in order to capture true exits.

To proceed with our analysis on carrybacks, we require a measure of the potential refund a firm could claim, regardless of whether it actually claimed. This value is not directly calculated by the tax authority, nor is it reported on a company's tax return. Instead, claimants simply report their carryback claim based on their own calculation of past tax payments and current losses. This presents an important measurement challenge we must overcome. We construct each firm's potential carryback from its tax history using the statutory formula created by Australian laws. However, the total amount of refund that a firm can claim is not necessarily unique. For example, a firm with a loss in 2020-21 and profits in both 2018-19 and 2019-20 has a choice of which tax year to apply the loss to first. We impose the assumption that losses are carried back to the most recent year first, with any leftover loss continued to the subsequent year. For example, we apply a 2020-21 loss first to taxable income in 2019-20, net of exempt income, and then apply any remaining loss to 2018-19 on the same basis. We value the loss at the 2020-21 corporate tax rate, cap the refund against each earlier year at that year's income tax liability, and cap the total at the closing franking account balance in the claim year. Appendix B.7 describes the calculation for each claim year in complete detail.

We assess the accuracy of this measure by comparing potential and actual refunds among claimants. A regression of our constructed potential carrybacks on true claimed refunds, conditioning on a positive refund, yields a slope of 0.988 (standard error 0.0164) and an R^2 of 0.977. This accuracy is broadly in line with the construction of potential carrybacks employed by Zwick (2021) for the United States. We learn two things from this exercise.

First, conditional on claiming, firms generally take the full refund available to them. Second, our calculation closely reproduces the refund they receive. This gives us confidence to use the same calculation for eligible non-claimants, although their potential refunds cannot be checked directly.

In 2020-21, 29 percent of firms in the estimation sample report negative taxable income. We restrict the analysis sample to firms with a strictly positive potential carryback in that year, leaving approximately 40 thousand corporations. These firms must have incurred a tax loss in 2020-21, had taxable income and an income tax liability in 2018-19 or 2019-20, and ended 2020-21 with a positive franking account balance.

The fact that franking account balances cap refunds means that eligibility depends on dividend distributions, in addition to past profits and current losses. The franking requirement excludes relatively few firms, but the excluded firms tend to be slightly larger. To better understand the effect of franking rules on sample selection, Appendix Table A.1 compares eligible firms with those that would qualify if the franking requirement were removed. Without a franking cap, we would expand the eligible population by 4 percent, raising average dividends paid from AUD 54 thousand to 94 thousand. Average franked dividends in the prior year rise from AUD 57 thousand to 84 thousand, and average revenue rises from AUD 2.01 million to 2.05 million. The requirement therefore shifts eligibility, and thus our analysis sample, toward smaller, more closely held corporations with a lower propensity to pay out dividends.

As a result, our estimates apply exclusively to firms that could receive a refund under these rules. The franking requirement may select firms with different responses to liquidity, but the direction of this selection is unclear. If dividend-paying firms face fewer financial constraints and have better access to external finance, the requirement could select firms that respond more strongly to a refund. Our estimates would then exceed the average effect across all loss-making corporations with a history of profits. However, closely held Australian companies routinely pay franked dividends to owner-managers, and these payments often reflect the owners' personal tax positions (Parliamentary Budget Office, 2024; Alstadsæter et al., 2014; Jacob and Michaely, 2017). An exhausted franking account therefore does not necessarily indicate that a firm is financially unconstrained.

3 Facts about carrybacks in Australia

Which firms became eligible for carrybacks? We begin by characterizing the firms that became eligible to carry back their losses during the pandemic. Broadly, a firm had to sustain a tax loss in 2019-20 or 2020-21 and have paid income tax in a year prior to a loss year,

as far back as 2018-19. This section focuses on understanding what this simple eligibility rule translates to in terms of firm attributes such as size and profitability persistence. We further explore the distribution of potential carrybacks across the distribution of firms, and discuss what drives take-up patterns.

To start, Table 1 compares four populations in the 2020-21 year: all firms in the estimation sample, firms with negative taxable income, firms eligible for a carryback, and firms that claimed a refund. Focusing on these four groups allows us to examine the characteristics of the firms that the carryback policy selected to fund, beyond the mechanical characteristics. Relative to the average loss-making firm, firms eligible to carry back are larger on every margin, though the differences in size are modest: 9.4 employees against 7.3, a wage bill of AUD 685 thousand against 544 thousand, and total assets of AUD 1.11 million against 859 thousand. On average they are also older by almost two years and pay 7 percent more per worker. The larger difference is in their histories, with 44 percent reporting positive taxable income in the year before the loss against 28 percent among loss-makers generally. Of course the carryback eligibility rule builds this selection in, since a refund requires prior tax paid and prior tax paid requires prior profits. Claimants resemble the eligible population from which they are drawn far more than either resembles the average loss-maker, though they are typically larger and deeper in loss. The average potential refund among eligible firms is AUD 29,335, and the average refund among claimants is AUD 55,800, though this average masks a large skew, as described below. Summed over the estimation sample, eligible firms could have claimed AUD 1.19 billion in refunds for 2020-21, and claimants received 681 million. Among firms that claimed their carryback refunds, the refund amounted to an average of 7 percent of annual payroll.

How were potential refunds distributed? Figure 2 ranks eligible firms into percentiles of the potential carryback constructed in Section 2 and plots the average potential and actual refund within each, on a log scale, so the vertical gap between the two series is take-up. We see a striking skew in the distribution of potential refunds, stemming from the skewed nature of the firm size distribution. The average potential refund is AUD 86 in the bottom ventile, 6,600 in the middle of the distribution, and 329,000 in the top ventile, a span of more than three orders of magnitude. Aggregate dollars are correspondingly concentrated: the top five percent alone accounts for 56 percent of aggregate potential refunds, and the cumulative distribution in Appendix Figure A.3 shows that the bottom half of eligible firms accounts for only 5 percent of potential refund dollars.

Figure 3 disaggregates by firm size, measured by the firm's average revenue over the preceding decade. In levels, in the left panel, the mean potential carryback rises steeply with

size, from AUD 6,400 in the bottom 30 percentiles to 255,000 between the 99th and 99.9th percentiles and 1.26 million in the top 0.1 percent, and the top 1 percent of firms by revenue hold 18 percent of all potential carryback dollars. Scaled by the firm's own payroll, in the right panel, the gradient is far flatter: the mean potential refund sits between 4 and 6.5 percent of the annual wage bill across the size distribution, and reaches 9 percent within the top 0.1 percent. Refund dollars are therefore concentrated among large firms due to their history of losses and prior tax payments, not because the policy is generous to large firms in proportion to their scale.

Who claimed their carrybacks? Motivated by evidence from Zwick (2021) that firms in the United States often do not claim their carryback refunds due to fixed costs and tax complexity, we examine the patterns of take-up in our setting in Australia. Overall, we find that 30 percent of eligible firms claimed a carryback in 2020-21, in line with Zwick (2021)'s take-up rate of 37 percent. Figure 4 plots the share of eligible firms claiming against the size of the potential refund. We can see from this figure that the average of 30 percent masks large heterogeneity. Take-up rises from 7 percent in the bottom percentiles of the potential carryback distribution to 65 percent at the top, consistent with fixed costs of claiming operating here as well. Because potential refunds are so skewed, dollar-weighted take-up is higher than the firm-weighted rate: claimed dollars are 57 percent of potential dollars.

Because, conditional on claiming, firms take essentially the whole refund available, the share of potential refund dollars used within each ventile tracks the share of firms claiming almost exactly (see also Appendix Figure A.4). While fixed costs and lack of sophistication are likely to hold in our setting in the same way they do for the United States, we next explore whether other features of firms' balance sheets can help explain what drives a firm's incentive to claim.

We find that across a wide set of measures of financial constraints, less liquid, worse performing or more constrained firms are more likely to claim their refunds, even after accounting for the size of the refund. In particular, we run partial regressions in which we residualize take-up and a measure of financial constraint against the size of the potential carryback for a firm. Figure 5 plots take-up against four measures of the firm's baseline financial position. Take-up is highest among the weakest firms on all four measures. Firms in the bottom percentiles of earnings relative to total liabilities claim at a rate 6 percentage points above those in the top percentiles, and the gap is 18 percentage points across percentiles of the growth in return on assets and 9 points across percentiles of revenue growth. Similarly, firms that raised their leverage by the largest amount claimed at a rate 11 per-

centage points larger than firms which made the smallest changes to leverage. Claimants are therefore disproportionately firms whose earnings were low or falling and whose debt was rising. The selection into claiming is informative about the policy's incidence and effectiveness: despite a refund being available to all eligible firms, those with the highest perceived need were the ones that indeed claimed. We expect this fact to have two potentially confounding effects. First, the causal effects of carryback refunds may be higher for firms most in need, meaning that there could be positive selection into treatment effects if these are viable firms that are solvent but illiquid. Second, the more fragile firms may be the ones least likely to return to profit, possibly raising the effective cost of the refunds and muting any causal effects.

What are the profit dynamics of carryback firms? Finally, to understand whether enabling firms to carry back losses indeed selects firms facing transitory shocks, we document the dynamics of profits and losses around the focal loss years. We find a remarkable pattern showing that losses are much less persistent for loss-making firms eligible for carrybacks, beyond that which is imposed by mechanical selection rules. For ease of comparison, here we focus exclusively on firms with losses in 2020-21 and profits in 2019-20, though these patterns hold with more years as well. Eligible firms enter the loss year from persistent histories of profit, and return to profit faster than other loss-makers. Figure 6 follows three populations defined in the loss year – all loss-makers, carryback eligible, and carryback claimants – over the two years on either side. Two years before the loss, 83 percent of eventually eligible firms had positive taxable income and 14 percent were making losses; among all loss-makers the corresponding shares are 31 and 53 percent, with the remainder not yet operating. Similarly, two years after the loss, 37 percent of eligible firms have returned to positive taxable income and 2 percent have ceased operating, against 21 and 6 percent among all loss-makers: eligible firms recover at nearly twice the rate of the average loss-maker, and exit at a rate that is just over a third. Claimants are nearly indistinguishable from the eligible population on both sides of the loss year. The eligibility criterion therefore selects firms whose losses interrupt otherwise profitable histories. This figure shows the remarkable fact that past profits are indeed a very good tag for future profits, a point shown for the United States by Coles et al. (2022).

Of course, tracking firms' profits after the availability of carrybacks mixes the selection effect of firms with any causal effects of the refunds on future profits. We separate the selection from any effect of the refund by applying the 2020-21 eligibility rules to a year in which no carryback existed. Appendix Figure A.2 does this for the 2016-17 loss year: we take firms with a loss in 2016-17, compute from their own filing histories the refund the

2020-21 provision would have granted them, and follow the resulting population over the same five-year window. The patterns for entry and recovery reproduce almost exactly: 80 percent of this synthetic eligible population had positive taxable income two years before the loss, against 83 percent in 2020-21, and 34 percent are back to positive taxable income two years after, against 37 percent. Among 2016-17 loss-makers at large, the latter figure is 21 percent, coinciding almost exactly with the 2020-21 cohort which could actually claim. This shows that the recovery gap in the center panel of Figure 6 comes primarily from the selection, as opposed to some effect of the refunds. Exit, in contrast, does not match across these time periods: 4 percent of the synthetic eligible population had ceased operating two years after the loss, against 3 percent of loss-makers, where in 2020-21 the eligible exit at a third of the loss-maker rate. We return to the effects of carryback refunds on exits in Section 5.

What targeting rule do carrybacks approximate? Carrybacks come with a targeting rule built in: whether a firm receives a refund, and how large the refund is, depends only on the firm's own history of profits and losses. Because designing well-targeted crisis support is difficult, the facts in this section are useful for learning which targeting rule this mechanical criterion approximates, and whether that rule selects firms facing transitory shocks. Overall, we find that carrybacks approximate a rule that provides liquidity to firms with a track record of profitability, in proportion to their size, at the moment they make a loss. Such a rule uses past profitability as a tag for viability, and since past profits are a good predictor of future profits, the tag selects firms whose losses are more likely to be transitory. As a result, we can conclude that a government wishing to reach viable firms hit by a temporary shock can implement a rule of this form using only information the tax authority already holds, with only minimal loss.

The patterns of take-up we document add a second layer of targeting on top of eligibility. Rafkin et al. (2023) show that incomplete take-up can improve the targeting of transfer programs when the eligible households that do not claim are less needy than those that do. We find similar self-targeting among carryback refunds: holding the potential refund fixed, eligible firms with low or falling earnings and rising debt were more likely to claim. The low take-up of carrybacks therefore overstates how much relief went undelivered, since unclaimed refunds were concentrated among firms with small potential refunds and stronger balance sheets, and elective claiming let firms reveal a need for liquidity that the government could not observe directly. Are these the most valuable firms to support during a pandemic? Refunds may have had the largest effects among financially weak firms that were solvent but illiquid, though weak firms are also the least likely to recover, in which case the refunds they

received were both less effective and more costly. Answering this question requires causal evidence on the effects of the refunds on firms and their workers, which the rest of the paper provides.

4 Comparing corporations to pass-throughs

Pass-throughs as a comparison group To estimate the causal effects of Australia's temporary carryback reform on firms and their workers, we form a comparison between corporations, allowed to carry their losses back, and pass-through businesses, which the statute excluded from the carryback provision and could only carry losses forward. The reform therefore altered the tax treatment of losses for one of two legal forms that operate side by side in every industry, and left the other unchanged. We therefore treat companies as a treatment group and pass-throughs as a control.

Importantly for this design, treatment status for each firm was fixed by a choice of legal form made before the pandemic, since a pass-through that incorporated after the announcement could not claim.[7] Firms typically choose their legal form at establishment, and non-tax factors such as liability, succession and owner-level taxation tend to dictate this choice (Mackie-Mason and Gordon, 1997).

Causal designs employing comparisons across legal form have precedent in public finance, which we draw from and expand on. Yagan (2015) uses S corporations, which the 2003 United States dividend tax cut did not affect, as the comparison group for C corporations, and documents that the two groups track each other closely outside the reform. More recently, Kennedy et al. (2026) use the same comparison to estimate the effects of the 2017 corporate rate cut on firms and workers. As discussed below, our design parallels the approach used in these papers, with some distinctions to adapt to our setting.

Counterfactual refunds for pass-throughs Our goal is to estimate the effects of carryback refunds on corporations, by comparing to firms that were not eligible to carry losses back. To do this, we need to construct a counterfactual potential carryback for pass-through firms. We construct this object by calculating, for every pass-through, the refund a corporation with an identical history of profits and losses would have received. We apply the statutory formula in Appendix B.7 to the firm's net business income, which all of the partnership, trust and individual returns report on a basis comparable to the taxable income of the company return. Table B.4 in the appendix maps these items and describes the con-

[7] Our sample excludes firms that switched organizational form at any point; in practice this is an extremely small number of firms.

struction in detail. In general, we apply the exact same procedure and assumptions to this counterfactual construction as we do to the true potential carrybacks we compute for eligible corporations.

One important consideration is that the franking account balance cap, which limits a corporation's refund to corporate tax paid but not yet passed to shareholders, has no pass-through analogue. This is because a pass-through firm remits no entity-level tax and so has no franking account. We construct the pass-through's potential refund without the cap, as if the hypothetical corporation had retained all of its after-tax earnings. In robustness checks we modify carryback-eligible corporations' potential carrybacks to remove the franking balance constraint and re-run our analysis, finding that results are unchanged. This is unsurprising because the firms that were constrained by franking account balances were generally not able to carry losses back at all – conditional on being able to claim, the amount of potential carryback lost to franking was empirically very small. We continue to apply the other eligibility conditions that were implemented at the time: we exclude pass-throughs with aggregated turnover above AUD 5 billion in the loss year, or without the lodgement history the statute required of corporate claimants.

A matched sample of corporations and pass-throughs Because firms that choose different legal forms upon formation can nonetheless differ in a variety of ways, such as ownership and governance, capital structure, and access to credit markets, we opt to compare like firms, within narrow industry and size cells. To do so, we match each carryback-eligible corporation to a pass-through on characteristics measured in 2019-20, the tax year that closed in June 2020, before the carryback was announced. We first estimate a logit for the probability that a firm is a corporation as a function of the logarithms of revenue, the wage bill and employment, the profit margin, firm age, revenue growth, and taxable income, measured for pass-throughs by net business income. We then pair each corporation with the pass-through closest to it in the fitted probability $\hat{p}(X_i)$ within an exact cell $c(i)$ defined by two-digit ANZSIC industry, decile of average wage, decile of revenue and decile of (counterfactual) potential carryback size, with deciles computed over the full population of firms. Pairing is one to one and without replacement, so a pass-through assigned to one corporation is unavailable to the rest:

$$m(i) = \underset{j:\,\text{Corp}_j=0,\; c(j)=c(i)}{\arg\min} \left|\hat{p}(X_i) - \hat{p}(X_j)\right|. \tag{1}$$

The benefit of this approach is that it allows for a clean control group that plausibly satisfies our identifying assumptions, spelled out in detail below. The cost is a reduction in

sample size. We must exclude a corporation from the sample if its cell contains no pass-through, or if every pass-through in the cell has already been assigned. In practice the former reason dominates. Of the 40,520 eligible corporations in our sample, we are able to find a pass-through match for 10,540 of these firms.

Columns 1 and 2 of Table 2 describe the eligible corporations before and after matching, which trims both tails of the corporate size distribution. Mean revenue falls from AUD 1.85 million to 1.68 million while median revenue rises from 0.95 million to 1.01 million, and the tenth percentile of employment rises from 0.6 to 1.9 full-time equivalents while the ninetieth falls from 19 to 17. In general, the largest corporations drop out because no pass-through shares their industry and revenue decile. The sample shifts toward industries in which both forms are common, such as food and beverage services (from 5.3 to 9.9 percent of firms), other store-based retailing (from 4.1 to 7.1 percent) and medical and other health care services (from 3.3 to 5.5 percent). Simultaneously, our sample shifts away from heavily incorporated industries, such as construction services (from 20.0 to 16.2 percent) and professional, scientific and technical services (from 10.6 to 7.1 percent). Table A.2 in the appendix reports the full composition. Importantly, the average potential refund changes little. As such, the estimates describe a different set of corporations than the eligible population as a whole, but matching does not select on the size of the refund.

Table 2 reports details of our matching procedure. In columns 2 and 3 we report means for matched corporations and pass-throughs, in column 4 the p-value from a test of equal means, and in column 5 the normalized difference, defined as the gap in means in units of the pooled standard deviation. Revenue, employment and firm age differ by less than 2 percent and payroll by 3.7 percent, with normalized differences below 0.03.

Identification Having constructed our treatment intensity variable, the size of the (counterfactual) potential carryback CB_i, we next turn to identification. Let Corp_i be an indicator that firm i is a corporation – this is our treatment variable throughout our study. Among corporations, outcomes during the pandemic can vary with CB_i for two reasons: the refund itself, and the characteristics of the firm that its potential carryback encodes, since that measure is built from the firm's own history. Among pass-throughs only the second operates, because the same kind of history generates a potential carryback to which no refund is attached. For pass-throughs, the relationship between outcomes and CB_i therefore shows how outcomes would have varied with the potential carryback in the absence of the refund. The difference between this relationship among corporations and among pass-throughs, the coefficient on $\text{Corp}_i \times CB_i$, measures the effect of the refund, and is our coefficient of focus in all specifications.

The identifying assumption is that, conditional on covariates X_i, corporations' outcomes without the carryback would have varied with the potential refund in the same way as pass-throughs' outcomes did. Writing $Y_i(0)$ for the outcome firm i would have realized without the opportunity to carry losses back, in levels or, in the event studies, as a change from baseline, we require

$$\mathbb{E}\left[Y_i(0) \mid CB_i = d, \text{Corp}_i = 1, X_i\right] - \mathbb{E}\left[Y_i(0) \mid CB_i = d, \text{Corp}_i = 0, X_i\right] = g(X_i) \qquad \text{for all } d. \tag{2}$$

This expression says that the gap between the forms may take any size but cannot vary with the potential refund. Differences in the level of outcomes between corporations and pass-throughs are absorbed by the main effect of Corp_i, and differences between firms with large and small potential refunds, which are above all differences in profit histories, are absorbed by the main effect of CB_i. For us to worry about a confounder, it must therefore differ across legal forms, covary with the size of the potential carryback, and affect firms' outcomes subsequent to the reform. Omitting a factor with only two of these properties leaves the estimate unbiased. In addition, for a pass-through, $Y_i(0)$ is the outcome it actually realized under its own loss rules. We therefore also need to impose that the differences between those rules and the corporate carryforward do not by themselves create a relationship between outcomes and the potential refund.[8]

We interpret the coefficient on the interaction term as the effect of an additional dollar of true potential refund, whether or not the firm claimed the carryback, meaning that this is an intent-to-treat effect. That effect is relative to the carryforward that corporations would otherwise have used, and can only be measured over the horizons we observe, which at this point in time is a maximum of two years. Because a corporation that claims a carryback gives up the later deductions its carried-back loss would have provided, it is possible that long-term outcomes may differ between treatment and control groups due to the fact that control firms have additional deductions they can use to offset taxes on future profits. Beyond our horizons, these deductions would accrue exclusively to pass-throughs in proportion to the losses that generate their counterfactual refund, so the estimates may overstate the long-run effect of the carryback. However, to the extent our results are driven by liquidity needs during a crisis and the presence of binding financing constraints, this effect would be minuscule in

[8] A trust's loss cannot be passed to its beneficiaries and is carried forward against the trust's future income. For family trusts, the conditions on using it are no stricter than those on companies. Sole-trader and partnership losses instead flow to the owners. An owner can deduct the loss against other income in the same year, unless that income exceeds AUD 250,000 or the business fails a set of commerciality tests, in which case the loss is carried forward against future profits of the business. In practice many owners' income does exceed the AUD 250,000 bar. Moreover, an immediate deduction is worth more when the loss is larger, meaning that any differences bias our estimates toward zero.

comparison. We plan to address this in future work with more years of data.

Threats to identification The most direct threat to identification in our study is a difference in access to credit. If corporations with long profit histories could borrow more easily than pass-throughs with the same histories, for example because incorporation eases lending against the business, corporations with large potential refunds would have outperformed pass-throughs with equally large counterfactual refunds in the downturn, even in the absence of the reform. Another possible threat is the presence of expanded limited liability provisions for corporations relative to pass-through businesses. While sole traders, general partners and trustees are personally liable for the debts of the business, small business lending in Australia is mostly secured, with the owner's home among the main forms of collateral (Connolly et al., 2015).

Importantly, no other business support measure during the pandemic depended on organizational form. JobKeeper, a cash flow boost and temporary full expensing were available to companies, partnerships, trusts and sole traders alike.[9] However, the legislation that introduced the carryback also brought forward to 1 July 2020 a scheduled cut in personal income tax rates. The cut lowered the tax on pass-through business income taxed at the owners' personal rates but not on income retained in a corporation, and the value rose with the owner's income up to a cap. If this tax cut favored the owners of pass-throughs with large potential refunds, it would make pass-through outcomes positively correlated with the counterfactual refund, which works against finding an effect of the carryback refund.

If our identifying assumptions hold, corporations and pass-throughs with the same potential refund should follow parallel paths in the months before refunds arrive. Similarly, a potential carryback constructed by the same formula for a loss year without a carryback should predict no difference in outcomes between the forms. We employ both of these tests in our empirical approach below, and find no threats to identification.

5 The effects of carrybacks on firms and workers

This section presents our estimated causal effects of carryback refunds on firms and on workers. We begin by measuring the effects of carryback refunds on survival, observed at

[9] JobKeeper was paid to eligible employers of every legal form, and to sole traders, partners, adult trust beneficiaries and company shareholders or directors as business participants, under the Coronavirus Economic Response Package (Payments and Benefits) Rules 2020. The cash flow boost was paid under the Boosting Cash Flow for Employers (Coronavirus Economic Response Package) Act 2020 to small and medium business entities that withheld tax from payments to employees, whatever their legal form. Temporary full expensing applied to every entity with aggregated turnover below AUD 5 billion.

an annual level. We then use the monthly payroll records to trace payroll and employment around the arrival of the refund, to separate the margins of that response, and to follow workers across employers. Every estimate comes from the matched sample of corporations and pass-throughs, as detailed in Section 4. Throughout, we refer to the matched corporations as treated firms.

Estimating equations We define a firm's year of exit as being the first financial year in which it no longer satisfies at least two of the following three conditions: the firm files a business tax return; the firm files a business activity statement, which every business registered for the goods and services tax lodges; and the firm has positive payroll records in at least 9 out of 12 months of the year. We denote a firm as being alive at time t if t is earlier than the firm's exit year, or if the firm has no exit year. For horizons $h \in \{1, 2\}$ years after 2021-22 we estimate

$$\mathbf{1}\{\text{alive}\}_{i,t+h} = \rho_h \text{Corp}_i + \gamma_h CB_i + \beta_h \, \text{Corp}_i \times CB_i + \kappa_{c(i),h} + X_i' \delta_h + \varepsilon_{i,h}, \tag{3}$$

where $\kappa_{c(i),h}$ are fixed effects for the exact matching cells and X_i collects the baseline covariates used in the match along with other firm characteristics such as age and prior receipt of JobKeeper. This can be interpreted as a repeated cross-sectional regression, or a series of local projections. The main effects of legal form and of the potential carryback absorb level differences between the forms and between firms with large and small potential refunds, and β_h is the effect of a dollar of potential refund on the probability that the firm is operating h years later. We cluster standard errors at the matched cell level, given that firms in a cell share an industry and size class and are exposed to similar shocks.

The remaining outcomes we study come from the monthly payroll records. Due to filing and refund timelines, we center our event studies around the expected refund month m^* of March 2022, nine months after the close of the 2020-21 tax year. This is consistent with typical refund timing for the majority of firms. The exact timing of refund receipt is not observable to us in the administrative data. However, because we assign the same expected refund month to every firm, any error in our measurement of that timing would shift the event study estimates forward or backward in time without changing their relative levels or overall shape. For outcome $Y_{i,m}$ of firm i in calendar month m, and for $k \in \{-16, \ldots, 16\} \setminus \{0\}$, which spans November 2020 to July 2023, we estimate an event study regression of the form

$$Y_{i,m} = \alpha_i + \lambda_m + \sum_k \gamma_k \, CB_i \cdot \mathbf{1}\{m - m^* = k\} + \sum_k \beta_k \, \text{Corp}_i \times CB_i \cdot \mathbf{1}\{m - m^* = k\} + \varepsilon_{i,m}, \tag{4}$$

where α_i are firm fixed effects and λ_m calendar month fixed effects. Because CB_i is in dollars, β_k reads directly as the effect of a dollar of potential refund whenever the outcome of interest is also in dollars. We omit the expected refund month, so every coefficient is measured relative to that baseline. We keep firms that exit in the panel at zero payroll and zero employment, so our estimates include the survival margin. Standard errors are clustered by firm. The outcomes are total monthly payroll in dollars, the number of employees paid, and average payment per employee.

Effects on firm survival Figure 7 reports the estimates of β_h from Equation 3. The refund raised the probability that a corporation was still operating one and two years later, by 0.95 percentage points per AUD 100,000 of potential refund after one year (standard error 0.21) and by 0.86 after two (standard error 0.18). At the average potential refund the effects are 0.28 and 0.25 percentage points. The changes in survival rates are small in magnitude primarily because most corporations stayed open through the pandemic: the two-year exit rate was 5.7 percent. Measured against those exits, however, the refund prevented about 4 percent of the closures that would otherwise have occurred within two years. In dollars, one additional corporation was operating two years after the refund for every AUD 11.6 million of potential refunds. The effect shows up within a year of the refund and persists into the second. Because the effect persists, a response of this size implies that some eligible corporations were short enough of cash that a refund averaging about 4 cents per dollar of annual payroll kept them open, consistent with evidence that liquidity constraints were significant for these firms (Schmalz et al., 2017; Gourinchas et al., 2025).

Of course, we are unable to test for pre-trends when using survival as an outcome, as all firms were alive in the periods immediately prior to the refunds. Instead, we test the identifying assumption for survival using data from a year without a carryback. We apply the carryback rules implemented during the pandemic to firms facing losses in the 2014-15 tax year. We construct a synthetic potential carryback for every firm, corporations and pass-throughs alike, rebuilding the matched sample on 2013-14 characteristics. We use these data to re-estimate equation (3). No refunds were paid against these synthetic carrybacks. Figure 8 reports the estimates at horizons of one to three years. We find a tight null effect, precisely estimated. This suggests that the interaction between the Corp_i coefficients and the size of the potential carryback CB_i picks up genuine differences arising from the differential treatment of losses during the pandemic, as opposed to other persistent differences between corporations and pass-throughs that may correlate with their survival rates and profit dynamics.

Effects on payroll and employment We next turn to the effects of the refunds on firms' payroll and employment. Figure 9 reports the path of the interaction term, β_k, for total monthly payroll, and Figure 10 for employment. Payroll is flat before the refund arrives: the coefficients average zero across the sixteen pre-refund months and show no trend, with only two of the sixteen individually distinguishable from zero. After the expected refund date, the coefficients are positive from the third month on. The response reaches 9.6 cents of additional monthly payroll per dollar of potential refund by month sixteen, with a standard error of 3.4 cents. At the average potential refund this is roughly AUD 2,800 of additional payroll a month, or 6.2 percent of the average monthly payroll of matched corporations. Cumulated over the sixteen months following the expected refund, the payroll response sums to 77 cents per dollar of potential refund, and we can reject a pass-through of less than 28 cents.

The employment path has the same shape, though it is estimated slightly less precisely. The coefficients after the refund are positive in every month and rise through the window to 2.6 employees per AUD 100,000 of potential refund by month sixteen (standard error 1.3). At the average potential refund this is 0.75 employees against an average of 8.4 full-time equivalents among matched corporations, or a 9 percent increase. Both profiles build gradually over the year after the refund.

The magnitude of this response reflects both the timing of the refunds and the core characteristics of the firms that were eligible to carry losses back. Treated corporations had just made a loss, and their refunds arrived roughly a year after the end of JobKeeper, the wage subsidy Australia paid to employers to keep workers on their payrolls. The refund therefore reached firms short of cash after government support for wages had been withdrawn. Because a corporation's franking account balance caps its refund, the sample of eligible firms is mechanically shifted toward corporations with a lower propensity to pay dividends. We cannot test for a dividend response directly, since pass-throughs do not pay dividends. Moreover, our payroll estimates count wages paid in full, while the additional cash a firm needs to keep a worker employed is the difference between that worker's pay and the revenue the worker continues to generate. It is therefore feasible for a dollar of refund to sustain more than a dollar of payroll. Finally, our estimates are in line with those of Melcangi (2026), who finds that firms in England and Wales spent 39 pence on employment for every pound of additional cash flow from the 2010 revaluation of business property taxes. Melcangi's average response is driven by firms with 25 or fewer employees and by the more leveraged, and the average treated corporation in our sample is well inside that size class.

Decomposing the payroll response The payroll response we document above could be driven by a number of mechanisms. It could come from firms that would otherwise have

closed, from additional workers at firms that would have survived in any case, or from higher pay for the same workers. These margins differ primarily in their economic incidence: higher pay accrues to workers who would have been employed in any case, while the other two margins operate through jobs that would otherwise not exist.

Overall, the marginal firms that the refund kept open account for a small part of the total response. Because exiting firms remain in the panel with zero payroll, a firm saved by the refund contributes its whole payroll to the differential path. One year after the refund, the survival estimate implies 9.5 additional operating corporations per AUD 100 million of potential refunds. If each paid the average monthly payroll of matched corporations, AUD 45,600, they would add 0.43 cents of monthly payroll per dollar of potential refund, 9 percent of the average post-refund payroll coefficient of 4.8 cents. The same calculation for employment gives 6 percent. Both shares are likely upper bounds: firms saved by the refund are plausibly smaller than the average survivor, and the calculation applies the one-year survival effect from the first month after the refund. The payroll and employment responses are therefore mostly responses at firms that would have survived without the refund.

Figure 11 reports equation (4) with average payment per employee as the outcome. The estimates move without pattern and are small in every month. At the average potential refund the largest post-refund estimate is a quarter of one percent of average monthly pay, the same order as the largest pre-refund estimate, and coefficients are individually distinguishable from zero in one of the sixteen months before the refund and three of the sixteen after, in both directions. The payroll response therefore reflects the number of workers on the payroll, not a change in the wages of incumbent workers.

We additionally examine directly whether the response is concentrated among retained workers or new hires. A response along the margin of retention would mean that the refund insured incumbent workers against displacement, whereas a strong hiring response would mean that carrybacks financed expansion and we would expect some of the refund money to also go to capital expenditures. We split each firm's monthly payroll by worker tenure, $Y_{i,m} = Y^{\text{ret}}_{i,m} + Y^{\text{new}}_{i,m}$, classifying a payment as going to a new worker in the first month the worker appears on the firm's payroll and to a retained worker in every later month, and estimate equation (4) separately for the two components.

Figure 12 reports the results. Payroll paid to retained workers follows the total: flat across the pre-refund window, positive in every month from the third after the expected refund, and individually distinguishable from zero in each of the last five months, reaching 11.8 cents per dollar of potential refund by month sixteen with a standard error of 5.1 cents. In contrast, payroll paid to new hires shows a very tight zero, with coefficients an order of magnitude smaller. Because a hired worker appears in the new-hire series only in their first

month and in the retained series thereafter, the series measures the flow of hiring as opposed to a stock.

Workers' earnings across employers A dollar of payroll retained at a treated firm overstates the true earnings the refund preserves if the workers involved would quickly have been reemployed elsewhere at similar pay. Implicitly, if we read the worker-level earnings response from the firm regression, we measure the response correctly only if the alternative for each worker let go is non-employment. The true earnings gain, and the welfare-relevant quantity, therefore depends on the counterfactual earnings of the workers a treated firm would otherwise have shed, which no firm-level regression can observe. To investigate the effects of these refunds on workers, we repeat our analysis at the worker level, tracking workers wherever they are employed and into unemployment spells.

The monthly payroll reports are filed for each employee, allowing us to create an employer-employee linkage from which we build a worker-level panel: for every worker, total earnings summed across all employers in each month. We assign each worker the treatment of their baseline employer. For worker w whose baseline employer is firm $i(w)$, and for $k \in \{-16, \ldots, 16\} \setminus \{0\}$, we estimate

$$y_{w,m} = \alpha_w + \lambda_m + \sum_k \gamma_k \, CB_{i(w)} \cdot \mathbf{1}\{m - m^* = k\} + \sum_k \beta_k \, \text{Corp}_{i(w)} \times CB_{i(w)} \cdot \mathbf{1}\{m - m^* = k\} + \varepsilon_{w,m}, \tag{5}$$

where α_w are worker fixed effects and λ_m calendar month fixed effects. The sample is every worker paid by a matched-sample firm, corporation or pass-through, in at least nine of the sixteen months before the expected refund month. Treatment is assigned at the worker's baseline employer. Standard errors continue to be clustered at the firm level.

Comparing the worker-level earnings response with the firm-level payroll response measures how much of the payroll retained at treated firms is earnings that workers would otherwise have lost. In the firm-level regression, a worker who leaves a treated firm drops out of that firm's payroll; in the worker-level regression, the departing worker is counted at their earnings from any new employer, and at zero only while not employed. The worker-level response therefore differences out the earnings that departing workers would have recovered elsewhere. If these two responses coincide, the payroll that treated firms retained is earnings their workers would not otherwise have had. As a result, the further the worker-level response falls below the payroll response, the larger the share of retained payroll that these workers would have earned at other employers, calling into question whether the refunds actually preserved total employment in the economy as opposed to keeping total employment fixed but concentrating it at recipient firms.

Figure 13 reports the differential path for workers' total earnings across all employers. Earnings rise after the refund: the coefficients are positive in all sixteen post-refund months and individually distinguishable from zero in eleven, peaking at AUD 161 of monthly earnings per AUD 100,000 of the baseline employer's potential refund in month twelve and averaging AUD 83 over the sixteen months. Cumulated over those months, the response is 1.3 cents of earnings per worker per dollar of potential refund.

Scaled to the firm, the worker-level response is just over a quarter of the payroll paid to retained workers. Multiplying the cumulative response by 20.6, the average number of workers per firm weighted by potential refund, gives 27 cents of earnings per dollar of potential refund. About two thirds of the payroll that treated firms kept paying their incumbent workers would have been earned by the same workers elsewhere, and the remaining third is earnings they would otherwise have lost, the analogue of the earnings losses measured in the literature on displaced workers (Jacobson et al., 1993).

What the refunds bought The 12,220 eligible corporations in our population that claimed a carryback received refunds totaling AUD 681 million. Every estimate in this section is an effect per dollar of potential refund, and under the exclusion restriction that a refund left unclaimed changes nothing, dividing by the dollar-weighted take-up rate $\theta = \sum_i R_i / \sum_i CB_i = 0.573$, where R_i is the refund firm i claimed, converts each into an effect per dollar paid. On this basis, one additional corporation was operating two years after the refund for every AUD 6.6 million of refunds, and every AUD 1 million of refunds added 29 job-years of employment at recipient firms over the sixteen months after the refund. A job-year at a recipient firm therefore cost AUD 34,400 in cash, about half of average annual pay at eligible corporations. For comparison, the Paycheck Protection Program spent between USD 169,000 and 258,000 per year of employment retained, 3.4 to 5.2 times median earnings (Autor et al., 2022a), and short-time work in France cost 45 percent of average annual labor costs per job saved in 2009, and 7 percent among the firms with the largest predicted fall in hours (Cahuc et al., 2021). These are jobs at the firms that received refunds, and some of the workers who held them would have found other work, so the figure overstates the employment that the economy would otherwise have lost. The worker-level estimates show that about a third of the payroll that recipient firms kept paying their incumbent workers is earnings those workers would have lost entirely in the absence of the refunds.

However, the cash outlay we present in these calculations overstates what these jobs cost the government, because a firm that claims a carryback can no longer deduct the refunded loss against later profits, and hence the government collects tax on income that the loss would otherwise have sheltered. Measuring the net cost of the refunds therefore requires an

estimate of how much of each refunded loss a firm would have deducted, had no carryback existed. In order to make welfare statements about how cost effective the carryback policy was, we turn next to building a framework for valuing the refunds.

6 A welfare evaluation of carrybacks

In this section we combine our causal estimates into a single measure to value the welfare impacts of the carryback refunds. The measure we use is the marginal value of public funds (MVPF), defined as the ratio of beneficiaries' willingness to pay for a policy to the policy's net cost to the government (Hendren and Sprung-Keyser, 2020). The MVPF measures the welfare that a dollar of net government spending delivers to a policy's beneficiaries, so comparing the ratio across any two policies gives the welfare effect of moving a dollar from one to the other, whenever both groups of beneficiaries receive equal weight.

A single statistic of this kind is particularly useful in our setting, because the Australian carryback reached a narrow population of firms. In particular we estimate effects specifically for loss-making corporations with a recent history of tax payments that also had pass-throughs operating alongside them in the same industries and size classes. Our setting does not allow us to estimate, for example, what a wage subsidy or a grant would have done for the exact same set of firms, or what a cash transfer comparable in magnitude to carryback refunds would do for firms outside our sample population. The MVPF framework requires only the causal effects of a policy on its own beneficiaries and on the government's budget (Finkelstein and Hendren, 2020), so the carryback can be compared with programs that reached other firms without extrapolating our estimates to populations we do not observe.

Forming an MVPF calculation The carryback has two groups of beneficiaries: the owners of claiming firms, and the workers those firms employed. Owners receive the refund in the year of the loss, and they give up the deductions they would otherwise have taken against later profits. As a result, their gain is the value of the refund minus the value of those deductions. Workers gain the earnings they would have otherwise lost entirely, after income tax. The government pays the full value of the refund now, but recovers part of the initial outlay in three ways: through tax on the firms' subsequent profits that the forfeited deductions would have offset, through additional corporate tax revenue from firms that would have closed in the absence of the refunds, and through income tax on workers' additional earnings. Putting this together, we can express willingness to pay and net costs, per dollar

of refunds paid, as

$$\text{WTP} = \underbrace{1-\phi_f}_{\text{owners}} + \underbrace{(1-\tau_L)\,\Delta E}_{\text{workers}}, \tag{6}$$

$$\text{NC} = 1 - \underbrace{\phi_g}_{\text{deductions recovered}} - \underbrace{G}_{\text{tax from firms preserved}} - \underbrace{\tau_L \Delta E}_{\text{tax on earnings}}, \tag{7}$$

where ϕ_f is the value to the firm of the deductions it gives up, ϕ_g is the value of those same deductions to the government, ΔE is workers' additional earnings across all their employers, τ_L is the tax rate on those earnings, and G is the company tax remitted by firms the refund preserved. Throughout this section, a hat denotes an estimated coefficient, to distinguish estimates from discount factors.

Willingness to pay We measure workers' gain or willingness to pay, stemming from the earnings they would otherwise not have had, with the worker-level event study using Equation (5). Recall that this outcome sums each worker's earnings across all employers, and is therefore already net of moves between employers and unemployment spells. Write $\hat{\beta}_k^E$ for the differential path in month k, per worker and per dollar of the baseline employer's potential refund. We aggregate back to the firm level with $\nu = \sum_i N_i CB_i / \sum_i CB_i = 20.56$, the mean baseline headcount N_i weighted by potential refund, converting to dollars paid. This gives

$$\Delta E = \frac{\nu}{\theta} \sum_{k=1}^{K} \beta_g^{k/12} \hat{\beta}_k^E = 0.465, \tag{8}$$

where $K = 16$ months and $\beta_g = 1/(1+r_g)$. We set the annual rate r_g to 2.5 percent, the yield on 10-year Australian government bonds in March 2022, the month in which refunds were paid out (OECD, 2026), and use the same rate for every flow in the calculation. We leave the firm-level payroll responses out of willingness to pay, because payroll retained at a recipient firm is no gain to workers who would have been employed elsewhere at similar pay. This is important, as about two thirds of that payroll would have been earned elsewhere. We tax the additional earnings at $\tau_L = 0.18$, the 2021-22 average rate of income tax and Medicare levy for a resident earning twelve times the average monthly pay at eligible corporations (Australian Taxation Office, 2026). We omit transfers to workers who would otherwise have been out of work. Such transfers would lower willingness to pay and net cost by equal amounts, so omitting them understates the ratio whenever the ratio exceeds one.

Owners' gain is the refund less the value to the firm of the deductions it gives up, $1-\phi_f$, measured in the firm's own funds in the year of the loss.[10] The value of those deductions to

[10] In these units a grant of one dollar is worth one dollar to the firm. If the owners are unconstrained

the firm depends on the schedule of deductions that also determines what the government recovers, and on how scarce cash is for the firm in the loss year compared with the years in which the firm would have taken the deductions, so we derive ϕ_f together with the net cost below.

We count the refund at its full value to owners, even though recipient firms used part of the refund to pay their workers. A firm that uses the refund to retain workers it would otherwise have laid off pays them for labor it chose to keep, so its owners value the refund at no less than $1 - \phi_f$ however the refund was spent, while each worker gains the difference between the earnings of a job that continued and those the worker would otherwise have had. Counting both is valid only if the earnings response reflects employment that would otherwise have ended, and the estimates support that reading: pay per employee does not respond to the refund, and ΔE credits a worker who would have found another job only with the difference between their baseline pay and their subsequent pay.

The net cost of a refund, and its value to the firm A carryback replaces a deduction the firm could have taken against future income with a refund of tax paid on past income, so the government's net cost and the firm's valuation of the refund depend on the same counterfactual: how much of the refunded loss the firm would otherwise have deducted, as well as when those deductions would have taken place. Consider a corporate income tax levied at a constant rate τ on taxable profit, with indefinite carryforward and no carryback, the regime that prevails regularly in Australia. Under this regime a tax loss is an illiquid and contingent asset (Favilukis et al., 2025): the firm can realize the loss only by earning future taxable income, and cannot sell the loss, transfer the loss outside the firm, or straightforwardly borrow against the loss. A firm that earns taxable income $\pi_{-1} > 0$ before year 0 and incurs a tax loss $L_0 > 0$ in year 0 carries back

$$L^{cb} = \min\{L_0,\, \pi_{-1}\} \qquad \text{and receives} \qquad R = \tau L^{cb}, \tag{9}$$

and carries any remaining loss forward as before.

Under the status quo the firm would have deducted L^{cb} against its taxable income as that income arrived. Let d_s denote the share of L^{cb} the firm would have deducted in year $s \geq 1$. These shares are uncertain, since they depend on future income. Moreover, they sum to at most one, with the shortfall being the part of the loss never deducted. If the firm exits, the shares are zero in every year after the exit. We define the shares in the absence of the

investors and the friction lies between them and the firm, a dollar inside the firm in the loss year is worth $1 + \lambda_0$ dollars to them, and their willingness to pay in their own funds exceeds ours by $\lambda_0 (1 - \phi_f)$. That measure would also credit a grant to a constrained firm with a surplus.

carryback, so a firm that the refund keeps alive has $d_s = 0$ in every year, since without the refund the firm would have exited. The refund raises the government's later collections by $\tau d_s L^{cb} = R d_s$ in year s, so per refund dollar the government recovers

$$\phi_g = \sum_{s \geq 1} \mathbb{E}\left[m_s d_s\right], \tag{10}$$

where m_s is the discount factor that values a dollar in year s. Note that this object is not the share of all tax losses that firms go on to eventually recover – it covers only the portion of initial losses available to carry back. A firm with a large current loss and little past taxes paid may be eligible for a carryback refund that covers only a small portion of its overall loss. In our calculation we set $\mathbb{E}\left[m_s d_s\right] = \beta_g^s u_s$, where $u_s \equiv \mathbb{E}\left[d_s\right]$ is the expected share of the refunded loss deducted in year s, which discounts the deductions at the bond rate as if they were riskless. However, we test the sensitivity of our MVPF to smaller choices of β_g^s, which we can interpret as if the government were not discounting at a riskless rate.

What the government ultimately recovers from the refunds depends on the type of firm, as laid out in Table 4. A firm that would have survived and returned to profit without intervention exchanges the deduction for cash now. Such a refund functions as a loan or advance, repaid through higher collections if and when the firm returns to profit, at a net cost of $1 - \phi_{g,i}$. On the other hand, a firm that fails regardless of intervention would never have generated the income against which to deduct the loss, so the full refund leaves the tax base permanently and becomes a transfer to the firm's claimants. This is the sense in which a carryback refund can be either a transfer or a loan. Separately, there are firms whose survival depends on the refund, which we model with a cash floor on the firm's budget constraint. Suppose a firm must end year 0 with cash at or above $c \leq 0$, reflecting its reserves and its borrowing capacity. A firm below the floor without the refund and above the floor with the refund would have deducted none of its loss in the absence of a carryback, but the refund keeps open a firm that continues to operate, to remit tax, and to employ workers.

Summing over recipients with refund weights gives the net cost in (7), where ϕ_g is the refund-weighted mean of $\phi_{g,i}$, to which exits and firms the refund kept open contribute zero, and G is the discounted company tax remitted by firms the refund kept open. We measure G from the survival estimates of equation (3), valuing each additional survivor at $\bar{g}_h$, the mean company tax payable at horizon h among matched corporations that are operating, with loss years counted at zero (Table 5):

$$G = \sum_{h=1}^{H} \beta_g^h \frac{\hat{\beta}_h}{\theta} \bar{g}_h = 0.035, \tag{11}$$

where $\hat{\beta}_h$ is the survival effect at horizon h and $H = 2$ because we observe survival for two years. Assigning the average survivor's tax bill to firms that survive only because of the refund likely overstates G, since such firms are plausibly less profitable than the average survivor. In the other direction, (7) assumes that the refund does not change the later income of a firm that survives either way; if the refund raises that income, we omit the additional tax and overstate the net cost.

The firm values the forfeited deductions differently from the government, because the firm cannot borrow freely against them. We take m_s to be the same for the firm's owners and for the government, so that without any constraint on the firm the two would value the forfeited deductions alike, and derive differences in the firm's and government's valuations from the firm's financing constraint. Let $\lambda_t \geq 0$ denote the multiplier on that constraint in year t, normalized so that an additional dollar of internal funds in year t is worth $1 + \lambda_t$ dollars paid out to owners in that year, with $\lambda_t = 0$ whenever the financing constraint is slack. Measured in its own funds in year 0, the firm then values a dollar in year s with the discount factor

$$\Lambda_s = m_s \frac{1 + \lambda_s}{1 + \lambda_0}, \tag{12}$$

which varies across years and states with the tightness of the financing constraint (Whited and Wu, 2006). The deductions the firm gives up for the refund are worth $\phi_f = \sum_{s \geq 1} \mathbb{E}\left[\Lambda_s d_s\right]$ to the firm, and the valuations differ by

$$\phi_g - \phi_f = \sum_{s \geq 1} \mathbb{E}\left[m_s d_s \frac{\lambda_0 - \lambda_s}{1 + \lambda_0}\right]. \tag{13}$$

When the gap is positive, such as if cash is scarcer for the firm in the loss year than in the years and states in which the firm would have taken the deductions, this is a source of welfare gains from the refunds. It is sensible to assume that cash is less scarce in the years in which the firm has taxable income to deduct against. The refund, in contrast, arrives in a year in which the firm is losing money. A carryback therefore moves cash forward in time, from years in which the firm generates funds to the year in which it is short, and across states, since the deductions it replaces pay only if the firm returns to profit, the states in which an additional dollar is worth least to the firm.[11] In this setting, if credit markets were perfect, λ_t would be zero in every year and state, the firm would value the deductions as

[11] Writing $\bar{\lambda}_s = \mathbb{E}\left[\lambda_s\right]$, the numerator of (13) equals $\sum_s \mathbb{E}\left[m_s d_s\right]\left(\lambda_0 - \bar{\lambda}_s\right) - \sum_s \mathrm{Cov}\left(m_s d_s, \lambda_s\right)$. The first term is the value of moving relief forward in time, which is positive if the constraint is expected to loosen. The second term is the value of removing the dependence of relief on the firm's recovery, which is positive if deductions arrive in the states in which the constraint is slack. This is the motive that leads a firm facing costly external finance to hedge, in the style of Froot et al. (1993).

the government does, and willingness to pay would equal net cost for every value of ϕ_g. A grant to a firm that would never have used its losses and an interest-free advance to one that would have used them at once would then have the same ratio of one. Moreover, the gap between firm and government valuation is zero as well if the firm's financing constraint is equally tight in every year. In this sense, the gap only measures the value of relieving a constraint that binds in the loss year and would have loosened by the time the loss was used. The mechanical eligibility rule of carrybacks, which requires a history of profit before the loss, tends to pick out firms of this kind.

For the government, relieving the firm's constraint exposes it to no more risk than a private lender would bear, since the risk that the loss is never used is equivalent to default risk for the lender. The net cost we construct counts that risk in full through ϕ_g. However, there are benefits to having the government intervene instead of a private lender. By relying on the mechanics of the tax system, the government avoids the frictions that prevent firms from borrowing against a tax loss. A lender advancing cash against the loss, for example, cannot easily observe or make a claim against the firm's future income. Assuming a lack of (or high costs of) tax evasion, the government's advance is repaid automatically, through the tax on that income. This argument evokes the model of Holmström and Tirole (1998), in which the government supplies liquidity backed by income that private agents cannot pledge.

We can also connect this framework to the puzzle of low take-up of carrybacks first examined by Zwick (2021). The firm's valuation of the forfeited deductions also determines whether the firm claims. With a fixed cost κ of claiming, a firm claims if and only if

$$R\,(1-\phi_f) \geq \kappa, \tag{14}$$

so take-up rises with the size of the potential refund and, for a given refund, is highest among firms least likely to use the loss and among those for which cash is scarcest in the loss year. Both patterns appear in the data: take-up rises with the potential refund and, holding its size fixed, is highest among firms with low or falling earnings and rising debt (Section 3), and it also rises with the stock of unused losses ahead of the refunded loss, which lowers that loss's utilization.

Measuring utilization Valuing the forfeited deductions requires the schedule u_s for the refunds paid in 2020-21, a counterfactual that recipients' own returns cannot reveal, since claiming removed the refunded loss from their stock of unused losses and the refund may itself have changed their survival and later income. Eligible firms that did not claim are a selected comparison, since (14) implies that claiming selects on ϕ_f. We therefore measure

utilization on the losses of earlier cohorts, incurred when carrying a loss forward was the only option. For each loss year from 2002-03 to 2016-17, we select the companies that would have been eligible under the 2020-21 rules (Appendix B.7). For each firm-cohort i, we observe the potential carryback CB_i and the part of the loss the firm carries back, L_i^{cb}, and we follow the firm-cohort for seven years after the loss.

Since Australian tax losses are pooled, we cannot observe how much of a particular year's loss was used. Instead, we can measure how much the firm's total deductions would fall if L_i^{cb} were removed from its stock of unused losses. That reduction is the exact amount of deduction displaced by the carryback refund. We compute the reduction by running each firm's loss stock forward twice, over the same observed path of income, once with and once without the refunded loss. In each year $s \geq 1$ after the loss, the firm adds any new loss $L_{i,s}$ to its stock and deducts the smaller of the stock and its taxable income before loss deductions, $Y_{i,s}$:

$$\begin{aligned} D_{i,s} &= \min\left\{B_{i,s-1} + L_{i,s},\, Y_{i,s}\right\}, \quad B_{i,s} = B_{i,s-1} + L_{i,s} - D_{i,s}, \\ \tilde{D}_{i,s} &= \min\left\{\tilde{B}_{i,s-1} + L_{i,s},\, Y_{i,s}\right\}, \quad \tilde{B}_{i,s} = \tilde{B}_{i,s-1} + L_{i,s} - \tilde{D}_{i,s}, \end{aligned} \tag{15}$$

where $B_{i,0}$ is the stock at the end of the loss year, including the loss itself, and $\tilde{B}_{i,0} = B_{i,0} - L_i^{cb}$. The share of the refunded loss that the refund displaces in year s is $d_{i,s} = \left(D_{i,s} - \tilde{D}_{i,s}\right)/L_i^{cb}$, the empirical counterpart of d_s. Later losses compete for the same income in both runs and the order in which vintages of loss are relieved does not affect the measure. The return records losses carried forward only from 2019-20, so we simulate the stock from 2002-03 based on observed taxable income (Appendix B.8).

We weight each firm-cohort by its potential refund, since the fiscal question concerns dollars, and reweight the pre-policy cohorts to the 2020-21 eligible population within cells x defined by two-digit industry, the size of the loss, and the loss relative to taxable income in the two preceding years:

$$\hat{u}_s = \sum_x \mu_x \frac{\sum_{i \in \mathcal{C}_x} CB_i\, d_{i,s}}{\sum_{i \in \mathcal{C}_x} CB_i}, \qquad s = 1, \ldots, S, \qquad S = 7, \tag{16}$$

where $\mathcal{C}_x$ is the set of pre-policy firm-cohorts in cell x and μ_x is the share of 2020-21 potential refund dollars held by eligible firms in that cell. We count deductions after the seventh year at zero, in order to increase our estimation sample size. The assumption underlying this exercise is that, within a cell, a firm incurring a loss in 2020-21 would have, on average, followed the same future profit dynamics as firms incurring losses in other years. Most of the departures from this assumption that we can identify would make our estimates of $\hat{u}_s$ too low, and lead us to overstate the net cost of the refunds. For example, the 2020-21

losses coincided with temporary full expensing, which can create a tax loss at a firm whose operations are sound, and losses of that kind are more likely to be relieved than earlier losses in the same cell. In addition, our truncation ignores deductions taken more than seven years after the loss.

Utilization of the 2020-21 refunds Reweighted to the 2020-21 eligible population, 34 percent of refunded loss dollars would have been deducted within three years of the loss and 52 percent within seven years, as shown in Figure 14. Just under half of the seven-year total appears in the first two years. Discounted at 2.5 percent a year, we find an estimate of $\phi_g = 0.485$. Ignoring any effect of the carryback refunds on survival, the government could therefore have expected to recover about half of each refund dollar. The seven-year sum of the unweighted average differs by less than half a percentage point from the weighted sum. If we restrict the cohorts to loss years 2006-07 to 2010-11, which span the global financial crisis, we find a lower value of 47 percent, with the gap opening mainly over the first three years (Appendix Figure A.5).

Seven-year utilization falls from 61 percent in the lowest quartile of the opening balance, scaled by average taxable income over the three years before the loss, to 57, 48 and 38 percent in the second, third and highest, respectively (Appendix Figure A.6).[12] We also find that take-up of the refunds rises by 48 percentage points from the lowest quartile of loss stock to the highest, so refund dollars are drawn disproportionately from losses less likely to have been used. For robustness, we report the MVPF with the schedule of the highest quartile of losses as a lower bound.

The marginal value of public funds of the 2020-21 carryback We have now measured all of the objects necessary to construct our MVPF. As a first step, we take the difference of equations (6) and (7), which has the effect of removing every transfer from one party to another:

$$\text{WTP} - \text{NC} = (\phi_g - \phi_f) + \Delta E + G, \qquad \text{so} \qquad \text{MVPF} = 1 + \frac{\phi_g - \phi_f + \Delta E + G}{\text{NC}}. \quad (17)$$

The refund and the tax on workers' earnings cancel, and what remains is surplus: the value to firms of receiving cash in the year in which it was scarcest, the earnings that workers would otherwise not have had, and the company tax of firms that would otherwise have closed.

[12] The lowest quartile also holds firms whose loss histories predate the reconstruction and are assigned a zero balance, so 61 percent is an upper bound and the slope is a lower bound (Appendix B.8).

Our design does not rely on the identification of the firm financing constraint multipliers λ_t. Our results on survival and payroll show that the constraint was indeed binding for some recipients, since the real decisions of a firm that can raise funds freely do not depend on its cash on hand. However, our estimates do not reveal how tightly the constraints bind. If the constraint is slack in every year in which the firm has taxable income against which to deduct, (13) reduces to $\phi_g \lambda_0 / (1 + \lambda_0)$, and the gap between ϕ_g and ϕ_f depends solely on the premium on a dollar of internal funds in the loss year. Our baseline estimate of the MVPF sets $\lambda_0 = 0$, which credits firms with nothing for receiving the cash early, and Table 6 shows how the ratio rises with λ_0.

We estimate a marginal value of public funds of 2.26 for the 2020-21 carryback, against a net cost of 40 cents per dollar of refunds, as reported in Table 5. Overall willingness to pay is 90 cents per refund dollar. Earnings that workers would otherwise not have had account for 93 percent of the total surplus, and company tax from preserved firms for only 7 percent. The ratio is high, exceeding 2, because the government recovers 60 cents of each dollar paid out; a surplus of half the outlay is divided by a net cost of 40 cents. Crediting firms with the value of receiving cash early raises the ratio, albeit slowly: the MVPF is 2.37 if a dollar in the loss year is worth 1.10 dollars to the firm, and 2.67 if it is worth 1.50. The gradient is low because the benefit accrues only on the 48 cents of each refund dollar that is an advance. The refund-weighted premium is also likely smaller than a firm-weighted one, since the constraint is plausibly looser for larger firms and refund dollars are concentrated among large claimants. Moreover, most of the value of relieving the constraint accrues to workers, whose earnings losses a firm does not value directly.

In summary, each dollar of earnings that workers would otherwise have lost cost the government 85 cents net of recoveries, and each dollar paid out cost 40 cents. By comparison, in Italy each euro of short-time work transferred to workers cost the government about 1.38 euros once behavioral responses are counted (Giupponi and Landais, 2023). Turning to the United States, Granja et al. (2022) find that the employment effects of the Paycheck Protection Program were small compared with the program's size.

To see what drives our estimate, we compare it with counterfactual benchmarks, removing one source of value at a time. First, at a firm whose survival and employment the refund did not change, ΔE and G are zero, and the MVPF of its refund is $(1 - \phi_f) / (1 - \phi_g) = 1 + (\phi_g - \phi_f) / (1 - \phi_g)$. This quantity equals one, the MVPF of a cash transfer, at $\lambda_0 = 0$. This is the case where the firm values the forfeited deductions as the government does. If $\lambda_0 = 0.25$, we find an MVPF of 1.19. Second, consider a cash grant, instead of a tax refund, that has identical effects on survival and earnings. A firm receiving the grant forfeits no deductions, so $\phi_g = \phi_f = 0$: the government recovers nothing through later collections. The

MVPF in this case would be 1.57 for any value of λ_0, far below our baseline estimate of 2.26. Third, had firms instead passed the refund to their workers as higher pay, with nothing else changing, the earnings gain would have been a transfer from owners to workers. This transfer would then drop out of the surplus, while the tax on it still lowered the net cost, and the MVPF would be $1 + (\phi_g - \phi_f + G)/\text{NC}$, or 1.09 at $\lambda_0 = 0$. The difference between our baseline estimate and this benchmark, $\Delta E/\text{NC} = 1.17$, is the value we estimate from the employment relationships that the refund preserved.

Table 6 reports sensitivity to a variety of other assumptions. First, we show how much the value of the MVPF depends on reading ΔE as employment that would otherwise have ended. Taking the lower bound of the 95 percent confidence interval for the cumulative earnings response, a deliberately conservative bound, gives us an MVPF of 1.41. On the other hand, incorrectly crediting all the payroll that recipient firms kept paying, as the firm-level estimates alone would suggest, would give an extreme value of 6.60. Valuing the forfeited deductions with the schedule of loss years 2006-07 to 2010-11 gives an estimate of 2.12, and with that of the highest quartile of the opening balance gives 1.93. The net cost of the refund reaches zero at $\phi_g = 0.88$. Taxing the additional earnings at the marginal rate of income tax and Medicare levy at average pay, 34.5 percent, gives an MVPF estimate of 2.56. Finally, a constraint that loosens each year by the spread between the average fixed rate on new loans to small businesses in March 2022, measured at 4.53 percent by Reserve Bank of Australia (2026), and the government bond rate gives an MVPF of 2.33. However, part of that spread compensates lenders for default risk that the net cost already counts.

It is important to interpret this MVPF estimation carefully. Because the reform introduced a carryback where none had existed, the MVPF in (17) is the average marginal value of public funds of the program as implemented. Reading this as the value of expanding the program at the margin would require the marginal claimant to resemble the average one. Given the steep rise of take-up with the size of the potential refund, as well as with financial fragility, this is particularly unlikely.

Our calculation leaves out a few terms. We credit a firm that the refund preserved with the tax the firm remits, while leaving out the after-tax profit its owners retain, which would raise our estimated MVPF. We plan to address this in future work. We also assign no value for workers to time spent out of work, so ΔE may overstate workers' gain to the extent that non-employment has value of its own. Finally, we ignore the costs of claiming refunds, which would reduce willingness to pay. The difference $\phi_g - \phi_f$ is also the term most exposed to distributional weighting: this is a gain that accrues entirely to shareholders, while ΔE accrues exclusively to workers.

Discounting the government's recovery We discount every flow at the same rate, so the surplus in our MVPF does not stem from a difference between the rates at which firms and the government discount the future. In practice, a firm borrows at a higher rate than the government because lenders price its risk of default and charge for the frictions of lending. Only the elimination of these frictions is a source of surplus. Default risk is a cost the government also bears when advancing the refund, and the net cost already counts that risk through the deductions lost when a firm exits.

Discounting at the government's bond rate, as we do, treats these deductions as riskless, although they arrive only if and when recipients return to profit, and so disproportionately as the economy recovers. A literature on the valuation of government obligations argues that a government should discount a cash flow at a rate that reflects the risk of that cash flow, because the market risk of a government's claims is borne by taxpayers, for whom the risk is as costly as it is to private investors (Lucas and Moore, 2010; Lucas, 2012). For example, Novy-Marx and Rauh (2009, 2011) show how far the choice of rate moves the measured value of public pension liabilities. Applied here, a rate that priced the procyclicality of the deductions would lower ϕ_g for the same schedule and raise the net cost. However, this correction turns out to be empirically small in our setting: at 5 percent the net cost rises from 40 to 43 cents per refund dollar, and the MVPF falls to 2.13, while at 1 percent the MVPF is 2.36.

It is also possible to take the opposite view, stating that a government that spreads a risk across many taxpayers bears that risk at negligible cost (Arrow and Lind, 1970). In this case the government would value the deductions above their market value, and the difference between its valuation and that of investors would be a further source of surplus, accruing on every refund dollar whether or not the firm's behavior changed. We leave this term out, since the argument of Arrow and Lind (1970) requires the returns being spread to be independent of national income, and the deductions a carryback displaces arrive as the economy recovers and are therefore likely to be correlated.

7 Conclusion

Governments that support firms in a crisis usually have to commit funds before they can tell which firms are viable and will preserve employment. This paper studies an instrument whose inherent eligibility rules select viable firms facing transitory losses. By allowing firms to receive refunds for past taxes paid, governments are able to provide liquidity to firms in need while limiting fiscal costs. We find that Australia's 2020 carryback reached firms whose profit histories predicted recovery, and among eligible firms, those in more constrained

financial positions were the most likely to claim, suggesting that these firms most valued the cash. Comparing corporations with the pass-through businesses excluded by the statutory rules, we find that the refunds kept some firms open, and kept workers employed across all firms. Moreover, about a third of the earnings preserved at firms would have been lost entirely if the workers separated. The refunds were also inexpensive fiscally, because a firm that is refunded for a loss can no longer deduct it: about half of each refund dollar would have returned to the government as recipients' later profits were taxed. Importantly, we show that the very feature of carrybacks that selects firms likely to recover is also the source of the carryback's low net cost.

It is important to recognize that our study focuses on a particular set of firms: corporations that made losses during the pandemic after paying tax in the years before it, which also have pass-throughs operating alongside them in the same industries and size classes. It is plausible that the benefits and costs of providing carrybacks to different types of firms may differ. There also remain important questions about the effects of tax loss refunds on other firm outcomes, such as future profits and induced investment; we plan to take up these questions in subsequent work. As a policy instrument, a carryback can reach only corporations with a recent history of paying tax, so it is best suited as a complement to broader programs such as wage subsidies and forgivable loans, which can support the pass-through businesses and the firms too young to have paid tax that a carryback leaves out.

Our results show that the asymmetric taxation of profits and losses affects how much the government insures firms and their workers when a shock arrives, in addition to the incentives to invest and take risk that prior work has emphasized. While refunds of past tax are rare as a permanent feature of tax systems, in recent years they have become increasingly common as crisis policy. In this respect, Australia's temporary introduction of carryback was typical, since it was introduced suddenly during the pandemic and was available for only a few years. We believe that the results in this paper may therefore apply in other settings as well. However, a permanent carryback would pay out whenever firms that had recently paid tax made losses. In this case a firms may also anticipate the refunds and could change how much they invest and how much risk they take. Because our estimates come from a temporary provision announced after the crisis had begun, they are silent on these behavioral responses. We hope future work will explore this further, and help establish whether carryback policies, adopted frequently in emergencies, belong in the tax system at all times.

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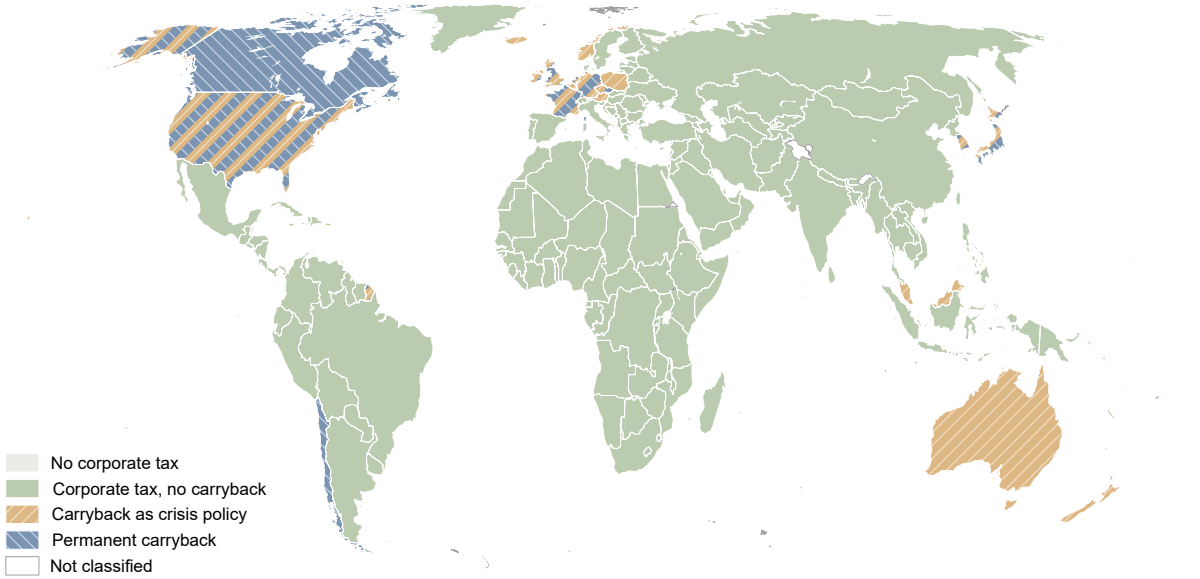
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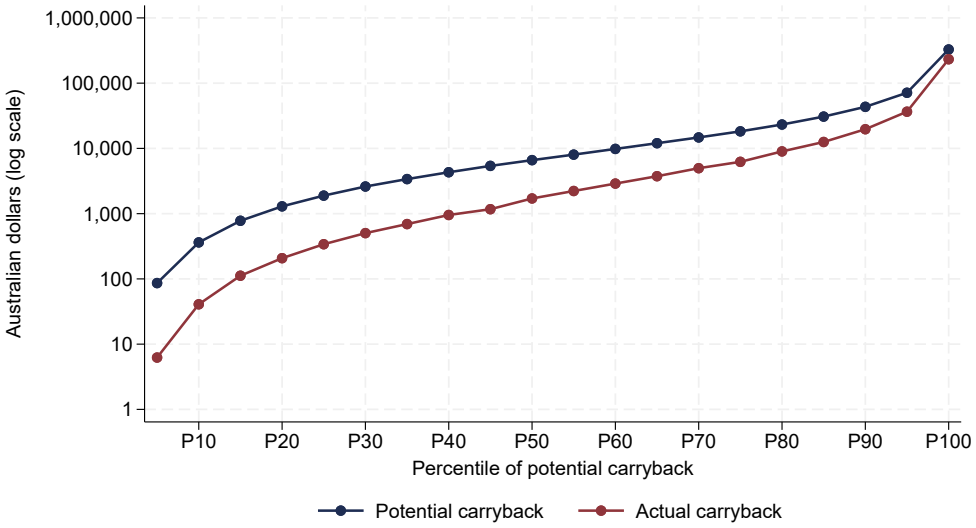
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Figure 1: Corporate income taxes and loss carrybacks around the world



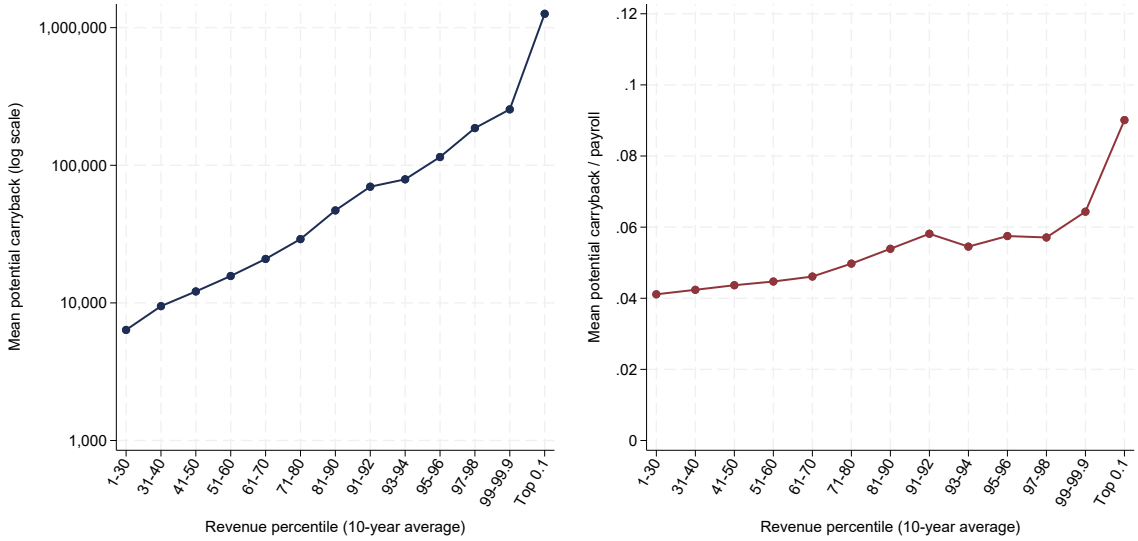
Notes: Each jurisdiction is classified by whether it levies a general corporate income tax in 2025, whether it has had a loss carryback without a sunset at any point since 2000, and whether it introduced or temporarily extended a carryback in response to the 2001 recession, the global financial crisis or the COVID-19 pandemic, by lengthening the carryback period, raising its cap, widening eligibility or accelerating refunds. Jurisdictions with both a permanent and a crisis carryback are drawn in alternating bands of the two. Jurisdictions whose only corporate taxes are a minimum tax on large multinational groups or a tax on one industry are classified as having no corporate income tax. Areas of undetermined status, and small territories that no tax source covers, are not classified. Appendix B.10 gives the sources and the provisions behind each classification.

Figure 2: The distribution of potential and actual carrybacks



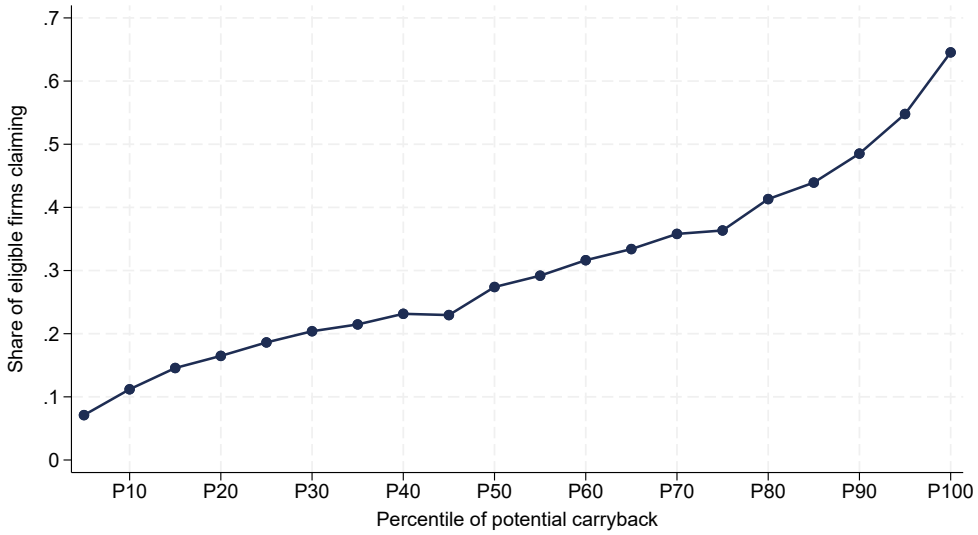
Notes: The sample is firms eligible for a carryback in 2020–21, ranked into ventiles of the potential carryback constructed in Section 2. The figure plots the mean potential carryback and the mean refund actually claimed within each ventile, in 2023 Australian dollars on a log scale. Means are taken over all eligible firms in the ventile, so the actual series includes non-claimants at zero.

Figure 3: Potential refunds by firm size



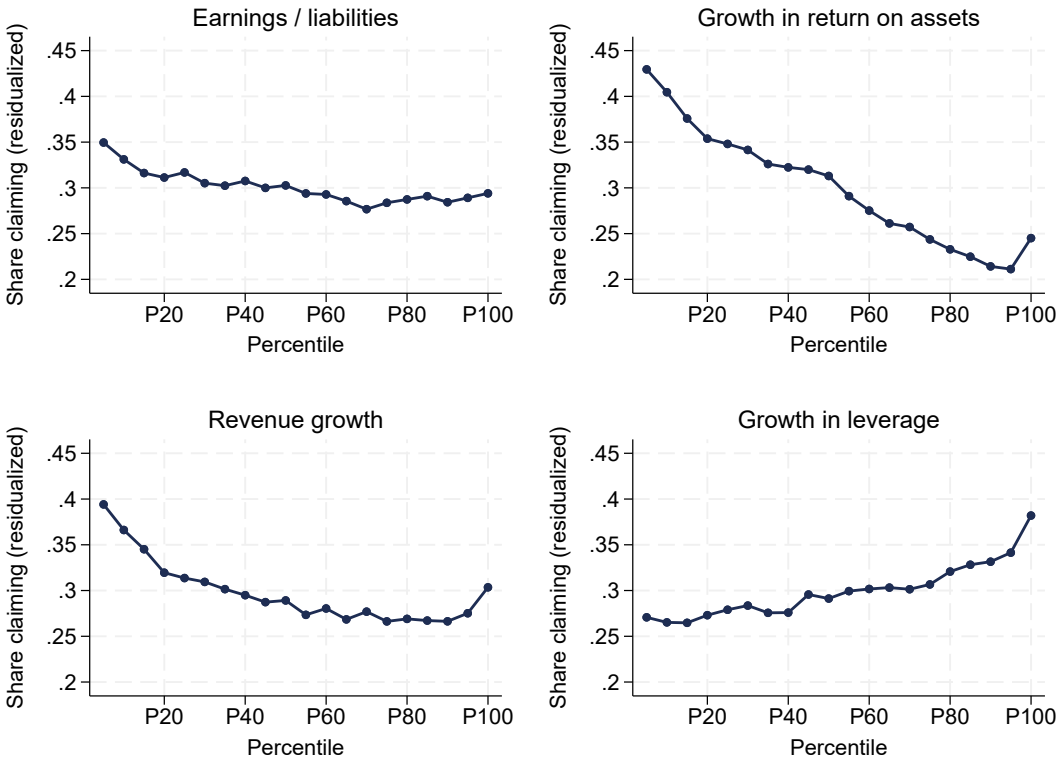
Notes: Firms are grouped by percentile of average revenue over the ten years preceding the loss year. The left panel plots the mean potential carryback within each group, in 2023 Australian dollars on a log scale. The right panel plots the mean ratio of the potential carryback to the firm's annual payroll.

Figure 4: Take-up of the carryback by size of the potential refund



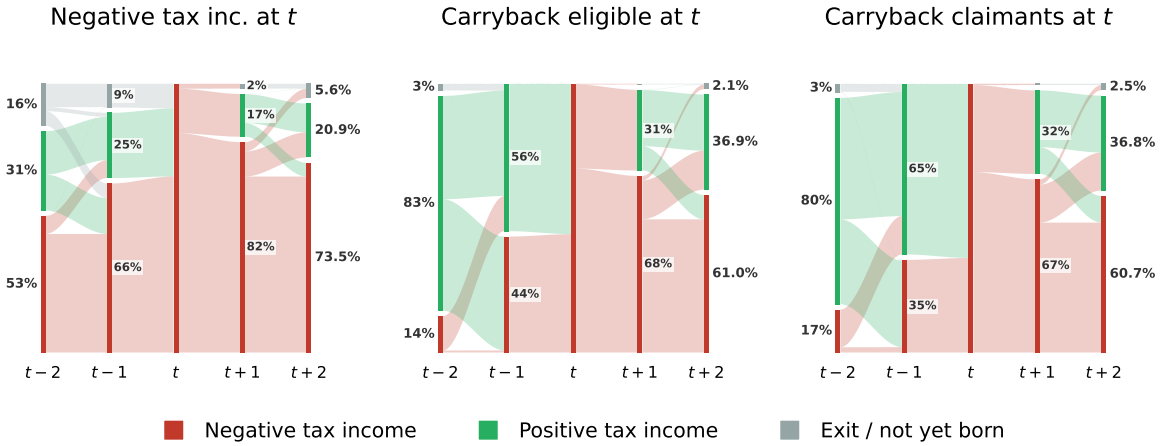
Notes: The sample is firms eligible for a carryback in 2020–21, ranked into ventiles of the potential carryback. The figure plots the share of firms within each ventile that claimed a carryback on their 2020–21 return.

Figure 5: Take-up and financial fragility



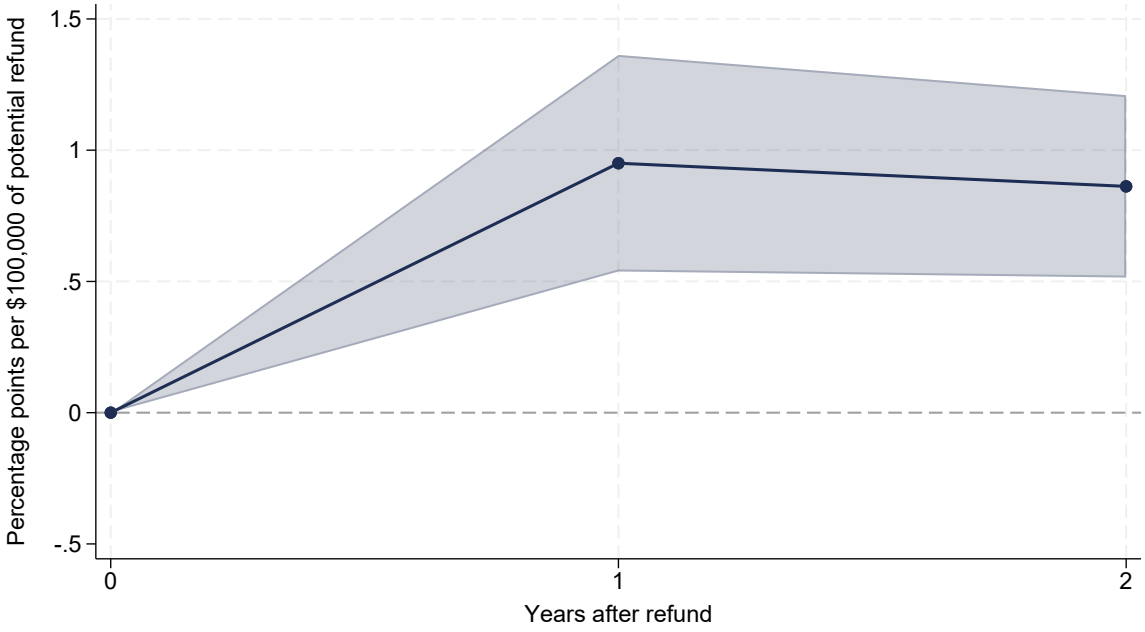
Notes: The sample is firms eligible for a carryback in 2020–21, ranked into ventiles of each of four measures of financial position at baseline: earnings over total liabilities, the growth of return on assets, revenue growth, and the growth of leverage. Each panel plots the share of firms claiming within each ventile, residualized on the size of the potential carryback with the sample mean added back, so that the gradient is net of the relationship between take-up and refund size in Figure 4.

Figure 6: Taxable income trajectories around the 2020–21 loss year



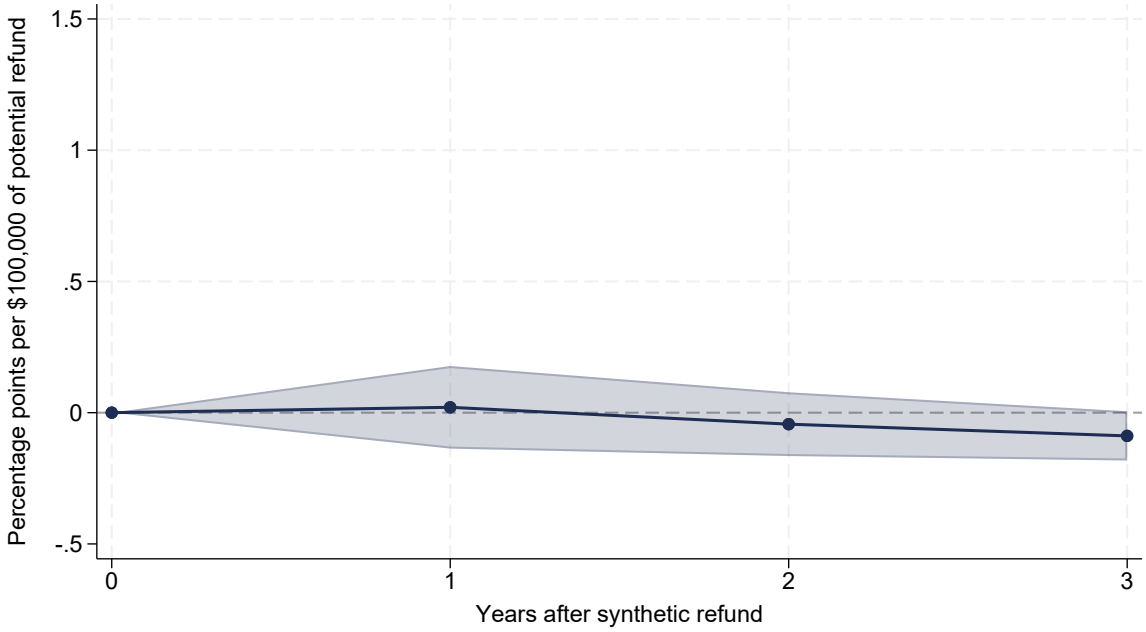
Notes: Each panel follows a fixed population of firms defined in the 2020–21 loss year, denoted t: firms with negative taxable income (left), the subset eligible for a carryback (center), and firms that claimed one (right). Columns give the share of each population with negative taxable income, positive taxable income, or not operating (exited or not yet born) in each year from $t-2$ to $t+2$, with flows between states shaded.

Figure 7: The effect of carrybacks on firm survival



Notes: The figure plots the coefficients β_h from equation (3) one and two years after the year of the expected refund, with 95 percent confidence intervals, estimated on the matched panel of corporations and pass-throughs. The outcome is an indicator that the firm is operating in the year, that is, that it has not reached the exit year defined in Section 5, and coefficients are in percentage points per AUD 100,000 of potential carryback. Every firm operates at horizon zero, so the coefficient there is zero; standard errors are clustered by matched cell.

Figure 8: Placebo: synthetic carrybacks in 2014-15



Notes: The figure plots the coefficients β_h from equation (3) estimated on synthetic potential carrybacks constructed by applying the statutory formula to 2014–15 losses, a year in which no carryback was available, with the matched sample rebuilt on 2013–14 characteristics. Coefficients are in percentage points per AUD 100,000 of potential carryback. 95 percent confidence intervals are built from standard errors clustered by matched cell.

Figure 9: The effect of carrybacks on monthly payroll

Notes: The figure plots the differential path β_k from equation (4) with total monthly payroll in dollars as the outcome, for event months $k \in \{-16, \ldots, 16\}$ relative to the expected refund, with 95 percent confidence intervals, estimated on the matched panel of corporations and pass-throughs. The potential carryback enters in dollars and is not scaled, so a coefficient is dollars of monthly payroll per dollar of potential carryback. Coefficients are measured relative to the expected refund month, and standard errors are clustered by firm.

Figure 10: The effect of carrybacks on employment

Notes: The figure plots the differential path β_k from equation (4) with the number of employees paid as the outcome, for event months $k \in \{-16, \ldots, 16\}$ relative to the expected refund, with 95 percent confidence intervals, estimated on the matched panel of corporations and pass-throughs. Coefficients are employees per AUD 100,000 of potential carryback; the average potential carryback among eligible corporations is AUD 29,335. Coefficients are measured relative to the expected refund month, and standard errors are clustered by firm.

Figure 11: The effect of carrybacks on average pay per employee

Notes: The figure plots the differential path β_k from equation (4) with average payment per employee in dollars as the outcome, for event months $k \in \{-16, \ldots, 16\}$ relative to the expected refund, with 95 percent confidence intervals, estimated on the matched panel of corporations and pass-throughs. Coefficients are dollars of monthly pay per employee per AUD 100,000 of potential carryback; average monthly pay per employee among matched corporations is AUD 5,269. Coefficients are measured relative to the expected refund month, and standard errors are clustered by firm.

Figure 12: Decomposition of the payroll response: retained workers and new hires

Notes: The figure plots the differential path β_k from equation (4) estimated separately for payroll paid to retained workers (left panel) and to new hires (right panel), on a common vertical scale, with 95 percent confidence intervals. A payment is classified as going to a new worker in the first month the worker appears on the firm's payroll, and to a retained worker in every later month. Coefficients are dollars of monthly payroll per dollar of potential carryback. Coefficients are measured relative to the expected refund month, and standard errors are clustered by firm.

Figure 13: The effect of carrybacks on workers' total earnings

Notes: The figure plots the differential path β_k from equation (5) with each worker's total monthly earnings across all employers as the outcome, for event months $k \in \{-16, \ldots, 16\}$ relative to the expected refund month, with 95 percent confidence intervals. The sample is the 225,084 workers paid by a matched-sample corporation or pass-through in at least nine of the sixteen months before the expected refund month; a worker who meets the condition at more than one firm is assigned to the one that paid them more. Coefficients are dollars of monthly earnings per worker per AUD 100,000 of the baseline employer's potential carryback. Coefficients are measured relative to the expected refund month.

Figure 14: The counterfactual utilization of refunded losses

Notes: The sample is firms that would have been eligible for a carryback in a pre-policy loss year, reweighted to the 2020–21 eligible population within cells of two-digit industry, loss size, and the loss relative to taxable income in the two preceding years. The left panel plots $\hat{u}_s$, the share of refunded loss dollars that would have been deducted s years after the loss, with the cumulative share on the right axis. The right panel plots the cumulative share separately by quartile of the opening balance of unused losses, scaled by average taxable income over the three preceding years. Shares are weighted by the potential refund and the horizon is truncated at seven years.

Table 1: Firm characteristics by population, 2020–21

	All firms	Negative taxable inc.	Carryback eligible	Claimed a carryback
Number of firms	328,720	96,050	40,520	12,220
Size and age				
Revenue	2,243,202	1,448,475	2,011,347	2,394,843
Employment	11.9	7.3	9.4	12.1
Payroll	940,522	543,835	684,539	907,367
Payroll per worker	64,680	62,623	66,859	68,266
Total assets	1,072,326	859,312	1,105,014	1,377,788
Current assets	612,323	444,980	630,097	773,047
Firm age	11.6	10.5	12.3	12.1
Profitability				
Taxable income	395,274	-288,125	-116,520	-326,255
Profit margin	0.059	-0.166	-0.021	-0.100
Taxable in prior year	0.439	0.279	0.438	0.630
Taxable in following year	0.468	0.185	0.458	0.424
Distributions and the carryback				
Dividends paid	201,941	41,172	53,682	84,591
Franked dividends, prior year	172,277	40,576	57,060	90,813
Potential carryback	3,616	10,216	29,335	58,505
Potential carryback / payroll	0.006	0.016	0.046	0.068
Share claiming carryback	0.037	0.116	0.301	1.000
Carryback refund claimed	2,071	6,636	16,805	55,760

Notes: Columns report means over four populations of firms in the 2020–21 income year: all firms in the estimation sample; firms with negative taxable income; firms eligible for a carryback; and firms that claimed a refund. Rows reporting shares are means of indicator variables, and the prior and following year are 2019–20 and 2021–22. Dollar amounts are deflated to 2023 Australian dollars.

Table 2: Baseline characteristics of eligible corporations and the matched sample

	All eligible corporations (1)	Matched corporations (2)	Matched pass-throughs (3)	p-value (2) = (3) (4)	Normalized difference (5)
Number of firms	40,520	10,540	10,540		
Used in matching					
Revenue	1,854,302	1,678,216	1,657,734	0.409	0.011
Employment	9.4	8.4	8.3	0.431	0.011
Payroll	684,539	547,166	527,109	0.092	0.023
Payroll per worker	66,794	63,231	61,185	<0.001	0.129
Firm age	12.3	12.1	12.1	0.756	-0.004
Not used in matching					
Total assets	1,047,500	917,713	886,490	0.076	0.024
Current assets	589,185	484,356	385,792	<0.001	0.156
The potential carryback					
Potential carryback / payroll	0.0461	0.0427	0.0526	<0.001	-0.146

Notes: Entries are group means in 2020-21. The unit of observation is the firm. Column 1 covers every carryback-eligible corporation entering the matching procedure of Section 4; columns 2 and 3 cover the corporations and pass-throughs that the procedure pairs, one pass-through to each corporation, exactly within two-digit industry, revenue decile and average-wage decile. Column 4 reports the p-value from a test of equal means across columns 2 and 3. Column 5 reports the normalized difference, the difference between the means in columns 2 and 3 divided by the square root of the average of their variances. Employment is measured in full-time equivalents and firm age in years; all other levels are in 2023 Australian dollars. The potential carryback of a pass-through is the counterfactual refund constructed in Section 4. The potential carryback is reported relative to payroll in the same year. Total income, the profit margin and income per worker are omitted because they appear only on the company tax return.

Table 3: What the 2020-21 refunds cost and what they bought

	Per AUD 1 million paid	Program total
Panel A. Cost to the government (AUD)		
Refunds paid	1,000,000	681 million
Deductions recipients can no longer take, present value	484,700	330 million
Company tax from firms kept open	34,900	24 million
Net cost	480,400	327 million
Panel B. What the refunds bought		
Firms operating after two years that would otherwise have closed	0.15	102
Job-years at recipient firms, sixteen months	29.0	19,800
Payroll at recipient firms, sixteen months (AUD)	1,352,400	921 million
Panel C. Cost per unit (AUD)		
Net cost per job-year at recipient firms	16,500	
Cash outlay per job-year at recipient firms	34,400	

Notes: Effects per dollar paid divide each estimate per dollar of potential refund by the dollar-weighted take-up rate. Panel A discounts at 2.5 percent a year: deductions over the seven years after the loss and company tax over the two years after the refund. In Panel B, firms kept open are from equation (3) at a horizon of two years, and job-years and payroll cumulate the differential paths of equation (4) over the sixteen months after the expected refund month, undiscounted. Program totals multiply effects per dollar by the AUD 681 million of refunds paid to eligible corporations in our population. Net cost excludes the income tax on workers' additional earnings, which lowers it to 40 cents per refund dollar (Table 5).

Table 4: Carrybacks as transfers, loans, and lifelines

Firm type	Survival condition	Utilization	Firm's gain	Government's net cost	Character
Inframarginal exit	$\pi_0 + R < c$	0	R	R	Transfer
Inframarginal survivor	$\pi_0 \geq c$	$\phi_i \in [0,1]$	$R\,(1-\phi_{f,i})$	$R\,(1-\phi_{g,i})$	Loan
Marginal survivor	$\pi_0 < c \leq \pi_0 + R$	0	$R + v_i$	$R - G_i$	Lifeline

Notes: The table records the gain to a firm receiving a carryback refund R and the corresponding net cost to the government, for each of the three firm types defined by the cash floor c. An inframarginal survivor that is constrained on payroll retains workers it would otherwise shed, and the earnings it preserves are counted in willingness to pay through ΔE. $\phi_{g,i}$ and $\phi_{f,i}$ value the deductions the firm would have taken without the carryback, at the discount factor m_s of equation (10) and at the firm's discount factor Λ_s of equation (12), respectively. v_i is the present value of the firm's expected post-tax profits from continuing, and G_i the discounted company tax remitted by a firm the refund preserves. All quantities are measured relative to the status quo of indefinite carryforward with no carryback.

Table 5: Inputs to the marginal value of public funds

	Symbol	Value	Source
Panel A. Estimated inputs			
Utilization of refunded losses, discounted at r_g	ϕ_g	0.485	eqs. (10), (16)
Survival at one and two years	$\hat{\beta}_1$, $\hat{\beta}_2$	0.95, 0.86	Figure 7
Cumulative worker earnings response	$\sum_k \beta_g^{k/12} \hat{\beta}_k^E$	0.0130	Figure 13
Company tax of operating corporations	$\bar{g}_1$, $\bar{g}_2$	99,266; 131,377	Matched sample, Section 4
Panel B. Moments of the potential refund distribution			
Dollar-weighted take-up rate	θ	0.573	Section 3
Headcount weighted by potential refund	ν	20.56	Section 5
Panel C. Calibrated constants			
Annual discount rate	r_g	2.5 percent	OECD, March 2022
Premium on internal funds in the loss year	λ_0	0	Baseline
Tax rate on labor income	τ_L	0.18	ATO, 2021-22
Utilization horizon	S	7 years	
Survival horizon	H	2 years	
Earnings horizon	K	16 months	
Panel D. Assembled quantities, per dollar of refunds paid			
Difference in valuation of forfeited deductions	$\phi_g - \phi_f$	0	eq. (13)
Company tax from firms preserved	G	0.035	eq. (11)
Workers' earnings preserved	ΔE	0.465	eq. (8)
Willingness to pay	WTP	0.896	eq. (6)
Net cost	NC	0.397	eq. (7)
Marginal value of public funds	MVPF	2.26	eq. (17)

Notes: The table reports every input to the marginal value of public funds in equation (17) and the quantities assembled from them. All entries in Panel D are measured per dollar of carryback refunds actually paid in 2020-21. In Panel A, ϕ_g discounts at r_g the schedule of deductions that refunded losses would have generated, estimated from pre-policy cohorts as in equation (16). $\hat{\beta}_h$ is the differential gradient in the potential carryback for corporations from equation (3), with the outcome equal to one if the firm is operating, in percentage points per AUD 100,000 of potential carryback. $\hat{\beta}_k^E$ is the differential path from equation (5) with monthly earnings summed across all employers as the outcome, per worker and per dollar of potential carryback, discounted monthly at r_g. $\bar{g}_h$ is the mean company tax payable in AUD at horizon h among matched corporations that are operating, with loss years counted at zero. In Panel B, θ is claimed refund dollars as a share of potential refund dollars and ν the mean of baseline headcount weighted by potential refund. In Panel C, r_g is the yield on 10-year Australian government bonds (OECD, 2026) in March 2022, $\lambda_0 = 0$ credits firms with no value from receiving cash early, and τ_L is the 2021-22 average rate of income tax and Medicare levy, net of the low income and low and middle income tax offsets, for a resident earning twelve times the average monthly pay at eligible corporations (Australian Taxation Office, 2026); it does not include state payroll taxes.

Table 6: The marginal value of public funds under alternative assumptions

	MVPF	Net cost
Baseline: $r_g = 2.5$ percent, $\lambda_0 = 0$, $\tau_L = 0.18$	2.26	0.397
Panel A. Premium on internal funds in the loss year		
$\lambda_0 = 0.10$	2.37	0.397
$\lambda_0 = 0.25$	2.50	0.397
$\lambda_0 = 0.50$	2.67	0.397
Constraint loosening at the small-business lending spread	2.33	0.397
Panel B. Discount rate		
$r_g = 1$ percent	2.36	0.373
$r_g = 5$ percent	2.13	0.433
Panel C. Utilization		
Loss years 2006-07 to 2010-11	2.12	0.445
Highest quartile of the opening loss balance	1.93	0.536
Every refund a grant, $\phi_g = \phi_f = 0$	1.57	0.881
Panel D. Workers' earnings		
Earnings response a transfer from owners	1.09	0.397
No earnings response	1.07	0.480
Firm-level payroll in place of ΔE	6.60	0.242
95 percent lower bound for sum of monthly ΔE	1.41	0.453
Panel E. Tax rate on earnings		
Marginal rate at average pay, $\tau_L = 0.345$	2.56	0.320

Notes: Each row changes one input and holds the rest at the baseline of Table 5. Net cost is per dollar of refunds paid. In Panel A, the first three rows set $\phi_f = \phi_g / (1 + \lambda_0)$, the case of equation (13) in which the constraint is slack whenever the firm has taxable income to deduct against; the fourth sets $(1 + \lambda_s) / (1 + \lambda_0) = (1 + \rho)^{-s}$, where $1 + \rho = 1.0453/1.025$ is the ratio of one plus the average fixed rate on new loans to small businesses (Reserve Bank of Australia, 2026) to one plus r_g, both in March 2022. In Panel B, changing r_g revalues ϕ_g, G and ΔE. In Panel C, the forfeited deductions are valued with the utilization schedule of pre-policy loss years 2006-07 to 2010-11, with the schedule of the highest quartile of the opening balance of unused losses, or at zero. In Panel D, the first row treats ΔE as a transfer from owners to workers, which removes it from the surplus but leaves the tax on it in the net cost; the third replaces ΔE with the cumulative payroll response of equation (4) per dollar paid, discounted at r_g; and the fourth takes the lower end of the 95 percent confidence interval for the cumulative earnings response. Panel E taxes the additional earnings at the 2021-22 marginal rate of income tax and Medicare levy for a resident earning average pay at eligible corporations.

Appendix

A Additional Figures and Tables

Table A.1: The franking account requirement and sample selection

	Carryback eligible	Eligible without franking test
Number of firms	40,520	42,090
Size and age		
Revenue	2,011,347	2,050,670
Employment	9.4	9.9
Payroll	684,539	741,751
Payroll per worker	66,859	66,955
Total assets	1,105,014	1,117,120
Current assets	630,097	634,979
Firm age	12.3	12.5
Profitability		
Taxable income	-116,520	-122,181
Profit margin	-0.021	-0.025
Taxable in prior year	0.438	0.438
Taxable in following year	0.458	0.451
Distributions and the carryback		
Dividends paid	53,682	94,286
Franked dividends, prior year	57,060	83,970
Potential carryback	29,335	28,244
Potential carryback / payroll	0.046	0.046
Share claiming carryback	0.301	0.290
Carryback refund claimed	16,805	16,180

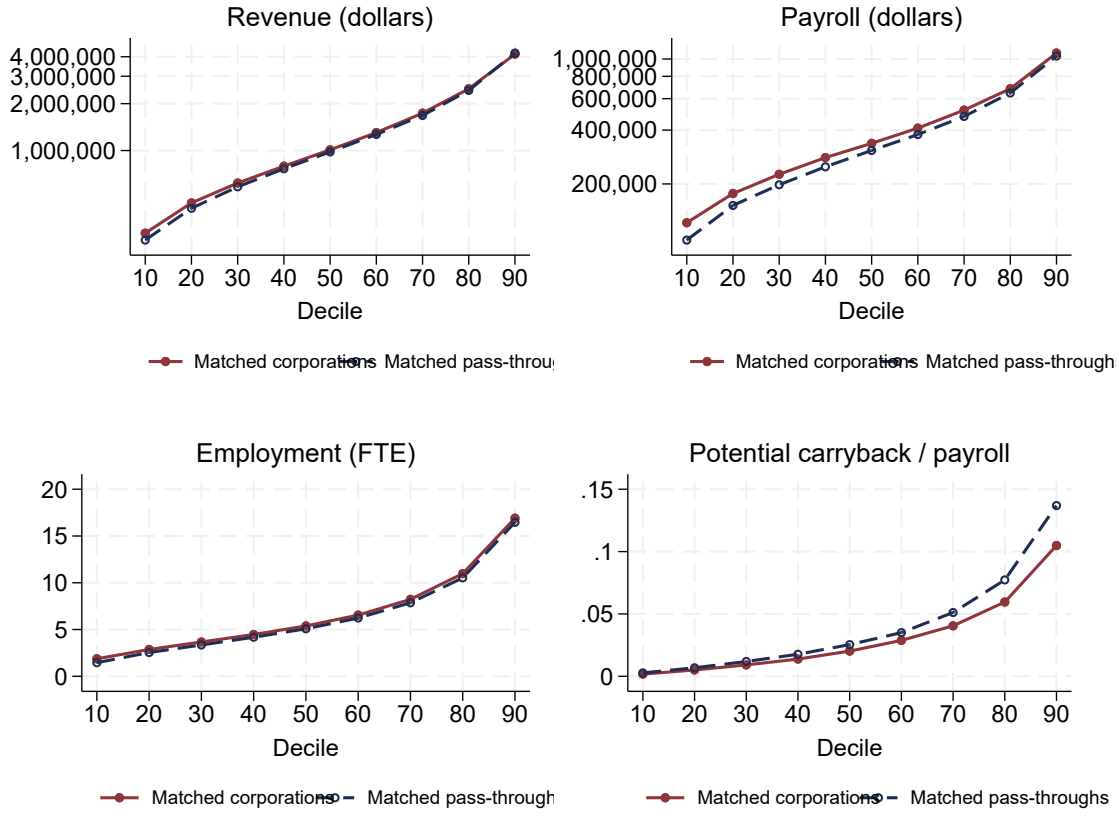
Notes: Columns report means over firms in the 2020–21 income year. The first column is the analysis sample of Section 2: firms with a tax loss in 2020–21, an income tax liability in 2018–19 or 2019–20, and a positive closing franking account balance. The second column drops the last of those conditions and is therefore a superset of the first, so the difference between the two columns is the set of firms the franking requirement excludes. Rows reporting shares are means of indicator variables, and the prior year is 2019–20. Dollar amounts are deflated to 2023 Australian dollars.

Table A.2: Industry and legal form composition of the matched sample

	All eligible corporations (1)	Matched corporations (2)	Matched pass-throughs (3)
Industry (two-digit ANZSIC subdivision)			
01 Agriculture	0.016	0.034	0.034
30 Building Construction	0.054	0.031	0.031
32 Construction Services	0.200	0.162	0.162
42 Other Store-Based Retailing	0.041	0.071	0.071
45 Food and Beverage Services	0.053	0.099	0.099
46 Road Transport	0.036	0.043	0.043
67 Property Operators and Real Estate Services	0.022	0.029	0.029
69 Professional, Scientific and Technical Services	0.106	0.071	0.071
72 Administrative Services	0.045	0.030	0.030
85 Medical and Other Health Care Services	0.033	0.055	0.055
94 Repair and Maintenance	0.039	0.049	0.049
95 Personal and Other Services	0.020	0.028	0.028
Other subdivisions	0.335	0.299	0.299
Total	1.000	1.000	1.000
Legal form			
Company	1.000	1.000	0.000
Individual (sole trader)	0.000	0.000	0.082
Partnership	0.000	0.000	0.110
Trust	0.000	0.000	0.808
Total	1.000	1.000	1.000
Number of firms	40,520	10,540	10,540

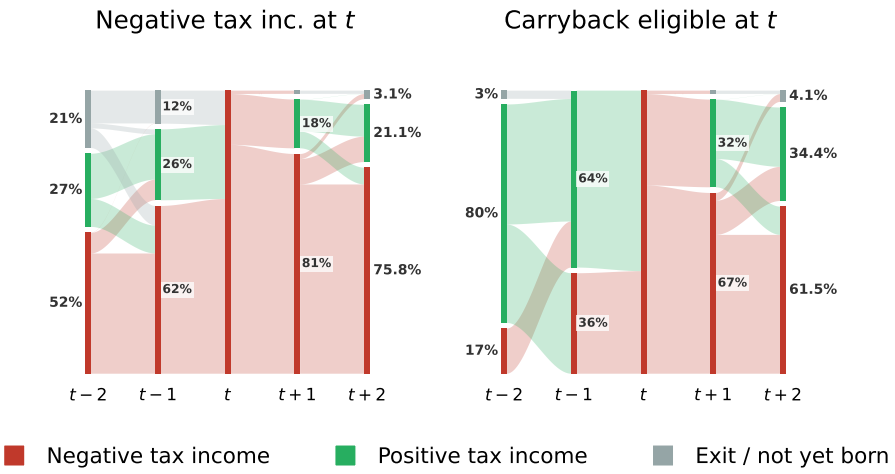
Notes: Entries are shares of firms in 2020-21 and each column sums to one. Column 1 covers every carryback-eligible corporation entering the matching procedure of Section 4; columns 2 and 3 cover the corporations and pass-throughs the procedure pairs. Industries are two-digit subdivisions of the Australian and New Zealand Standard Industrial Classification, 2006 revision 2.0. Subdivisions that fall below the disclosure threshold in any column are collected in the residual row, which is why the listed subdivisions account for two thirds of column 1 and seven tenths of columns 2 and 3. The title of subdivision 69 is shortened from "Professional, Scientific and Technical Services (Except Computer System Design and Related Services)". Columns 2 and 3 agree in every industry row because the matching is exact on the two-digit subdivision; the columns are reported separately so that the exactness can be read off the table. Every firm in columns 1 and 2 is a company by construction. Firm counts are rounded in accordance with the disclosure rules of the ABS DataLab.

Figure A.1: Distributions of size and the potential carryback in the matched sample



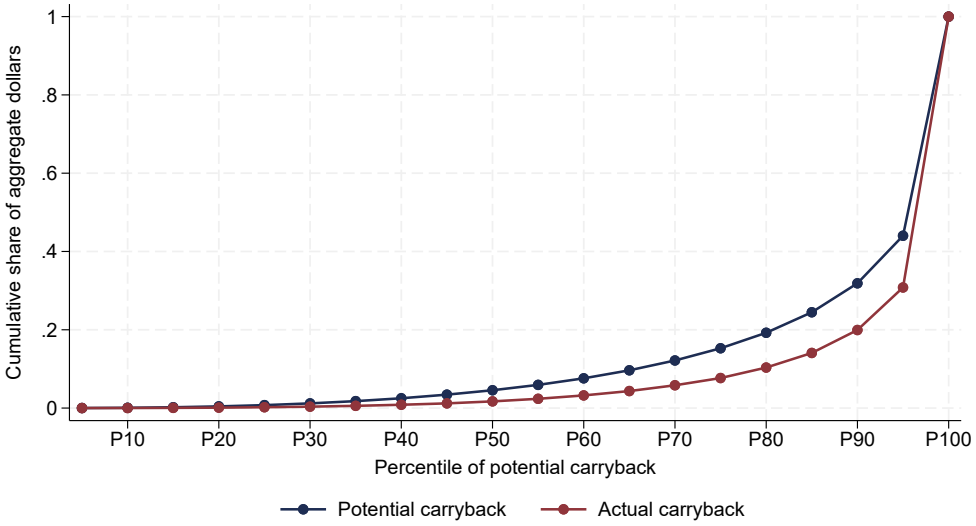
Notes: Each panel plots the tenth to ninetieth percentiles of one variable for the matched corporations and the matched pass-throughs of Table 2, in 2020-21, with the two dollar panels on a logarithmic scale. The potential carryback of a pass-through is its counterfactual refund, and the potential carryback is expressed relative to payroll in the same year. Employment is measured in full-time equivalents; revenue and payroll are in 2023 Australian dollars. Percentiles are computed in the ABS DataLab subject to its minimum-contributor rule.

Figure A.2: Taxable income trajectories around a synthetic 2016–17 loss year



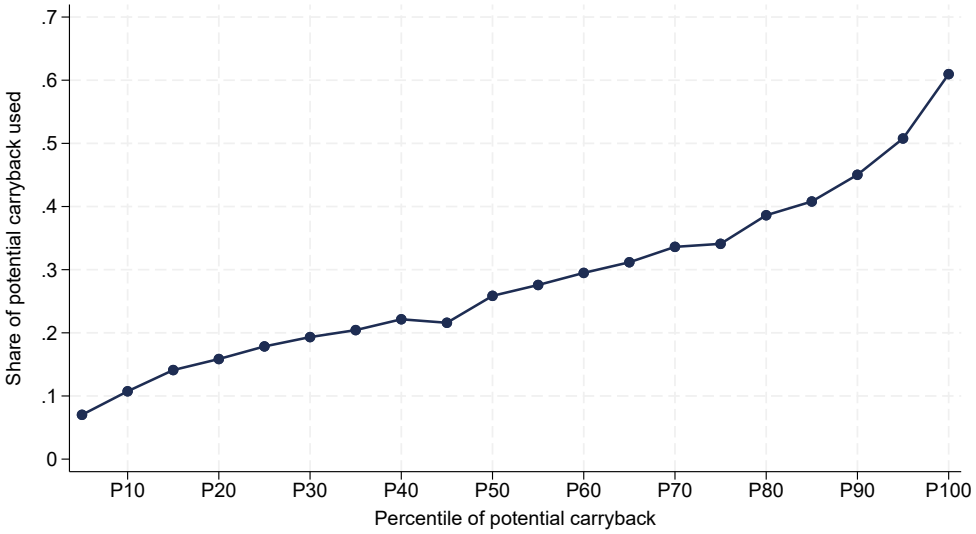
Notes: The 2020–21 carryback rules are applied to the 2016–17 income year, in which no carryback was available, so that eligibility is defined by a loss in 2016–17 together with an income tax liability in 2015–16 or 2014–15 and a positive closing franking account balance. Each panel follows a fixed population of firms defined in that year, denoted t: firms with negative taxable income (left) and the subset that would have been eligible (right). Columns give the share of each population with negative taxable income, positive taxable income, or not operating in each year from $t-2$ to $t+2$, with flows between states shaded. The figure isolates the selection the eligibility criterion induces, since no firm in it received a refund.

Figure A.3: Concentration of aggregate carryback dollars



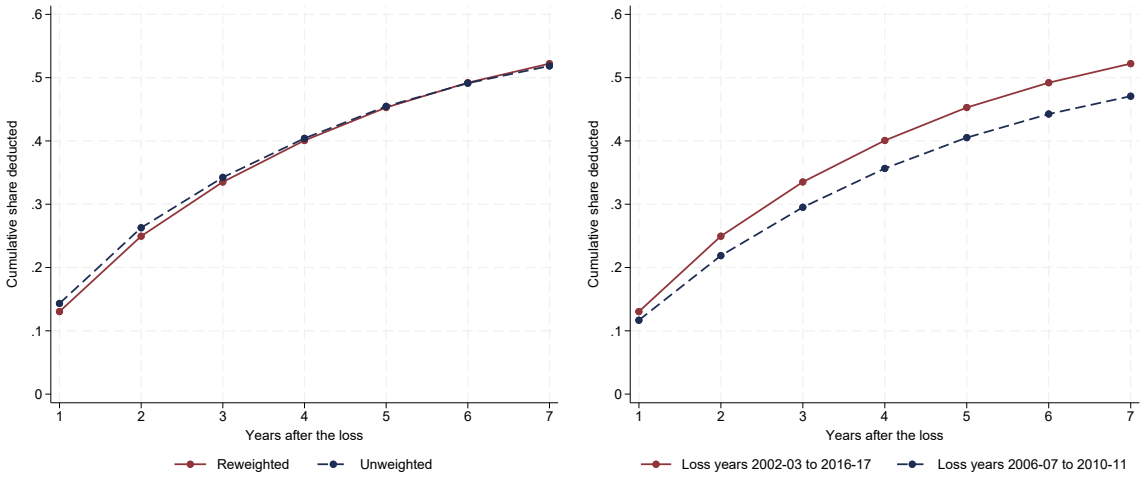
Notes: The sample is firms eligible for a carryback in 2020–21, ranked into ventiles of the potential carryback. The figure plots the cumulative share of aggregate potential and actual carryback dollars accounted for by firms at or below each ventile.

Figure A.4: Share of potential refund dollars used



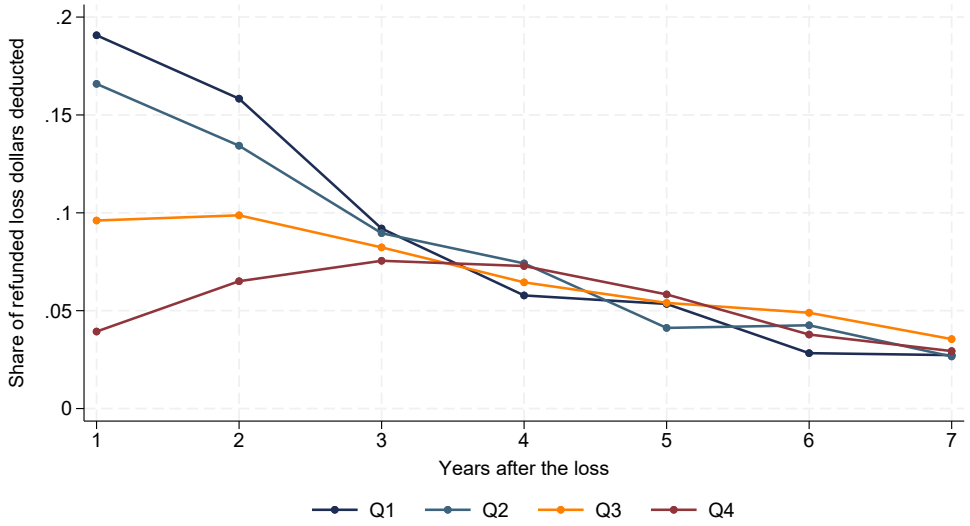
Notes: The sample is firms eligible for a carryback in 2020–21, ranked into ventiles of the potential carryback. The figure plots the mean share of the potential carryback actually claimed within each ventile.

Figure A.5: Utilization without reweighting and in loss years 2006–07 to 2010–11



Notes: The sample is firms that would have been eligible for a carryback in a pre-policy loss year, as in Figure 14. Both panels plot the cumulative share of refunded loss dollars deducted within s years of the loss, weighted by the potential refund. The left panel compares the schedule for loss years 2002–03 to 2016–17, reweighted to the 2020–21 eligible population within cells of two-digit industry, loss size, and the loss relative to taxable income in the two preceding years, with the same schedule without that reweighting. The right panel compares the reweighted schedule for all loss years with the reweighted schedule for loss years 2006–07 to 2010–11. The horizon is truncated at seven years.

Figure A.6: The shape of the utilization schedule by opening balance



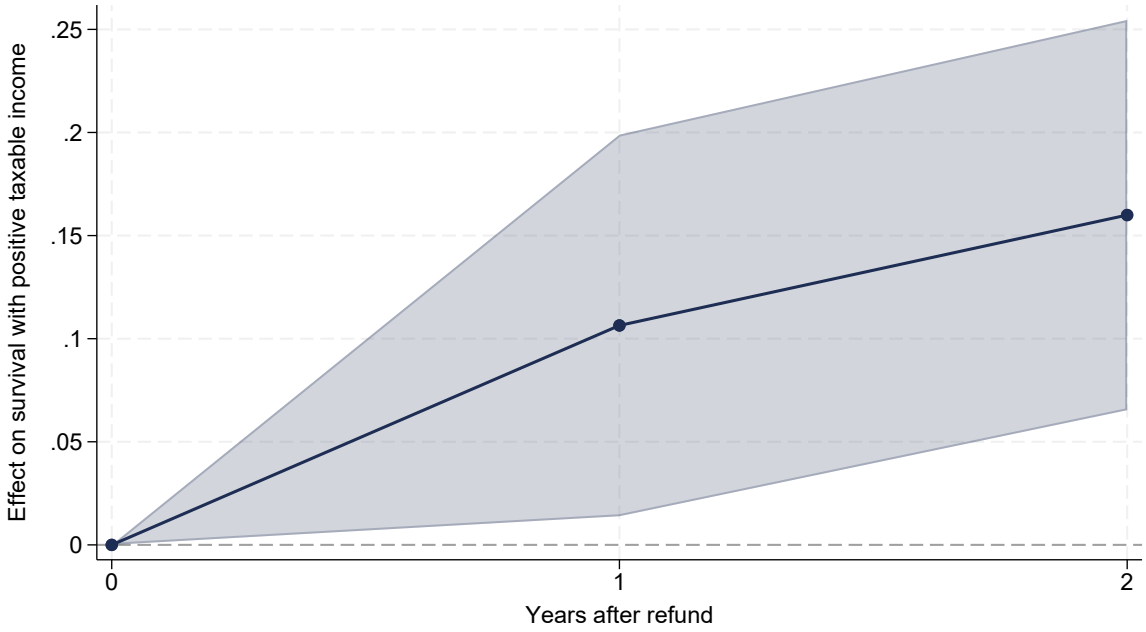
Notes: The figure plots u_s, the share of refunded loss dollars that would have been deducted s years after the loss, separately by quartile of the opening balance of unused losses and without cumulating. The peak moves later as the opening balance rises, which is the queue described in Section 6: a dollar added to an empty stock is deducted at the first opportunity, while the same dollar added behind several years of unused relief waits for the stock ahead of it to clear. Shares are refund-weighted and reweighted to the 2020–21 eligible population.

Table A.3: The counterfactual utilization schedule

	All firms		Quartile of opening balance			
Years after loss	Unweighted	Reweighted	Q1	Q2	Q3	Q4
1	0.143	0.130	0.191	0.166	0.096	0.039
2	0.120	0.119	0.158	0.134	0.099	0.065
3	0.080	0.086	0.092	0.090	0.082	0.075
4	0.062	0.066	0.058	0.074	0.064	0.073
5	0.051	0.052	0.053	0.041	0.054	0.058
6	0.037	0.039	0.028	0.043	0.049	0.038
7	0.027	0.030	0.027	0.027	0.035	0.029
Cumulative, 7 years	0.519	0.522	0.608	0.574	0.480	0.378
Firm-years	96,660	96,660	32,540	15,870	24,430	23,830

Notes: Rows give the share of refunded loss dollars that would have been deducted s years after the loss, constructed as in Appendix B.8, with the seven-year cumulation beneath. The first column is unweighted and the remainder are reweighted to the 2020–21 eligible population within cells of two-digit industry, loss size, and the loss relative to income in the two preceding years. Quartiles are of the opening balance of unused losses, scaled by average taxable income over the three preceding years, and are unequal in size because firms whose loss history precedes the start of the reconstruction are assigned a zero opening balance.

Figure A.7: The effect of carrybacks on survival with positive taxable income



Notes: The figure plots the coefficients β_h from equation (3) with the outcome equal to one only if the firm reports positive payroll and positive taxable income in the year, with 95 percent confidence intervals, estimated on the matched panel of corporations and pass-throughs. Coefficients are in percentage points per AUD 100,000 of potential carryback. The horizon runs to two years, the last for which the outcome is observed. The horizon-zero value is zero by construction and standard errors are clustered by matched cell.

Table A.4: Summary of the monthly event studies

		Mean coefficient		Sum,	Months significant
	Month 16	Months −16 to −1	Months 1 to 16	months 1 to 16	before / after
	(1)	(2)	(3)	(4)	(5)
Payroll	0.096	−0.002	0.048	0.775	2 / 7
	(0.034)				
Employment	2.55	−0.17	1.25	19.97	2 / 1
	(1.28)				
Pay per employee	−3.73	−3.51	2.06	33.01	1 / 3
	(3.00)				
Payroll, retained workers	0.118	0.002	0.061	0.970	0 / 5
	(0.051)				
Payroll, new hires	0.003	−0.002	0.001	0.008	0 / 0
	(0.005)				
Worker earnings	46.55	18.29	82.52	1,320.24	3 / 11
	(26.57)				

Notes: Each row summarizes the differential path β_k for one outcome: equation (4) on the matched panel of corporations and pass-throughs for the firm-level outcomes, and equation (5) for workers' earnings across all employers. Column 1 reports the coefficient sixteen months after the expected refund month, with its standard error in parentheses. Columns 2 and 3 average the coefficients over the sixteen months before and after the expected refund month, and column 4 sums them over the sixteen months after. Column 5 counts the months in which the coefficient is individually distinguishable from zero at the 5 percent level, before and after the expected refund month. Payroll outcomes are dollars of monthly payroll per dollar of potential carryback. Employment is employees paid, pay per employee is dollars of monthly pay per employee, and worker earnings are dollars of monthly earnings per worker, each per AUD 100,000 of potential carryback, of the baseline employer in the case of workers. Payroll to retained workers and to new hires is computed from the worker-linked payroll records and does not sum to total payroll. Standard errors for the firm-level outcomes are clustered by firm.

B Data Appendix

This appendix documents the construction of the analysis data set used throughout the paper. References to numbered BLADE tables follow the Australian Bureau of Statistics *BLADE Modular Product Data Item List, 2001-02 to 2024-25* (released September 2025). Item and label references on the tax return generally come from the 2020-21 company tax return unless otherwise noted.

B.1 Source modules

Table B.1 lists the BLADE modules we draw on. Included in this table are the level at which each measure is reported, in addition to frequency and coverage. Every module is delivered as one file per financial year, indexed by the two-digit time series identifier `tsid`, which records the last two digits of the end year of the financial year. The 2020-21 fiscal year, for example, carries the value 21. Quarterly and monthly files additionally carry `quarter` and `month_actioned`; we collapse these to the financial year for all variables except the payroll series used in the monthly event studies, which we retain at monthly frequency.

B.2 Identifiers, linkage and panel structure

The BLADE data carry two unit identifiers. The de-identified Australian Business Number, `bn`, identifies the tax-filing entity. All of the administrative modules (Tables 4, 5, 6, 7 and 26) are reported at this level. The de-identified economic unit identifier, `id`, identifies the enterprise. A discussion of what constitutes an enterprise is in Section 2. This is the unit at which ABS constructs its business statistics. A third identifier, `bg_id`, identifies the BLADE enterprise group. Entities with a non-missing value of `bg_id` belong to ABS's profiled population, for which unit structure is actively maintained rather than inferred from registration data.

We link `bn` to `id` using the cross-sectional ID to BN Key (Appendix 1 of the data item list), merging on `bn` and `tsid`. The key carries two flags describing the mapping. We drop observations with `one_abn_to_many_tau` = 1, that is, filing entities whose activity ABS splits across more than one economic unit: the tax return and payroll records for such an entity are reported as a single undivided total and cannot be apportioned. We retain observations with `many_abn_to_one_tau` = 1; these are the multi-entity enterprises that motivate the aggregation step in Section B.4. The key also carries a `match` variable describing how each entity was assigned to a unit, ranging from an exact assignment where the enterprise group contains a single unit through to matches on progressively coarser industry classifications.

Table B.1: BLADE modules used in this paper

Module	BLADE table	Reporting unit	Frequency (coverage)	Content used here
Cross-sectional Indicative	Table 1	`bn`, `id`	Quarterly (2001–02 to 2024–25)	Industry (`d_div06`, `x_anzsic06`), legal form (`x_tolo`), institutional sector (`d_sisca08`), state (`x_state`), non-profit and public-sector flags (`x_npi`, `x_sector`), activity status (`x_al_st`), enterprise group (`bg_id`)
Business Activity Statement	Table 4	`bn`	Quarterly and annual (2001–02 to 2024–25)	`turnover`, `capex`, `oexp`, `tot_expenses`, `wages`, `payg_tax_withheld`, `gst_payable`, `exports_amt`
Pay As You Go	Table 5	`bn`	Annual (2001–02 to 2022–23)	Headcount (`hcnt`) and full-time equivalent employment (`fte`)
Business Income Tax	Table 6	`bn`	Annual (2001–02 to 2022–23)	Company, individual, partnership and trust return items; see Table B.3
Single Touch Payroll	Table 7	`bn`	Monthly (2019–20 to 2024–25)	Employees paid (`d_total_payees`), gross payments (`ed_incm_grs`, `ed_pmt_sumry_totl_grs_pmt`), withholding (`ed_tax_wheld_totl`), reference month (`month_actioned`)
Business Birthdate	Table 26	`bn`	Static (1992–93 to 2023–24)	`birth_date`, used to construct firm age
ID to BN Key	Appendix 1	`bn`, `id`	Annual (2001–02 to 2024–25)	`id`, `one_abn_to_many_tau`, `many_abn_to_one_tau`, `match`

Notes: Table numbers refer to the ABS *BLADE Modular Product Data Item List, 2001–02 to 2024–25* (released September 2025). `bn` is a de-identified Australian Business Number; `id` is a de-identified ABS economic unit identifier. We do not use the ABS survey modules (Tables 8–22), the business location, insolvency and intellectual property modules (Tables 23–27 other than Table 26), or the requestable modules (Tables 28–48).

We do not condition on this variable, although the coarser match categories are concentrated among small entities within large groups.

The resulting panel is unbalanced, since entities enter when they first register and lodge and leave when they cease to lodge. We measure survival as in the main text: a firm exits in the first financial year in which it fails at least two of three conditions, namely lodging a business income tax return, lodging a business activity statement, and reporting positive payroll in at least nine of the twelve months.

B.3 Sector and legal-form exclusions

From the cross-sectional Indicative module (Table 1) we drop non-profit institutions, identified by `x_npi` $= 1$, and public-sector entities, identified by `x_sector` $= 2$. We additionally drop entities whose type of legal organization, `x_tolo`, falls in the government ranges: codes 21 to 26 (Commonwealth departments, legislatures and courts, territory municipal authorities, marketing boards, statutory authorities, and other Commonwealth entities), 31 to 36 (state departments, legislatures and courts, marketing boards, local government authorities, other local government, and other state entities), and 41 and 42 (diplomatic and trade missions, other foreign governments). As a cross-check we drop entities whose derived institutional sector, `d_sisca08`, takes the values 3000 (general government), 5000 (non-profit institutions serving households) or 6000 (rest of the world). The three criteria overlap heavily, so applying all three, instead of any one of them, is a conservative choice that costs few genuine operating businesses.

We impose no further restrictions on legal form. The comparison between corporations and pass-throughs requires that trusts (code 9), family and other partnerships (codes 7 and 8) and sole proprietors (code 6) be retained. The corporate population comprises codes 1 through 5, that is, proprietary, limited, proprietary limited, no liability, and other registered companies. In the non-profiled population ABS collapses several of these codes: code 1 is folded into code 3, code 4 into code 2, and code 11 into code 5. We therefore work with the collapsed classification throughout, so that the corporate indicator has a consistent meaning across the profiled and non-profiled populations.

Legal form as recorded on the business register is imperfect, and we cross-check it against the return form each entity actually lodged. BLADE Table 6 carries a separate flag for each of the four return types (`bit_comp_yyyy`, `bit_ind_yyyy`, `bit_part_yyyy`, `bit_trust_yyyy`). We classify an entity as a corporation in a given year if it lodged a company return that year, and fall back on the register's legal form only where no return is observed.

B.4 Aggregation from the filing entity to the firm

Having formed a panel indexed by `bn` × `tsid` and merged in the tax, activity statement, payroll and birth date modules, we collapse to `id` × `tsid`. Table B.2 gives the rule applied to each class of variable. The majority of economic units contain a single filing entity, so these rules bind only for the multi-entity enterprises identified in Section B.2. We have verified that the results in the paper are unchanged if the analysis is run at the filing-entity level on the subsample of single-entity firms.

Table B.2: Aggregation rules from the filing entity to the firm

Rule	Variables	Rationale
Sum across constituents	All dollar flows and stocks from Tables 4 and 6; employment counts `hcnt`, `fte`, `d_total_payees`; carryback amounts and offsets	The enterprise's income, expenses, balance sheet and workforce are the sum of those of its filing entities
Largest constituent	`d_div06`, `x_anzsic06`, `c_anzsic`, `x_tolo`, `x_state`, `x_pcode`	Categorical attributes cannot be summed; we take them from the constituent with the largest total income, falling back on Business Activity Statement turnover where total income is missing
Earliest value	`birth_date`	Firm age is the age of the oldest constituent, which is when the enterprise began operating
Any constituent	`c_bm_sgmt_cd`, `c_base_rt_bus_cd`, `c_sobconin`, form indicators `bit_comp_yyyy` and its analogues, an indicator for having claimed a carryback	Status indicators are set to one if any constituent reports them
Recomputed after aggregation	Statutory tax rate, potential carryback, profit margins, revenue and payroll per worker, leverage, cash-to-assets	Ratios of aggregates rather than aggregates of ratios

Notes: Aggregation is performed within `id` × `tsid` cells. The vast majority of economic units contain a single filing entity, so these rules bind only for the multi-entity enterprises identified by `many_abn_to_one_tau` = 1.

B.5 Variable dictionary

Table B.3 maps each concept used in the paper to the corresponding item on the company income tax return, organized by the panel of the return on which it appears. Label positions shift somewhat across years, but the BLADE variable names are stable, and where a variable was renamed the data item list records both names. Table B.4 gives the corresponding items on the individual, partnership and trust forms. Table B.1 above lists the items taken from the non-tax modules.

Table B.3: Company income tax return items used from BLADE
Table 6

Concept in the paper	BLADE variable	Return label and notes
Panel A. Identifiers and firm characteristics		
Filing entity	`bn`	De-identified Australian Business Number
Financial year	`tsid`	Last two digits of the end year; 2020–21 = 21
Company form indicator	`bit_comp_yyyy`	Set to 1 where a company return exists; analogous flags `bit_ind_yyyy`, `bit_part_yyyy`, `bit_trust_yyyy` identify the three pass-through forms
Industry	`c_anzsic`	ANZSIC code reported on the return
Small business entity	`c_bm_sgmt_cd`	Item 3, label F1; code 5 = yes
Base rate entity	`c_base_rt_bus_cd`	Item 3, label F2; code 5 = yes. Determines the reduced rate from 2017–18
Consolidation status	`c_sobconin`	Item 3, labels Z1–Z2; head company or subsidiary member of a consolidated group
Significant global entity	`c_clnt_glbl_ent_typ_cd`	Item 3, label G1
Aggregated turnover	`c_agrgtd_tnovr_amt`	Item 8, label Y. Used for the $5 billion carryback eligibility test and the base rate entity threshold
Panel B. Income statement (item 6)		

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Table B.3, continued

Concept in the paper	BLADE variable	Return label and notes
Sales	`c_sales`	Other sales of goods and services, label C
Interest income	`c_grosintr`	Gross interest, label F
Rent and leasing income	`c_grosrent`	Gross rent and other leasing and hiring income, label G
Dividends received	`c_grosdivd`	Total dividends, label H
Government industry payments	`c_govind`	Assessable government industry payments, label Q. Captures JobKeeper and cash-flow boost receipts
Total income	`c_totlinc`	Label S
Cost of sales	`c_costsale`	Label A (expenses)
Contractor and commission expenses	`c_extnlabr`	Label C (expenses)
Superannuation expenses	`c_superann`	Label D (expenses)
Rent and lease expenses	`c_rentexps`, `c_leaexpau`, `c_leaexpos`	Labels H, F and I (expenses)
Interest expenses	`c_intexpau`, `c_intexpos`	Labels V and J (expenses)
Depreciation expenses	`c_deprexps`	Label X (expenses)
Total expenses	`c_totlexps`	Label Q (expenses)
Accounting profit	`c_toprolos`	Total profit or loss, label T
Operating profit	`c_oproloss`	Operating profit or loss
Panel C. Balance sheet (item 8)		
Opening and closing stock	`c_opnstock`, `c_clostock`	Labels A and B

continued on next page

Table B.3, continued

Concept in the paper	BLADE variable	Return label and notes
Trade debtors and creditors	`c_debtors`, `c_creditrs`	Labels C and F
Current and total assets	`c_currasst`, `c_totlasst`	Labels D and E
Current and total liabilities	`c_currliab`, `c_totlliab`	Labels G and H
Total debt	`c_totl_debt_amt`	Label J
Shareholders' funds	`c_sharhold`	
Total wage bill	`c_totlwage`	Total salary and wage expenses, label D (expenses)
Cash proxy	`c_currasst` − `c_debtors` − `c_clostock`	Cash is not reported; we net inventories and receivables out of current assets
Panel D. Reconciliation to taxable income (item 7)		
Net capital gain	`c_ncg_amt`	Label A
Exempt income	`c_exemptax`	Label V (expenses)
Non-deductible exempt income expenditure	`c_nondedex`	Label U. Netted against `c_exemptax` to form net exempt income
Non-deductible expenses	`c_non_ddctbl_expnss_amt`	Label W
Tax losses deducted	`c_ddctd_tl_amt`	Label R (expenses)
Tax losses transferred in	`c_forgn_fincl_ent_tl_tfrd_in_amt`	Label S (expenses)
Taxable income or loss	`c_taxinc`	Label T (expenses). Negative in loss years
Tax losses carried forward	`c_tlcf_amt`	Item 13, label U

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Table B.3, continued

Concept in the paper	BLADE variable	Return label and notes
Net capital losses carried forward	`c_nlcf_amt`	Item 13, label V
Panel E. Calculation statement		
Taxable or net income	`c_taxicalc`	Label A
Tax on taxable income	`c_taxti`	Label T1. Numerator of the implied statutory rate
Gross tax	`c_grstx`	Label B
Non-refundable offsets	`c_nonrfnblencfto`, `c_nonrfnblefcfto`	Labels C and D
Refundable tax offsets	`c_rfnbltaxo`	Label E. Contains the loss carryback offset
Tax payable	`c_subt5`	Label T5
PAYG instalments raised	`c_pygis_rsd_amt`	Label K
Amount due or refundable	`c_tax_pybl_or_rfndbl_totl_amt`	Label S
Panel F. Imputation and distributions (item 8)		
Franked dividends paid	`c_divfrank`	Label J
Unfranked dividends paid	`c_divufran`	Label K
Franking credits received	`c_divs_fcr_amt`	Item 7, label J
Opening franking account balance	`c_div_frnkg_acnt_opng_bal_amt`	Label P

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Table B.3, continued

Concept in the paper	BLADE variable	Return label and notes
Closing franking account balance	`c_div_frnkg_acnt_closg_bal_amt`	Appears only from 2021–22; `c_franbalc` (label M) is the closing balance for 2020–21 and every earlier year and caps the carryback refund
Excess franking offsets	`c_divs_frnkg_tax_ofsts_excs_amt`	Label H (expenses)
Panel G. Loss carryback items (2020–21 to 2022–23 returns, item 13)		
Loss carried back, by pairing	`c_fy_`Y_L`_to_fy_`Y_G`_tax_lss_cba`	One variable for each of the ten admissible loss-year Y_L to gain-year Y_G pairings; see Table B.6
Corporate tax rate in the loss year	`c_fy_2020_tax_rt`, `c_fy_2021_tax_rt`, `c_fy_2022_tax_rt`	Reported to four decimal places
Net exempt income of the gain year	`c_fy_`Y_G`_net_exmt_incm_amt`	Available for $Y_G \in \{2018\text{–}19, \ldots, 2021\text{–}22\}$
Income tax liability of the gain year	`c_fy_`Y_G`_it_lblty_amt`	Caps the offset attributable to that gain year
Loss carryback tax offset	`c_lss_crry_bck_to_amt`, `c_lss_crry_bck_to`	Item 13, label S. The refund actually claimed
Early balancer items	`c_chsnyrtaxlssbckerlyyramt`, `c_chsnmdyrntutlstxlsbckerlyyramt`, `c_erlyst_yr_net_exmt_incm_amt`, `c_erlyst_yr_it_lblty_amt`	Used by substituted-accounting-period filers in place of the year-specific labels
Panel H. Investment incentives (items 9 and 10)		
Temporary full expensing deduction	`c_tfe_bus_ddctn_amt`	Item 9, label S
Instant asset write-off	`c_wrt_off_dtl_itm_amt`	Item 9, label O

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Table B.3, continued

Concept in the paper	BLADE variable	Return label and notes
Backing business investment deductions	`c_frst_yr_ast_dprtn_bbi_ddctn_to`, `c_sbsq_yr_ast_dprtn_bbi_ddctn_to`	Item 9, labels M and N
Depreciating assets first deducted	`c_intdepas`, `c_othdepas`	Item 9, labels A and B

Table B.4: Corresponding items on the pass-through return forms

Concept	Individual form	Partnership form	Trust form
Form indicator	bit_ind_yyyy	bit_part_yyyy	bit_trust_yyyy
Industry	i_anzsic	p_anzsic	—
Cost of sales	i_costsale	p_costsale	—
Total expenses	i_totlexps	p_totlexps	—
Total wage bill	i_totlwage	p_totlwage	—
Depreciation	i_deprexps	p_deprexps	—
Trade debtors	i_debtors	p_debtors	—
Total assets	—	p_totlasst	—
Total liabilities	—	p_totlliab	—
Net income or loss	i_netincls, i_ntinnpp	p_netilbus	t_netilbus
Net Australian income or loss	—	p_ausn_incm_or_lss_net_amt	t_ausn_incm_or_lss_net_amt
Total net income or loss	—	p_incm_or_lss_net_totl_amt	t_incm_or_lss_net_totl_amt
Aggregated turnover	—	p_agrgtd_tnovr_amt	t_agrgtd_tnovr_amt
Tax losses deducted	—	—	t_ddctd_tl_amt
Tax losses carried forward	—	—	t_tlcf_amt
Temporary full expensing	i_tfe_bus_ddctn_amt	p_bus_ddctn_amt	—

Notes: The pass-through forms are considerably less detailed than the company form; in particular none of the three reports a calculation statement, a franking account, or any loss carryback item, since pass-through entities were statutorily ineligible for the carryback. Where a balance sheet item is unavailable on the individual or trust form we fall back on the Business Activity Statement equivalents from BLADE Table 4. A dash indicates that no corresponding item exists on that form.

B.6 Derived variable: the statutory tax rate

Let τ_{it} denote the statutory corporate tax rate facing firm i in year t. Our preferred measure is the rate implied by the return itself, the ratio of tax charged on taxable income to taxable income:

$$\hat{\tau}_{it} \;=\; \frac{\texttt{c_taxti}_{it}}{\texttt{c_taxinc}_{it}}.$$

We accept $\hat{\tau}_{it}$ as the statutory rate when taxable income is strictly positive and $\hat{\tau}_{it}$ lies within 0.001 of one of the two rates in force in year t, as listed in Table B.5.

This constructed ratio is either unavailable or uninformative in three cases. The ratio is undefined when taxable income is zero or negative, which by construction is true in the loss years that matter most for the carryback calculation. The ratio is also contaminated when the firm is taxed under one of the special schedules, since life insurance companies, retirement savings account providers, pooled development funds, credit unions, and not-for-profit companies each face a different structure, and in the not-for-profit and credit union cases the schedule is not even proportional. Finally, the ratio is occasionally implausible for reasons we cannot diagnose, presumably reflecting amendments and reporting error. In each case we impute the rate from Table B.5 using the firm's own reported status: `c_base_rt_bus_cd` (code 5 indicates a base rate entity) for 2017-18 onward, and `c_bm_sgmt_cd` (code 5 indi-

cates a small business entity) for 2015-16 and 2016-17, in each case checking the reported status against aggregated turnover, `c_agrgtd_tnovr_amt`, and the threshold in force that year. For years through 2014-15 the rate was a flat 30 percent and no imputation is required. Where the status indicator is itself missing we assign the reduced rate if aggregated turnover is below the threshold and the standard rate otherwise.

From 2017-18 the reduced rate applies to base rate entities, which are defined both by a turnover threshold and by the requirement that no more than 80 percent of assessable income be passive income, which comprises dividends and the franking credits attached to them, royalties, rent, interest, gains on qualifying securities, and net capital gains. Because turnover alone does not determine the rate, we prefer the implied rate wherever it is available, and the imputation relies on the firm's own reported base rate entity status rather than reconstructing the passive income test from the income items on the return.

Table B.5: Statutory company tax rates used for imputation

Income year	Reduced-rate concept	Turnover threshold	Rate: reduced / standard
2001–02 to 2014–15	—	—	30% / 30%
2015–16	Small business entity	\$2m	28.5% / 30%
2016–17	Small business entity	\$10m	27.5% / 30%
2017–18	Base rate entity	\$25m	27.5% / 30%
2018–19	Base rate entity	\$50m	27.5% / 30%
2019–20	Base rate entity	\$50m	27.5% / 30%
2020–21	Base rate entity	\$50m	26.0% / 30%
2021–22	Base rate entity	\$50m	25.0% / 30%
2022–23	Base rate entity	\$50m	25.0% / 30%

Notes: Rates are published by the Australian Taxation Office. From 2017–18 the reduced rate applies to base rate entities, defined as companies with aggregated turnover below the threshold and with no more than 80% of assessable income classified as base rate entity passive income; for 2015–16 and 2016–17 it applied to small business entities. Special rates apply to life insurance companies, retirement savings account providers, pooled development funds, credit unions and not-for-profit companies; firms whose implied rate matches one of these schedules are flagged and, in the case of not-for-profit companies, dropped at the sample selection stage. We use `c_base_rt_bus_cd` (code 5 = base rate entity) from 2017–18 and `c_bm_sgmt_cd` (code 5 = small business entity) for 2015–16 and 2016–17, checking each against `c_agrgtd_tnovr_amt`.

B.7 Derived variable: the potential carryback

The carryback items on the tax return are populated only for firms that actually claimed a carryback refund. To measure the refund available to a firm that did not claim, which is the object of interest throughout the paper, we reconstruct the refund available under the statute from the firm's own reported history.

B.7.1 Notation and inputs

For firm i and income year t, define the following, all measured after aggregation to the firm level and before deflation.

- TI_{it}, taxable income or loss (`c_taxinc`), which is negative in loss years.
- $L_{it} = \max\{0, -TI_{it}\}$, the tax loss of the year.
- $E_{it} = \max\{0, X_{it} - Z_{it}\}$, net exempt income, where X_{it} is exempt income (`c_exemptax`) and Z_{it} is non-deductible exempt income expenditure (`c_nondedex`).
- T_{it}, the income tax liability of the year: tax on taxable income (`c_taxti`), label T1 of the calculation statement.
- τ_{it}, the statutory rate constructed in Appendix B.6.
- F_{it}, the closing franking account balance (`c_div_frnkg_acnt_closg_bal_amt`), which the return carries only from 2021–22; the closing balance is reported as `c_franbalc` for 2020–21 and every earlier year, which is the variable the cap uses throughout our analysis.
- Ω_{it}, an indicator for statutory eligibility, equal to one if aggregated turnover (`c_agrgtd_tnovr_amt`) is below \$5 billion, the entity lodged a company return (`bit_comp_yyyy` $= 1$), and $F_{it} > 0$.

We use net exempt income rather than gross exempt income because the carryback statute requires the loss carried back to a year to be reduced by that year's net exempt income to the extent it has not already been absorbed; the return reports exempt income and the associated non-deductible expenditure separately, and their difference is the relevant quantity. Similarly, we use tax on taxable income rather than tax payable as the income tax liability of the gain year, because tax payable is net of offsets already applied and would understate the pool of prior-year tax available for refund. Finally, the franking cap binds at the end of the claim year, not of the loss year, so a firm that paid large franked dividends between the profitable year and the claim has less carryback capacity than its profit history alone would suggest.

B.7.2 The calculation

Table B.6 lists the admissible pairings of a loss year with an earlier profitable year, together with the order in which we apply the loss and the rate at which it is valued. Consider a firm claiming on its 2020-21 return in respect of a 2020-21 loss, the leading case in our analysis.

Write $\ell_0 = L_{i,2021}$ for the loss, and let the ordered list of gain years be (2020, 2019), denoting the 2019-20 and 2018-19 income years by their end years. The loss is applied sequentially:

$$a_{i,2020} = \min\Big\{\max\{\ell_0 - E_{i,2020},\, 0\},\ \max\{TI_{i,2020},\, 0\}\Big\}, \tag{18}$$

$$\ell_1 = \max\Big\{\ell_0 - E_{i,2020} - a_{i,2020},\ 0\Big\}, \tag{19}$$

$$a_{i,2019} = \min\Big\{\max\{\ell_1 - E_{i,2019},\, 0\},\ \max\{TI_{i,2019},\, 0\}\Big\}. \tag{20}$$

That is, the loss is first reduced by the net exempt income of the year it is being carried back to, then applied against that year's taxable income up to the amount of that taxable income. Whatever remains is carried to the next year, where we repeat the operation. The potential refund is the sum of the amounts so applied, valued at the loss-year rate and capped year by year at the income tax liability actually incurred in the gain year, with a final cap at the franking account balance:

$$P_{i,2021} \;=\; \Omega_{i,2021} \cdot \min\left\{ \sum_{s \in \{2020,\,2019\}} \min\big\{\tau_{i,2021}\, a_{i,s},\ T_{i,s}\big\},\ \ F_{i,2021} \right\}. \tag{21}$$

Equation (21) follows the statute at every step. The rate is that of the loss year, not of the year the loss is carried back to, so a 2020-21 loss carried into a year taxed at 27.5 percent is nonetheless refunded at the 2020-21 rate. The liability cap applies separately to each gain year, so a large loss cannot recover more from a given year than the tax that year generated. Finally, the franking cap applies to the total, after summing across gain years.

The same construction is applied to the other claim years in Table B.6, extending the ordered list of gain years accordingly. Three accounting details arise once more than one loss year can be carried into the same gain year. First, a firm with losses in both 2019-20 and 2020-21 could claim in respect of both on its 2020-21 return; we apply the earlier loss year first, then reduce the remaining taxable income and remaining income tax liability of each gain year by the amounts already absorbed, so that no dollar of prior-year tax is refunded twice. Second, once a firm has actually claimed in an earlier year, the taxable income and liability of the gain years are depleted for the purposes of any subsequent claim; we carry this depletion forward using observed claim amounts where a claim was made and our own imputed amounts otherwise. Third, a loss cannot be carried back if it has already been deducted against income in an intervening year, so we net `c_ddctd_tl_amt` out of the loss pool before applying the calculation, and check the residual against tax losses carried forward, `c_tlcf_amt`.

B.7.3 Substituted accounting periods

A small number of companies do not balance on 30 June. For these early and late balancers the return does not carry the year-specific carryback labels but a generic set instead: the loss chosen to be carried back to the earliest year, the corresponding amount for any middle year, and the net exempt income and income tax liability of the earliest year. These are the four early balancer items listed in Panel G of Table B.3. We apply the same algorithm to these firms, using the balancing date reported on the return to map their accounting period to our financial-year convention, and we flag these firms so that the results can be re-estimated without them.

B.7.4 Validation against observed claims

The reconstruction can be checked directly on the subsample of firms that did claim, for whom the true refund is reported. Regressing the constructed potential carryback $P_{i,2021}$ on the refund actually claimed, `c_lss_crry_bck_to_amt`, among claimants yields a coefficient of 0.988, with a standard error of 0.0164 and an R^2 of 0.977. The near-unit slope and very high fit reflect two facts. Take-up operates almost entirely on the extensive margin, since a firm that claims at all claims essentially the whole of what is available to it, so the observed refund and the potential carryback coincide for claimants. In addition, our implementation of the statutory formula reproduces the statutory refund itself, and this second fact is what justifies using the constructed variable for the much larger population of non-claimants. The residual variation is concentrated among firms with substituted accounting periods and among consolidated groups whose head company reports on behalf of subsidiaries.

Table B.6: Admissible loss-year to gain-year pairings and the order of application

Claim year (return lodged)	Loss year Y_L	Gain years Y_G, in order of application	Rate applied
2020–21	2019–20	2018–19	$\tau_{i,2019\text{–}20}$
	2020–21	2019–20, then 2018–19	$\tau_{i,2020\text{–}21}$
2021–22	2021–22	2020–21, then 2019–20, then 2018–19	$\tau_{i,2021\text{–}22}$
2022–23	2022–23	2021–22, then 2020–21, then 2019–20, then 2018–19	$\tau_{i,2022\text{–}23}$

Notes: A firm lodging its 2020–21 return could claim in respect of a 2019–20 loss, a 2020–21 loss, or both; losses incurred in 2019–20 could not be claimed until the 2020–21 return was lodged. The statute imposes no ordering requirement across gain years, but applying the loss to the most recent profitable year first weakly maximizes the refund because the income tax liability of nearer years is more likely to remain unabsorbed, and it matches the order in which claims are in fact reported. When more than one loss year is carried back to the same gain year we apply the earlier loss year first and reduce the remaining taxable income and income tax liability of that gain year accordingly, so that no dollar of prior-year tax is refunded twice. Each pairing corresponds to a distinct BLADE variable of the form `c_fy_`Y_L`_to_fy_`Y_G`_tax_lss_cba`, where years are labeled by their end year.

B.8 Derived variable: the counterfactual utilization schedule

This section documents the construction of our measure of the rate at which refunded losses would have been deducted had they been carried forward, discussed in Section 6 Two items the calculation needs are unavailable over most of the period the calculation requires: tax losses carried forward appear on the company return only from 2019-20, and tax losses deducted only from 2012-13. We therefore reconstruct the stock of unused losses directly from other items in the tax returns.

In particular we simulate the stock from flows. For each firm we run a balance forward from 2002-03, adding the loss of each year and subtracting the deduction the simulation assigns to it, the smaller of the balance and the year's taxable income before loss deductions, with the balance floored at zero. Taxable income before loss deductions is taxable income (`c_taxinc`) plus prior-year tax losses deducted (`c_ddctd_tl_amt`), floored at zero and set to zero after exit. The return reports losses deducted only from 2012-13, and for earlier years we impute them. The balance omits any unused relief the firm had accumulated before 2002-03, so it understates the opening stock by an amount that shrinks as the accumulation lengthens.

The schedule itself is the difference between two runs of this balance. In the first the firm carries its whole loss forward; in the second the balance begins with the carried-back slice removed. Both runs face the same path of taxable income before loss deductions and the same later losses, and in each year the firm deducts the smaller of its accumulated balance and that income. Differencing makes the schedule marginal rather than average: a firm with ample later income exhausts its balance under either run, so the whole slice would have been deducted, while a firm whose later income never exhausts the balance that remains without the slice deducts the same amount in both runs, so the slice would never have been used. Later losses belong in both balances because they compete for the same income, so a firm that loses money again shelters that income whether or not the carryback occurred.

Firms that cease to operate report no taxable income and deduct nothing in either run, so exit requires no separate treatment. Because losses are pooled rather than tracked by vintage, we need no assumption about the order in which vintages are relieved, since the government forgoes total deductions and the change in total deductions depends only on the balance.

The opening balance used for the quartile split is the reconstructed stock at the end of the year preceding the loss, scaled by the firm's average taxable income over the three preceding years. Firms whose entire loss history precedes 2002-03 are assigned an opening balance of zero by construction, and fall in the lowest quartile alongside firms that genuinely carry no unused relief. That quartile's utilization rate is therefore an upper bound, so the

gradient across quartiles in Section 6 should be read as a lower bound on the true one.

The reweighting cells interact two-digit ANZSIC industry (`c_anzsic`), the absolute size of the loss in logarithmic bins, and the loss relative to taxable income in the two preceding years in thirteen bins between 0.01 and 50. The weight on a pre-policy firm-cohort is constant within its cell and equal to the cell's share of 2020-21 potential refund dollars divided by its share of potential refund dollars among the pre-policy cohorts.

The refund is paid at the tax rate of the loss year while the deduction it displaces is valued at the rate of the year it would have been taken, and we have verified that valuing the schedule at the deduction-year rate rather than the loss-year rate changes it negligibly, because refund dollars are concentrated among firms facing the standard rate throughout. Table A.3 reports the schedule in full and undiscounted, so that any discount rate can be applied without re-estimation.

B.9 Sample selection

The employment and revenue screens are applied at the level of the firm rather than the firm-year: a firm that satisfies the condition in any pair of consecutive years is retained for its entire spell in the panel. Screening firm-years would drop the observations in which a firm's employment or revenue collapsed, which is the outcome we are trying to measure. Employment is headcount from the withholding module, supplemented from 2019-20 by the count of employees paid in the monthly payroll module; where the two disagree we use the withholding measure for the annual screens and the payroll measure for the monthly analysis. Revenue is total sales from the activity statement module, deflated to 2023 dollars.

B.10 Cross-country classification of loss carrybacks

Figure 1 classifies 236 jurisdictions: those in the corporate tax rate data compiled by Enache (2025), together with ten that those data omit: North Korea, the Marshall Islands, Palau, Tuvalu, Western Sahara and the five French overseas departments. Counts of countries refer to the 195 jurisdictions that the UN boundary data record as states, other than the Holy See, which no tax source covers. We code three indicators for each jurisdiction.

A jurisdiction is coded as taxing corporate income if it levies a general corporate income tax in 2025. The fifteen jurisdictions that Enache (2025) list without one are coded as not taxing corporate income, including the six that apply a 15 percent minimum tax to large multinational groups from 2025 under the OECD Pillar Two rules and the two that tax only oil or petroleum companies. So is the Marshall Islands, which taxes gross revenue rather than profit. Kuwait, which taxes only foreign corporate bodies, and North Korea, which

taxes the profits of foreign-invested enterprises at 25 percent, are coded as taxing corporate income, as are Palau, which introduced a business profits tax in 2023, Tuvalu and Somalia.

A jurisdiction is coded as having a permanent carryback if a general loss carryback, legislated without a sunset, was in force at any point since 2000. Provisions limited to small and medium-sized companies, as in Japan and Korea, count, as do capped provisions and provisions since repealed, as in the United States and Chile. Provisions that apply only on the cessation of a business, or only to long-term construction contracts, mining or petroleum, do not count. Nor does a provision in force for a single year, or a sequence of temporary measures: Australia, whose 2012-13 carryback was repealed with effect from the following year, is coded as having no permanent carryback. Distributed-profits taxes, under which no annual loss is computed, and the Swedish tax allocation reserve, which defers taxable profit rather than refunding tax, are also coded as having none, although Mengden (2026) records them as carrybacks.

A jurisdiction is coded as having used a carryback as crisis policy if a measure enacted between 2001 and 2022 in response to the 2001 recession, the global financial crisis or the COVID-19 pandemic introduced a carryback or temporarily lengthened its period, raised its cap, widened eligibility or accelerated its refunds. France and Ireland are coded on the strength of accelerated refunds alone. Table B.7 lists the provisions behind every country with a permanent or crisis carryback.

Both carryback indicators draw on the Tax Foundation surveys of loss provisions in Europe (Locher, 2021; Mengden, 2026) and the OECD (Asen, 2021), the data underlying its International Tax Competitiveness Index for 2014 to 2025 (Tax Foundation, 2025), the OECD survey of loss provisions after the global financial crisis (OECD, 2011) as reproduced by Business Tax Working Group (2012), the survey of carryback measures in 2020 by WTS Global (2020), and PwC (2026), supplemented by national sources for individual measures. Coverage is complete for OECD members. Elsewhere it rests on these compilations and on targeted searches, so a measure in a smaller economy that was never reported in English could be missing.

The boundaries are the UN Geodata simplified (United Nations Geospatial, 2023), generalized from the 1:25 million UN Geodata and drawn in the Eckert IV projection. Kosovo, which the layer draws within Serbia, and Wallis and Futuna, which it omits, have no carryback. Areas whose status the UN records as undetermined are left unclassified, whatever code the layer assigns them, as are the Holy See and ten small territories that no tax source covers. The French overseas departments and the Åland Islands take the classification of France and Finland, whose corporate taxes apply there. Guam, the Northern Mariana Islands and the US Virgin Islands, whose income taxes mirror the US Internal Revenue Code,

take that of the United States, and Western Sahara takes that of Morocco.

Table B.7: Permanent and crisis loss carrybacks since 2000

Country	Permanent carryback	Crisis measures
Australia	None. A one-year carryback for 2012–13 losses, intended to become permanent, was repealed with effect from 2013–14	Refundable offset for companies with turnover below AUD 5 billion, claimed in 2020–21 to 2022–23 returns
Austria	None	2020 losses carried back to 2019 (EUR 5 million) and then 2018 (EUR 2 million)
Belgium	None	One-off carryback of the estimated 2020 loss against the preceding year's profit, through an exempt reserve
Canada	Three years	None
Chile	Losses absorbed retained taxable profits, refunding the tax paid on them; abolished in 2017	None
Czech Republic	Two years, CZK 30 million cap, from 2020	Permanent provision introduced in 2020 as COVID-19 relief
France	One year, EUR 1 million cap; reduced from three years by 2012	Immediate refund of carryback credits, 2008 and 2020
Germany	One year, EUR 1 million cap; two years from 2022	Cap raised to EUR 10 million for 2020 and 2021 losses
Iceland	None	Expected 2020 losses offset against tax on 2019 income, up to ISK 20 million
Ireland	One year	Interim claims for up to 50 percent of estimated 2020 trading losses
Japan	One year; suspended since 1992 except for new small firms, on dissolution and, from 2009, for companies with capital of JPY 100 million or less	2009: suspension lifted for companies with capital of JPY 100 million or less. Fiscal years ending February 2020 to January 2022: extended to capital of JPY 1 billion or less
Korea	One year, small and medium-sized companies	2020: early refund on first-half losses. Tax years including 31 December 2021: two years. Both for small and medium-sized companies
Malaysia	None	2009 and 2010 losses carried back one year, RM 100,000 cap
Netherlands	One year	2009–2011 losses: three years, capped at EUR 10 million per year. 2020: estimated losses set against 2019 profit through a reserve
New Zealand	None	2019–20 and 2020–21 losses, including anticipated losses, set against the preceding year's income
Norway	None; carryback only on cessation of a business	2008 and 2009 losses: two years, NOK 20 million cap per year. 2020 losses up to NOK 30 million carried back to 2018 and 2019
Poland	None	2020 losses carried back to 2019, PLN 5 million cap, for firms whose revenue fell by at least half
Singapore	One year, SGD 100,000 cap	Budget 2009: three years, SGD 200,000 cap. 2020 losses: three years
United Kingdom	One year; three years on cessation of trade	2008 and 2009 losses: three years, GBP 50,000 cap. Periods ending April 2020 to March 2022: three years, GBP 2 million cap on the two earlier years
United States	Two years until 2017	2001 and 2002 losses: five years. 2008 and 2009 losses: up to five years. 2018 to 2020 losses: five years

Notes: The table lists every country with a permanent or crisis carryback in Figure 1. Among territories, the Isle of Man allows a one-year carryback, and Puerto Rico allowed 2020 losses of up to USD 200,000 to be carried back two years by firms with gross revenue below USD 10 million. Caps apply to the loss