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The Value of a Loss: The Impact of Restricting Tax Loss Transfers*

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Abstract

This paper examines the economic consequences of anti-loss trafficking rules, which disallow the use of tax loss carry-forwards after a substantial change in ownership or activity. Using staggered changes to anti-loss trafficking rules across EU28 Member States and Norway from 1998 to 2019 in a stacked-cohort difference in difference design, we find that limiting the transfer of tax losses leads to a 22% decrease in the volume of mergers and acquisitions in targets that are more likely to have tax loss carry-forwards. M&As related to profitable targets are not affected, confirming the tax channel mechanism. We further study the broader economic effects of anti-loss trafficking rules: we observe decreases in birth and survival rates of young companies in response to stricter regulations and vice versa. Our findings further suggest that tighter (looser) anti-loss trafficking rules impair (increase) firms' return on assets, especially for R&D intensive firms. Furthermore, a 22% decrease in successful patent applications in case of tighter rules suggests that limiting the transferability of losses affects innovative activity.

JEL classification: G34, G38, H25

Keywords: Mergers and acquisitions, anti-loss trafficking rules, taxes, market entry, market exit, productivity, innovation

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1 Introduction

In 2008, bids for the struggling US bank Wachovia increased more than seven-fold within days after a limitation on the transfer of tax losses was temporarily suspended (Choi et al., 2019). The suspension allowed the acquiring firm to use Wachovia's tax loss carry-forwards (LCF) post-acquisition to generate considerable tax savings. This anecdote suggests that tax savings in the target may be a pivotal determinant of M&A transactions. However, there is only scarce evidence of how limitations on the transfer of tax losses affect aggregate M&A activity and whether there exist consequent repercussions on firms' entry and exit decisions, risk-taking, and innovation. This paper aims to address this gap. This is a highly relevant question because most major economies (including the U.S. and many European countries) have implemented rules that restrict tax loss transfers in corporate takeovers. These regulations are at the risk of distorting the M&A market, which is an essential driver for economic growth (David, 2021). M&A activities can significantly shape industry productivity, both directly by influencing the combined equity value of the target and acquiring firms (e.g., Bradley et al., 1988; Morck et al., 1990; Devos et al., 2009; Li, 2013), and indirectly by influencing entry and exit decisions in anticipation of future M&A deals (Dimopoulos and Sacchetto, 2017).

Typically, countries treat losses asymmetrically for tax purposes. Profits are subject to taxation, whereas losses do not immediately result in a tax refund; they must be carried over to the past (loss carry-back, LCB) or future (LCF). Anti-loss trafficking rules determine the extent to which targets' intertemporal losses can be used to reduce taxable income after takeover. If taxable losses can be transferred without limitation, profitable buyers can acquire loss-making targets and use their losses as tax shields to reduce their corporate tax burden (Auerbach and Reishus, 1988). Anti-loss trafficking rules aim to protect government revenues and prevent tax-driven transactions by restricting the use of acquired losses when there are substantial changes in ownership and/or activity.¹ Whether these rules are desirable for economic value creation is not clear ex-ante. Theoretically, they can hinder or foster the realization of synergies in M&As, which depends on whether the value of tax losses outweighs potential synergy gains (Erickson et al., 2019) and with that on which type of firms are affected.²

If the transfer of accumulated losses is restricted when ownership changes, the tax asset does not carry value for the acquirer. This reduces the price the acquirer is willing to pay for the target but not the reservation price of the seller, which can affect the decision to buy a target. Anecdotal evidence indicates that enforcing or loosening anti-loss trafficking rules substantially affects M&A transaction values. The

¹Substantial changes in ownership are often defined as ownership changes above 50% of equity or changes in control. Changes in activity can be tied to financial statement figures or target markets or a general reference that often provides considerable room for interpretation.

²See section 3.1 and the example calculations in footnotes 10 and 11 for a detailed argument for why tax loss trafficking rules can increase or decrease pre-tax synergies in M&As.

Wachovia example introduced above is one among several, showing how the ability to utilize the target's tax assets can shape the probability of a deal and the final value.³ In fact, companies actively use net operating loss poison pills to reduce the likelihood of being taken over as the ownership change would trigger anti-loss trafficking rules (Sikes et al., 2014a). First, we hypothesize that anti-loss trafficking rules can affect the probability of a deal taking place as offer and reservation prices diverge. Second, changes in the probability of deals taking place will have broader economic consequences for industry dynamics.

Despite some anecdotal evidence, there has been no systematic examination of the importance of tax loss transfer restrictions as a barrier to M&A activity and related economic outcomes. The lack of comprehensive institutional data – in conjunction with a lack of proper “within country” counterfactuals – has posed a significant challenge for empirical analysis in this area. To address this issue, we hand-collect detailed information from tax guides and national tax codes of EU28 Member States and Norway⁴ to generate a comprehensive dataset of anti-loss trafficking rules in place from 1998 to 2019. We identify 17 changes in legislation during this period, where the rules were tightened eight times and relaxed nine times. The large number of changes allows us to select treatments for our analysis that do not coincide with other economic events (the 2008 financial crisis) and that occur in countries with sufficient coverage of M&A deals in our sample.

We adopt a stacked cohort difference-in-differences (DiD) research design, relying on the timing differences in these reforms to evaluate the economic consequences of restricting the transfer of losses across countries. This provides us with control groups, which we would lack in a within-country approach, enabling us to identify the treatment effect of this type of regulation (in additional tests, we exploit within-country variation in deal and industry). Due to the staggered implementation of these legislative changes over the sample period and a comprehensive set of control variables, our empirical identification resembles a quasi-experiment similar to the one in Baugh et al. (2018) or Fuest et al. (2018). Additionally, we use entropy-balancing matching in all our specifications to ensure the comparability of treatment and control groups.

We begin our study by investigating the effect of anti-loss trafficking rules on the market for corporate control, looking at deal volumes. For this purpose, we combine our hand-collected institutional information with micro-level data from Zephyr, covering over 214,000 M&A deals in the EU28 Member States and Norway. Using a DiD strategy, we find that anti-loss trafficking rules reduce the number of deals with loss-making targets by about -22% on average. The effect is almost symmetric when differentiating between introducing or tightening (-32%) or loosening of regulations (+28%). We do not find an effect when running a placebo test on M&As with profitable targets, which provides reassurance that the observed

³For additional examples collected from the news and court cases, please refer to Appendix C.

⁴See Bührle and Spengel, 2020 for details of the regulatory framework.

treatment effect on M&As with loss-making targets is indeed due to changes in the anti-loss trafficking regulation.

Having established a direct effect of anti-loss trafficking rules on M&A activity, we proceed by studying the broader economic consequences of such rules, that is, consequences on firm entry and exit, industry-level productivity, and innovation. In our initial tests, we showed that loss firms are significantly less likely to be M&A targets in the presence of strict anti-loss trafficking regulations. Whether this change in the M&A activity improves or deteriorates capital allocation is not clear ex-ante, as anti-loss trafficking rules may affect both persistently unproductive loss firms and firms for which losses are an inherent part of their life-cycle such as start-ups or R&D-intensive firms investing in innovation. The theoretical model of Dimopoulos and Sacchetto (2017) suggests that firms' entry and exit decisions are affected by their anticipation of potentially being acquired. On the one hand, loosening anti-loss trafficking rules might thus induce unproductive firms to stay alive due to the value of the loss tax shield. This can lead to overinvestment in line with existing evidence on reducing the asymmetric treatment of losses and profits in Bethmann et al. (2018) and Olbert (2022). Additionally, M&A deals motivated primarily by the value of the target's tax shield may crowd out other potential deals with inherent synergy gains in a 'search and matching' M&A market. A lack of anti-loss trafficking rules would thereby stifle productivity and innovation as it inhibits those firms which rely on a well-functioning M&A market. On the other hand, loosening of anti-loss trafficking rules may encourage (technology and R&D) start-up formation and survival and innovation as it increases the net present value of the loss-making investment scenarios due to the loss tax shield being transferable. It also facilitates changes in ownership which are necessary for scaling up and relaxing the financial constraints of growth firms without having to forfeit tax-deductible accumulated losses.⁵ Hence, looser regulation can lead to more competition which induces even more technology investments by incumbents (McGowan et al., 2017), generating positive spillovers to the whole industry. In general, firms may exhibit less risk-averse behavior if anti-loss trafficking rules are loose, which would be in line with evidence on LCB and LCF increasing investment (Ljungqvist et al., 2017; Langenmayr and Lester, 2018).

To study the impact of anti-loss trafficking rules on young firm entry and exit rates, we rely on industry-country-level data from Eurostat's business demography statistics and employ an industry-level stacked cohort DiD analysis with industry-country and industry-year fixed effects. Hence, differences in entry and exit rates due to industry trends and time-invariant industry-country characteristics are eliminated precluding the possibility that the findings are due to general industry trends. The specification allows a within-industry comparison of the effect of a change in anti-loss trafficking rules between industries in

⁵Put another way, the loss of the tax shield may outweigh the synergy gains from an acquisition (Erickson et al., 2019).

treated countries and counterfactual industries from the same industry year in non-treated countries. We measure firm birth rate as the percentage of new enterprises relative to the population of active enterprises and firm survival rate as the ratio of surviving entrants to all entrants in that age group. On average, we find a significant reduction in firm birth rates of -0.7 percentage points relative to all active firms and a decrease in survival rates of about -2 percentage points for young firms relative to all entrants of that age group.

We study industry-wide productivity effects by aggregating firm-level measures for the whole population of EU firms (i.e., public and private) from Orbis for the years 1998-2019 at the industry level. As just above, we employ an industry-level DiD analysis and include industry-country and industry-year fixed effects. To capture mean industry productivity, we use the mean return on assets of that industry weighted by sales in the industry. We find that a tightening of anti-loss trafficking rules results in an 0.04 percentage point decrease in productivity. In line with our expectation that especially R&D-intensive firms are inhibited, this effect is more pronounced in R&D-intensive industries.

To corroborate this channel further, we study if, in particular, investments in innovations, i.e., risky investments, are affected. We proxy for innovative investment by granted patent applications. In line with our expectation, we detect an average change in patent applications by 22% in the years after the change in legislation, which is mainly driven by a decrease in patent applications when anti-loss trafficking rules are tighter. This result is in line with our productivity findings and suggests that firms decrease risky and productivity-enhancing investments if the possibility to carry-over losses in case of a takeover is limited.

We run several robustness checks to validate the assumptions used in our approach. We carefully check that no other local events⁶ may cause both changes in anti-loss trafficking rules and changes in firm behavior, establishing a spurious correlation between taxes and firm performance or M&A activity. In Figure 6, we show that local economic shocks, measured by GDP trends and trade trends pre-reform, do not evoke the introduction or changes of anti-loss trafficking rules. Nevertheless, to ensure that economic conditions between control countries are comparable to treated countries in our sample, we run all our estimations in a sample that is entropy-balanced on the level of pre-treatment GDP and trade between treated and control countries. Finally, the event study figures support that treatment and control groups follow parallel trends before the treatment.

This paper contributes to the literature on the determinants of M&A activity and its effects on corporate decisions. Prior studies by, e.g., Rossi and Volpin (2004); Erel et al. (2012); John et al. (2015); Cao et al. (2019); Dessaint et al. (2017) show that economic and institutional factors such as international

⁶We discuss possible confounding events in the appendix D and control for these possible confounding factors in all our regressions (this includes controlling for changes in tax LCF and LCB legislation and corporate tax rate changes).

trade integration, financial reporting quality, political uncertainty, and regulations on shareholder and employment protection can substantially shape the market for corporate control. We shed light on the impact of tax-related incentives on takeovers and how they shape market structure and corporate investments. Prior research indicates that taxes affect the decision to acquire a target (e.g., Di Giovanni, 2005; Arulampalam et al., 2019; Huizinga and Voget, 2009; Meier and Smith, 2020) and deal values (e.g., Kaplan, 1989; Ayers et al., 2003; Huizinga et al., 2012; Hayn, 1989). When considering the effect of limiting the transfer of losses for tax purposes, empirical evidence so far suggests that it affects the market value of listed corporations (Moore and Pruitt, 1987). We offer first evidence on the broader economic outcomes of restricting and loosening anti-loss trafficking rules. In particular, we provide novel empirical evidence of the analytical results from Dimopoulos and Sacchetto (2017) by showing that shocks to the volume of takeovers have not only direct effects on aggregated economic outcomes generated by potential post-deal synergies but also indirect effects coming from changes in targets' expectations of possible future buyers.

We also add to the literature on behavioral responses to tax policy. Previous literature shows that taxes influence investment decisions (e.g., Heider and Ljungqvist, 2015; Giroud and Rauh, 2019; Djankov et al., 2010). The results of our study shed light on possible unintended consequences of preventing abusive behavior by restricting the transfer of losses for tax purposes. Several studies show that managers take real actions to preserve the value of tax losses (e.g., Maydew, 1997; Erickson et al., 2013; Erickson and Heitzman, 2010; Sikes et al., 2014b). Research shows that more generous tax loss rules stimulate risky investment (Ljungqvist et al., 2017; Langenmayr and Lester, 2018; Armstrong et al., 2019; Bührle, 2021), while Bethmann et al. (2018) and Olbert (2022) provide evidence that they might also encourage poorly performing businesses to over-invest. Our paper complements prior studies by documenting that limiting the benefits from tax losses can shape the probability of being acquired, in line with Auerbach and Reishus (1988), and have far-reaching consequences on overall industry performance.

Finally, our results have important policy implications. The COVID-19 crisis resulted in a massive negative economic shock and triggered unprecedented quick policy responses from governments around the world.⁷ Among the variety of measures introduced, tax incentives represented valuable tools to mitigate the immediate liquidity crunch firms and households were experiencing. Fiscal measures can alleviate potential long-term economic crises resulting from the temporary shutdown of corporate activities and the widespread travel and mobility restrictions (Collier et al., 2020). To support economic growth, it may be most effective to implement measures that particularly target young and innovative companies. Specifically, one important policy tool at the disposal of governments around the world is to change the

⁷OECD (10 June 2020), Evaluating the initial impact of COVID-19 containment measures on economic activity, available at: https://read.oecd-ilibrary.org/view/?ref=126_126496-evgsi2gmqj&title=Evaluating_the_initial_impact_of_COVID-19_containment_measures_on_economic_activity.

rules related to tax loss deductions.⁸ Besides increasing the generosity of the LCB, relaxing the restrictions on the transfer of tax losses in case of substantial changes in ownership could be considered after the Covid crisis. We test the economic consequences of such a policy tool on the market for corporate control and industry-wide productivity and innovation. We find that looser regulations stimulate the M&A market and lead to more enterprise births, increased entrant survival, higher productivity, and more patent applications. In this way, our study timely informs policymakers on the desirability of restricting the transfer of tax losses in times of crisis recovery when part of the economy is profitable again. Profitable acquirers could then find loss targets more attractive if LCFs are transferable in takeovers.

The remainder of this paper is organized as follows. Section 2 provides the institutional background. Section 3 develops the hypotheses. Section 4 presents the research design, including the empirical strategy, the data, and sample selection. Section 5 describes the main results and robustness checks. Section 6 concludes.

2 Institutional background

If losses cannot be used to reduce profits incurred from other activities in the same period, they must be carried over to the past (LCBs) or future (LCFs). Changes in ownership or activity can activate anti-loss trafficking rules, resulting in the forfeiture of accumulated LCFs. Without these rules, unprofitable corporations with high LCFs can be bought and merged with profitable companies to benefit from the tax loss shield. Anti-loss trafficking rules assume abuse blanketly based on codified criteria.

Most European countries have implemented anti-loss trafficking rules. We observe 17 introductions or changes in legislation over our sample period. The reasons for the introduction of anti-loss trafficking regulations are often idiosyncratic and out of the public eye involving very low media coverage. Reasons for loosening of regulation are similarly idiosyncratic. We identify two trends over time: On the one hand, more countries introduced anti-loss trafficking rules over the years. On the other hand, existing regulations became less restrictive, i.e., the bar for losses to be denied after a transaction was set higher. Regulations are usually introduced or tightened out of the political desire to protect tax revenue, along with the general trend towards stronger anti-abuse legislation in different areas of taxation during the last decades. We also observe other exogenous reasons that require changes in legislation. E.g., the German Federal Constitutional Court ruled parts of the regulations as unconstitutional, forcing the German legislator to adjust the law.⁹ Importantly, we do not find any indication of anti-loss trafficking legislation being

⁸See KPMG (14 October 2020), OECD Government and institution measures in response to COVID-19, available at: <https://home.kpmg/xx/en/home/insights/2020/04/oecd-government-and-institution-measures-in-response-to-covid.html> [Accessed 27 May 2022].

⁹Duttiné, T. (May 2017), German Federal Constitutional Court decides that German loss forfeiture rule is unconstitutional, available at <https://www.nortonrosefulbright.com/en-mh/knowledge/publications/d767331c/german-federal-constitutional->

implemented or changed in response to the local economic climate in our sample. Figure 6 shows no pre-trend in GDP or international trade running up to changes in these regulations.

The tax loss transfer restrictions commonly require a substantial change in ownership or activity as triggers; the definition of these criteria depends on national legislation. For our analysis, we assess whether changes in legislation result in looser or tighter regulations. We thus rank regulations according to the following dimensions (by increasing strictness). Cumulative regulations require a change in ownership and a connected change in activity. If there is either only a change in ownership or only a change in activity, this type of restriction is not triggered. Alternatively, rules can mandate the forfeiture of losses after a change in activity independent of any changes at the ownership level. A third type of anti-abuse regulation relies solely on a change in ownership. Fourth, countries can relate their loss transfer restrictions to either a change in ownership or a change in activity; the fulfillment of either criterion is sufficient. We consider regulations that depend solely on a change in ownership or activity to be more restrictive than those that only take effect when both occur simultaneously. Table 1 provides an overview of the different categories ranked by strictness. Newly introduced (abolished) anti-loss trafficking regimes always constitute a tightening (loosening) in legislation. If the legislator adjusts an existing ownership-based regime by adding a cumulative activity criterion, we define the change as a loosening in legislation. Vice versa, if the activity criterion is omitted, and the anti-loss trafficking rule relies on changes in ownership only, legislation has been tightened.

Some countries use escape clauses to exempt certain cases. These exceptions vary by country and include reorganizations within groups, quoted companies, availability of hidden reserves, and providing compelling economic reasons to tax authorities. The burden of proof of non-abuse rests upon the taxpayer.¹⁰

3 Hypothesis development

3.1 Tax loss transfer and M&A activity

The transferability of losses from the target to the acquirer can play an important role in determining the success of an M&A, as tax losses constitute valuable assets (Hayn, 1989). If losses can be utilized to lower the tax liability, they can increase the acquirer's willingness to pay (Auerbach and Reishus, 1988). However, if the ownership change causes the accumulated losses to be non-deductible for tax purposes, the tax asset loses its value for the acquirer, reducing her willingness to pay. The seller's reservation price does not change, as the losses remain with the target until the M&A deal takes place. Only if the

court-decides-that-german-loss-forfeiture-rule-is-unconstitutional [Accessed 4 July 2023].

¹⁰We control for escape clauses in our analysis. For more details on the institutional background, refer to Appendix B.

expected non-tax synergies are sufficiently high for the acquirer will the deal still be conducted (Sikes et al., 2014a).

Absent anti-loss trafficking rules, purely tax-driven M&A transactions may occur since, with no limitation on the transfer of losses, even M&As with negative pre-tax synergies can be attractive for firms as long as the value of the losses to the acquirer is sufficiently high.¹¹ Thus, despite negative pre-tax synergies, the combined company can generate a larger after-tax income from the merger. However, anti-loss trafficking rules can also apply to acquisitions that are not tax-driven by putting a wedge between buyers and targets reservation prices, inhibiting the realization of synergies.¹²

We expect that the deal volume in a country is reduced in response to the introduction or tightening of anti-loss trafficking rules. Only if the expected synergies are sufficiently high for the acquirer deals will still be conducted. Whether deals that are prevented due to anti-loss trafficking legislation are purely tax-driven is not clear ex-ante. We therefore broaden our analysis and investigate the consequences of inhibited M&A activity at the industry level.

3.2 Tax loss transfer, industry dynamics, and productivity

The size, timing, and uncertainty of tax payments and deductions can create distortions in the expected profitability and valuation of a project, making taxes a critical determinant of corporate decisions (Blouin et al., 2021). For example, from previous literature, we know that changes to corporate tax rates shape industry dynamics, like the entry and exit of firms and investment decisions (Hanlon and Heitzman, 2010; Jacob, 2022). Moreover, the asymmetric treatment of losses and profits in most tax systems around the world has been shown to impact firm behavior. Relaxing the asymmetric treatment of tax losses has been found to encourage risky investments (Ljungqvist et al., 2017; Langenmayr and Lester, 2018; Armstrong et al., 2019; Bührle, 2021), affect firm performance (Olbert, 2022) and stimulate innovation (Guceri, 2020). Hillmann and Jacob (2022) show that, on the other hand, time limits on the use of LCFs

¹¹This can be shown on a simple numerical example taken with slight adaption from Erickson et al., 2019 (Erickson et al., 2019 generalize this example in a parsimonious model in their appendix): Assume a target with \$100 in usable net operating losses (NOLs) and poor future economic outlook that expects to generate \$ 60 in net present value terms. Let the tax rate be 50%. If the corporation stays independent, it will generate taxable income of \$0. While after-tax profits will be \$60, pre-tax income will be too small to use all its NOLs. Now, assume a buyer without NOLs with future taxable income of \$80 and consequently after-tax income of \$40. The combined after-tax income pre-merger is, therefore \$100. In case of no limitations on NOL use, the acquisition would lead to an increase of combined pre-tax income of \$ 140 and after-tax income to \$ 120 ($\$80 + \$60 - (\$80 + \$60 - \$100) * 0.5$), if there are no synergies generated from the merger. Even if we assume negative synergies, i.e., value destruction, of -\$20, the combined after-tax income would be \$110 ($\$120 - (\$120 - \$100) * 0.5$).

¹²We can show this again in a simple numerical example which is taken with slight adaption from Erickson et al., 2019, who generalize this example in a parsimonious model in their appendix: Suppose a target has NOLs in amount of \$100 and can use after a merger only 30% (\$30) of such. Further, assume that the merger will generate synergies of \$20. The combined pre-tax income of the target and acquirer as standalone firms shall be \$140. It will then be increased to \$160 due to the merger. Nevertheless, the merger is not beneficial, as the combined after-tax income of the target and acquirer pre-merger would be \$100 ($\$60 + \$80 - (\$80 * 0.5)$), while after merger the NOLs will be lost and therefore combined after-tax income will reduce to \$95 ($\$160 - (\$160 - \$30) * 0.5$).

increase investment by loss-making firms, especially among those firms that can quickly generate profits to use the time-limited LCF.

So far, we know little about how limiting the transfer of losses in case of ownership change affects industry dynamics. Anti-loss trafficking rules put a wedge between buyers' and targets' reservation prices, affecting a firm's chances of future involvement in takeovers. As highlighted in section 3.1 above, this can lead to the forfeiture of pre-tax synergies or prevent purely tax-driven transactions. Following Dimopoulos and Sacchetto (2017), a decrease in the probability of future mergers is likely to alter industry dynamics by affecting young firm entry and exit rates. Specifically, a lower likelihood of mergers could lead to a decrease in entry rates and an increase in exit rates. In the context of anti-loss trafficking rules, stricter rules reduce future after-tax cash flow in case of change of ownership since accumulated net operating losses can no longer be deducted from future profits.

On the one hand, this can lead to an improvement in capital allocation by discouraging unproductive firms from staying alive absent the financial incentives from the tax benefits. Vice versa, loosening of anti-loss trafficking rules might induce less productive firms to overinvest (ex-ante) and could foster the continued survival of losers (ex-post). On the other hand, stricter anti-tax loss trafficking rules can lead to a deterioration of capital allocation. The forfeiture of LCFs is particularly painful for 'idiosyncratic-loss' firms like innovative start-ups, which face financial constraints due to limited collateral. Relaxing the financial constraints of developing firms and scaling these firms up frequently requires substantial changes in the set of owners. However, the value of the firm decreases markedly if the previously incurred losses are no longer tax deductible after the ownership change, thereby increasing the likelihood that the firm remains on a smaller-than-optimal growth path or that it is discontinued altogether. As capital providers anticipate these frictions, some firms will not even be founded in the first place.¹³ Moreover, investing in innovative and risky projects may require several years before generating profits. Hence, if entrepreneurs consider future tax loss shields in their decision-making process regarding market entry and exit, stricter anti-loss trafficking rules will discourage the birth of firms and might jeopardize the survival of innovative start-ups. This has immediate economy-wide consequences on productivity and innovation. Vice versa, loosening anti-tax loss trafficking rules can stimulate more technology investments and start-up entry. This will also put incumbents under pressure to innovate and, overall, increase industry productivity. For example, Bena and Li (2014) shows that mergers in R&D intensive firms generate synergies that lead to increased technological outputs.

Thus, ex-ante, it is unclear whether anti-loss trafficking rules improve or deteriorate capital allocation and, subsequently, whether they affect industry productivity and innovation.

¹³Firm entry can be affected without founders knowing about the existence of anti-loss trafficking rules because it suffices for financially savvy capital providers to be aware of the effect of anti-loss trafficking rules on targets' market values.

4 Empirical strategy

4.1 Data

Data on anti-loss trafficking rules: We hand-collected information on anti-loss trafficking rules across the EU28 Member States and Norway using the IBFD tax research platform as well as the respective country's tax code for the years 1998-2019. In 2019, 20 of the EU28 Member States had anti-loss trafficking rules, as visible in Figure 1, with substantial variation in design across countries (Bührle and Spengel, 2020). Overall, we observe a total of 17 changes in legislation in eleven countries (see Table 2 in the appendix). Regulations were tightened eight times and relaxed nine times. The number of changes exploited in each regression can differ. However, we exclude any reform which occurred two years before or after the financial crisis in 2008 (i.e., 2006-2010) as unobserved factors would dominate our outcome variables, such as M&A activity and productivity, in an extremely heterogeneous manner. Furthermore, the sample horizon in the industry-level regressions is constrained by data availability.¹⁴

Data on M&A deals: We collect data on M&A deals from Zephyr over the years 1998-2019 in the EU28 Member States and Norway disregarding countries without M&A activity (less than one M&A per year on average). To account for the applicability of anti-loss trafficking rules, we consider all M&As with non-listed targets, in which more than 50% of the firm change ownership. We have a total of about 214,000 M&A transactions across our sample period. For the purpose of our analysis, we aggregate deals at the country-year level.

In panel (a) of Figure 2, we plot for reforming countries the development of M&A deals involving loss-making targets around the change in legislation. We normalize coefficients to the year before the change and only include country and year fixed effects to show the basic time trends in the data. The graph indicates a clear and significant decrease in M&A activity following changes in anti-loss trafficking rules. We take this as initial evidence in support of our hypothesis that the restrictions prevent M&A transactions. In our main analysis, we formally test the hypothesis in a saturated DiD specification in section 5.1.

Data on industry dynamics: We gather data on firm births and survival rates for the years 2004-2019 from Eurostat's Business Demography Database.¹⁵ From this data set, we obtain data on the birth and survival rate for the total population of firms in each EU country aggregated by industry-country-year (at the NACE 2-digit level). Firms with zero employees are disregarded.

Data on productivity: To study the effects of anti-loss trafficking regulation on overall industry pro-

¹⁴The data on entry and exit start in 2004. The analysis of granted patents ends in 2015 due to data availability.

¹⁵For more information on the data, see Eurostat (2022), Eurostat Data Browser, available online at https://ec.europa.eu/eurostat/databrowser/view/bd_9bd_sz_cl_r2/default/tablelang=en.

ductivity, we construct an industry-country panel for the whole population of EU firms combining data from Orbis for the years 1998-2019, gathering information from discs 2008-2019. We begin our sample by selecting all firms located in the EU28 Member States and Norway and obtain financial statement information at the unconsolidated level. We exclude companies from financial and extracting industries or with negative total assets, employees, sales, or tangible fixed assets. Finally, we calculate the sales-weighted average ROA at the industry-country-year level, where the industry is the 2-digit NACE, if the average is based on at least 50 firms.

Panel (b) of Figure 2 depicts the time trends of productivity (proxied by sales-weighted industry ROA) in reforming countries differentiating between industries with high and low R&D intensity. We again normalize coefficients to the year before a change in anti-loss trafficking rules and only include country and year fixed effects as basic controls. The graph shows a clear decline in productivity after changes in legislation for highly R&D intensive industries. This suggests that strict anti-loss trafficking rules impair industry productivity, especially in industries where high development costs and initial losses are to be expected. We do not find a similar pattern in low R&D industries. We provide stringent tests in a complete DiD in section 5.3.

Data on patent activity: To better identify effects on industry innovation, we combine the Orbis data with Patstat for the period 1998 to 2015 by matching patent publication numbers, focusing on patents filed with the European Patent Office.¹⁶ We aggregate the number of granted patents at the industry-country level based on the date of first application (instead of the grant date). If a patent has been filed by several companies, we count one full patent for each company.¹⁷

Data on control variables: The control variables are collected from various sources. Macro data on GDP, inflation, trade, and value-added are taken from the World Bank.¹⁸ Population data stems from the United Nations.¹⁹ Moreover, we obtain statutory corporate tax rates²⁰ and an indicator for EU membership from the European Commission²¹. Finally, we collect the audit and reporting quality indicators from the Global Competitiveness Report conducted by the World Economic Forum.²²

All continuous variables are winsorized at the 1% and 99%-level. We present the summary statistics for all variables in Table 3.

¹⁶The analysis of granted patents ends in 2015 due to data availability.

¹⁷Filing by more than one company occurs in 7% of observations.

¹⁸The World Bank data are available at <https://databank.worldbank.org/source/world-development-indicators>

¹⁹The United Nation data are available at <https://population.un.org/dataportal/home>

²⁰The EU Commission data on corporate tax rates are available at https://taxation-customs.ec.europa.eu/taxation-1/economic-analysis-taxation/economic-studies_en

²¹The EU commission data on EU membership are available at https://neighbourhood-enlargement.ec.europa.eu/enlargement-policy/6-27-members_en

²²The World Economic Forum data are available at <https://www.weforum.org/reports/the-global-competitiveness-report-2020/>

4.2 Empirical specification

4.2.1 Identification strategy

The staggered changes in legislation allow us to control for common unobserved confounding factors at the country level that do not change over time, common EU-wide time trends, and observed time-variant country-specific factors. Based on the recent literature which points out potential confounding factors in staggered difference in difference designs, we investigate the effect of anti-loss trafficking rules in a stacked cohort DiD design following the approach of Cengiz et al. (2019) (see also Baker et al., 2022). The estimation datasets throughout our analysis are calculated as follows. We construct a separate cohort dataset for each treatment event, where the treatment event is defined at the year level. In each cohort dataset, the treated group is composed of countries that change the anti-loss trafficking rule in the year corresponding to the treatment event, while the control group is composed of countries that change the anti-loss trafficking rule in subsequent years or never during our sample period. We restrict observations in each cohort dataset to the five years pre- and post-changes in the treated countries. In this stacked design, we deal with repeatedly treated countries by dropping the second treatment if it is less than five years apart from the first treatment (this is relevant only for Greece, with a second treatment in 2018). We run all regressions on the stacked cohort dataset. In robustness analyses, we rerun our analysis in a non-stacked standard staggered DiD design.

A concern for our identification could be that the decision to change anti-tax loss trafficking rules is systematically correlated with economic conditions in the treated countries, and our findings would then be confounded by spurious correlations. If the concern holds, countries that adopt anti-loss trafficking rules would be on differing trends with regard to core economic factors compared to those countries that build our control group (countries without a change in anti-loss trafficking legislation). To alleviate this concern, we show in robustness tests in Figure 6 that pre-trends in important economic outcomes, GDP, and trade (as defined in Appendix A), are parallel between our treated and control group. This approach follows similar tests in Fuest et al. (2018).

Additionally, to ensure that treated and control countries are comparable in terms of core observable economic characteristics, we employ entropy-balancing matching in all our tests (Hainmueller and Xu, 2013). This approach enhances our identification. It reduces the potential bias introduced by co-variate differences, allowing for more reliable estimation of causal effects and enhancing the validity of our causal inference.²³ We match treated and control firms within each cohort on pre-treatment GDP (measured as log of purchasing power adjusted GDP), and trade (measured as logarithm of the sum of exports and

²³Athey and Imbens, 2017 describe this approach for a generalized matching introduced by Hainmueller and Xu, 2013 as substantial improvement beyond the standard DiD analysis: "This method builds on difference-in-differences estimation, but uses systematically more attractive comparisons."

imports as % of GDP). We then use the weights from the entropy-balancing matching in our estimations (see similarly, e.g., Patel and Seegert, 2015, Jacob et al., 2018).

4.2.2 Tax loss transfer and M&A activity

We start our analysis by investigating the overall effects on M&A activity at the country level. First, we adopt a stacked DiD identification strategy to obtain a comprehensive measure of the average effect.

$$Outcome_{ct} = \alpha + \beta_1 * ChangeALT_{ct} + \rho * Controls_{ct} + \sigma * FE_c + \delta * FE_t + \epsilon_{ct}. \quad (1)$$

c stands for country, and t for year. As the outcome, we define the logarithm of the number of M&A deals aggregated at the country level by year. In the spirit of Dessaint et al. (2017), we construct a treatment indicator that takes the value of 1 (-1) if a country tightens (loosens) anti-loss trafficking rules. Thus, the indicator variable of interest, $ChangeALT_{ct}$, increases (decreases) by 1 if a country tightens (loosens) anti-loss trafficking rules. The value does not change in the following years as long as the regulation stays in place. To show the effects separately for tightening and loosening of the regulation, we construct additionally two separate treatment indicators, one that takes the value of 1 if a country tightens anti-loss trafficking rules and the other takes the value of 1 if a country loosens anti-loss trafficking rules, and zero otherwise ($TighteningALT$, $LooseningALT$).

Our country-level control variables include the lagged log of GDP, lagged GDP growth, the log of population, lagged inflation, a country's audit quality, a dummy for EU membership, the annual growth rate of value added of the service sector in percent of GDP, trade openness, and the corporate tax rate. We add controls for tax loss regulations, namely, a dummy for the presence of LCF or LCB regulations, and a dummy that controls for escape rules present in the anti-loss trafficking rules.

We include country and year fixed effects at the cohort level. The fixed effects structure in this analysis allows estimating the M&A effects on the country-level pre- versus post-treatment (first difference) relative to counter-factual deals in countries that are not treated (second difference) (within cohort). Differences in M&A activity due to time trends across countries and time-invariant country characteristics are eliminated. Controlling for other time-variant factors that influence the investment decisions in the same country, any remaining change in the treated versus the control country should be attributable to the change in anti-loss trafficking rules. Standard errors are clustered at the country-cohort level, the level of treatment variation.

Second, we investigate the dynamic effects over time in a stacked event study at the cohort level:

$$Outcome_{ct} = \alpha + \sum_{m=-4}^4 \gamma_m * Treat_{cm} + \rho * Controls_{ct} + \sigma * FE_c + \delta * FE_t + \epsilon_{ct} \quad (2)$$

The variables are defined as in Equation 1. We include the treatment at the event time, as well as four leads and lags of the treatment indicator (*Treat*). The treatment indicators are binned at endpoints, such that t-4 would indicate treatment at time t-4 and all previous years, and t+4 would indicate treatment at t+4 and all following years.²⁴ Hence, we do not interpret the coefficients for t-4 and t+4. Coefficients are normalized to zero based on the level in the period preceding the treatment (t-1).

4.2.3 Tax loss transfer, industry dynamics, and productivity

Further, we estimate whether the market structure and overall industry performance in a country change in response to the introduction or tightening of anti-loss trafficking rules. We extend equations 1 and 2 to the industry level (within a country), testing different industry-level outcomes. The more fine-grained aggregation level allows us to minimize the possibility of other simultaneous disturbances affecting the treated countries. By utilizing this aspect of the data, we can control for industry-specific shocks across countries and country-industry fixed effects.

With view to market structure, we are interested in how the entry and exit of young firms are affected by anti-loss trafficking regulations. For this purpose, we look at firm entry measured by the birth rate in the industry and changes in the survival rate of young entrants. Additionally, we look at overall industry performance by studying the impact of anti-loss trafficking rules on the country-industry productivity rate measured as the average return on assets weighted by sales. Finally, we test for effects on country-industry risk-taking and innovation, measuring risky innovation activity by the forward lag of granted patents per industry by application year.²⁵

We control for the logged sum of total, fixed, and cash assets at the country-industry level in addition to the country-level control variables used in Equation 1.²⁶ Our industry-level specification includes industry-country and industry-year fixed effects at the cohort level. Residuals are clustered at the country-cohort level. With this structure, we compare industry-country effects pre- versus post-treatment (first difference) relative to counter-factual industries from the same industry year in countries that are not

²⁴Binning is done to control for bias introduced by samples that are unbalanced in event time (in cases of staggered treatment dates).

²⁵By taking granted patents rather than patent applications dated by the year of application, we follow prior literature (e.g., Aghion et al., 2013; Bena and Li, 2014; Mukherjee et al., 2017; Acemoglu et al., 2018; Atanassov and Liu, 2020). Total application numbers, including failed applications, are likely to be distorted by strategic patenting behavior and patent trolls (Cohen et al., 2019).

²⁶For tests with firm birth and survival rates, we cannot control for total, fixed, and cash assets. Eurostat does not provide the necessary data for industry-level controls. We cannot employ the industry controls derived from the full universe of firms in Orbis, as the Eurostat sample only contains a sub-sample of young companies.

treated (second difference) (within cohort). Standard errors are clustered at the country-cohort level.

5 Results

5.1 M&A activity

Anti-loss trafficking rules restrict the use of losses after substantial changes in ownership and could thus directly impair M&A activity.

Table 4 lists the regression results for the effect of these rules on the number of M&A deals. The first two columns present the baseline results for the *ChangeALT* treatment indicator (column (1)) and the individual dummies for tightening and loosening of legislation (column (2)) in the full sample. Rechbauer and Runger (2023) demonstrate that previous year’s earning serve as a reliable proxy for the existence of LCFs. We thus use reported accounting losses as proxy to identify target firms that are more likely to have LCFs. Columns (3) to (6) display the estimates for sub-samples of targets with (columns (3) and (4)) and without reported accounting losses in the year prior to the deal (columns (5) and (6)). All regressions include the full set of controls and fixed effects.

The baseline results show a negative and significant decrease in the number of deals of -13% within treated countries relative to within control countries after treatment (Table 4, column (1)). Tightening of legislation appears to reduce the number of M&A deals by -24%, while loosening of legislation has a smaller significant effect on M&A activity (15%) (column (2)). The effects are driven by loss-making targets, for which we find larger and more significant effects (columns (3) and (4)). In this sub-sample, the overall effect of -22% is driven by both tightening (-32%) and loosening of legislation (28%). For targets without losses in the previous year, the coefficients show the same signs but are smaller and lack statistical significance (columns (5) and (6)). The difference in the *ChangeALT* coefficient between loss vs. non-loss target firms (column 3 vs. 5) is statistically significant with a p-value of 0.0577.²⁷ In untabulated analyses, we find that the change in M&A deals involving loss targets is robust to excluding controls or without entropy balancing matching.

Figure 3 displays the event study results. We observe a slight upward trend in the number of deals in the period before treatment, which is consistent with some deals being conducted in anticipation of tighter anti-loss trafficking legislation to come. However, overall, we do not find pre-treatment trends in M&A activity; the sum of lead coefficients in the pre-period is not statistically significantly different from zero (the p-value is 0.41). This observation gives us confidence in the validity of the central parallel-trends assumption. As apparent, loss-making firms are driving the overall decline in deal numbers in treated

²⁷This difference is estimated in a fully interacted model including both loss and non-loss target firms, and 0.0577 denotes the p-value of the coefficient on the interaction term Loss target * ChangeALT.

relative to control countries. In loss targets, the number of M&A deals shows a significant decline from the first year after the change in legislation, which persists over time.

Overall, these findings support the notion that anti-loss trafficking rules impede M&A activity. More restrictive legislation reduces the number of deals, while less restrictive legislation leads to more deals. The finding that deal number effects seem to be present only for loss-making targets further supports that it is the transferability of losses following a change in ownership that drives the M&A outcomes.

5.2 Market structure: Young firm entry and exit

In addition to the direct effect on M&A activity, anti-loss trafficking rules can also indirectly affect the market composition if firms anticipate the deterring effects of the restrictions (Dimopoulos and Sacchetto, 2017). The regulations tend to particularly affect young firms as compared to mature diversified companies since young firms are not able to offset their losses with income from other business lines (Henrekson and Sanandaji, 2011). The restrictions could thus discourage the founding of new firms. Furthermore, new companies may give up at an earlier point if they perceive the probability of exit by being acquired as small. We thus look at changes in the birth and survival rate. We adjust Equation 1 and Equation 2 and conduct the analysis at the industry level.

In Table 5, we analyze the impact of changes in anti-loss trafficking rules on enterprise birth rates (columns (1)-(2)) and four-year entrant survival rates (columns (3)-(4)).²⁸ All regressions include the full set of fixed effects and country control variables. In each group, the first column displays the results for *ChangeALT* as the main variable of interest. We decompose the regression coefficient to study the differential effect of tightening and loosening of the anti-loss trafficking rules in the second column, showing the results for *TighteningALT* and *LooseningALT*.

We find a strong negative effect of *ChangeALT* for both outcomes (columns (1) and (3)). The overall decrease in birth (survival) rates amounts to about -0.7 percentage points (-2 percentage points). Compared to a sample average of 7% (56%), this denotes an economically significant reduction in the mean birth rate (survival rate) of young firms by 10% (4%). The combined effect for birth rates seems to be driven by loosening of legislation (0.7 percentage points); the coefficient for tightening is close to zero (column (2)). However, this is made up for by a stronger effect of tightening on firm survival (-5 percentage points) as compared to 2 percentage points for loosening (column (4)).

We confirm the DiD results in a dynamic event study analysis presented in Figure 4, where Panel (a)

²⁸We do not consider younger entrant survival (one- to three-year-old entrants) as these firms are founded just a few years before, just around or even after the post-treatment period we study (one-five years after the law change), and therefore treatment (or treatment anticipation) can affect the entry probability of these firms, which would distort our measure of survival probability of firms. Our results are robust to using the five-year instead of the four-year survival rate (five-year survival is the last available measure in the Eurostat database).

((b)) depicts the estimates for enterprise births (survival). It is visible that the effect is immediate and persistent over time in both cases and that the treated and control groups show parallel trends in the pre-periods.

These findings indicate that anti-loss trafficking rules not only directly affect M&A activity but also indirectly influence young firm entries and exits, altering the market composition by deterring start-up firms.

5.3 Industry productivity and innovation

We continue to investigate how anti-loss trafficking rules affect industry productivity and innovation to shed more light on the desirability of the legislation. Purely tax-driven acquisitions of loss-making targets could, on average, be prevented, while at the same time, such rules may also have immediate adverse effects on industry performance by limiting the realization of synergies in M&A deals. We use industry-level mean return on assets, weighted by firm sales in the industry, to capture effects on industry productivity. Because tax loss forfeiture could have particularly detrimental consequences in R&D intensive industries, we split our sample by high and low R&D intensity. R&D intensive firms are more likely to accumulate idiosyncratic losses from innovative risky investments. We use an industry-level R&D intensity indicator based on the OECD Taxonomy of Economic Activities, which clusters activities according to their level of R&D expenditure to value added (see Galindo-Rueda and Verger, 2016). In order to apply the EU taxonomy of R&D intensity to our data we have to match the industry classification to the NACE2 classification used in our sample. In case one NACE2 category falls in more than one EU category, we always assign the industry to the lower category with respect to R&D intensity. We build a binary measure of R&D intensity such that we define all industries as R&D intensive if the EU taxonomy classifies them as medium, medium-high, or high R&D intensive, and all industries in our sample of medium-low or lower R&D intensity as low R&D intensive.

Additionally, we test the effect on industry innovation by looking at changes in patenting activity. Patents reflect the uncertain output of research and development activity but only materialize sometime after these investments have been undertaken. We thus use the first filing date for later granted patents (as opposed to the grant date) and look at the aggregate patent count per industry one year after a change in legislation.²⁹

Table 6 presents the DiD results for the effect of the anti-loss trafficking rules on return on asset rates jointly and split by high and low R&D intensive industries (columns (1)-(6)) and the effect patent output (columns (7)-(8)) as the outcome of particularly risky and innovative investments. Again, we start with

²⁹For a closer look at the dynamic effects, we refer to the event study results in Figure 5.

ChangeALT as overall measures and then differentiate between tightening and loosening of legislation.

Our results indicate that the mean return on assets in an industry decreases by -0.01 percentage points in response to changes in anti-loss trafficking rules in treated industries versus peer control industries in other countries (column (1)). The effect seems to be driven by more restrictive legislation, as we find an effect mainly for *TighteningALT* (column (2)). Splitting industries into high and low R&D intensive – column (3) versus (5) – shows that the treatment effect is double as strong in high R&D-intensive industries indicating that productivity is reduced in particular in innovative industries, for which initial losses are part of the life cycle. The difference in the *ChangeALT* coefficients between columns (3) and (5) is statistically significant at the 2.10 percent level.

Given that general R&D expenditures are often not reported or missing in financial accounting databases - including Orbis - we alternatively approximate the effects on risky investments by looking at the probability of successful patent applications measured in $t+1$. We estimate a 22% decrease in successful patent applications in the first year after the change in legislation (column (7)). The effect is driven mainly by a decrease in patenting activity after the tightening of legislation (-39%; column (8)). It is also positive and significant for the loosening of legislation, albeit a little less than half in size (column (9)).

Figure 5 shows the dynamic results for productivity (Panel (a) and (b)) and patent applications (Panel (c)). We see a significant and immediate effect on return on assets which persists over time (Panel (a)). This effect is stronger for R&D intensive industries (Panel (b)). Our coefficient for patenting activity is negative and significant in the year of treatment and the second year post-treatment. As we record granted patents with a one-year lag at the first date of application (instead of the date of approval), these findings indicate a significant decline in later-on successful patent applications after the change of legislation within industries in treated countries relative to the same industries within control countries. In all panels, we do not observe a significant difference between control and treated country industries in the pre-treatment period.

In sum, our findings indicate that anti-loss trafficking rules impair aggregated industry productivity and innovation, especially in R&D intensive industries. The loosening of legislation seems to mitigate some of the deterrence effects of the legislation, positively influencing productivity. Our results further suggest that the increase in productivity after loosening of legislation is caused by additional investments in new technologies that may carry higher risks.

5.4 Robustness analyses

In this section, we provide additional robustness tests of our analysis. Our event study results already provide support for the parallel trends assumption, and our channel analyses provide confidence that our results are driven by the policy changes we intend to study instead of spurious correlations. E.g., we find that effects on M&A deals are driven by loss targets and that productivity effects are more pronounced in R&D intensive industries where the probability of occurrence of idiosyncratic losses from risky investments is higher. To further validate the assumptions made in our approach, we conduct additional robustness tests.

We show in Figure 6 that the changes we observe are not driven by differences in pre-trends in economic performance between treated and control countries. The figure shows the trends in GDP and trade in treated versus control countries in a non-stacked sample, only controlling for country and time-fixed effects. GDP and trade are determinants of (cross-border) M&As and measures of industry productivity and output. We find no pre-trends in both outcomes.

One important concern that cannot be ruled out by testing for pre-trends in event studies is the presence of confounding events whose effects coincide in time with the treatment. The staggered introductions of the regulations that are widely spread over our sample period reduce concerns about concurrent shocks; however, an individual (large) country could be driving the effect we observe, and then the threat of confounding events is more relevant. To alleviate this concern, we test what happens if we drop a treatment cohort at a time from our main specification. In un-tabulated tests, we find that the average effects on the number of deals involving loss targets in treated versus control countries are almost unchanged in magnitude (they lie between -0.18 to -0.29), and remain significant at the 1%-level of significance. In additional robustness analysis, we identify other changes in tax legislation that occur around the time of changes in anti-loss trafficking rules and could lead to alterations in firm behavior. We discuss possible confounding events in Appendix D and control for possibly confounding factors in all our regressions (this includes controlling for changes in tax LCF and LCB legislation and corporate tax rate changes). By controlling for these events, we avoid spurious correlations between our reform dates and industry performance or M&A activity. We observe some larger tax rate changes concurrent to the reforms we study. Instead of only controlling for these potential confounds, we also re-run the analysis in un-tabulated tests limiting the sample to only those treatment events that were not accompanied by large changes in the corporate income tax rates. We define a large change in the corporate tax rate as a change of more than 3 percentage points. This classifies the concurrent tax rate change in Lithuania in 2002 as large (a change of 9 percentage points) and the change in Greece in 2014 (a change of 6 percentage points). In the reduced sample, which excludes both treatments, we continue to find a statistically significant reduction in the

number of M&As involving loss targets (the effect size is smaller yet significant at the 1-percent level with a coefficient estimate of -0.18 instead of -0.25). The effects on firm entry and survival, industry ROA (including the split in high and low R&D industries), and patenting are qualitatively unchanged.

6 Conclusion

In this paper, we analyze the economic impact of anti-loss trafficking rules in the context of M&As, young firm entry and exit, and industry productivity. We exploit up to 12 changes in anti-loss trafficking rules within the European Union and Norway which took place between 1998 to 2019 to study the economic effect of such rules empirically. Our findings suggest that limiting the transfer of losses for tax purposes results in a decrease in the volume of M&As. Furthermore, we find that restrictions on LCFs negatively impact industry dynamics, as evidenced by reduced firm entry levels and entrant survival rates. Conversely, relaxed rules lead to the opposite effect, stimulating entrepreneurship. Finally, we show that anti-loss trafficking rules impact firm productivity, as return on assets significantly decreases in response to tighter legislation. The productivity reduction is especially strong for firms in R&D-intensive industries. This is consistent with the reduction in patenting activity we observe. In sum, our findings are consistent with fewer financing opportunities for less-diversified idiosyncratic loss firms, e.g. young start-ups. Ex-post to the loss, this will be detrimental to firm's ability to attract equity financing and even survival rates if they have substantial tax losses and ex-ante to the loss, this will negatively impact the willingness to take risks and therefore reduce investments in innovation. At the extreme, such rules will affect a start-up's decision to enter the market.

Our study's findings have significant implications for policymakers and investors who aim to comprehend the impact of regulatory changes on market dynamics and firm behavior. Anti-loss trafficking rules aim to protect tax revenues and avert tax-driven transactions. Our analysis demonstrates that limiting the transfer of tax losses crucially affects the market for corporate control. Furthermore, our research suggests that anti-loss trafficking rules exert a considerable influence on firms' entry and exit and innovation levels through the M&A channel. Therefore, our study highlights the importance of carefully considering the consequences of anti-loss trafficking rules on market dynamics and aggregate economic outcomes.

Ultimately, policymakers face a trade-off: On the one hand, overly restrictive loss offset limitations could threaten to impair economic growth. Our results suggest that anti-loss trafficking can entail unintended consequences that are particularly detrimental to risk-taking and innovation. On the other hand, anti-loss trafficking rules can prevent abuse and protect tax revenues. Accrued LCFs can be substantial and, if a large part were offset, could mean significant revenue losses for the tax authorities. E.g., the German Federal Office of Statistics reported that German corporations declared a total stock of €680

billion in LCFs in 2018.³⁰ The comprehensive assessment of the overall welfare impacts of the legislation remains beyond the scope of this study, as we lack administrative data on corporate tax returns and the stock of LCFs. We, therefore, leave it to future research to gain a more complete understanding of the trade-off between economic consequences and tax revenues and the desirability of anti-loss trafficking rules.

³⁰See DeStatis (n.d.), Über 39 Milliarden festgesetzte Körperschaftsteuer in 2018, available at: <https://www.destatis.de/DE/Themen/Staat/Steuern/Unternehmenssteuern/koerperschaftsteuer.html> [Accessed 15 May 2023].

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Tables and Figures

Table 1: Anti-loss trafficking rules categories

Stringency	Description
0	No explicit anti-loss trafficking rule
1	Denial of loss transfer after change in ownership and activity (cumulative requirement)
2	Denial of loss transfer after change in activity
3	Denial of loss transfer after change in ownership
4	Denial of loss transfer after change in ownership or activity (fulfilment of one criteria sufficient)

Table 2: Changes in anti-loss trafficking rules in the EU28 and Norway

Country	Year	Change
Tightening		
LT	2002	Introduction regime <i>cumulative activity and ownership change</i>
CZ	2004	Introduction regime <i>cumulative activity and ownership change</i>
NO	2004	Introduction regime <i>ownership change</i>
SI	2005	Introduction regime <i>ownership change</i>
PT*	2006	Change regime <i>activity change to activity or ownership change</i>
DE*	2008	Change regime <i>cumulative activity and ownership change to ownership change</i>
HR*	2010	Introduction regime <i>cumulative activity and ownership change</i>
HU	2012	Introduction regime <i>cumulative activity and ownership change</i>
GR	2014	Introduction regime <i>ownership change</i>
Loosening		
LV	2000	Change regime <i>ownership change to cumulative activity and ownership change</i>
HU	2001	Abolition regime <i>ownership change</i>
NL	2001	Change regime <i>ownership change to cumulative activity and ownership change</i>
SI*	2007	Change regime <i>ownership change to cumulative activity and ownership change</i>
PT	2014	Change regime <i>activity or ownership change to ownership change</i>
ES	2015	Change regime <i>ownership change to cumulative activity and ownership change</i>
DE	2016	Change regime <i>ownership change to cumulative activity and ownership change</i>
GR**	2018	Change regime <i>ownership change to cumulative activity and ownership change</i>

Source: Bührle and Spengel (2020).

Notes: Changes in treatment of tax losses after an acquisition. Ownership-based are more restrictive than activity-based regulations. Cumulative rules are the least restrictive type of anti-loss trafficking rules. Retro-actively applicable rules are disregarded. * dropped from main analysis due to Financial Crisis (all treatments 2 years around the crisis year 2008), ** dropped from stacked design due to repeated treatment in a time window <5 years. *Source:* Update of Bührle and Spengel (2020).

Table 3: Descriptive statistics

Variable	Obs	Mean	Median	Std. Dev.	P25	P75
M&A deal outcomes						
Number of M&A Deals	1,434	217.410	399.765	33.000	92.000	207.000
Number of M&A Deals (log)	1,434	4.359	1.530	3.497	4.522	5.333
Industry-level outcomes						
Survival Rate	24,615	0.558	0.135	0.470	0.546	0.640
Birth Rate	23,220	0.067	0.047	0.035	0.057	0.088
Mean ROA, salesweighted	47,432	0.0004	0.0002	0.0005	0.0000	0.0004
Patents (log)	10,033	2.310	2.197	1.675	0.693	3.664
Country-level controls						
Lagged GDP Growth (in %)	1,434	1.923	3.143	0.739	1.892	3.180
Lagged GDP (log)	1,434	27.065	1.175	26.335	26.816	28.520
Audit Quality	1,434	5.700	0.683	5.464	5.867	6.197
Service Sector Growth (% of GDP)	1,434	65.309	5.713	62.001	65.236	69.229
Population in th. (log)	1,434	9.371	1.349	8.602	9.201	10.987
Lagged Inflation	1,434	1.677	1.252	0.814	1.696	2.469
Trade (% of GDP, log)	1,434	4.533	0.545	4.113	4.400	4.788
CIT	1,434	28.097	7.243	24.500	28.000	33.990
LCF	1,434	0.884	0.320	1.000	1.000	1.000
LCB	1,434	0.307	0.461	0.000	0.000	1.000
EU Membership	1,434	0.985	0.123	1.000	1.000	1.000
Escape Clause	1,434	0.791	0.407	1.000	1.000	1.000
Industry-level controls						
Total Assets (log)	47,432	20.800	1.622	19.833	20.900	21.821
Fixed Assets (log)	47,432	19.750	1.583	18.817	19.837	20.747
Cash Assets (log)	47,432	18.343	1.500	17.420	18.359	19.321

Notes: The table shows the descriptive statistics for the variables in our analysis in the stacked sample. All variables are defined in appendix A. Sources of variables are also provided in appendix A.

Table 4: Loss transfer and number of M&A deals

	(1)	(2)	(3)	(4)	(5)	(6)
	Number of M&A Deals (log)					
Sample	Full Sample		Split Sample			
			Loss Targets		Non-Loss Targets	
Change ALT	-0.1368*		-0.2466***		-0.0184	
	(0.0815)		(0.0591)		(0.0696)	
Tightening ALT		-0.2685**		-0.3888**		-0.1253
		(0.1272)		(0.1523)		(0.1784)
Loosening ALT		0.1368*		0.2466***		0.0184
		(0.0815)		(0.0591)		(0.0696)
Lagged GDP Growth	0.0128	0.0128	0.0005	0.0005	0.0218**	0.0218**
	(0.0118)	(0.0118)	(0.0091)	(0.0091)	(0.0102)	(0.0102)
Lagged GDP (log)	-0.0356	-0.0356	-0.5359	-0.5359	0.6488	0.6488
	(0.4568)	(0.4568)	(0.5323)	(0.5323)	(0.5468)	(0.5468)
Service Sector Growth	-0.0271**	-0.0271**	-0.0581***	-0.0581***	0.0037	0.0037
	(0.0136)	(0.0136)	(0.0152)	(0.0152)	(0.0165)	(0.0165)
Population (log)	2.1515	2.1515	4.3037**	4.3037**	0.2576	0.2576
	(1.3563)	(1.3563)	(1.6559)	(1.6559)	(1.2176)	(1.2176)
Lagged Inflation	0.0125	0.0125	-0.0008	-0.0008	0.0263	0.0263
	(0.0193)	(0.0193)	(0.0194)	(0.0194)	(0.0246)	(0.0246)
Trade (log)	0.5347	0.5347	0.6838	0.6838	0.6173	0.6173
	(0.4842)	(0.4842)	(0.5181)	(0.5181)	(0.5090)	(0.5090)
CIT	0.0114*	0.0114*	-0.0015	-0.0015	0.0218**	0.0218**
	(0.0060)	(0.0060)	(0.0057)	(0.0057)	(0.0083)	(0.0083)
Audit Quality	-0.0060	-0.0060	0.0356	0.0356	-0.0654	-0.0654
	(0.0967)	(0.0967)	(0.1380)	(0.1380)	(0.1101)	(0.1101)
LCF	-0.0111	-0.0111	0.0447	0.0447	-0.0718	-0.0718
	(0.1012)	(0.1012)	(0.0837)	(0.0837)	(0.0941)	(0.0941)
LCB	0.6032***	0.6032***	0.4882***	0.4882***	0.7222***	0.7222***
	(0.1216)	(0.1216)	(0.1263)	(0.1263)	(0.1361)	(0.1361)
Escape Clause	-0.1317		-0.1422		-0.1069	
	(0.1440)		(0.1674)		(0.2093)	
Constant	-16.5385	-16.6147	-23.1899	-23.2725	-18.3659	-18.4273
	(12.7296)	(12.7062)	(18.4101)	(18.3787)	(13.5109)	(13.4973)
Difference Change ALT Coeff. (3) vs. (5)				0.0577*		
Observations	1,434	1,434	707	707	727	727
Adjusted R-squared	0.9679	0.9679	0.9624	0.9624	0.9733	0.9733
FE	Year-Cohort, Country-Cohort					

Notes: The table shows the results for the stacked and entropy-balanced DiD regressions of change in anti-loss trafficking rules on logarithm of number of M&A deals. In columns (3)-(4), the sample only includes targets with pre-deal losses and in columns (5)-(6), the sample excludes targets with pre-deal losses. The analysis is conducted at country level. All variables are defined in appendix A. Specification: $M\&A_{Deals_{ct}} = \alpha + \beta_j * ChangeALT_{ct} + \rho * Controls_{ct} + \sigma * FE_c + \delta * FE_t$, where c stands for country and t for year. *, **, and *** indicate significance at the 10, 5 and 1% level. Standard errors: Clustered at country-cohort level.

Table 5: Loss transfer and young firm entry and exit

Variable	(1) Birth Rate	(2)	(3) Survival Rate	(4)
Change ALT	-0.00702** (0.00310)		-0.0205** (0.00848)	
Tightening ALT		-0.000647 (0.00452)		-0.0497*** (0.0186)
Loosening ALT		0.00703** (0.00310)		0.0205** (0.00848)
Country controls	Yes	Yes	Yes	Yes
Observations	23,220	23,220	24,615	24,615
Adjusted R-squared	0.818	0.818	0.763	0.763
FE	Industry-Year-Cohort, Country-Industry-Cohort			

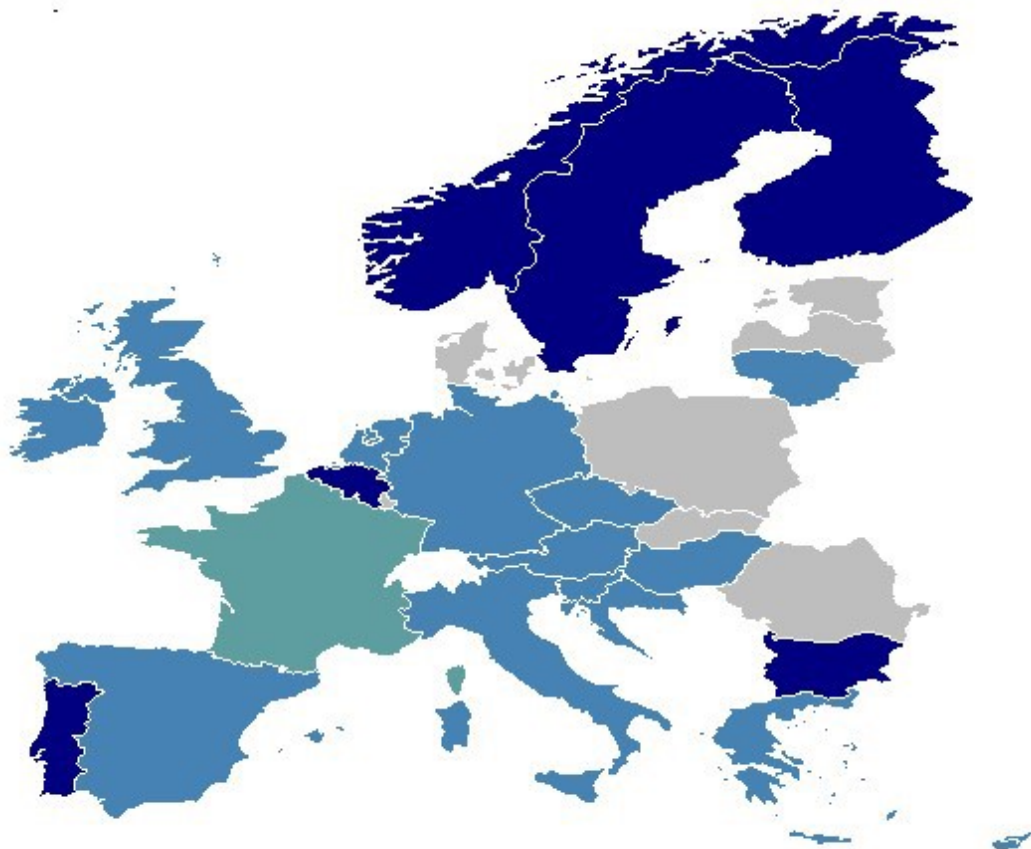
Notes: The table shows the results for the stacked and entropy-balanced DiD regressions of change in anti-loss trafficking rules on birth rate (columns (1)-(2)) and survival rate (columns (3)-(4)). Birth rate is the number of births as a percentage of the population of active enterprise. Survival rate is the rate of survival of four year old entrants. Specification: $Outcome_{ict} = \alpha + \beta_1 * ChangeALT_{ct} + \rho * Controls_{ict} + \sigma * FE_{ic} + \delta * FE_{iT} + \epsilon_{ict}$, where i stands for industry, c for country and t for year. The analysis is conducted at country-industry level. All variables are defined in appendix A. *, **, and *** indicate significance at the 10, 5 and 1% level. Standard errors: Clustered at country-industry-cohort level.

Table 6: Loss transfer and industry productivity

	(1)	(2)	(3) Return on assets		(5)	(6)	(7)	(8)
Sample	Full Sample		Split Sample				Patent Applications	
			High R&D	Low R&D				
Change ALT	-0.0001*** (0.000)		-0.0002*** (0.000)		-0.0001** (0.000)		-0.2844*** (0.080)	
Tightening ALT		-0.0004*** (0.000)		-0.0007*** (0.000)		-0.0002** (0.000)		-0.4936*** (0.136)
Loosening ALT		0.0000 (0.000)		0.0001* (0.000)		0.0000 (0.000)		0.2121*** (0.057)
Difference Change ALT Coeff. (3) vs. (5)					0.021**			
Country controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	47,432	47,432	10,333	10,333	34,456	34,456	11,657	11,657
Adjusted R-squared	0.814	0.815	0.833	0.838	0.813	0.814	0.929	0.929
FE	Industry-Year-Cohort, Country-Industry-Cohort							

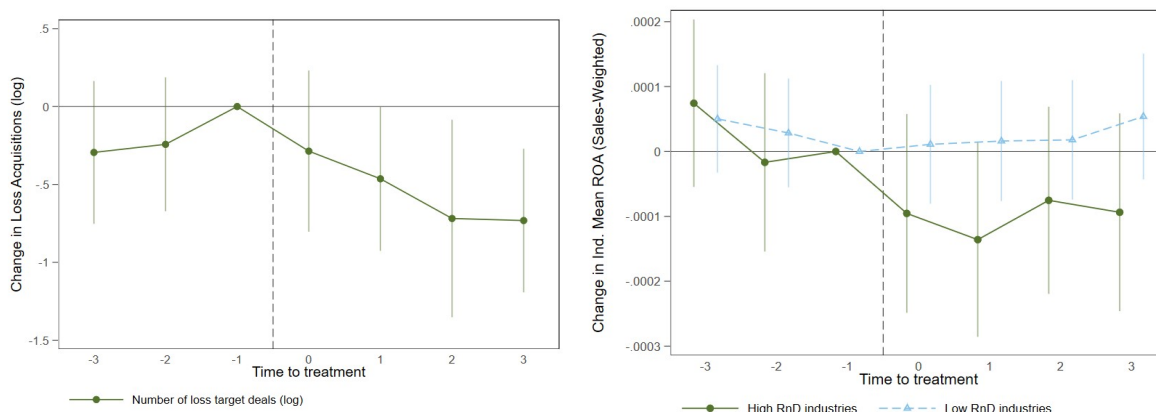
Notes: The table shows the results for the stacked and entropy-balanced DiD regressions of change in anti-loss trafficking rules on mean ROA (columns (1)-(6)) and patent applications (columns (7)-(8)). The regression for mean ROA is additionally split between high (columns (3)-(4)) and low R&D intensive industries (columns (5)-(6)) classified based on NACE2 codes. Mean ROA is the sales-weighted average ROA across all firms in a country-industry-year cluster. The dependent variable for the patent regressions is the one year lead of the logarithm of granted patents in the country-industry cluster dated by the year of application. All variables are defined in appendix A. The analysis is conducted at country-industry level. Specification: $Outcome_{ict} = \alpha + \beta_1 * ChangeALT_{ct} + \rho * Controls_{ict} + \sigma * FE_{ic} + \delta * FE_{it} + \epsilon_{ict}$, where i stands for industry, c for country and t for year. *, **, and *** indicate significance at the 10, 5 and 1% level. Standard errors: Clustered at country-industry-cohort level.

Figure 1: Loss transfer and M&A deals



Note: The figure displays the map of the EU, UK and Norway and the status of anti-loss trafficking rules as of 2019. Countries with no rules are colored grey; countries which restrict the transfer of loss after a change in activity are colored green, countries which restrict the transfer of loss after a change in ownership and activity are colored dark blue, countries which restrict the transfer of loss after a change in ownership are colored light blue.

Figure 2: Descriptives: M&A deal and industry productivity trends in treated countries

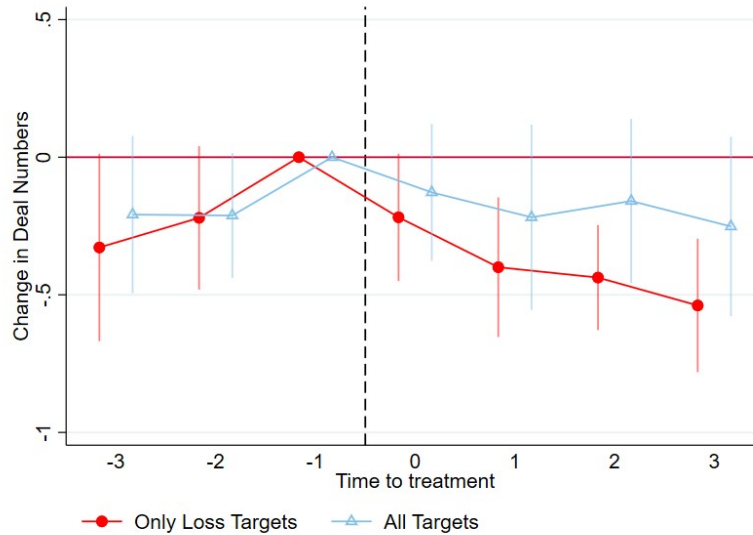


(a) Trend in Loss Target Acquisitions in Treated Countries (Log)

(b) Trend in ROA in Treated Countries by High/Low R&D industries

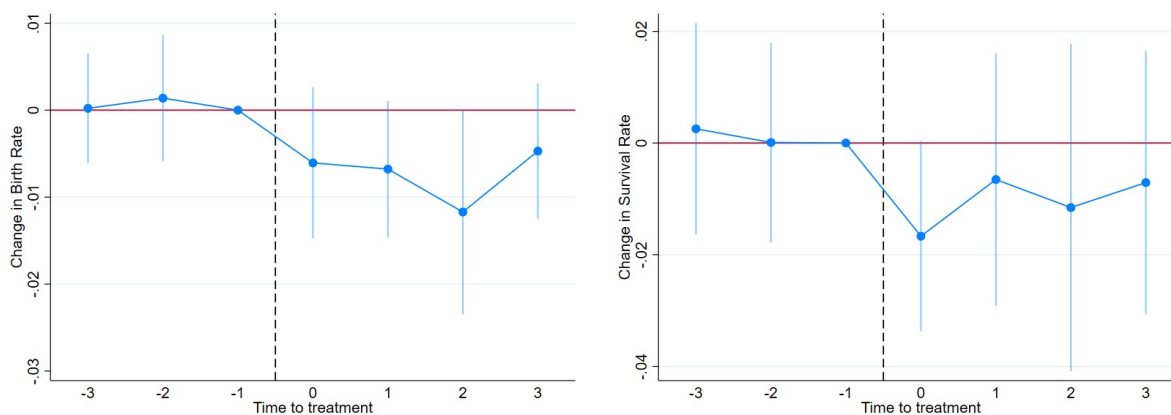
Note: The figure plots the regression coefficients (the green and blue dots), β_k s, and 95 percent confidence intervals (the vertical lines) based on cluster robust standard errors (country-year) from the following specification: $Outcome_{(i)ct} = \alpha + \sum_{n=-4}^4 \beta * ChangeALT_m + \sigma * FE_c + \delta * FE_t + \epsilon_{(i)ct}$, where i denotes industry, c country and t year. The sample includes all countries which changed their anti-loss trafficking legislation. Panel A is estimated at the country-year level, and Panel B at the country-industry-year level. The outcome in Panel A is the Deal Number in loss targets, defined as the log of the number of M&A deals aggregated at the country level by year. Loss targets are proxied by those targets with accounting losses in the year prior to the deal. The outcome in Panel B is the sales-weighted mean ROA in an industry by year. The regression in Panel B is split into high versus low R&D industries. The treatment indicator takes value of 1 (-1) if a country tightens (loosens) anti-loss trafficking rules and the following years and zero otherwise. We include the treatment at the event time as well as four leads and four lags of the treatment indicator. The lead and lag dummies are binned at the beginning and end of the event window (after three years). Binned coefficients are not displayed. Coefficients are normalized to zero based on the level in the period preceding the treatment. Fixed effects include country and year fixed effects. Control variables are not included. All variables are defined in appendix A.

Figure 3: Loss transfer and M&A activity



Note: The figure plots the event study regression coefficients displaying the change in outcome relative to the control group and time $t-1$ (the blue dots), β_k s, and 95 percent confidence intervals (the vertical lines) based on cluster robust standard errors (country) from the following stacked and entropy-balanced specification: $Outcome_{ct} = \alpha + \sum_{m=-4}^4 \beta * ChangeALT_m + \rho * Controls_{ct} + \sigma * FE_c + \delta * FE_t$, where c stands for country and t year. The outcome is the volume of M&A deals, defined as the logarithm of the number of M&A deals, aggregated at the country-year level. The red dots display the same test but with a sample limited to loss targets. Loss targets are proxied by those targets with accounting losses in the year prior to the deal. The treatment indicator takes value of 1 (-1) if a country tightens (loosens) anti-loss trafficking rules and the following years and zero otherwise. We include the treatment at the event time as well as four leads and four lags of the treatment indicator. The lead and lag dummies are binned at the beginning and end of the event window. Binned coefficients are not displayed. Coefficients are normalized to zero based on the level in the period preceding the treatment. Fixed effects include country and year fixed effects. Control variables include a dummy for the existence of an escape clause, lagged GDP growth, log of GDP, audit quality, value added of the services sector, the log of population, lagged inflation, the log of trade, a dummy for EU membership, corporate income tax, a dummy for the existence of a generous loss carry-forward rule, a dummy for the existence of a loss carry-back rule. All variables are defined in appendix A. The standard errors are clustered at country-cohort level.

Figure 4: Loss transfer and young firm entry and exit

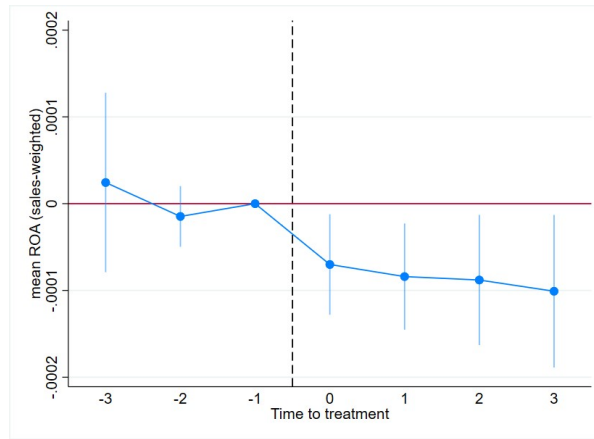


(a) Birth rate

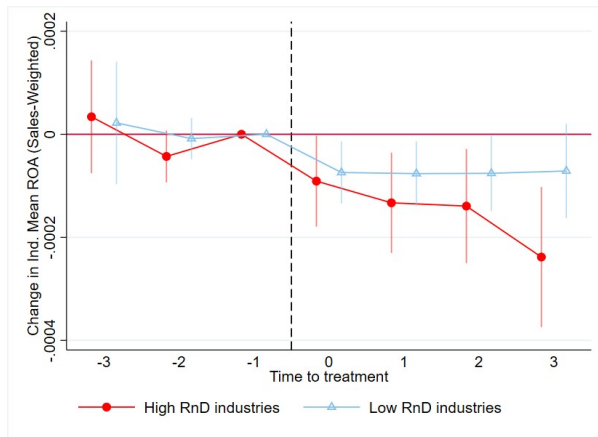
(b) Entrant survival rate

Note: The figure plots the event study regression coefficients displaying the change in treated relative to the control group and time t-1 (the blue dots), β_k s, and 95 percent confidence intervals (the vertical lines) based on cluster robust standard errors (country-year) from the following stacked and entropy-balanced specification: $Outcome_{ict} = \alpha + \sum_{n=-4}^4 \beta * ChangeALT_m + \rho * Controls_{ict} + \sigma * FE_{ic} + \delta * FE_{it} + \epsilon_{ict}$, where i denotes industry, c country and t year. The outcome in Panel A is the birth rate, defined as the number of births as a percentage of the population of active enterprise. The outcome in Panel B is the survival rate, defined as the rate of survival of four year old entrants. Both outcomes are measured at the country-industry-year level. The treatment indicator takes value of 1 (-1) if a country tightens (loosens) anti-loss trafficking rules and the following years and zero otherwise. We include the treatment at the event time as well as four leads and four lags of the treatment indicator. The lead and lag dummies are binned at the beginning and end of the event window (after three years). Binned coefficients are not displayed. Coefficients are normalized to zero based on the level in the period preceding the treatment. Fixed effects include country-industry-cohort and year-industry-cohort fixed effects. Control variables include a dummy for the existence of an escape clause, lagged GDP growth, log of GDP, audit quality, value added of the services sector, the log of population, lagged inflation, the log of trade, a dummy for EU membership, corporate income tax, a dummy for the existence of a generous loss carry-forward rule, a dummy for the existence of a loss carry-back rule. All variables are defined in appendix A. The standard errors are clustered at country-industry-cohort level.

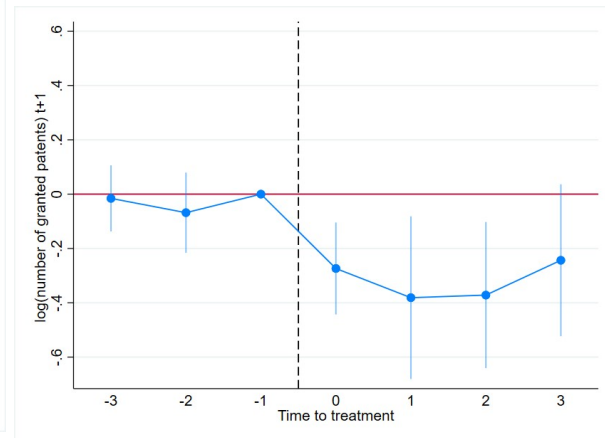
Figure 5: Loss transfer and industry productivity



(a) Mean ROA, sales-weighted



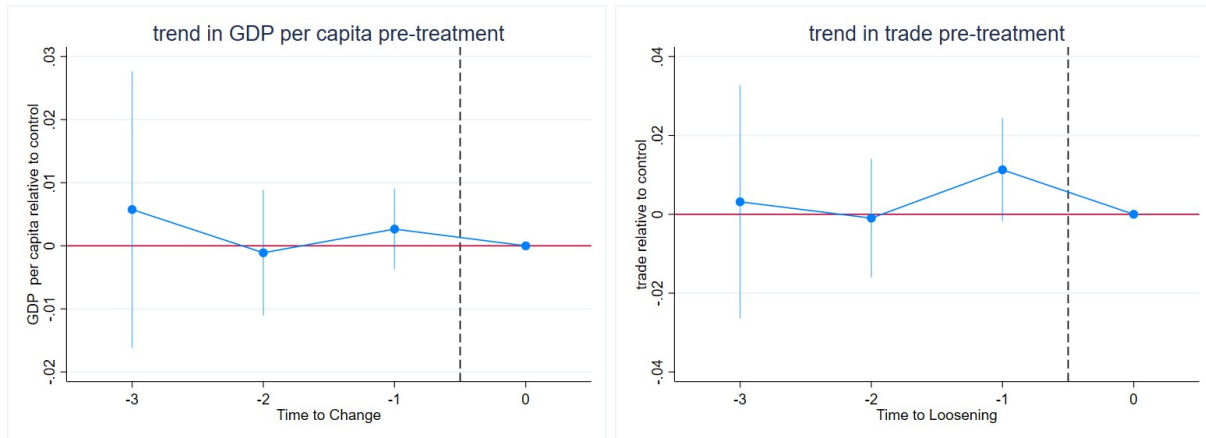
(b) Mean ROA, sales-weighted, by industry R&D intensity



(c) Granted patent applications

Note: The figure plots the event study regression coefficients displaying the change in treated relative to the control group and time $t-1$ (the blue dots), β_k s, and 95 percent confidence intervals (the vertical lines) based on cluster robust standard errors (country) from the following stacked and entropy-balanced specification: $Outcome_{ict} = \alpha + \sum_{n=-4}^4 \beta * ChangeALT_m + \rho * Controls_{ict} + \sigma * FE_{ic} + \delta * FE_{it} + \epsilon_{ict}$, where i denotes industry, c country and t year. The outcome in panel A is the sales-weighted mean industry ROA. The outcome in panel B is equally the sales-weighted mean industry ROA, but the sample is split into high and low R&D-intensive industries. The outcome in panel C is the one year lead of the logarithm of granted patents dated by the year of application. Both outcomes are aggregated at the country-industry-year level. The treatment indicator takes value of 1 (-1) if a country tightens (loosens) anti-loss trafficking rules and the following years and zero otherwise. We include the treatment at the event time as well as four leads and four lags of the treatment indicator. The lead and lag dummies are binned at the beginning and end of the event window (after three years). Binned coefficients are not displayed. Coefficients are normalized to zero based on the level in the period preceding the treatment. Fixed effects include country-industry-cohort and year-industry-cohort fixed effects. Control variables include log of fixed assets, log of total assets, log of cash, a dummy for the existence of an escape clause, lagged GDP growth, log of GDP, audit quality, value added of the services sector, the log of population, lagged inflation, the log of trade, a dummy for EU membership, corporate income tax, a dummy for the existence of a generous loss carry-forward rule, a dummy for the existence of a loss carry-back rule. All variables are defined in appendix A. The standard errors are clustered at country-industry-cohort level.

Figure 6: Test of confounding events: GDP and Trade pre-trends



(a) Panel A: Test of pre-trends in GDP

(b) Panel B: Test of pre-trends in trade

Note: The figure plots the event study regression coefficients displaying the change in treated relative to the control group and time 0 (the blue dots), β_k s, and 95 percent confidence intervals (the vertical lines) based on cluster robust standard errors (country) from the following stacked (not entropy-balanced) specification: $Outcome_{ct} = \alpha + \sum_{n=-4}^4 \beta * ChangeALT_m + \sigma * FE_c + \delta * FE_t + \epsilon_{ct}$, where c denotes country and t denotes year. The outcome in panel A is the log of GDP, PPP (constant 2017 international \$). The outcome in panel B is the logarithm of sum of exports and imports (as % of GDP). Both outcomes are measured at the country-year level. The treatment indicator takes value of 1 (-1) if a country tightens (loosens) anti-loss trafficking rules and the following years and zero otherwise. We include the treatment at the event time as well as four leads and four lags of the treatment indicator. The lead and lag dummies are binned at the beginning and end of the event window (after three years). Binned coefficients are not displayed. Coefficients are normalized to zero based on the level in the period preceding the treatment. Only lead coefficients are reported, since we are interested in trends in economic outcomes pre-treatment that might confound our treatment effects. Fixed effects include country-cohort and year-cohort fixed effects. Control variables are not included. All variables are defined in appendix A. The standard errors are clustered at country-cohort level.

Appendices

A Variable Definitions

Change ALT	Change ALT increases (decreases) by 1 in the year a country tightens (loosens) anti-loss trafficking rules and in the following years. The value does not change the following years as long as the regulation stays in place. Source: hand-collected.
Tightening ALT	Tightening ALT takes a value of 1 in the year a country tightens anti-loss trafficking rules and in the following years. Source: hand-collected.
Loosening ALT	Loosening ALT takes the value of 1 in the year a country loosens anti-loss trafficking rules and in the following years. Source: hand-collected.
Deal Number	The logarithm of the number of M&A deals aggregated at country level by year. Source: BVD's Zephyr.
Birth Rate	The number of enterprise births as a percentage of the population of active enterprises measured in $t+1$. According to Eurostat, a birth occurs only if an enterprise starts operations from scratch. This excludes births due to mergers, break-ups, split-off or restructuring of a set of enterprises and entries resulting from a change in activity. Firms with zero employees are excluded. Source: Eurostat - Business Demography.
Survival Rate	The survival rate of entrants by industry where we consider as entrant, firms of four years of age and take the ratio of surviving entrants to all entrants of that age group. According to Eurostat, survival occurs if an enterprise is active in terms of employment and/or turnover. Two types of survival can be distinguished: <ol style="list-style-type: none">1. An enterprise born in year xx is considered to have survived in year $xx+1$ if it is active in terms of turnover and/or employment in any part of year $xx+1$ (= survival without changes).2. An enterprise is also considered to have survived if the linked legal unit(s) have ceased to be active, but their activity has been taken over by a new legal unit set up specifically to take over the factors of production of that enterprise (= survival by takeover). Deaths do not include exits from the population due to mergers, takeovers, break-ups or restructuring of a set of enterprises nor from a change of activity. An enterprise is included in the count of deaths only if it is not reactivated within two years. Source: Eurostat - Business Demography.

Mean ROA	Sales-weighted average of return on assets across firms in the same industry-country-year cluster. Averages based on less than 50 firms are disregarded. Source: BVD's Orbis.
Patent	One year lead of the logarithm of granted patents in a country-industry cluster dated by year of application. Source: Patstat Global.
Lagged GDP Growth	The lagged annual GDP growth in %. Source: World Bank - World Development Indicators.
Lagged GDP, log	The log of lagged GDP, PPP (constant 2017 international \$). Source: World Bank - World Development Indicators.
Audit Quality	Strength of auditing and reporting standards index (1-7, best). Source: World Economic Forum - Global Competitiveness Report.
Service Sector Growth	The annual growth rate of value added of the services sector in percentage of GDP. Source: World Bank - World Development Indicators.
Population, log	The log of total population in thousands. Source: United Nations.
Lagged Inflation	Lagged inflation. Source: World Bank - World Development Indicators.
Trade, log	Lagged logarithm of sum of exports and imports (as % of GDP). Source: World Bank - World Development Indicators.
EU Membership	A dummy for country EU Membership. Source: European Commission.
CIT	The statutory corporate income tax rate. Source: European Commission.
LCF	A dummy equal to 1 for a loss carry-forward available for more than five years in a country and 0 otherwise. Source: hand-collected.
LCB	A dummy equal to 1 for a loss carry-back available in a country and 0 otherwise. Source: hand-collected.
Escape Clause	A dummy for anti-loss trafficking rules that offer an escape clause. Source: hand-collected.
Fixed Assets, log	The log of the industry-country sum of fixed assets. Source: BVD's Orbis.
Total Assets, log	The log of the industry-country sum of total assets. Source: BVD's Orbis.
Cash Assets, log	The log of the industry-country sum of cash assets. Source: BVD's Orbis.

B Treatment of losses in tax law

The offset of losses for tax purposes is subject to several restrictions. Intra-periodic offset can be restricted to the same source of income that generated the losses (so-called horizontal loss offset). This is often the case for capital losses. Business losses can usually also be offset against profits from other sources (so-called vertical loss offset). If losses cannot be offset in the same period, they have to be carried over to other periods in the past (LCBs) or future (LCFs). These tax loss assets carry value (assuming the company becomes profitable or used to generate profits in the past) as they embody potential tax savings (Amir and Sougiannis (1999)). The value of these tax assets depends on the expected time needed to offset them against positive income. Longer time horizons embody higher risk and lower present values of current losses. Inter-periodic loss offset is also subject to several restrictions.

First, temporal and/or absolute restrictions limit the amount of losses that can be offset in a given year. All countries that allow for a LCB limit the amount of years a loss can be carried back to. The variation in temporal restrictions for LCFs ranges from five years to no time limit. Absolute restrictions are usually expressed in a specified percentage above an allowance. As a result, companies with large LCFs cannot reduce their full taxable income and are obliged to pay taxes on the residual (so-called minimum taxation).

Second, events such as a change in ownership or activity trigger anti-loss trafficking rules which can lead to the forfeiture of accumulated tax LCFs. Absent tax loss transfer limitations, unprofitable corporations with high LCFs can be acquired and merged with profitable firms to set off the otherwise worthless losses. The restrictions aim to prevent loss trafficking; in other words, the acquisition of shell companies with significant LCFs but which lack any other economic rationale. Legislators deem these transactions abusive as the sole purpose is the transfer of the tax assets. Abuse is assumed based on codified criteria, and the taxpayer bears the burden of proof to show otherwise.

The provisions commonly refer to a significant change in ownership and/or a change in activity as triggering criteria. What constitutes such a significant change differs depending on the national legislation. In general, a change in ownership is considered harmful when the controlling majority of the corporation carrying the losses changes. The aim is to limit the benefits of LCFs to the shareholders that bore them. Changes in activity are often evaluated based on changes in assets, turnover, or targeted customer markets. The legislator ties the use of losses to profits generated by the activity that caused them in the first place. There are different types of anti-loss trafficking rules. Cumulative regulations require a change in ownership and connected change in activity. If there is either only a change in ownership or only a change in activity, this type of restriction is not triggered. Alternatively, rules can mandate the forfeiture of losses after a change in activity independent of any changes at the ownership level. A third type of anti-abuse regulation relies solely on a change in ownership. Fourth, countries that relate their loss transfer restrictions to either a change in ownership or a change in activity pose the most restrictive rules, as the fulfillment of either criterion is sufficient.

In some cases, exemptions from the regulations are allowed through "escape clauses". Depending on the national legislation, anti-loss trafficking rules may not apply in situations such as reorganizations within groups, for publicly traded companies, if adequate hidden reserves exist, or if sufficient evidence of economic reasons is presented to tax authorities (such as the rehabilitation of a company).

C Anecdotal evidence for loss trafficking

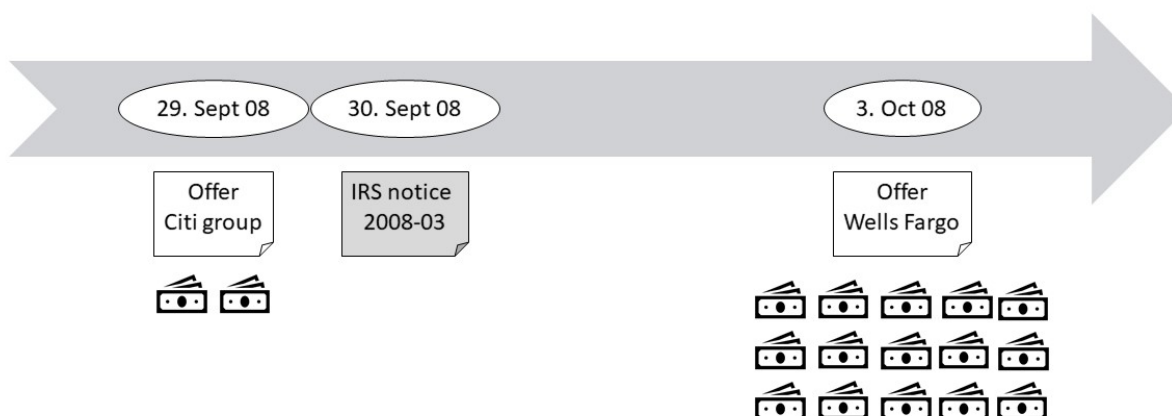
E.g., Erickson et al. (2019) provide anecdotal evidence in their appendix that losses can be considered an important factor in acquisitions. In the following, we additionally present some cases where anti-loss trafficking rules also played an important role.

C.1 Acquisition of Wachovia (USA)

Due to the financial crisis, the banking group Wachovia incurred substantial losses. Citigroup agreed to purchase the company for around 2 billion dollars. Just a few days later, Wells Fargo declared interest as well and offered a multiple of the amount, approximately 15 billion dollar.³¹

The cause for this substantial increase in perceived value of Wachovia was generally perceived to be a tax rule clarification that was issued by the US Internal Revenue Service just a day after Citigroup had announced the deal (and was revoked a few months later).³² Based on the notice, losses and deductions attributable to loans of a bank were not subject to the Section 382 limitations after changes in ownership. Any buyer of Wachovia was thus able to utilize the accumulated losses to offset taxable income even after the acquisition.³³

Figure 7: Timeline acquisition of Wachovia



Note: Timeline of the offers by citi group and Wells Fargo for Wachovia in 2008 around the publication of IRS notice 2008-03, which allowed the transfer of \$ 60 billion in losses that were sitting on Wachovia's balance sheet.

³¹See Crowell (6 Oct 2008), Tax Notice Drives Wachovia Takeover Turmoil, available online at <https://www.crowell.com/NewsEvents/AlertsNewsletters/all/Tax-Notice-Drives-Wachovia-Takeover-Turmoil> [Accessed 4 April 2022].

³²See Crowell (6 Oct 2008), Tax Notice Drives Wachovia Takeover Turmoil, available online at <https://www.crowell.com/NewsEvents/AlertsNewsletters/all/Tax-Notice-Drives-Wachovia-Takeover-Turmoil> [Accessed 4 April 2022]; The Paypers (06 Oct 2008), Wachovia abandons Citi for surprise Wells Fargo deal, available online at <https://thepayers.com/payments-general/wachovia-abandons-citi-for-surprise-wells-fargo-deal-735571> [Accessed 4 April 2022]; The Street (10 Nov 2011), How Wells Fargo Won the Tax-Dodging Trophy, available online at <https://eu.wickedlocal.com/story/bulletin-tab/2011/11/10/how-wells-fargo-won-tax/65157599007/> [Accessed 4 April 2022].

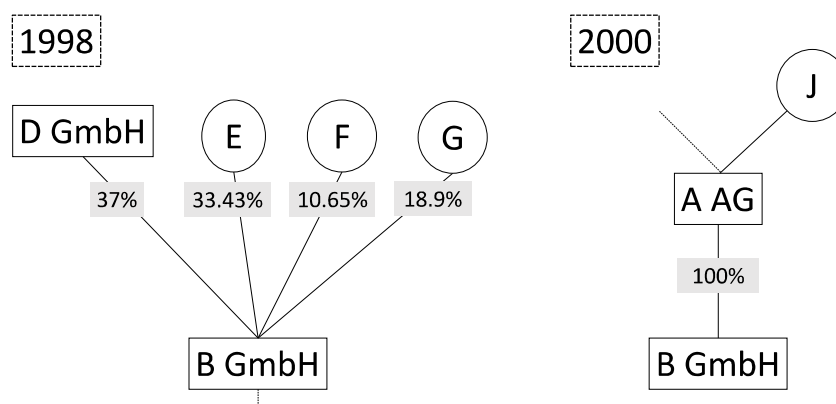
³³IRS (2008), Application of Section 382(h) to banks. Notice 2008-83, available online at <https://www.irs.gov/pub/irs-drop/n-08-83.pdf> [Accessed 4 April 2022].

C.2 Case 3 K 65/08 (Germany)

B GmbH (B) was founded in 1991 and was conducting business as holding of the B-Group with ten to eleven employees. The B-Group traded in computer games and accessories and sometimes also manufactured them; B itself participated in some computer game trades. The firm was incurring losses from 1996 to 1998 due to partial depreciation of the holdings in its subsidiaries. At the end of 1998, business was discontinued by selling the subsidiaries to a third party and laying off all employees. B's assets were mainly consistent of liquid assets. At this point, the company had accumulated LCFs for corporate tax purposes up to around DM 35 million. In 2000, A AG (A) bought the shares in B GmbH from the previous owners. The purchase agreements included a section stating that an additional purchase price was to be paid in case the LCFs could be offset against taxable income of B earned after the acquisition. B changed its focus to the investment in high-tech start-ups, effectively changing its business activity from an executive holding of an entertainment software group to a venture capital firm, acquiring substantial shareholdings in start-ups in the "new economy". B was later merged with A in 2001.

The court denied the offset of B's LCFs with profits from the new business activities, stating that the plaintiff's only aim when acquiring the shares in B was to take advantage of its LCFs. This inference arises in particular from the remuneration agreed specifically for the transfer of the LCFs. The plaintiff did not intend to operate in the former business area of B, entertainment software. A acquired a company whose assets consisted almost exclusively of liquid receivables and investments, i.e., a cash box, at a price that corresponded exactly to this value. The visible reason for the acquisition instead of liquidation of B were the use of the existing LCFs. The fact that B was merged with the plaintiff in 2000 to simplify the corporate structure also shows that B was active in the same business area as the plaintiff that B, as an independent company, was of no use to the plaintiff and that the latter was only striving to transfer the LCFs to itself.

Figure 8: Schematic representation shareholdings B GmbH



Note: Schematic representation of the shareholdings in the case 3 K 65/08 at the financial court Hamburg, judgement from 20.04.2010. The court denied the use of accumulated losses of around DM 35 Mio after the company had been sold to the A AG, having assessed the transaction as an abusive trade in losses.

C.3 Urban Redevelopment Corporation v. C.I.R (USA)

Urban Redevelopment Corporation (Urban) was a New York corporation established in 1949 and dealing with real and personal property. The corporation incurred substantial losses in 1950 and 1951 and was inactive during 1952. In 1953, the sole owner, Fred F. Stoneman sold the corporation to Randolph Rouse

(Rouse), a Virginian land developer and builder. The place of business of Urban was consequently moved to Virginia. The stated purpose for the acquisition were plans, drawings and specifications belonging to the corporation. However, Rouse failed to obtain these items after some ineffectual efforts, refraining from taking legal action against the former director that supposedly had them in their possession. In 1954 and 1955 Urban constructed and sold residential properties in Virginia, generating substantial profits. The resulting income taxes were reduced by offsetting the previously accumulated LCFs, claiming deductions of roughly USD 46,000.

The tax court considered the avoidance of income tax Rouse's principal purpose in acquiring Urban's stock and denied the loss offset. The court found that, while Rouse had his certified public accountant thoroughly verify Urban's LCFs, he failed to check the existence of the plans he claimed seeking to acquire. Overall, the court assessed Rouse's stated economic reasons as "inherently improbable".

D Confounding events

Oftentimes, changes in tax loss transfer restrictions are part of bigger tax law packages than include other, potentially confounding, legislative measures. More restrictive general LCF legislation, i.e., shorter time horizons and absolute limits, decreases the value of accumulated LCFs and thus acquisition prices (e.g., Erickson et al. (2019)). Consequently, one would expect stricter temporal and absolute loss restrictions exerting an opposing effect to stricter anti-loss trafficking rules. Lower corporate taxes are associated with higher acquisition activity (e.g., Arulampalam et al. (2019), Todtenhaupt and Voget (2021)). However, in the tax loss setting higher taxes also imply higher tax savings if LCFs can be set off and thus increases in expected values of the tax assets. The direction of potentially confounding effects is unclear. Lower taxes on capital gains from the sale of shares in subsidiaries decreases the costs imposed on sellers and thus the required acquisition premium (e.g., Todtenhaupt et al. (2020)), leading to a positive effect on acquisition activity. In our empirical specification, we specifically control for the time-variant country-specific aspects by including variables for tax rates as well as LCB and LCF provisions in the estimation equation. Nevertheless, in the following we discuss concurrent changes in tax law that fall together with the changes in anti-loss trafficking rules we use for our identification.

Table 7 presents an overview over relevant tax changes at the time of change in anti-loss trafficking rules. At the time of change in anti-loss trafficking rules (column ALT), we list changes in temporal and absolute restrictions of LCFs (columns LCF time and limit), statutory corporate income tax (column CIT) and capital gains taxes levied on the sales of shares of substantial holdings in non-listed subsidiaries (column Cap. Gains). For each column, changes in legislation are indicated with the status before and after the change; if there was no change the space is left blank. Around half of the changes in tax loss transfer restrictions were accompanied by additional changes in legislation in the same year.

Table 7: Concurrent changes in tax law

Country	Year	ALT	LCF time	LCF limit	CIT	Cap. Gains
CZ	2003	-	7		0.31	
	2004	cum	5		0.28	
DE*	2007	cum			0.25	
	2008	own			0.15	
DE	2015	own				
	2016	cum				
ES	2014	own	18		0.30	
	2015	cum	inf		0.28	
GR	2013	-			0.20	
	2014	own			0.26	
GR**	2017	own				
	2018	cum				
HR*	2009	-				
	2010	cum				
HU	2000	own				
	2001	-				
HU	2011	-		-		
	2012	cum		x		
LT	2001	-			0.24	
	2002	cum			0.15	
LV	1999	own				
	2000	cum				
NL	2000	own				
	2001	cum				
PT*	2005	act				
	2006	act/own				
PT	2013	act/own	5		0.25	50% exemption
	2014	own	12		0.23	full exemption
SI	2004	-				
	2005	own				
SI*	2006	own	7		0.25	no exemption
	2007	cum	inf		0.23	50% exemption
NO	2003	-				no exemption
	2004	own				full exemption

Notes: The table shows concurrent changes in tax legislation at the time of change in anti-loss trafficking rules (ALT). Listed are changes in loss carry-forward (LCF) time and limit, statutory corporate income tax (CIT) and capital gains taxes on sales of shares of substantial holdings in non-listed subsidiaries.* dropped from main analysis due to Financial Crisis (all treatments 2 years around the crisis year 2008), ** dropped from stacked design due to repeated treatment in a time window <5 years. *Sources:* IBFD Country Analyses, EY Worldwide Corporate Tax Guides.

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