Measuring the Effects of the Global Tax Reform - Evidence from High-frequency Data

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Abstract

Over 140 countries agreed on a fundamental corporate tax reform in 2021. To measure its effects, we compute asset price changes within minutes of the reform announcements. We construct granular proxies for the reform's costs regarding companies' tax burdens and countries' public finances. Highly exposed companies exhibit significant negative stock returns. The immediate total shareholder value loss ranges from $26 billion to $65 billion. Further, exposed countries experience increases in sovereign debt credit risk. Our documented effects are economically large, persistent and increase over time. Our findings inform the cost-benefit analysis of the most important international tax reform in history.

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1 Introduction

How to tax companies in today's globalized and digitalized world is one of the most pressing public policy issues. Academics, policymakers, and society have criticized the current tax system as outdated and exacerbating inequality. Two key related issues are often cited. First, countries engage in a tax rate race to the bottom to attract global capital (i.e., tax competition). Second, multinational companies (MNCs) can shift profits to favorable tax jurisdictions (i.e., tax avoidance) (e.g., OECD, 2013; Devereux and Loretz, 2013; Clausing, Saez, and Zucman, 2021; Tørsløv, Wier, and Zucman, 2022). In 2021, more than 140 countries agreed on a fundamental tax reform to address these issues beginning in 2023. The speed with which consensus was reached and the far-reaching scope of the reform surprised many stakeholders. Yet little is known about the reform's potential consequences. Does such a global tax reform affect shareholder value? If so, which companies and industries are affected the most, and what is the reform's aggregate impact on shareholder value? Which countries' public finances are worse off and which are better off with the reform? This paper seeks to provide the first answers to these important questions.

The reform will introduce the biggest changes to the international tax system in history and represents a remarkable diplomatic agreement. For instance, Larry Summers described it as '*the most significant international economic pact of the 21st century so far*' (Larry Summers on October 30, 2021). The reform aims to limit international tax planning opportunities, increase and reallocate global tax revenues, and end tax competition among countries. To this end, it will introduce a consumer-location-oriented approach to tax a portion of the profits of the largest companies and a global minimum tax rate of 15% for most MNCs (OECD, 2021b).[1] The reform package is a significant

[1]We provide a simplified illustration of these changes. (We discuss details in Section 2.1.) Assume an internet company has a return on sales of 20% and generates sales of $100 with customers located in a high tax country, like Brazil or Germany, and incurs costs through its subsidiaries' operations in several countries across the globe. Under the current system, the company may report almost all of the $10 pre-tax income in a country with a preferential tax regime, like Ireland. The reason is that the company can claim that its revenue streams rely on the use of intellectual property and that the intellectual property is legally owned by its subsidiaries in these low-tax countries (e.g., Kleinbard, 2011; Dyreng, Hanlon, Maydew, and Thornock, 2017; Albertus, Glover, and Levine, 2022). Under the new rules, at least $2.5 of these profits will be taxed in the market country, that is, Brazil or Germany. Further, a minimum rate of 15% will be applied on remaining profits in Ireland in case Ireland still

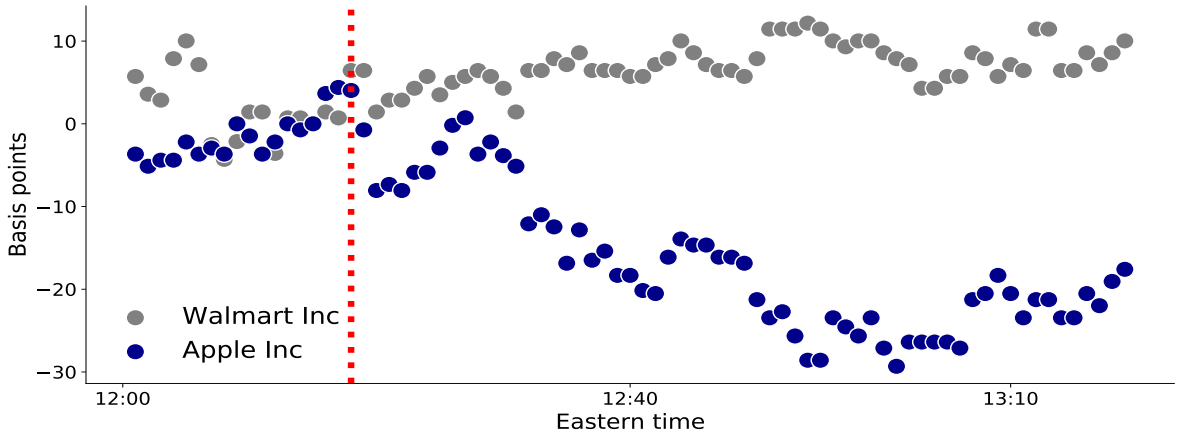
departure from the current tax regime, which provides MNCs with leeway to choose how to allocate taxable income to countries if the management can argue that functions, assets, and risks are attributable to MNC's legal entities in the pertinent country. Further, countries can set arbitrarily low tax rates or offer preferential tax treatments that reduce MNCs' tax burdens in these countries to far below an effective tax rate of 15%.

There are two empirical challenges when examining the costs and benefits of the reform for the key stakeholders, companies and countries, based on market expectations. First, we need to isolate the effect of the tax reform on asset prices. To overcome this challenge, we exploit that the rapid agreement by over 130 countries was largely unexpected and that we can accurately time-stamp the main events concerning the achievement of political consensus at the OECD level. We then compute changes in companies' stock prices and countries' sovereign debt credit default swap spreads in a tight window around the events to isolate the impact of the news. Our identifying assumption is that no other relevant information affecting asset prices in the same systematic way is released over the short time window around the announcements. The idea behind our tests is that, although the true impact of the reform is not directly observable, we can learn about the cost and benefits from forward-looking asset price movements around the main legislative events. If the reform will impact growth or discount rates, it should have a measurable effect on current asset prices.

Second, we need granular measures that proxy for individual companies' and countries' ex-ante exposure to the reform. At the company level, the reform likely increases the tax burden for companies that benefit from the current tax system. At the country level, the reform will impact countries' public finances through the reallocation of global companies' tax bases and the possibility for countries to levy a minimum tax on foreign low-taxed profits (OECD, 2020; Vella, Collier, and Devereux, 2021). Therefore countries that currently attract disproportionately large tax bases of MNCs will likely suffer. At the company level, we combine an array of data sources to measure MNCs' benefits related to international tax planning under the current tax regime. At the country level, we propose a new methodology to combine aggregated country-by-country reporting and macroeconomic data to measure the disproportionate attraction of global capital and

chooses to apply corporate income tax rates of below 15%.

Fig. 1. **Normalized stock prices around the global tax reform announcement**



Notes: This figure shows the minute-level stock price of Walmart Inc. and Apple Inc. in the narrow time window surrounding 2021-07-01 12:19:26 EDT. At this time, it was first released to the public that 130 countries had agreed to the fundamental international tax reform (Pillar 1 and Pillar 2 of the OECD's reform proposal). The red dotted line highlights the exact time of the OECD's press release.

corporate tax bases under the current tax regime.

To pinpoint companies' exposure to the reform at a large scale, we use the share of foreign-sourced income, hand-collect a granular measure of the allocation of income to low-tax countries from companies' annual reports, and exploit data on MNCs' subsidiary ownership structures. Collectively, these measures capture companies' tax planning opportunities through, for example, the use of intellectual property and tax havens for cross-border profit shifting (Blouin et al., 2012; Blouin, 2014; Dyreng et al., 2017; Albertus et al., 2022). Results based on all of these measures show that companies with higher exposure to the tax reform experienced significant losses in shareholder value within minutes after the announcement events of the reform. Figure 1 provides evidence for the intuition underlying our main findings. We document that the stock price of Apple Inc. drops significantly within minutes after the main event on July 1, 2021. In contrast, we find no significant stock price movements for companies that generate most of their pre-tax income in their domestic market, such as Walmart Inc.

To quantify the full impact of the reform on shareholder value, we need to account for investors' anticipation of the news (Huberman and Schwert, 1985; Bhattacharya, Daouk, Jorgenson, and Kehr, 2000; Borochin, Celik, Tian, and Whited, 2021). For example, on one of the main event dates on July 1, 2021, asset prices had likely already incorporated

a portion of the reform's effect because reform proposals had been discussed in advance and several countries had expressed their support. Thus using our well-identified stock price response coefficients to calculate changes in firm values attributable to the reform would likely understate the true effect. To approximate investors' perceived change in the probability that the reform will happen after investors learn about the news on July 1, 2021, we follow Subramanian (2004), Barraclough, Robinson, Smith, and Whaley (2013), Borochin and Golec (2016), and Borochin et al. (2021) and exploit information in stock and option prices. We derive an option-implied anticipated probability of the reform passage of approximately 30%. Once we account for this degree of anticipation, the estimated effect of the reform on immediate stock prices increases by a factor of 1.5 to 4. Using these adjusted asset-price responses allows us to compute the reform's aggregate impact on shareholder value, which ranges from -$26.8 billion to -$65 billion, within minutes after the OECD announcement.

While stock prices react immediately to the tax news, the effects persist and grow when focusing on longer time windows. For example, the estimated price response is four times larger when using daily data, even after accounting for relevant controls. To further quantify the economic significance of the price responses, we form a value-weighted long-short portfolio strategy that buys (shorts) stocks with low (high) exposure to the reform at the end of each tax event and holds the position for two weeks. The strategy yields a daily CAPM alpha of 17 basis points or over 3% per month. This result suggests that market participants are slow to incorporate the full extent of the reform's effect on firm values, consistent with the regulatory details being complex, as in Cohen, Diether, and Malloy (2013).

In an additional test, we leverage that the informational content of each tax event varies, depending on the details released at each stage of the regulatory process. For instance, on October 8, 2021, the OECD released that only the largest multinationals with sales of more than EUR 10 billion would be affected by Pillar 1 (the new consumer-location-based taxation of profits). We use this new information to tighten identification by exploiting sharp discontinuities in company sizes that determine whether companies fall under the new rules. Our regression discontinuity estimates suggest that stock prices of MNCs above the size thresholds decrease by around 31-34 basis points, relative to

MNCs just below the threshold. This finding is consistent with the consumer-market-based approach of taxation (Pillar 1 of the reform) posing a significant cost to MNCs benefitting from tax planning opportunities under the current regime.

To measure countries' exposure to the reform, we combine macroeconomic data from the World Bank with data from the OECD's country-by-country reporting (CbCR) database. In 2016, the OECD mandated companies to produce reports to make their international tax strategies transparent (De Simone and Olbert, 2022b). This type of data allows us to observe the tax bases that global companies allocate to a certain country. If the reported tax bases are disproportionately high, relative to a country's market size, which we measure by total household consumption, a country will likely suffer from the reform. Thus the CbCR database is uniquely useful to our study because the reform intends to counter this misalignment observable in the data. Further, it allows us to construct country-level measures that are conceptually well aligned with the company-level exposure proxies. Specifically, the latter capture MNCs' propensity to engage in international tax planning and the former capture the aggregate consequences of MNCs' tax planning at the country level.[2] To measure the impact on public finances, we use credit default swap (CDS) spreads on sovereign debt, where higher spreads indicate that investors have a more negative perception of a country's future public finances. Sovereign debt CDS are frequently traded and thus allow us to observe market expectations with respect to the outcomes of an entire country in a short time window (Augustin, Subrahmanyam, Tang, and Wang, 2014; Lando, 2020). We discuss construct validity and the channels through which the global tax reform should impact public finances in Sections 4.

We find that countries that attract disproportionately high corporate tax bases under the current system experience a significant increase in CDS spreads after the reform. Specifically, a one standard deviation higher MNCs' revenues reported in a country

[2]Our statistics reveal that under the current tax regime, global companies disproportionately allocate tax bases to countries with favorable tax regimes but relatively small consumer markets. Scaling the total sum of global companies' revenue reported in these countries by these countries' total household consumption yields the following figures: Brazil: 0.58, India: 0.014, China: 0.42 on the one hand, and Ireland: 2.38, Luxembourg: 3.55, Singapore 3.52, Bahamas 2.38 on the other hand. Consistent with our prediction, the OECD estimates that the consumer-location-based taxation of profits would decrease corporate tax revenues in investment hub countries, like Singapore, Luxembourg, or Ireland, by almost 6% and increase tax revenues in low income countries by almost 2% (OECD, 2020).

relative to total household consumption is associated with approximately 30 basis points higher CDS spreads. These effects persist and grow over time. These findings indicate that market participants expect that emerging countries like Brazil, India, and China will likely enjoy substantial economic benefits from higher tax revenues under the reformed tax regime. Countries at the forefront of tax competition under the current system like Ireland or smaller tax haven jurisdictions, in contrast, likely expect a significant decline in corporate tax revenues and allocation of MNCs' resources like intellectual property or cash holdings.

Collectively, our results show how a globally coordinated tax reform impacts the valuation of exposed companies. Ex-ante it was unclear whether we would find strong price responses to the reform announcements. Investors might have expected that MNCs would implement new tax planning strategies to circumvent an increase in their tax burdens.[3] However, our results suggest that investors valued previously successful corporate tax planning strategies and expect the new rules to be effective in collecting more taxes from MNCs. Importantly, documenting the cross-sectional differences in stock price responses based on our granular exposure measures allows us to quantify the full impact of the reform on shareholder value. Furthermore, we provide the first macroeconomic evidence on potential tax revenue reallocation effects induced by a global tax reform. Our evidence suggests that the reform fundamentally changes the tax competition landscape and should therefore impact the political economy of tax policy design. Specifically, countries currently offering preferential tax treatments, like small financial centers or low-tax jurisdictions like Ireland, will likely lose out in terms of tax revenues and domestic economic activity if they do not change their tax policies. Emerging countries, which currently face outward profit shifting by global companies, on the other hand, will likely enjoy an increase in corporate tax revenues.

We contribute to two streams of literature. First, we add to the literature using

[3]There are other reasons that work against us finding asset price responses to the reform announcements. First, investors might not have revised their beliefs that the reform would eventually be enacted to a sufficient extent for asset prices to move. A potential reason is the complex and ambitious nature of the political economy behind agreeing on the specific rules and implementing those into the domestic laws of more than 140 countries. Second, it is unclear whether the average market participant can infer the cost the reform imposes on individual companies or countries, given the new framework is complex and departs substantially from the standard tax system. Thus it is an empirical question whether asset prices ultimately respond to the reform announcement and, if so, by how much.

investor responses to measure tax reform effects (e.g., Wagner, Zeckhauser, and Ziegler, 2018a,b; Gaertner, Hoopes, and Williams, 2020; Wagner, Zeckhauser, and Ziegler, 2020; Borochin et al., 2021).[4] This literature either examines domestic tax reforms initiated by one legislator and mainly affecting companies in the respective country or transparency regulation forcing companies to disclose more information to the public or tax authorities. We extend this literature by providing the first evidence on the impact of a fundamental and historically unprecedented international reform, which is coordinated and implemented by more than 140 countries. Moreover, we propose a novel method to estimate the effect of an international reform on individual countries' public finances. Our approach of combining of macroeconomic data and information on MNCs' country-level tax data can be used in future research to assess the impact of specific reform elements or other reforms that likely impact several countries at the same time.

Second, our paper adds to a large literature that studies the effect of public policies and regulation on asset prices (Cohen et al., 2013; Meng, 2017; Kelly, Pástor, and Veronesi, 2016) and uses high-frequency identification in macroeconomics and finance (Kuttner, 2001; Gürkaynak, Sack, and Swanson, 2005; Bernanke and Kuttner, 2005; Nakamura and Steinsson, 2018; Känzig, 2021; Haddad, Moreira, and Muir, 2021; Bianchi, Gomez-Cram, and Kung, 2021). We build on this literature by analyzing asset price responses in a narrow window around the main events of a major global policy change. To the best of our knowledge, our study is the first to investigate the microeconomic and macroeconomic effects of the recently agreed reform of taxing global companies' profits. Our results have important policy implications, as regulators work to set out the rules for implementing the reform and domestic policymakers consider policy changes to counteract the potential impact on their countries' tax revenues. Our results also inform future research on the real effects of companies' responses to the reform.

[4]Other studies include Hoopes, Thornock, and Williams (2016); Johannesen and Larsen (2016); Dutt, Nicolay, Vay, and Voget (2019); Gaertner, Hoopes, and Maydew (2019); Müller, Spengel, and Weck (2021); Klein, Ludwig, and Spengel (2022). Most closely related to the global tax reform is the border adjustment tax studied by Gaertner et al. (2019). This reform was considered but not implemented as part of the proposed U.S. corporate tax reform in 2017. Gaertner et al. (2019) document negative market reactions for stocks of U.S. companies with high import shares because import costs would not be tax deductible and exports would be tax exempt. In contrast to this U.S.-focused consideration of a reform, the global tax reform we study was agreed on by 140 countries.

2 The global tax reform and the timeline of news

2.1 Institutional setting

In the last two decades, regulators, the media, and academics have regularly pointed at two core problems of the corporate tax system. First, a fundamental concern is that current corporate tax rules rely on physical factors to determine the tax nexus and liability in a given country, but companies operate increasingly digitally and remotely (e.g., Olbert and Spengel, 2017; Devereux, Auerbach, Keen, Oosterhuis, Schoen, and Vella, 2021). Second, and, in particular, in the aftermath of the global financial crisis, multinationals have faced criticism for aggressively exploiting loopholes in international tax rules to avoid paying taxes in the countries in which they operate (Zucman, 2014; Beasley, Goldman, Lewellen, and McAllister, 2020; Financial Times, 2021; Clausing et al., 2021). Part of this problem is that countries have competed for global companies' capital (and profits) by reducing their tax rates. Consequently, there is a misalignment between the location where companies generate sales and where they pay taxes.

To combat corporate tax avoidance and tax competition and address the tax challenges in the digital economy, global policy leaders began to coordinate at the OECD level and launched the Base Erosion and Profit Shifting (BEPS) project in 2013. The aim of the BEPS project was to fight corporate tax avoidance by improving but not revolutionizing the tax system. However, after the BEPS project was concluded in 2018, the consensus view was that a more fundamental reform was required (Devereux et al., 2021). Accordingly, working groups at the OECD continued to develop reform options. By November 2019, the OECD had released documents proposing to consider a reform under two pillars. Pillar 1 consists of a change to the allocation of the rights to tax corporate profits. The idea is to allocate more rights to so-called market countries (i.e., where consumers are located). Pillar 2 focuses on rules that allow jurisdictions to tax profits allocated to other jurisdictions in case these jurisdictions would not levy high enough tax rates.

In 2021, more than 140 countries agreed on these rules. The specific agreed rules include a consumer-location-based taxation of profits (Pillar 1) and a global minimum

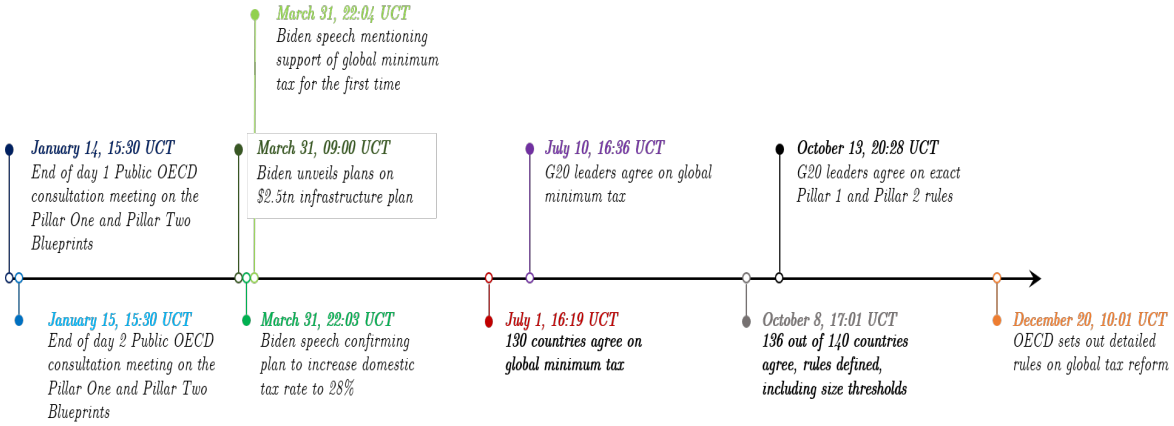
tax rate of 15% (Pillar 2). These core elements constitute a fundamental departure from the traditional corporate tax system, which taxes profits based on companies' location of activities and has no minimum tax rates (i.e., countries are free to set very low rates). Under the current system of corporate income taxation, companies file a tax return based on separate entity accounting in each country in which they have a taxable nexus (usually through the presence of a subsidiary). Because the current tax system relies on mostly functions, risks, and assets-based allocation factors, companies can strategically influence the amount of profits reported and thus how much they are ultimately taxed in a country by using intra-company transactions, that is, profit shifting (see, e.g., Tørsløv et al., 2022; Garcia-Bernardo, Janskỳ, and Zucman, 2022; Meier and Smith, 2022, and Heckemeyer and Overesch, 2017 and Dharmapala, 2019 for overviews).

Under the new rules, 25% of the profits in excess of 10% of sales will be taxed in market jurisdictions. The specific market jurisdiction is defined using a consumer-based sales allocation key (Pillar 1). This rule applies to global companies with more than EUR 10 billion in sales. Further, companies must calculate their effective tax rate for each jurisdiction where they operate and pay a top-up tax for the difference between their effective tax rate per jurisdiction and the new 15% minimum tax rate (Pillar 2). This rule applies to global companies with more than EUR 750 million in sales (OECD, 2021c). Vella et al. (2021) discusses these rules in detail. In the recent meeting of the G20 in Jakarta on February 17-18, 2022, finance ministers and central bank governors committed to implement the two-pillar reform by 2023.

2.2 The timeline of news

Our empirical design examines market responses to different information events around the international political process in 2021. We consider the evolution of the reform's consensus as a suitable laboratory to measure market expectations about the effects of the global tax reform for several reasons. First, the reform will have a significant impact on companies' global tax payments and the allocation of corporate tax revenues across countries. Second, the rapid agreement on specific rules and their implementation by 2023 was largely unexpected at the beginning of 2021. Third, we can accurately time-stamp

Fig. 2. **Key global tax reform dates**



Notes: This figure shows the evolution of the consensus process for the global tax reform in 2021. We depict the key political events and summarize the information content at each event date. The press release from July 1, 2021, and the document containing the specific rules are available here and here.

each reform event, which allows us to identify the news component by computing high-frequency price changes in a narrow window around the events. We use Factiva, Google News, Bloomberg, and the OECD's and G20's official web pages to create time-stamped events of information releases regarding the reform. Figure 2 depicts these events and summarizes the most important information revealed at each event.

At the end of 2020, it seemed unlikely that a global consensus could be reached based on this proposal, due to diverging political interests of the many countries involved and the high coordination required. However, the reform proposals gained significant momentum in early 2021. The first important event was the two-day consultation meeting held by the OECD on January 14 and 15. At the meeting, the OECD invited stakeholders to discuss the Inclusive Framework on Pillar 1 and 2 laid out in November 2020. As a result of the meeting, political leaders expressed strong support for the tax reform while acknowledging the existence of different views among countries and the need for compromise. The next important date was March 31, the day of U.S. President Biden's announcement of the USD 2.5 trillion infrastructure plan. The plan focuses on public spending in the United States to stimulate the economy post Covid-19 and includes increasing the U.S. domestic tax rate to 28%. These news components were not entirely new to the public. However, at the end of his speech (at 26 minutes and 52 seconds), the President mentioned that the United States would support a global corporate minimum

tax, which was an unexpected news element concerning the global tax reform debate.

The two main events happened at 16:19 UCT on July 1 and at 17:01 UCT on October 8. On July 1, the OECD announced that 130 countries agreed on the reform. Thus this day marked the official announcement that the reform would take effect, which was unexpected by many stakeholders. On October 8, the OECD released the detailed rules of the tax reform. For the first time, it was publicly announced that only the largest multinationals, those with sales of more than EUR 10 billion, would be affected by Pillar 1 (market-based taxation) and that Pillar 2 (global minimum tax rate of 15%) would apply to all large multinationals with sales of more than EUR 750 million. Figure A.2 in the appendix shows that these two events received significant attention. Specifically, Google Trends data suggests that public attention regarding the term *global minimum tax*, the key buzzword of the global tax reform, rose significantly on and after these two events.

Three other events were on July 10, October 13, and December 20. The first two dates relate to press releases after the G20 meetings (July and October), officially confirming that the agreements from July 1 and October 8 were backed by the G20 leaders. The last event in December constitutes the public release of the detailed new rules to be further discussed and implemented by 2023. This last announcement contained new information regarding which country was likely to collect the tax revenues generated and reallocated by Pillar 2. It was now more likely that countries where MNCs generate and declare profits at the subsidiary level rather than countries where MNCs' parent entities reside collect these revenues (see Vella, Devereux, and Wardell-Burrus, 2022 for details).

3 Effect on companies

3.1 Predictions

Our goal in this section is to measure the effects of the global tax reform on companies based on market perceptions. As the aggregate behavior of investors can reveal a sufficient statistic of a reform's costs and benefits to affected companies (Chetty, 2009; Meng, 2017), we interpret changes in equity valuations around the reform announcement as a

measure of the aggregate impact of the global tax reform for an individual firm.

We expect the overhaul of the global tax system to be costly for companies that employ tax-efficient strategies under the current tax system because the reform intends to combat aggressive tax avoidance and generally increase the tax burden for multinationals. When assessing the impact of the global tax on the value of a stock, investors should care about the extent to which a company is affected by the shift in the international profit taxation regime and will experience a higher tax burden, accordingly. Therefore we expect negative stock price reactions for companies that can exert leeway when allocating their taxable income across jurisdictions under the current tax regime (so-called cross-border profit shifting strategies).[5] If companies currently shift profits to low-tax jurisdictions, they will likely face a reallocation of their tax base to market countries with higher tax rates (the reform's Pillar 1) and a minimum tax rate of 15% (Pillar 2). If investors value companies' tax avoidance opportunities under the current tax regime (e.g., Goh, Lee, Lim, and Shevlin, 2016; Heitzman and Ogneva, 2019) and expect that the global tax reform will decrease after-tax cash flows, the stock prices of companies exposed to the reform should be negatively affected by the announcement of the reform.

3.2 Data

3.2.1 Measuring companies' exposures

We aim to measure MNCs' benefits from international tax planning under the current system to study the reform's effect on companies. To this end, we construct ex-ante measures of companies' exposure to the potential costs induced by the reform using three different data sources: Compustat Capital IQ, hand-collected footnote disclosures from companies' 10-K filings, and Bureau van Dijk Orbis historical ownership data. We

[5]Consistent with our prediction, The Wall Street Journal's headline from May 2021 suggests that the costs could be material and should trigger stock price drops, in particular for companies with high revenues in foreign countries and relatively low tax bills under the current system (The Wall Street Journal, 2021). We also inform our hypotheses by examining disclosures of global U.S. companies, like Alphabet Inc. or Apple Inc., that have been accused of benefiting from aggressive tax avoidance. The disclosures suggest that managers view the tax reform as harmful for their companies. Specifically, these companies mentioned in their risk factor disclosures of their 2020 10-K annual reports that a potential global tax reform at the OECD level is a risk to their business and could harm their cash flows. Walmart Inc., a company with its main operations and revenues within the United States, did not discuss the reform proposals as a risk to its business (see Figure A.5 for exemplary disclosures).

use information as of the last available period before the tax reform announcement in July 2021.[6] We then validate these measures using hand-collected data from companies' qualitative disclosures in the latest 10-K annual reports and earnings conference calls before the reform announcements. All variables used in the analysis are defined in Table A.1 in the appendix.

Our first company-level exposure variable is *Foreign Earnings Ratio*$_i$, which we define as the foreign earnings of company i scaled by its total pre-tax earnings.[7] We retrieve necessary financial information on companies publicly listed in the United States from Compustat Capital IQ. We use *Foreign Earnings Ratio*$_i$ as our first and primary measure because the global tax reform clearly targets foreign-sourced profits, and prior work considers the reported share of foreign earnings a valid proxy for the share of earnings taxed in foreign jurisdictions (Dyreng et al., 2017; Wagner et al., 2018a; Drake, Hamilton, and Lusch, 2020).

Our second variable is *Foreign Low Tax Benefit To Assets*$_i$, which we define as the tax benefit of company i due to its pre-tax earnings being taxed at low foreign tax rates scaled by the company's total assets. The tax benefit is the USD amount deviation of a company's tax expense according to the U.S. generally accepted accounting principles (GAAP, i.e., the tax expense observable in a company's income statement) from the expected tax expense if the U.S. statutory tax rate were applied to all pre-tax earnings.[8] Similar to the approach of Drake et al. (2020), we access the SEC's API and use XBRL tags to scrape the relevant information from companies' income tax footnote disclosures in their 10-K annual reports. This measure directly captures by how much a company benefits from reporting a part of its tax base in foreign jurisdictions with lower rates

[6]We use financial accounting data for all companies for the fiscal year 2020 to observe the most recent financial characteristics before the announcement of the reform agreement. For most companies, this means the December 31, 2020 data. However, for some companies, fiscal years end in other months in early 2021. (For example, Walmart Inc. reports as of January 31.) For these companies, the fiscal year 2020 means that most of the calendar year 2020 is captured in the financial accounts, but the reporting date is in the calendar year 2021. Ownership data from Orbis is as of December 31, 2020.

[7]We use the three-year average of the foreign earnings ratio to mitigate the effect of companies reclassifying foreign and domestic income in response to the 2017 U.S. tax reform, which incentivized U.S. firms to reclassify income and cost items to mitigate the adverse impact of the U.S. reform's provisions (Laplante, Lewellen, Lynch, and Samuel, 2021; Garcia-Bernardo et al., 2022). Inferences remain unchanged when we use the foreign earnings ratio as of fiscal year 2020.

[8]We use the three-year average prior to the tax reform consistent with our measurement of the first exposure variable *Foreign Earnings Ratio*$_i$.

under the current tax regime and explains a significant part of the negative difference between many U.S. MNCs' GAAP effective tax rates and the U.S. statutory tax rate (Dyreng et al., 2017; Drake et al., 2020). Panel B in Figure A.5 in the appendix provides an example for the tax benefit of Apple Inc. in 2020. Apple reported pre-tax income of USD 109 billion, which, if taxed at the U.S. statutory rate of 21%, would have resulted in a tax expense of USD 22.9 billion. However, Apple's actual GAAP tax expense was only USD 14.5 billion, resulting in a GAAP effective tax rate of 13.3%. The foreign low tax benefit was USD 4.7 billion and thus was the key determinant of this low effective rate. The average three-year foreign low tax benefit was 1.2% of total assets for Apple, 0.8% for Alphabet, and 0.2% for Walmart.[9]

Our third variable is *MNC Tax Rate Differential*$_i$, which we define as the average difference between the statutory corporate income tax rate faced by a U.S. MNC's parent in 2020 (i.e., the U.S. rate of 21%) and the statutory corporate income tax rates faced by its subsidiaries in their respective countries of incorporation. To construct this measure, we first assemble an MNC's ownership tree of all majority-owned subsidiaries following the procedure of De Simone and Olbert (2022b) and Olbert (2021). We then merge country-specific corporate income tax rates from KPMG to measure the difference between the foreign and U.S. tax rates.[10] This measure shares the intuition of the individual subsidiary-level measure of Huizinga, Laeven, and Nicodeme (2008) and Huizinga and Laeven (2008). A higher value captures a higher tax rate incentive to shift the corporate income tax base across foreign jurisdictions.

We use qualitative disclosures from companies' earnings conference calls and 10-K annual reports to validate our company-level exposure measures before conducting the event studies. First, we access the transcripts of companies' last quarterly earnings conference call before the reform announcement to identify company-specific tax risk in

[9]We document no negative stock price reaction for Walmart around the reform announcement, although Walmart's foreign low tax benefit is higher than that of many predominantly domestic companies. This finding is consistent with Walmart reporting foreign taxable income in countries where its consumers reside (Canada and Latin America), and the tax rates in these countries being above the reform's minimum rate of 15%. Thus investors seem to expect that Walmart is unlikely to be negatively affected by the reform.

[10]To provide a simplified example, consider a U.S. MNC with the domestic parent firm, one domestic, and one Irish subsidiary. The *MNC Tax Rate Differential*$_i$ based on the average tax rate differential across all three legal entities will be 2.83% $(= ((21-21)+(21-21)+(21-12.5))/3)$.

the vein of Hassan, Hollander, Van Lent, and Tahoun (2019) and Gallemore, Hollander, Jacob, and Zheng (2021). Specifically, we search for mentions of the global tax reform to construct an indicator variable equal to one if the company's managers mentioned the reform in the call.[11] Second, we scrape the risk factor disclosures (Item 1A) of companies' 10-K annual reports and search for mentions of the global tax reform.[12] Panels A and C of Figure A.5 in the appendix provides two examples of risk factor disclosures, with Alphabet clearly describing the potential overhaul of the international tax framework as a risk to its business and Walmart not mentioning the reform.

If investors care about the impact of the global tax reform on companies, they likely ask managers about it in conference calls or managers mention the reform in the calls. Further, according to the SEC, companies should mention the global tax reform in their 10-K risk factor section if the reform has enough potential (negative) to impact their cash flows. Thus we should, on average, observe higher values in the company-level exposure variables for companies that mention the reform in their earnings conference calls or risk factor disclosures. In the descriptive statistics in Tables A.2 and A.3 in the appendix, we indeed document higher means and medians across all exposure variables for the subsample of companies mentioning the reform in either their conference calls or 10-K risk factor disclosures, consistent with our exposure variables capturing this cash flow risk.

3.2.2 Asset prices: Company stock prices

To measure market perceptions of the effects of the global tax reform, we use high-frequency financial data to compute price changes in narrow time windows around reform announcement dates. To do so, we combine data from several sources. We use the NYSE Trade and Quote (TAQ) database to obtain intraday transactions data for all companies'

[11] Specifically, we search for mentioning of the terms 'International tax', 'Global tax', 'Minimum tax', 'Pillar 1', 'Pillar one', 'Pillar 2', 'Pillar two', and 'taxation of multinational corporations'. We also search for mentions of OECD and Organisation for Economic Cooperation and Development but impose the restriction that they appear in proximity to the term 'tax'. Table A.9 in the appendix provides two examples of such mentions.

[12] We follow the approaches of Hope, Hu, and Lu (2016) and Dyer, Lang, and Stice-Lawrence (2017) to identify and classify business risk factor disclosures in 10-K annual reports. Lyle, Riedl, and Siano (2022) show that companies' risk disclosures inform investors, as they influence market measures of firm risk.

shares listed on the New York Stock Exchange, American Stock Exchange, and Nasdaq National Market System. In supplementary tests, we use daily asset price data from the Center for Research in Security Prices (CRSP). We use daily data to show that the stock price responses persist and grow when focusing on longer time windows. Finally, we use options data to compute an estimate of investor anticipation of the tax events. The daily options data comes from OptionMetrics.

3.3 Empirical Strategy and Results

3.3.1 High-frequency analysis

In our benchmark analysis, we examine the effect of the global tax reform using a high-frequency identification approach. Specifically, we organize our results around the following equation.

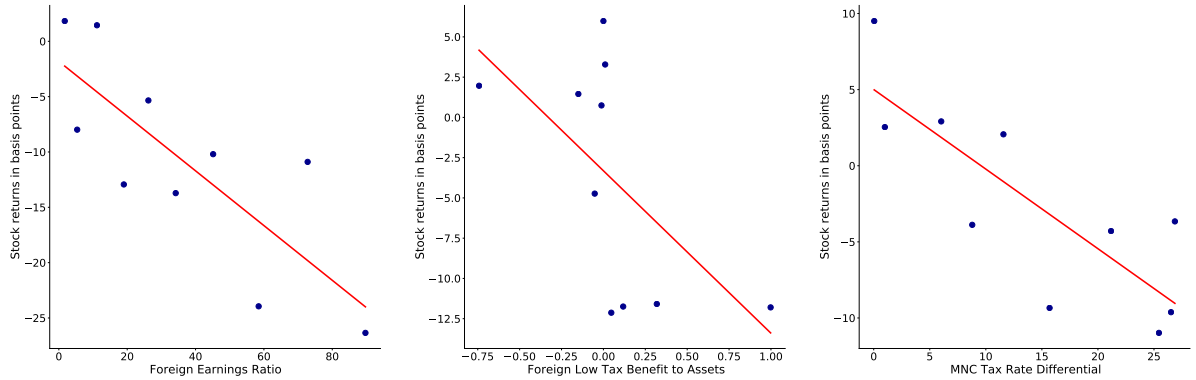
$$\Delta p_{i,t} = a + b \cdot CompanyExposure_i + \epsilon_{i,t}, \tag{1}$$

where $\Delta p_{i,t}$ is the change in log stock prices for company i in a narrow window around tax event t. To identify the effect of the global tax reform on firm values, we consider the difference in log stock prices in an 80-minute window around the tax event t. Specifically, we use the price associated with the last trade at least 60 minutes before the event and the price related to the first trade at least 20 minutes afterward. Our identifying assumption is that, over such a short window of time, changes in stock prices are driven by the information about future taxes released during the tax events depicted in Figure 2.[13] The variable $CompanyExposure_i$ is the exposure of company i to the global tax reform news. The error term is given by $\epsilon_{i,t}$. The parameter of interest is b, which measures the average effect of the tax announcements on $\Delta p_{i,t}$ given the companies' exposure.

We first provide an illustration of our results. The left panel of Figure 3 shows the stock price reactions for different levels of *Foreign Earnings Ratio*. We sort all companies

[13]It is unlikely that other news events that have a significant impact on asset prices occur in such a time window. For confounding news events to bias our estimates, they would need to impact equity prices in the same systematic and differential way as the tax reform announcements do depending on companies' level of exposure to the reform. As we use several exposure proxies that specifically account for MNCs' tax planning benefits under the current system, it is hard to think of news other than those related to the global tax reform which could systematically impact asset prices in the short time windows of our analyses.

Fig. 3. **Stock returns and companies' exposure**



Notes: We first sort companies into 10 bins based on their $CompanyExposure_i$ measure. We then compute both average $CompanyExposure_i$ and average stock returns for each of the bins. The lines denote regression fit lines. The left panel uses *Foreign Earnings Ratio* as the sorting variable. The panel in the center uses the *Foreign Low Tax Benefit To Assets* as the sorting variable, while the right panel uses the *MNC Tax Rate Differential* variable. These variables are described in Section 3.2.1 and in Table A.1 in the appendix. Stock returns are in basis points, and $CompanyExposure_i$ is in percentage.

into 10 equal-sized bins based on sample deciles of *Foreign Earnings Ratio*, and compute both the average *Foreign Earnings Ratio* and the average high-frequency stock returns for each sorted bin. The red line is the regression fit line. The figure shows a strong negative relation between these two variables. For instance, companies in the last decile experience an average drop in stock prices of about -26.34 basis points (t-statistic = -6.3), while the average stock price movement for firms in the first decile is 1.83 basis points (t-statistic = 0.3). The other two panels of Figure 3 repeat the analysis using *Foreign Low Tax Benefit To Assets* and *MNC Tax Rate Differential* as sorting variables. Stock prices of companies with high values of *Foreign Low Tax Benefit To Assets* and *MNC Tax Rate Differential* tend to decrease within minutes after the tax events.

We next estimate equation (1) using a pooled ordinary least squares (OLS) regression. To facilitate an interpretation of the estimated coefficients, we standardize the $CompanyExposure_i$ measure in all regressions below. Panel A of Table 1 reports the results. In column (1), the coefficient estimate on the *Foreign Earnings Ratio* variable is -7.73 (t-statistic = -4.55), suggesting that the stock prices of companies with a one standard deviation higher *Foreign Earnings Ratio* decreased by 7.7 basis points more shortly after the tax event t. Columns (2) and (3) show that the stock price of companies with a one standard deviation higher *Foreign Low Tax Benefit To Assets* and *MNC*

Table 1. **High-frequency stock prices responses to the global tax reform**

Panel A: Tax event dates				
	High-freq. stock returns $\Delta p_{i,t}$			
	(1)	(2)	(3)	(4)
Foreign Earnings Ratio	-7.73			-6.92
	[-4.55]			[-3.63]
Foreign Low Tax Benefit to Assets		-3.96		-4.31
		[-3.07]		[-2.48]
MNC Tax Rate Differential			-7.46	-6.51
			[-5.93]	[-2.94]
Constant	-2.05	-1.99	2.09	-1.81
	[-1.06]	[-1.22]	[1.43]	[-0.87]
R-squared (%)	0.30	0.09	0.31	0.90
Observations	5355	8239	9228	4007
Panel B: Placebo dates				
	High-freq. stock returns $\Delta p_{i,t}$			
	(1)	(2)	(3)	(4)
Foreign Earnings Ratio	0.52			-0.14
	[0.74]			[-0.23]
Foreign Low Tax Benefit to Assets		-1.81		-1.40
		[-1.05]		[-0.76]
MNC Tax Rate Differential			-0.45	-0.26
			[-0.67]	[-0.28]
Constant	-4.82	-4.80	-4.10	-4.91
	[-6.05]	[-6.61]	[-5.32]	[-4.38]
R-squared (%)	0.01	0.02	0.01	0.09
Observations	4495	6726	7415	4190

The table reports the regression estimates for the following Equation:

$$\Delta p_{i,t} = a + b \cdot CompanyExposure_i + \epsilon_{it},$$

where $\Delta p_{i,t}$ denotes the change in log stock prices for stock i around the tax event t. To compute these price changes, we use an 80-minute window around the tax event t (60 minutes before and 20 minutes after). $CompanyExposure_i$ denotes the exposure of company i to the tax event. In column (1), $CompanyExposure_i$ denotes the foreign earnings of company i scaled by its total pre-tax earnings. In column (2), $CompanyExposure_i$ denotes the tax benefit of company i due to its pre-tax earnings being taxed at low foreign tax rates scaled by the company's total assets. In column (3), $CompanyExposure_i$ is the average difference between the statutory corporate income tax rate faced by a U.S. MNCs' parent in 2020 and the statutory corporate income tax rates faced by its subsidiaries in their respective countries of incorporation. We cluster the standard errors at the firm-tax-event level. T-statistics are in squared brackets. $CompanyExposure_i$ is standardized, while $\Delta p_{i,t}$ is in basis points. R^2 statistics are in percentage.

Tax Rate Differential decrease by around -3.96 bps (t-statistic = -3.07) and -7.46 bps (t-statistic = -5.93), respectively. Finally, column (4) shows that regression estimates

remain largely the same when we include all three variables as regressors.[14]

Panel B of Table 1 repeats the analysis for placebo event dates. As placebo event days, we use one business day before each tax event and compute price changes around an alternative window that mimics the daytimes of the original event window. We do not find any significant stock price responses. The estimated coefficients are small, and the t-statistics are below or around one.

3.3.2 Measuring the reform's full value effect

In this section, we aim to assess the full impact of the global tax reform on firm values. Although the immediate stock price responses documented above are well-identified, using our estimates at face value will likely only capture a fraction of the total effect. The reason is that investors could have anticipated that the reform happens because policymakers had been discussing the proposed new framework in the first half of 2021 and even before 2020. If market participants highly anticipated the outcome of the respective news events, asset prices would have already incorporated much of the effect before the actual event. In this case, our previous estimates would constitute a lower bound of the actual effect of the reform on stock prices (Huberman and Schwert, 1985; Bhattacharya et al., 2000).[15] Therefore it is critical to incorporate the extent of investors'

[14]We document nearly identical effects when excluding companies with more than USD 12 billion in sales in fiscal year 2020. This size cutoff approximates the EUR 10 billion threshold used by the regulators to determine whether companies fall under the new Pillar 1 regulations, i.e., the customer-location-based taxation of profits. Therefore our main results suggest that investors expect that Pillar 2, the global minimum tax, will impose a significant cost on the average exposed company. These findings also mitigate the concern that our effects are only driven by the large U.S. MNCs in the technology sector that have been criticized for their aggressive tax avoidance. In supplementary tests in Section 3.3.4, we exploit the USD 12 billion threshold in a regression discontinuity design and document evidence consistent with investors also expecting Pillar 1 to impose significant costs on MNCs with foreign earnings and sales of more than USD 12 billion.

[15]Taken at face value, our estimates would incorporate the full value of the effect if investors did not anticipate the reform such that investors' perceived change in the probability that this reform will happen changed from 0% to 100% on the event date. Given the reform discussions even before 2021, is implausible that investors did not anticipate the event such that the perceived ex ante probability was 0%. We also document evidence consistent with the perceived ex ante probability being nonzero. For example, around 20% of sample companies discussed the reform as a potential risk to their business in the Item 1A risk factor disclosures of the annual 10-K report just before the main event on July 1, 2021. Around 10% of companies also mentioned the reform in their earnings conference calls before the main event on July 1, 2021. Consistent with investors perceiving the reform discussions before the event as an uncertainty, we document an increasing implied volatility leading up to the the main event on July 1, 2021 for the highly exposed firms consistent with the findings in Kelly et al. (2016) around national elections and global summits.

anticipation of the reform when computing total effects on shareholder value. To this end, we build on the approaches of Borochin and Golec (2016); Borochin et al. (2021) and use stock and option prices to compute an estimate of investor anticipation.

The idea is to adjust the stock price responses with changes in the probability (i.e., level of anticipation) of the global tax reform at time t as follows.

$$V_i = \frac{\Delta p_{i,t}}{\Delta \pi_t} \times M_{i,t-1}, \tag{2}$$

where V_i denotes the full value effect of the reform for a given company i, $\Delta p_{i,t}$ is the high-frequency stock price change for company i around event t, $M_{i,t-1}$ is the market capitalization for company i immediately before the event t, and $\Delta \pi_t$ is investors' perceived change in the probability that the reform will happen after learning about the event at time t. Hence the full value effect of the global tax reform on the corporate sector with N companies in our sample is given by $V_e = \sum_{i=1}^{N} V_i$.

The key empirical challenge to recover V_i is that $\Delta \pi_t$ is not observable by the researcher and must be estimated. (Note that we identified $\Delta p_{i,t}$ in the previous section and that the market capitalization $M_{i,t-1}$ is observable). In some cases, π_t is readily available in prediction markets. For instance, Snowberg, Wolfers, and Zitzewitz (2007), Snowberg, Wolfers, and Zitzewitz (2011), Meng (2017), and Wolfers and Zitzewitz (2009) use prices from market trading contracts (bets) tied to political events to measure market participants' expectations of such events. Unfortunately, we cannot use betting data, as the prediction markets did not cover the global tax reform. Instead, we follow prior work (Subramanian, 2004; Barraclough et al., 2013; Borochin and Golec, 2016; Borochin et al., 2021) and exploit the information contained in option prices to estimate π_t.

We focus our analysis on one of our main events on the 1^{st} of July 2021. On this day at 16:19 UCT, the OECD announced that 130 countries had agreed on the reform. We report a range of results in Table 2, which shows different estimates for investors' perceived change in the probability of the reform across columns, the implied conversion factor to translate the estimated coefficients into the full price effect (first row), the full price effect (second row), and the full value effect in USD based on all sample companies' estimated effects and market capitalizations. To compute V_i in equation (2), we first estimate $\Delta p_{i,t}$ for each stock. To this end, we estimate regression specification (1) using

stock price data around the event on July 1, 2021. For the three company-level reform exposure measures *Foreign Earnings Ratio*, *Foreign Low Tax Benefit to Assets*, and *MNC Tax Rate Differential*, we obtain the following regression coefficients [t-statistics]: -6.21 [-2.56], -5.16 [-2.18], -7.50 [-3.06]. We also report these results in the notes to Table 2.

We then compute several values for investors' perceived change in the probability of the reform and translate these regression coefficients into full price effects and changes in firm values. Assuming a complete surprise (i.e., $\Delta\pi_t = 1$), one can use the regression coefficients at face value to compute the immediate price effect of the OECD announcement for the highly exposed companies (i.e., companies that are one standard deviation above all $CompanyExposure_i$ measures). The sum of the three coefficients and the constant equals -17.19 basis points ($= a + b_1 + b_2 + b_3$). To compute the full value effect of the reform in dollars we multiply the predicted price change $\Delta\hat{p}_{i,t}$ with the equity market value right before the event $M_{i,t-1}$ and then sum this product across all companies in our sample (i.e., $V_e = \sum_i^N V_i$). When market anticipation is ignored or assumed to be zero, the global tax reform's full value effect amounts to -$18.25 billion. We report these results in Column (1) of Table 2. Using option prices to recover expected probabilities following Borochin and Golec (2016), we obtain an average options-implied probability of 31% that the OECD announces the successful agreement on the reform on July 1, 2021.[16] Column (2) of Table 2 reports the immediate full value effect of the reform announcement on July 1^{st} once we account for market anticipation. If the event probability following the announcement equals 100%, then the full value effect for the highly exposed companies equals -26.33 basis points, and the full value effect for all companies in our sample equals -$26.8 billion.

We believe these estimates constitute a lower bound because there were still significant uncertainties regarding the passage of the tax reform right after the OECD announcement. For example, the specific rules still had to be drafted, which requires a lengthy coordination process and the cooperation of lawmakers from more than 100 countries. Further, it is

[16]We provide details on the estimation procedures in Section A.2 of the appendix. The median implied probability equals 28%, while the 25 and 75 percentiles equal 25% and 35%, respectively. To put these numbers in perspective, Borochin et al. (2021) estimated the probability of the passage of Tax Cuts and Jobs Act (TCJA) to be around 95% one day before it passed on December 22, 2017. Hence the market anticipated to a large extent the TCJA's passage, which is plausible because the bill had already passed the House of Representatives and the Congress a few days earlier.

Table 2. **The full value-effect of the global tax reform on the 1^{st} of July, 2021**

	Using different thresholds for $\Delta\pi_t = \pi_1 - \pi_0$				
	100% - 0%	100% - 31%	80% - 31%	60% - 31%	50% - 31%
	(1)	(2)	(3)	(4)	(5)
$1/\Delta\pi_t$	1.00	1.47	2.08	3.57	5.55
$\Delta p_{i,t}/\Delta\pi_t$ (in bps)	-17.91	-26.33	-37.30	-63.92	-99.39
V_e in dollars (billions)	-18.25	-26.83	-38.00	-65.13	-101.27

This table reports the immediate full value-effect of the global tax reform on the 1^{st} of July 2021. The full value effect is estimated by adjusting the immediate price change around the exact time of the announcement with the model-based estimate of the event probability. To compute the price changes, we use the following regression.

$$\Delta p_{i,t} = \underset{0.95\ [0.40]}{a} + \underset{-6.21\ [-2.56]}{b_1 \cdot ForeignEarnings_i} + \underset{-5.16\ [-2.18]}{b_2 \cdot TaxBenefit_i} + \underset{-7.50\ [-3.06]}{b_3 \cdot TaxDiff_i} + \epsilon_{it},$$

where $\Delta p_{i,t}$ denotes the high-frequency price change around the OECD announcement. We compute the model-implied probabilities from stock and option prices, following Borochin and Golec (2016). $\Delta p_{i,t}/\Delta\pi_t$ reports the immediate value effect for the highly exposed companies (i.e., companies that are one standard deviation above all $CompanyExposure_i$ measures ($= a + b_1 + b_2 + b_3$)). To compute the effect in dollars (V_e in \$ (billions)), for each firm i, we multiply the predicted price change $\Delta\hat{p}_{i,t}$ with the equity market value right before the announcement and then sum this product across all companies in our sample (i.e., $V_e = \sum_i V_i$, where V_i is defined in equation (2)).

uncertain that the reform agreement could be translated into national law in all important stakeholder countries, like the United States and European Union member states (The Wall Street Journal, 2022). Thus it is reasonable to assume that investors' perception of the probability of the actual enactment of the reform is not 100% but some smaller value. Columns (3) to (5) of Table 2 adjust the probability following the event from 100% to 80%, 60%, and 50% to provide ballpark estimates for the total reform effect, depending on this expected probability. If one assumes that the probability following the announcement ranges from 100% to 50%, the immediate full value effect for the highly exposed companies ranges from -26.33 basis points to -99.39 basis points.[17] In terms of dollars, this amounts to an immediate drop in equity valuations between \$26.8 billion and \$101.3 billion.

[17] Alternatively, we can use the estimated market implied value effect V_i that we obtained as a byproduct of our minimization problem required to estimate π_t. The mean of the estimated net firm-specific impact V_i/S_n across our sample of highly exposed companies equals -48 basis points.

3.3.3 Daily-frequency analysis and trading strategy

The previous sections showed that the global tax reform has a statistically significant impact on stock price in a short window around the tax events. This section uses daily data to show that these effects persist and grow when focusing on longer time windows. A major strength of using daily data is that it allows us to quantify the economic significance of the effects. However, expanding the event window gives weakens identification, which is why we include various controls in the subsequent analysis.

We start by estimating the following pooled OLS regression using all trading days for 2021:

$$\begin{aligned} r_{i,t,t+1} = a + b \cdot TaxEvent_d + c \cdot CompanyExposure_i \\ + d \cdot (CompanyExposure_i \times TaxEvent_d) + \epsilon_{i,t}, \end{aligned} \tag{3}$$

where $r_{i,t,t+1}$ denotes company i's stock return from day t to day $t+1$, $TaxEvent_d$ is a dummy variable equal to one if there was a tax reform announcement on day d (shown in Figure 2) and zero otherwise. Our expect that the coefficient d is negative, that is, stock returns decrease for companies that have a higher exposure to the global tax reform as measured by $CompanyExposure_i$.

Table 3 presents the daily regressions results. In all regressions, we include industry fixed effects and use double clustered standard errors at the stock and day level. We follow the 48 industry definitions provided on Kenneth R. French's website. Columns (1), (2), and (3) in Panel A show that the market responded strongly to cross-sectional differences in $CompanyExposure_i$ on tax reform days. The negative estimated coefficient $\hat{d}$ suggest that companies with high values of *Foreign Earnings Ratio*, *Foreign Low Tax Benefit to Assets*, and *MNC Tax Rate Differential* experienced lower future returns on $TaxEvent_d$ days. Economically, the effect is large. The coefficient on *Foreign Earnings Ratio* is -31.93 (t-statistic = -4.92). This implies that companies with a one standard deviation higher foreign earnings ratio suffer a drop in stock prices that is 32 basis points larger on the tax event days, which is an about four times larger result than the high-frequency results presented in Table 1. Finally, we find that, on non-tax event days, the $CompanyExposure_i$ measure is not related to future stock returns. All estimated coefficients $\hat{c}$ are statistically insignificant, and, for *Foreign Earnings Ratio*, the estimated

Table 3. **Daily stock prices responses to the global tax reform**

Panel A: Daily raw returns	(1)	(2)	(3)	(4)
TaxEvent × *Foreign Earnings Ratio*	-31.93			-20.92
	[-4.92]			[-3.00]
TaxEvent × *Foreign Low Tax Benefit to Assets*		-18.85		-24.49
		[-3.85]		[-2.90]
TaxEvent × *MNC Tax Rate Differential*			-41.18	-26.58
			[-4.89]	[-3.06]
Foreign Earnings Ratio	4.54			3.07
	[1.43]			[1.03]
Foreign Low Tax Benefit to Assets		-0.43		-1.52
		[-0.47]		[-0.76]
MNC Tax Rate Differential			3.64	4.01
			[0.95]	[1.34]
TaxEvent	42.65	37.41	57.72	32.84
	[1.51]	[1.41]	[2.30]	[1.35]
Constant	15.64	19.95	23.51	15.42
	[23.06]	[31.22]	[38.97]	[26.34]
R-squared (%)	0.02	0.01	0.01	0.05
Observations	245,511	495,471	507,232	189,912

coefficients have the opposite sign.

Panel B of Table 3 shows results using risk-adjusted returns, instead of raw returns. To compute the abnormal returns we use the Fama–French three-factor model using a rolling 252-daily estimation window (with a minimum data availability requirement of 126 days) to estimate the factor betas. The daily returns on the size and value factors come from Kenneth R. French's website. After adjusting for companies' exposures to the size and the value factors, the estimated coefficients are somewhat smaller but still economically large. For instance, a one standard deviation increase in *Foreign Earnings Ratio* is associated with about 14.47 bps (t-statistic = -2.63) lower Fama-French adjusted returns on the days of the tax event. Finally, Table A.5 in the appendix presents additional robustness results using CAPM-adjusted returns and four-factor-adjusted returns. The point estimates remain largely unchanged when we use either CAPM-adjusted returns or when we control for companies' exposure to the momentum factor.

Long-Short portfolio results. Our previous tests suggest that the tax reform

Table 3. **(continued)**

Panel B: Daily Fama–French-adjusted returns	(1)	(2)	(3)	(4)
TaxEvent × *Foreign Earnings Ratio*	-14.47			-12.72
	[-2.63]			[-2.27]
TaxEvent × *Foreign Low Tax Benefit to Assets*		-13.50		-16.55
		[-3.13]		[-2.46]
TaxEvent × *MNC Tax Rate Differential*			-17.41	-1.98
			[-2.57]	[-1.27]
Foreign Earnings Ratio	3.04			2.14
	[1.51]			[1.11]
Foreign Low Tax Benefit to Assets		-0.67		-0.90
		[-1.20]		[-0.67]
MNC Tax Rate Differential			-0.02	1.75
			[-0.01]	[1.35]
TaxEvent	2.87	5.02	21.70	1.77
	[0.14]	[0.29]	[1.30]	[0.09]
Constant	-6.46	-5.79	-3.01	-5.98
	[-13.41]	[-14.12]	[-7.45]	[-13.03]
R-squared (%)	0.01	0.00	0.01	0.01
Observations	245,511	495,471	507,232	189,912

The table reports the regression estimates for the following equation:

$$r_{i,t,t+1} = a + b \cdot TaxEvent_d + c \cdot CompanyExposure_i + d \cdot (CompanyExposure_i \times TaxEvent_d) + \epsilon_{i,t},$$

where $r_{i,t,t+1}$ denotes the company i's abnormal stock return from day t to day $t+1$, $TaxEvent_d$ is a dummy variable equal to one if there was a tax announcement day d (shown in Figure 2) and zero otherwise. $CompanyExposure_i$ measures the ex-ante exposure of company i to the global tax reform. These variables are described in Section 3.2.1 and in Table A.1 in the appendix. Stock returns are in basis points, and $CompanyExposure_i$ is standardized. We use all trading days during 2021. In all regressions, we include industry fixed effects and use double clustered standard errors at the stock and day level. T-statistics are in squared brackets.

events shifted market expectations about firm values. Stock prices reacted within minutes after the tax events, and the price impact grew in magnitude during the day. This section further examines the effect of the tax reform on stock returns by forming long and short portfolios. The portfolios' performance further quantifies the economic relevance of our findings.

We form portfolios by first sorting companies into deciles based on their foreign earnings scaled by total pre-tax earnings. The long portfolio is then the value-weighted portfolio that buys the stocks in the first decile (i.e., companies with the smallest *Foreign*

Table 4. **Factor alphas**

	Long	Short	Long - Short
CAPM alpha	6.57	-11.22	17.79
	[0.60]	[-2.45]	[2.29]
Three-factor alpha	5.16	-9.11	14.27
	[0.80]	[-3.86]	[2.10]
Four-factor alpha	5.24	-9.12	14.36
	[0.80]	[-3.90]	[2.11]

This table reports daily factor alphas for three different portfolios. We form portfolios by first sorting companies into deciles based on their foreign earnings scaled by total pre-tax earnings. The long portfolio is then the value-weighted portfolio that buys the stocks in the first decile (i.e., companies with the smallest *Foreign Earnings Ratio* measure). The short portfolio sells the value-weighted stocks in the last decile (i.e., companies with the highest *Foreign Earnings Ratio* measure). The long-short portfolio buys the long portfolio and sells the short portfolio. Affected stocks do not enter the portfolio until the day following the tax event, and we close the position two weeks after each tax event. The alphas denote the intercepts from time series regression of the portfolio excess returns on factors. Alphas are in basis points. We report the t-statistics in brackets.

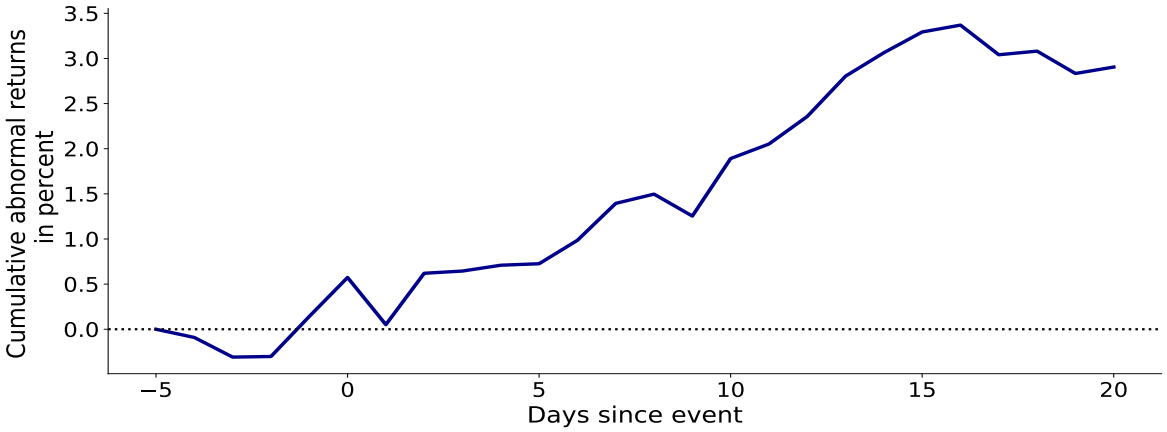
Earnings Ratio measure). In contrast, the short portfolio sells the value-weighted stocks in the last decile (i.e., companies with the highest *Foreign Earnings Ratio* measure). Affected stocks do not enter the portfolio until the day following the tax event, and we close the position two weeks after each tax event.

Table 4 reports daily alphas from the long-short portfolio. The table shows that the long-short portfolio earns substantial risk-adjusted returns. The CAPM alpha equals 17.79 basis points per day (t-statistic = 2.29), implying over 3% per month in risk-adjusted abnormal returns. The alpha is very similar if we risk-adjust returns using either the three- or four-factor model.[18] Notably, most of this return spread comes from the short portfolio, with alphas ranging from -9 to -11 basis points per day (t-statistic = 2.45 and t-statistic = 3.86, respectively). This result suggests that companies with relatively high foreign earnings experience the most substantial decrease in firm value in the two weeks immediately after the tax events.

Figure 4 shows the average event-time cumulative abnormal returns (CARs) of the long-short portfolio. The figure suggests that there is no run-up in the days immediately

[18]The CAPM alpha is equal to the intercept obtained from a regression of the long-short portfolio onto the excess market return. The three-factor alpha is equal to the intercept from a regression of the long-short portfolio onto the excess market return, the size factor, and the value factor. The four-factor alpha is equal to the intercept from a regression of the Long-Short portfolio onto the excess market return, the size factor, the value factor, and the momentum factor.

Fig. 4. **Event-time cumulative abnormal returns to the Long-Short portfolio**



Notes: This figure shows cumulative abnormal returns (CARs) to the long-short portfolio. We form portfolios by first sorting companies into deciles based on their foreign earnings scaled by total pre-tax earnings. The long portfolio is then the value-weighted portfolio that buys the stocks in the first decile (i.e., companies with the smallest *Foreign Earnings Ratio* measure). The short portfolio sells the value-weighted stocks in the last decile (i.e., companies with the highest *Foreign Earnings Ratio* measure). The figure shows long-short CARs from six days before the tax event to 22 days afterward.

before the tax events. From day $t-6$ to day $t-1$, the average CARs are statistically indistinguishable from zero, consistent with results presented in Panel B of Table 3. However, following the tax event, from day 0 to day $t+20$, cumulative abnormal returns drift upward by about 300 basis points. Returns then flatten and stay flat after that.

3.3.4 Supplementary tests

Discontinuity analysis. Our analysis so far exploits each announcement event of global tax reform described in Section 2.2. As such, we interpret the stock price reactions as average responses to perceived changes in the likelihood that the global tax reform would happen. However, the informational content released during each event date varied. On October 8, 2021, the OECD released the detailed rules of the reform. For the first time, the OECD officially announced that Pillar 1 (the new consumer-location-based taxation of corporate profits) affects only the largest multinational companies with sales of more than EUR 10 billion.

To tighten identification and assess the impact of Pillar 1 specifically, we exploit the sharp discontinuity in companies' consolidated revenues that determines whether companies fall under the new rules using a regression discontinuity design (Lee and

Lemieux, 2010; Meng, 2017). We perform local regression discontinuity estimations based on the following equation.

$$\Delta p_{i,t} = a \cdot Treated_i + b \cdot \text{RV}_i + c \cdot \text{RV}_i \cdot Treated_i + \epsilon_{it}, \tag{4}$$

where $\Delta p_{i,t}$ denotes the change in log stock prices for stock i around the tax event t on October 8, 2021. $Treated_i$ is an indicator variable equal to one if the company reported sales of at least USD 12 billion in fiscal year 2020 and zero otherwise.[19] We use robust bias-corrected confidence intervals and inference procedures following Calonico, Cattaneo, and Titiunik (2014).

To identify the effect of the global tax reform on firm values, we exploit this size threshold as quasi-exogenous local variation in treatment assignment. Here the identifying assumption is that differences in stock prices within a narrow time window between companies above and below USD 12 billion in sales are driven by the reform's Pillar 1 rules applying only to companies above the threshold. In addition, we must assume that companies did not manipulate their 2020 sales to influence assignment to the treatment.[20]

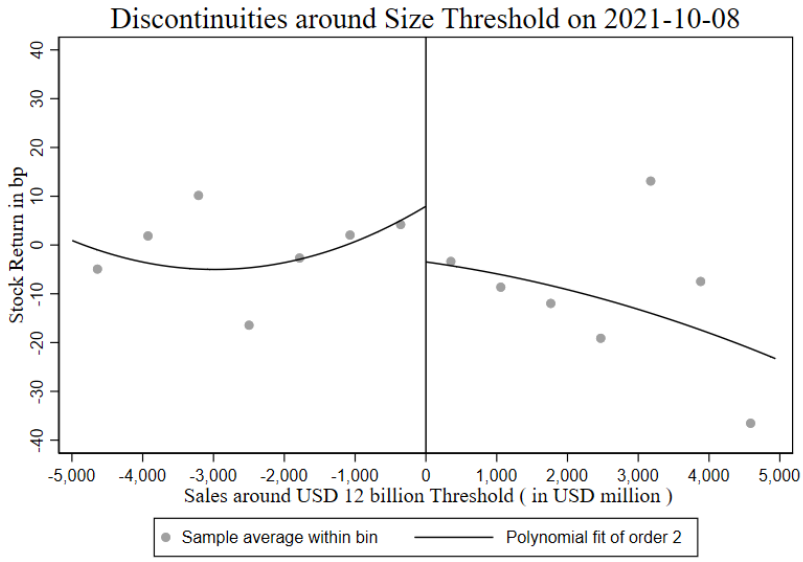
We first illustrate our discontinuity analysis results in Figure 5. This figure shows the stock price reactions for evenly spaced bins of companies' 2020 sales and fitted second-order polynomials. The figure shows a discontinuity in stock prices at the threshold. Specifically, companies in the bins between USD 10 billion and 12 billion in sales on average do not experience stock price changes around the event on October 8. Companies in the bins between USD 12 billion and 14 billion in sales on average experience negative stock price reactions of 10-20 basis points, and the fitted polynomials indicate a continuing negative trend.[21]

We estimate several specifications based on equation (4) and report results in Table 5.

[19] RV_i is the running (or forcing) variable, defined as the difference between a company's sales in fiscal year 2020 and USD 12 billion as an approximation of the EUR 10 billion threshold. We acknowledge that we observe US-listed companies' sales as of fiscal year 2020 in USD. We argue that the approximated value of USD 12 billion most likely reflects investors applying a simple heuristic to convert the threshold into expected USD sales of the affected companies on the day of the event. We acknowledge that this definition is potentially noisy and that it is impossible to use a correct value because investors would need to know the USD-EUR currency exchange rate and the companies' sales as of fiscal year 2023 when the rule would become effective. However, the noise in our measure should, if anything, limit our ability to identify local treatment effects in a regression discontinuity design.

[20] Given the uncertainty in exchange rates and future performance until 2023, it seems highly unlikely that companies could have done this. Nonetheless, we follow the recommendations of McCrary (2008) and test for sales manipulation by inspecting the density of observations around our threshold. We document strongly overlapping 95 percent confidence intervals at both sides of the threshold in Figure

Fig. 5. **High-frequency stock prices responses around the EUR 10 billion sales threshold**



Notes: This graph plots average values of changes in log stock prices around the tax event t in an 80-minute window surrounding 2021-10-08 13:01 EDT for evenly spaced bins of the companies' sales in fiscal year 2020. The graphs also show second-order polynomial fits. At 13:01 EDT on October 8, the OECD released that 136 countries had agreed on the specific rules of the global tax reform. This was the first announcement that companies with sales of greater than EUR 10 billion would be subject to the new rules of consumer-location-based taxation of profits under Pillar 1.

In all specifications in Panel A, we use observations on the event date of October 8, 2021, and estimate negative coefficients which are statistically significant at conventional levels (t-statistics of -1.98, -1.91, and -2.30). The coefficients suggest that companies' stock prices above the size thresholds decreased by around 31-34 basis points, relative to companies below the threshold, after the OECD released the detailed rules of the global tax framework on October 8. Results in Panel B corroborate these inferences. Consistent with companies that are less international being less exposed to the reform, we document a smaller and statistically insignificant coefficient in column (1) based on the full sample of companies. Similarly, we document no evidence for a negative reform effect using all event dates and the full sample (column (2)). Re-running our test based on observations

A.3 in the appendix, consistent with no evidence of manipulations.

[21] As our measurement of the threshold value might be noisy and therefore bias our estimates from the local RDD, we complement our results by providing average stock returns in larger categories of 2020 sales. Consistent with our RDD results, we only document negative average stock returns for companies with sales greater than USD 12 billion. Specifically, we observe a clear discontinuity between average returns for companies reporting between USD 10 billion-12 billion and between USD 12 billion-14 billion (Figure A.4 in the appendix).

on the event date of October 8, 2021, but using a placebo size threshold of USD 5 billion yields an insignificant coefficient with a positive sign (column (3)).

Other determinants of stock market reactions. To further pin down the relationship between MNCs' tax planning benefits under the current tax regime and the global tax reform's negative impact on MNCs' values, we re-run our main analysis using additional company-level exposure measures. Specifically, these are *Intangible Ratio*$_i$ and *Tax Haven Subsidiaries Ratio*$_i$. These measures capture the MNCs' ability to shift income to low-tax jurisdictions using intellectual property and foreign acquired assets and their propensity to aggressively avoid international taxes through the use of tax havens.[22] We use these variables in tests reported in Table A.4 and provide variable definitions in Table A.1 in the appendix.

We document significantly negative stock price responses in the event window for companies with a higher share of intangible assets and more subsidiaries incorporated in tax havens. Specifically, a one standard deviation increase in intangible assets ratio (tax haven subsidiaries ratio) is associated with a 3.3 (1.4) basis point decrease in stock prices. As high intangibility indicates an ability to shift income to low-tax jurisdictions and tax haven operations facilitate the most aggressive tax avoidance under the current tax regime (e.g., Dyreng et al., 2017; Tørsløv et al., 2022), we view these results as confirmatory evidence of our main inferences.

Aggregate results by industry. We next examine the effects of the global tax reform on industries. Each company in our dataset is assigned to an industry based on its four-digit SIC code. We use the 48 industry classifications provided on Kenneth F. French's website. We then compute the value-weighted returns for each industry using three-factor-adjusted daily returns on the day of the tax event. Figure 6 shows average risk-adjusted returns as a function of the industry average foreign earnings scaled by total pre-tax earnings. Each circle corresponds to one industry.

Our analysis yields several insightful patterns. First, consistent with our findings

[22] *Tax Haven Subsidiaries Ratio*$_i$ is defined as the number of an MNC's subsidiaries incorporated in tax haven countries scaled by the total number of legal entities in an MNC's corporate group. The measure is based on the MNC's corporate ownership tree constructed based on the BvD Orbis data that we use to measure *MNC Tax Rate Differential*$_i$. We classify tax haven countries following Bennedsen and Zeume (2018).

Table 5. **High-frequency stock prices responses around the EUR 10 billion sales threshold**

Panel A	2021 October 8 (1)	2021 October 8 (2)	2021 October 8 (3)
RD Estimate	-34.61	-32.66	-31.01
	[-1.98]	[-1.91]	[-2.30]
Observations	1,444	1,444	1,225
Observations in BW	222	167	172
Polynomial Order	2	1	1
Covariates	No	No	Yes
Sample	Foreign Earnings	Foreign Earnings	Foreign Earnings

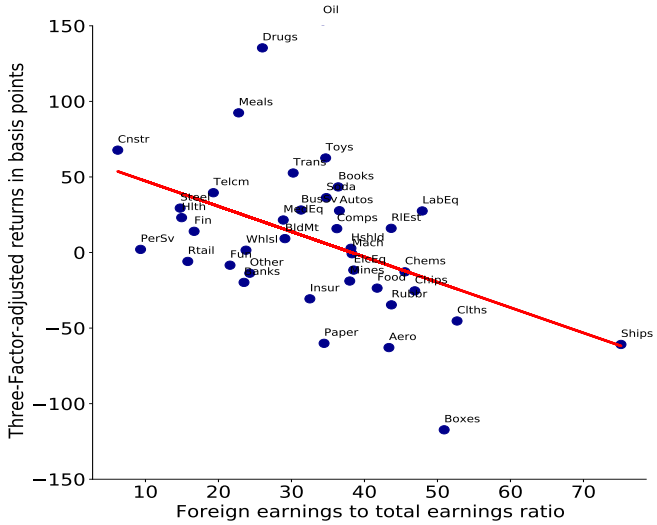
Panel B	2021 October 8 (1)	other Events (2)	2021 October 8 (3)
RD Estimate	-13.28	23.51	
	[-1.08]	[0.60]	
Placebo Estimate			11.56
			[0.80]
Observations	2,047	7,024	1,444
Observations in BW	358	939	410
Polynomial Order	2	2	2
Covariates	No	No	No
Sample	Full	Full	Foreign Earnings

The table reports the regression estimates from local polynomial regression discontinuity estimations based on the following equation.

$$\Delta p_{i,t} = a \cdot Treated_i + b \cdot \text{RV}_i + c \cdot \text{RV}_i * Treated_i + \epsilon_{it},$$

where $\Delta p_{i,t}$ denotes the change in log stock prices for stock i around the tax event t. To compute these price changes, we use an 80-minute window around the tax event t (60 minutes before and 20 minutes after). $Treated_i$ is an indicator variable equal to one if the company reported sales of at least USD 12 billion in fiscal year 2020 and zero otherwise. RV_i is the running (or forcing) variable, defined as the difference between a company's sales in fiscal year 2020 and the threshold of USD 12 billion. We use robust bias-corrected confidence intervals and inference procedures following Calonico et al. (2014). Columns (1) in Panel A and (1) to (3) in Panel B use nonparametric local second-order polynomial regressions, and columns (2) and (3) in Panel A use nonparametric local linear (first-order polynomial) regressions. Covariates included in column 3 of Panel A are the natural logarithm of total assets, the GAAP effective tax rate, and the intangible assets ratio as of fiscal year 2020, respectively. We use mean-squared-error optimal bandwidths at both sides of the threshold. The *Foreign Earnings* sample includes companies with above-median values in Foreign earnings$_i$ (which is approximately 0.161). For calculating the *Placebo Estimate* in column (3) of Panel B, we use an arbitrary threshold of USD 5 billion. Price changes are in basis points. T-statistics are in square brackets.

Fig. 6. **Industry effects**



Notes: This figure shows average risk-adjusted returns as a function of the industry average foreign earnings scaled by total pre-tax earnings. Each circle corresponds to one industry. To compute the risk-adjusted returns, we use the Fama-French three-factor model. Returns are computed over the day of the tax events. Risk-adjusted returns are in basis points, and the foreign earnings scaled by total pre-tax earnings are in percentage points.

that companies with a higher share of intangible assets experience more negative stock price reactions, high-technology and intellectual property-intensive industries appear to be hurt more by the reform. Industries like computer chips, chemicals, electronic engineering, and laboratory equipment have a relatively high share of foreign earnings and experience negative stock price reactions. This finding indicates that investors anticipate broader effects of the reform for whole industries, rather than being concerned about the tax strategies of individual important players, like Google or Amazon. Second, several industries with companies providing physical goods or services in foreign markets seem to be harmed by the reform. Examples are the container/logistics or shipping industry. These findings indicate that also companies with less intellectual property but a high share of taxable income reported in foreign jurisdictions have likely exploited the current tax system and will face higher tax burdens under the new rules.

Finally, companies listed in the U.S. belonging to several industries on average exhibit a low share of foreign earnings and close to zero or positive returns. Examples are the construction industry, steel, meals, and retail industries. These findings are

consistent with companies in these industries generating the largest part of revenues and reporting the largest part of their taxable income in the United States, where most of their consumers are. Thus the global tax reform would have little impact on their tax burdens.[23]

4 Effect on countries

4.1 Predictions

Our goal in this section is to measure market perceptions of the effects of the global tax reform on countries' public finances. Under the current system, countries can compete via tax rates to attract international companies' capital and tax bases. Specifically, countries can choose to offer low corporate income tax rates or other favorable policies to encourage companies to allocate real resources and much of their taxable income to those countries (e.g., Tørsløv et al., 2022). However, this form of tax competition becomes largely obsolete under the new tax rules. A country's ability to collect taxes on MNCs' taxable income will partly be based on the size of the domestic consumer market. Further, the global minimum tax rate removes incentives to offer low corporate income tax rates.

We expect that the reform has macroeconomic effects because a primary function of the international tax system is to allocate taxing rights over business profits among countries. Cloyne, Martinez, Mumtaz, and Surico (2022) show that tax policy has significant effects at the macroeconomic level, and the global reform fundamentally changes the way international taxing rights are allocated (Vella et al., 2021). Thus the global reform will impact countries' public finances through changes in corporate tax revenues and the allocation of multinational companies' real resources, depending on the companies' responses to the reform (De Simone and Olbert, 2022a). In fact, the

[23]The drugs industry shows relatively high positive returns but a relatively low foreign earnings ratio. This result is driven by many companies with a large domestic (U.S.) focus and thus a low foreign earnings ratio. Manually inspecting the foreign earnings ratio and cumulative abnormal returns reveals that several companies in the drugs industry that have a low share of earnings generated abroad experienced relatively high positive returns. Limiting the sample to companies in the drugs industry with a foreign earnings ratio above the 75th percentile, we document average returns of -17.28 basis points.

OECD estimated changes in corporate tax revenues for different reform scenarios in 2020 (OECD, 2020).[24] Importantly, the reform should not only directly impact countries' tax revenues in a narrow sense, that is, the collection of relatively more or less corporate income taxes. It likely also indirectly impacts countries' public finances, as MNCs might reallocate their real resources like employment, intellectual property, and cash, which will in turn affect countries' economic growth.[25]

Therefore we predict that countries attracting large tax bases of multinationals and thus benefiting the most from the current tax regime will face the greatest cost associated with the reform. Countries likely being worse off after the reform would be Ireland, Luxembourg, or small tax havens. If investors expect that these countries will lose out in terms of a decrease in tax revenues and potentially a decrease in the activity of multinationals, investors' demand for these countries' sovereign bonds would fall and CDS spreads would increase, as these countries' macroeconomic outlook becomes bleaker. In contrast, countries that have large consumer markets but currently receive a relatively small part of the tax revenue pie, like large developing countries, should be the greatest beneficiaries of the reform. These expectations are supported by the fact that Ireland was one of the last countries to join the agreement in late November 2021, while developing countries have long been pushing for a reform of the international tax rules (Government of Ireland, 2021; OECD, 2021a).

[24]For a scenario that most closely reflects the market-based taxation of profits under the new rules (Pillar 1), OECD estimates indicate that corporate tax revenues would decrease in investment hub countries, like Singapore, Luxembourg, or Ireland, by almost 6% and increase in low income countries by almost 2%. The tax revenue effects of a global minimum tax are much harder to predict, given that specific rules have yet to be set out. Further, the effects strongly depend on behavioral responses of global companies with respect to their profit shifting and countries with respect to their tax policies. Recent theoretical work (Johannesen, 2022) suggests investment hub countries will increase their statutory corporate tax rates. Under such a scenario, low income countries will expect an increase in corporate tax revenue by 2%-4%. The effect for investment hub countries depends on companies profit shifting and could be negative or positive.

[25]Specifically, tax havens, like the Bahamas, currently levy a 0% tax rate on corporate profits. Thus, by construction, the reform will not lead to lower tax revenues in such countries. However, if MNCs reallocate their legal entities, staff, intellectual property, or cash holdings away from such countries, as the global tax reform removes the current incentives to operate in tax havens, the tax havens' public finances will suffer due to a drop in fees collected from MNCs, payroll taxes, and growth in the local professional service sector.

4.2 Data

4.2.1 Measuring countries' exposures

We aim to measure the extent to which a country will be affected by the global tax reform. The reform's goal is to significantly alter how much taxes companies have to pay on their global profits and how the resulting revenues are allocated across countries, given the country's size of the consumer market. Thus we need to capture by how much taxable income of MNCs will be allocated to or reallocated from a country. Further, the measures should capture how much of MNCs' income currently reported in a given country is due to aggressive profit shifting.

To generate ex-ante measures of exposure to the potential costs on countries' public finances induced by the reform, we combine macroeconomic data from the World Bank with information on multinationals' allocation of real factors, revenue, profits, and tax payments in a specific country from the OECD's Country-by-Country (CbC) Reporting database. The World Bank data is available through the World Bank Open Data API at https://data.worldbank.org/. We specifically use data on total household consumption measured in purchase-price adjusted international dollars as a proxy for a country's market size. CbC reporting data is available at https://stats.oecd.org/. The publicly available CbC data is based on all reporting MNCs' individual CbC reports.

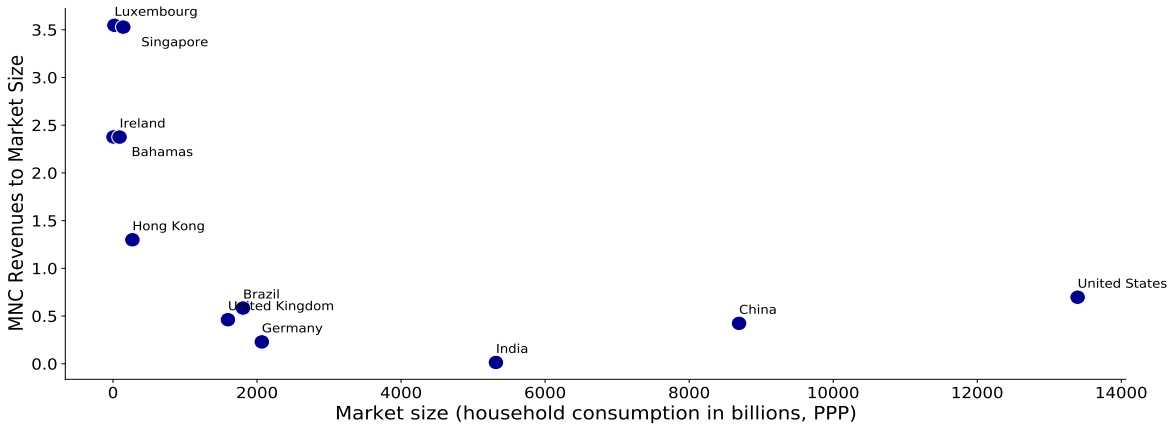
Since 2016, almost all countries in the world mandate that MNCs with sales of more than EUR 750 million produce reports detailing the location of their international operations, including the number and activity of legal entities, revenues, pre-tax income, taxes paid, and employees and assets in each country in which they have operations in. These rules were implemented to make companies' international tax planning strategies transparent. De Simone and Olbert (2022b) and Joshi (2020) discuss the CbC Reporting regime in detail. The OECD collects these reports from tax authorities around the world and aggregates the data at the country-pair level for each reporting year, where a country pair is an MNC's home jurisdiction (where the company is incorporated) and a given reporting jurisdiction (all countries where a company has operations through at least one legal entity). We aggregate these data by reporting jurisdiction. This procedure allows us to observe the total amount of, for example, revenues, pre-tax income, and taxes paid

of all globally operating companies reported in a given country as well as the number of legal entities of these companies in a given country.

Our first country-level exposure variable is *MNC Revenues to Market Size*$_k$, which we define as the sum of all MNCs' external revenues reported in the CbC files for a given country k scaled by this country's total household consumption. This measure aims to capture the misalignment between a country's size of its consumer market (i.e., where profits will be taxed under the reform) and tax bases of global companies allocated to a country under the current rules. To showcase the misalignment for specific countries, we illustrate selected values of this proxy in Figure 7. Countries typically labelled as tax havens exhibit values far above 1. For instance, in the financial centers and alleged tax havens Luxembourg and Singapore, global companies report that they generate external sales that exceed these countries' domestic household consumption by approximately 350%. In Ireland, a famous host country for global technology companies' intellectual property, and the Bahamas, a so-called dot haven without much of a real economy, global companies' reported revenues exceed domestic household consumption by approximately 200%-250%. In European countries with relatively large economies, like the United Kingdom and Germany, the ratio of global companies' reported revenues to household consumption is approximately 50%. In the emerging markets of India and China, which have very large consumer markets, the ratios are below 50%. For countries other than the United States, the *MNC Revenues to Market Size* measure is conceptually aligned with the company-level exposure measure *Foreign Earnings Ratio*, because the latter proxies for companies having relatively large tax bases in countries *outside* the United States and the former captures the aggregate tax bases of MNCs reported in a given country.

Our second country-level exposure variable is *MNC Taxable Income Margin*$_k$, which we define as the sum of all multinational companies' pre-tax earnings reported in the CbC files for a given country k scaled by all global companies' external revenues reported in the same CbC files. This measure aims to capture aggregate effects of companies' profit shifting in the spirit of Tørsløv et al. (2022). The intuition is that companies have a greater incentive to allocate pre-tax income to a given country in which it reports revenues if this country offers a preferential tax regime under the current system. Thus

Fig. 7. ***MNC Revenues to Market Size*: selected countries**



Notes: This figure plots the relationship between MNCs' revenues reported in a given country and the country's consumer market size of selected sample countries. The y-axis shows a country's value of our variable of interest, *MNC Revenues to Market Size*. The x-axis shows a country's market size (the denominator in our variable of interest *MNC Revenues to Market Size*). MNC revenues is the sum of revenues reported by MNCs in the CbC files. Consumer market size is defined as household consumption in billions (purchasing power parity-adjusted in current national currency per USD).

a disproportionately high pre-tax income to revenues figure is another proxy for a country's exposure to the global tax reform. This measure is conceptually aligned with the company-level exposure measures *Foreign Low Tax Benefit to Assets* and *MNC Tax Rate Differential*, because the latter two proxy for a company's income tax-motivated profit shifting and the former captures the consequence of MNCs reporting large income tax bases in a given country.

Table 6 provides summary statistics for these two variables. We show statistics for the full sample of countries and separately for nontax-haven and tax haven countries using the tax haven classifications of Bennedsen and Zeume (2018) and De Simone and Olbert (2022b). Consistent with our measures capturing global companies' tax base allocations and a misalignment between actual market sizes and tax bases under the current system, we observe substantially higher means in the reported revenues-to-market size ratio (Panel A) and in the reported taxable income margin (Panel B) for the subsample of tax haven countries.

In the appendix, we use three additional country-level variables for supplementary tests. Specifically, these are *MNC Taxable Income to Market Size*$_k$, *MNC Taxes Paid to Market Size*$_k$, and *MNC Entities to Population*$_k$. The construction of these variables

Table 6. **Summary statistics for country-level exposure variables**

Panel A: *MNC Revenues to Market Size*								
	Count	Mean	SD	p5	p25	p50	p75	p95
Total	131	0.32	0.67	0.0002	0.014	0.06	0.23	1.31
Non-tax haven	119	0.21	0.34	0.0004	0.014	0.05	0.21	0.96
Tax haven	12	1.46	1.60	0.0063	0.09	0.73	2.66	3.73
Panel B: *MNC Taxable Income Margin*								
	Count	Mean	SD	p5	p25	p50	p75	p95
Total	122	0.12	0.22	-0.11	0.05	0.10	0.16	0.35
Non-tax haven	113	0.10	0.18	-0.11	0.04	0.10	0.16	0.33
Tax haven	9	0.36	0.48	0.02	0.08	0.17	0.28	1.21

Notes: This table reports summary statistics for the main country-level variables for the full sample of countries and the subsamples of nontax-haven and tax haven countries. Panel A presents values for the reported revenues to market size ratio. Panel B presents values for reported taxable income margin. Variable definitions are provided in Table A.1 in the appendix.

follows the same intuition in that these variables capture the misalignment between companies' tax base allocations and countries' consumer market sizes under the current system. Tables A.6 and A.1 in the appendix provide summary statistics and variable definitions.

4.2.2 Asset prices: Sovereign debt CDS spreads

To measure investors' expected impact of the reform on countries' public finances, we use the prices of credit derivatives that measure the credit risk of countries. Specifically, we use credit default swap spreads for countries' sovereign debt. Sovereign debt CDS have several advantages for our setting. First, sovereign debt CDS are frequently traded and thus allow us to observe market expectations with respect to the outcomes of an entire country in a short time window (Augustin et al., 2014; Lando, 2020). Second, sovereign debt CDS contracts are distinct from corporate CDS in that the event triggering the contingent default insurance payment is not necessarily a country's bankruptcy. Instead, insurance payments are triggered if the reference entity repudiates one or more relevant obligations or declares a moratorium relating to these obligations (Cruces and Trebesch, 2013; Augustin et al., 2014). For example, the default of Greece in 2012 was mostly due to the majority of bond holders agreeing on a voluntary debt restructuring, rather than

Greece actually being bankrupt. Therefore higher CDS spreads should capture investors' expectation of a country facing greater difficulties in fulfilling its obligations and do not necessarily only reflect whether investors think a country is actually more likely to go bankrupt (Salomao, 2017).

The ability to fulfil debt obligations is a key aspect of a country's public finances, and tax revenues are the key income source for a country's public finances (e.g., Eaton and Fernandez, 1995). Therefore we argue that the global tax reform should affect countries' CDS if investors expect the reform to impact countries' tax revenues, either directly or in a broader sense through the allocation of MNCs' real resources (see Section 4.1 for a discussion). Thus we interpret higher CDS spreads as a proxy for investors' more negative outlook for a country's public finances.

We use five-year credit default swap spreads on sovereign bonds for 90 countries. The data comes from IHS Markit and Bloomberg and is available at daily frequency. We download data for all trading days in 2021. Table A.7 in the appendix provides summary statistics on our CDS variable. The level of the CDS spreads vary significantly across countries. For instance, the United States, Germany, Mexico, Ireland, India, and Hong Kong had average CDS spreads of 25, 26, 121, 162, 120, and 44 basis points in our sample period, respectively. However, the daily percentage change in CDS spreads is close to zero for the average country-day observation in 2021.

4.3 Empirical Strategy and Results

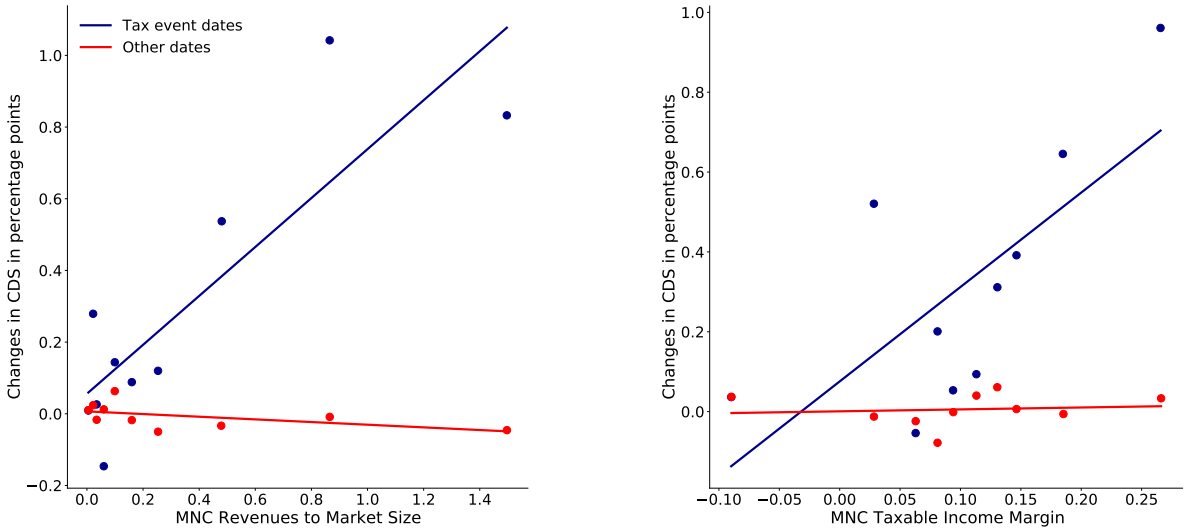
4.3.1 Effects on daily CDS spreads

We predict that the reform will impact countries' public finances through the reallocation of global companies' tax bases. To test this, we estimate the following regression.

$$\begin{aligned}\Delta CDS_{k,d} = a + b \cdot TaxEvent_d + c \cdot CountryExposure_k \\ + d \cdot (CountryExposure_k \times TaxEvent_d) + \epsilon_{k,d},\end{aligned} \tag{5}$$

where $\Delta CDS_{k,d}$ refers to the percentage change in CDS spreads for country k on day d and $TaxEvent_d$ is a dummy variable equal to one if day d happens to be on the day

Fig. 8. **Changes in sovereign CDS spreads and countries' exposure to the global tax reform**



Notes: We first sort countries into 10 bins based on their $CountryExposure_k$ measure. We then compute both average $CountryExposure_k$ and average CDSs' percentage changes for each of the 10 ordered bins. The blue circles use CDS changes occurred during tax event dates, while the red circles uses non tax event dates. The lines denote regression fit lines. The left panel uses MNCs' reported revenues scaled by a country's market size as the sorting variable. The right panel uses MNCs' reported pre-tax earnings scaled by revenues as the sorting variable.

of a tax event (shown in Figure 2) and 0 otherwise. $CountryExposure_k$ denotes the exposure of country k to the tax event (i.e., *CountryExposure* is either measured as *MNC Revenues to Market Size* or as *MNC Taxable Income Margin* in the main tests). To run this regression, we use all trading days for 2021. We cluster the standard errors at the country-tax-event level. We predict that $d > 0$, that is, the credit risk protection becomes more expensive for countries that have a higher exposure to the global tax reform.

We first illustrate our results in Figure 8. We sort countries into 10 bins based on their $CountryExposure_k$ measure. We then compute both average $CountryExposure_k$ and average CDSs' percentage changes for each of the 10 bins. The blue circles use CDS spreads changes occurred during tax event dates, while the red circles use nontax event dates. The lines denote regression fit lines. The left panel reports results using the ratio of reported revenues to market size as the sorting variable, while the right panel uses reported taxable income margin for $CountryExposure_k$. Figure 8 shows that the relation between $CountryExposure_k$ and CDS spreads changes is positive on tax event days but zero on any other date.

Table 7 presents regression estimates of Equation 5. To facilitate an interpretation,

in all regressions below, we standardize the $CountryExposure_k$ measure. In column (1), $CountryExposure_k$ is the MNCs' aggregate reported revenues scaled by the consumer market size in country k. Consistent with our prediction, the coefficient on the interaction term $CountryExposure \times TaxEvent$ is positive (27.99) and significant (t-statistic = 2.10), indicating that countries currently attracting a relatively high volume of reported revenues from MNCs' global operations experienced an increase in sovereign bond credit risk on the tax event dates. In terms of economic magnitude, the coefficient $\hat{d}$ indicates a 28 basis point higher change in CDS spreads on tax-event days if countries have a one standard deviation higher value in *MNC Revenues to Market Size*. This result represents a 19% increase, relative to the CDS spreads mean in our sample. For Hong Kong, a country acting as a tax-favourable jurisdiction under the current regime and with a mean CDS spread of 44.4 basis points in 2021, this effect would constitute a 63% increase in investors' perceived credit risk. Notably, the coefficient on $CountryExposure$ alone, $\hat{c}$, is small and statistically insignificant, suggesting that countries with a relatively high $CountryExposure_k$ do not exhibit differential trends in CDS spreads, relative to other countries on nontax event dates.

Column (2) of Table 7 shows results for when we use MNCs' aggregate pre-tax earnings scaled by revenues as our measure for $CountryExposure$. Countries with higher reported taxable income margin experience a substantial increase in their CDS spreads on tax event dates, as implied by the positive coefficient $\hat{d}$ equal to 27.91 (t-statistic = 3.31). In terms of economic magnitude, CDS spreads change by around 28 bps more for a one standard deviation higher value in countries' taxable income margin.

Table A.8 in the appendix presents consistent results when using alternative measures of country exposure. Specifically, we document that countries in which MNCs currently report more taxable income and pay more taxes, relative to a country's market size, experience significantly positive changes in CDS. We also document these effects for countries in which MNCs have incorporated a disproportionately high number of legal entities, likely for tax planning purposes, relative to a country's population size.

Table 7. **Changes in CDS spreads in response to the global tax reform**

	ΔCDS	
Country Exposure Variable:	*MNC Revenues to Market Size*	*MNC Taxable Income Margin*
	(1)	(2)
$CountryExposure \times TaxEvent$	27.99	27.91
	[2.10]	[3.31]
$CountryExposure$	-2.36	-1.14
	[-0.88]	[-1.60]
$TaxEvent$	47.80	45.67
	[3.08]	[2.89]
Constant	4.31	5.22
	[0.62]	[0.74]
R-squared (%)	0.08	0.07
Observations	19228	20493

The table reports the regression estimates for the following equation.

$$\Delta CDS_{k,d} = a + b \cdot TaxEvent_d + c \cdot CountryExposure_k + d \cdot (CountryExposure_k \times TaxEvent_d) + \epsilon_{kd},$$

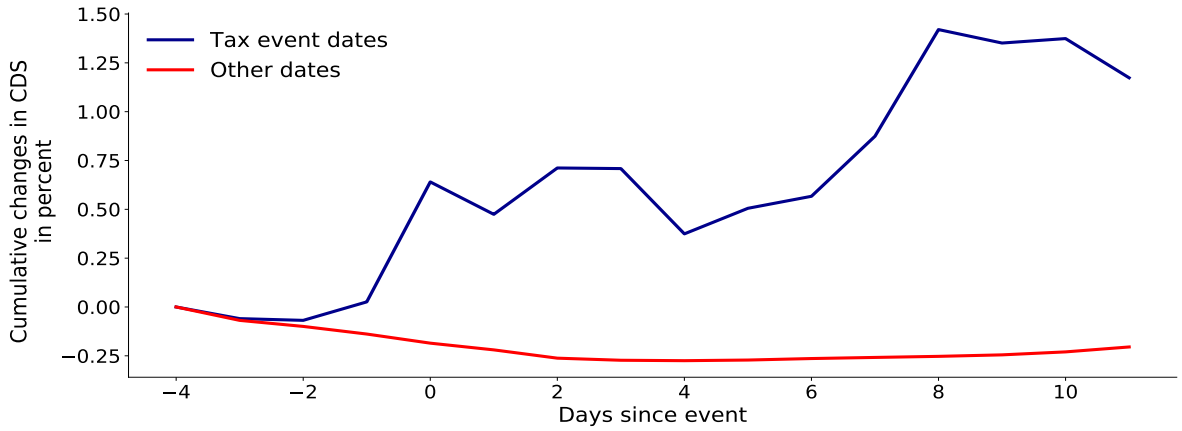
where $\Delta CDS_{k,d}$ refers to the change in CDS spreads for country k on day d (in basis points); $TaxEvent_d$ is a dummy variable equal to one if day d happens to be on the day of a tax event (shown in Figure 2) and 0 otherwise; $CountryExposure_k$ denotes the standardized exposure of country k to the tax event. In column (1), $CountryExposure_k$ is the MNCs' aggregate reported revenues scaled by the consumer market size in country k. In column (2), $CountryExposure_k$ is MNCs' aggregate pre-tax earnings scaled by external revenues in country k. We use all trading days during 2021. We cluster the robust standard errors at the country-tax-event level. T-statistics are in squared brackets.

4.3.2 Persistence of effects on CDS spreads

We then ask whether the effects on CDS persist by extending the analysis to the days surrounding the tax events. For each country, we compute the cumulative change in CDS from five days before the tax event and expand the window to two weeks after. We then sort countries into 10 groups based on $CountryExposure_k$, that is, their ex-ante exposure to the global tax reform. We then form a CDS spread by taking the difference in cumulative CDS changes between the countries sorted in the last decile (i.e., high values of $CountryExposure_k$) and the countries sorted in the first decile (i.e., low values of $CountryExposure_k$).

Figure 9 shows the CDS spread, where we use the reported taxable income margin as a sorting variable. After the tax event days, the CDS spread (blue line) significantly drifts upward for the next two to eight days and then flattens out. Consistent with our

Fig. 9. **Event-time cumulative CDS spread**



Notes: This figure shows differences in cumulative CDS changes between countries highly exposed to the tax reform and those with lower exposure. We first sort countries into 10 bins based on their reported taxable income margin (i.e., the $CountryExposure_k$ measure). Countries in the first (last) decile have a low (high) exposure. The blue line shows the difference in cumulative changes from four days before the tax event to 14 days afterward. The red line shows cumulative changes in CDS during any other day not overlapping with the tax event dates.

company-level results presented in Section 3, we do not observe a pre-announcement drift in the days leading up to the tax event days: The CDS spread from day $t-4$ to day $t-1$ is close to zero and statistically insignificant. Finally, as shown by the red line, on nontax event dates, the CDS spread is close to zero. Based on these results, we conclude that the effects of the global tax reform do persist and increase in the days following the tax reform announcement events.

Collectively, these macro-level results show that countries that attract large tax bases and operations of global companies under the current tax regime exhibit significant increases in their sovereign CDS spreads. This evidence suggests that the information events during the negotiations of the global tax reform changed market participants' expectations regarding the outlook for countries' public finances, proxied by the credit risk of sovereign bonds. The results are consistent with investors expecting a decrease in governments' revenues, which could impair their financial ability to service their sovereign debt after the global tax reform takes effect in 2023. These expectations can be due to investors anticipating that governments will collect less corporate income tax, relative to the current regime. Investors might also anticipate that multinationals would allocate fewer resources to these countries, resulting in lower economic activity and reductions

in government revenues through several indirect channels, like fees, payroll and other non-corporate income taxes, and economic growth in the professional service sectors. To the best of our knowledge, these results provide the first macroeconomic evidence on potential tax revenue reallocation effects induced by a global tax reform. Specifically, our results indicate that the global tax reform will benefit emerging markets with large consumer markets and hurt countries that operate as favorable tax jurisdictions under the current regime of international company taxation.

5 Concluding remarks

Our paper provides novel evidence on the impact of the global tax reform on affected companies' shareholder values and countries' public finances. In 2021, more than 140 countries agreed to overhaul the system of taxing global companies' profits by allocating tax bases to countries where final consumers reside and applying a global minimum tax rate of 15%. We exploit the reform's negotiations in 2021 and high-frequency asset pricing data to estimate the market participant's expectations of the reform effects. To measure companies' exposure to the reform, we combine several data sources to proxy for companies' current international tax planning strategies through foreign-sourced income, the allocation of income to low-tax countries, and the use of tax havens. To measure countries' exposure, we devise a novel approach by combining macroeconomic data on countries' market sizes and publicly available aggregate data from global companies' tax returns, which allows us to observe companies' tax bases and resource allocations to specific countries under the current regime.

We show that companies that minimize their global taxes under the current system exhibit significant decreases in firm value after the announcement of the global tax reform. Further, our results suggest that investors expect the reform to have significant macroeconomic effects through the reallocation of tax revenues across countries. Specifically, countries currently attracting a large portion of global companies' tax bases but having relatively small domestic economies experience increases in credit default swap spreads on their sovereign bonds, suggesting investors expect that these countries' public finances are worse off after the reform becomes effective. In contrast, our results suggest that

emerging countries with large consumer markets that currently do not have a large share of global companies' tax bases will likely benefit through higher tax revenues under the new rules.

To the best of our knowledge, our study is the first to investigate the microeconomic and macroeconomic effects of the recent global tax reform. Specifically, we show how a reform that comes with a fundamental shift in tax competition impacts firm values both in the cross-section depending on companies' characteristics and in terms of the aggregate loss in shareholder value. Furthermore, we provide the first macroeconomic evidence on potential corporate income tax revenue and MNCs' resource reallocations induced by a global tax reform. Our results have important policy implications, as regulators are working to set out the rules for implementing the reform and policymakers are considering domestic policy changes to counteract the potential impact on their tax revenues. Our results also inform future research on the real effects of companies' responses to the reform.

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Appendix A Additional analysis

A.1 Variable definitions

Table A.1. **Variable definitions and data sources**

Variable	Definition	Source
Company-level asset prices		
$\Delta p_{i,t}$	Change in log stock prices for stock i around the tax event t. The change is computed in an 80-minute window around the tax event t (the last trade at least 60 minutes before and the first trade at least 20 minutes after).	TAQ
$r_{i,t}$	Daily stock price return for stock i on day t.	CRSP
SMB, HML, MOM	Daily returns on the size (SMB), value (HML), and momentum (MOM) factors.	CRSP, & K. French's website
Company characteristics		
Foreign Earnings Ratio	Foreign earnings of company i scaled by its total pre-tax earnings (average over the three fiscal years before the tax reform announcement).	Compustat
Foreign Low Tax Benefit to Assets	Tax benefit due to pre-tax earnings being taxed at a low foreign tax rate scaled by total assets. The tax benefit is the deviation of company i's GAAP tax expense from the expected tax expense if the U.S. statutory tax rate was applied to all pre-tax earnings. (average over the three fiscal years before the tax reform announcement)	10-K reports (SEC)
MNC Tax Rate Differential	Difference between the highest and lowest domestic corporate income faced by subsidiaries' of the same multinational company i across its subsidiaries' countries of incorporation.	Orbis, KPMG
Intangible Ratio	Book value of intangible assets scaled by total assets of company i.	Compustat
Tax Haven Subsidiaries Ratio	Number of subsidiaries incorporated in tax haven jurisdictions scaled by the number of all subsidiaries of company i.	Orbis
RV	Running variable used in the regression discontinuity design, defined as the difference between company i's sales in fiscal year 2020 and USD 12 billion.	Compustat
Treated	Indicator variable equal to one if the running variable (RV) used in the regression discontinuity design is larger than 0 for company i.	Compustat
Disclosed (Earnings Calls)	Indicator variable equal to one if company i mentions the potential passage of the global tax reform in its last earnings conference call before July 2021.	Capital IQ

Continued on next page

Table A.1 – continued from previous page

Variable	Definition	Source
Disclosed (10-K)	Indicator variable equal to one if company i mentions the potential passage of the global tax reform as a risk to its business in Item 1A ("Risk Factors") in its last 10-K report before July 2021.	10-K reports (SEC)
Country-level asset prices		
$\Delta CDS_{k,d}$	Change in daily credit default swap spread for government bonds of country k around the tax event t on day d, scaled by the CDS spread at the beginning of the trading day	IHS Markit
MNC Revenues to Market Size	The sum of all global companies' external revenues reported in the Country-by-Country (CbC) Reporting files for a given country k scaled by this country's total household consumption.	OECD, Worldbank
MNC Taxable Income Margin	The sum of all global companies' pre-tax earnings reported in the CbC files for a given country k scaled by all global companies' external revenues reported in the same CbC files.	OECD
Tax Haven	Indicator variable equal to one if a given country k is classified as a tax haven jurisdiction.	Bennedsen and Zeume (2018)
MNC Taxable Income to Market Size	The sum of all global companies' pre-tax earnings reported in the CbC files for a given country k scaled by this country's total household consumption.	OECD
MNC Taxes Paid to Market Size	The sum of all global companies' taxes paid reported in the CbC files for a given country k scaled by this country's total household consumption.	OECD
MNC Entities to Population	The sum of all global companies' number of legal entities reported in the CbC files incorporated in a given country k scaled by this country's number of inhabitants.	OECD

A.2 Details on measuring the reform's full value effect

This section provides the details on how we estimate investor expectations about the global tax reform. Specifically, we follow Borochin and Golec (2016) and consider N call options on the same stock whose life span a specific tax event t and, therefore, protect against the risk associated with the event. These options have the same time to maturity and differ only with respect to the exercise price X_k, with $k = 1, \ldots, N$. For each k, we set the observed option price one day before the tax event t, $C_{k,t-1}(S_t, X_k)$ equal to the probability-weighted average of two hypothetical call options; one option price associated with the theoretical stock price, S_n, in the case the reform fails $C_{k,t-1}(S_n, X_k, \sigma_{n,k})$ (i.e., no event), and the other option price linked with the theoretical stock price, $S_n + V$, in the case the reform advances $C_{k,t-1}(S_n + V, X_k, \sigma_{e,k})$ (i.e., event):

$$\begin{aligned} C_{k,t-1}(S_t, X_k) =& (1 - \pi_t) C_{k,t-1}(S_n, X_k, \sigma_{n,k}) \\ &+ \pi_t C_{k,t-1}(S_n + V, X_k, \sigma_{e,k}), \quad \text{for} \quad k = 1, \ldots, N, \end{aligned} \tag{A.1}$$

where we are also allowing for different option implied volatilities (i.e., $\sigma_{e,k}$ and $\sigma_{n,k}$) across states. The state-dependent stock prices $\{S_n, S_n + V\}$ and volatilities $\{\sigma_{n,k}, \sigma_{e,k}\}$, as well as the ex ante event probability π_t are latent and not observable. However, we can use the system of N equations defined by equation (A.1) together with the stock pricing equation $S_t = (1 - \pi_t)S_n + \pi_t(S_n + V)$ to back-out the market's level of anticipation that the tax reform will occur.[26] To this end, we stack all observed and model-implied prices in vectors P_t and $P_t(\theta)$, respectively, and solve the following minimization problem: $\theta^* = \text{argmin}_{\theta \in \Theta} |P_t - P_t(\theta)|' e$, where $\theta = (\pi_t, V, S_n, \sigma_{n,k}, \sigma_{e,k})$ and e is a vector of ones.

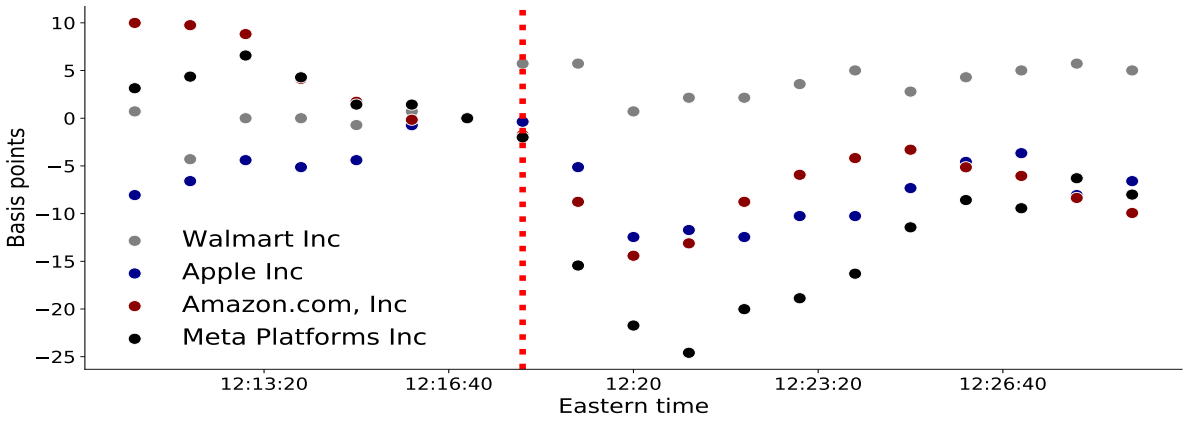
We use the Cox, Ross, and Rubinstein (1979) binomial pricing model to obtain a model-implied call price as it accounts for the early exercise premium embedded in American options. Regarding the observed option prices, we use call options for 30 different companies that satisfy three criteria. First, we consider only options for companies with a high ex ante $CompanyExposure_i$ (i.e., companies that are at least one standard deviation above in one of the three company exposures). We expect the reform to affect these companies significantly; therefore, their option prices are particularly informative about the value of protection against the tax events. Second, we consider only at-the-money options (i.e., options whose delta satisfies $0.4 < \delta < 0.5$), which tend to be more liquid than in-the-money options. Third, we select those options that have at least eight different strike prices for the same expiration date and the same firm. If multiple options satisfy this criterion, we select those options that have the closest date to maturity, span the tax events,[27] and have the largest positive open interest. Finally, we impose the identification constraint that $V < 0$ and use simulated annealing to estimate θ for each firm. Regarding the proxy for the risk free rate, we use the annualized one-month Treasury bill rate (from Ibbotson Associates).

[26] Strictly speaking, the estimated ex ante event probability π_t is the risk-neutral probability which equals the physical probability times the pricing kernel. Hence, the difference between the risk-neutral and physical probabilities is the market risk premium. Given that we are focusing on very short time windows around the tax events, the market risk premium is expected to be relatively small.

[27] We disregard those options that have a date to maturity within five days of the tax events as standard option pricing models produce significant measurement errors for ultra-short-maturity options (Kelly et al., 2016).

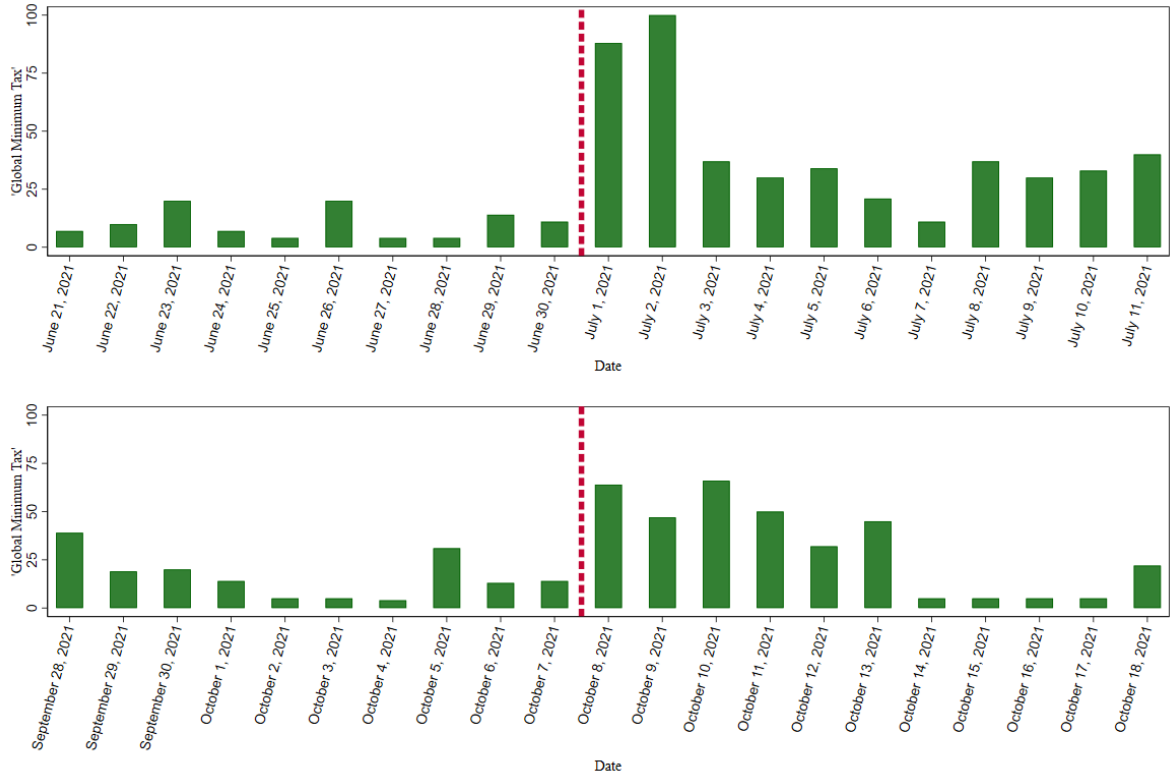
A.3 Additional figures and tables

Fig. A.1. **Stock prices around the global tax reform announcement**



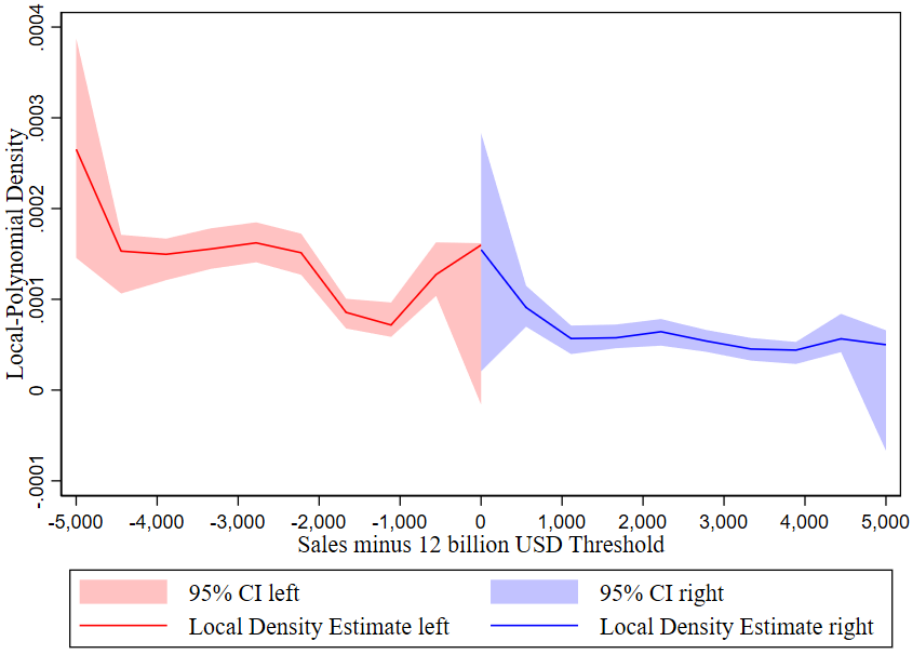
Notes: This figure shows the minute-level stock prices of selected companies in an 80-minute window surrounding 2021-07-01 12:19:26 The red dotted line highlights the exact time of the OECD press release.

Fig. A.2. **Google trends on 'global minimum tax' around July 1 and October 8, 2021**



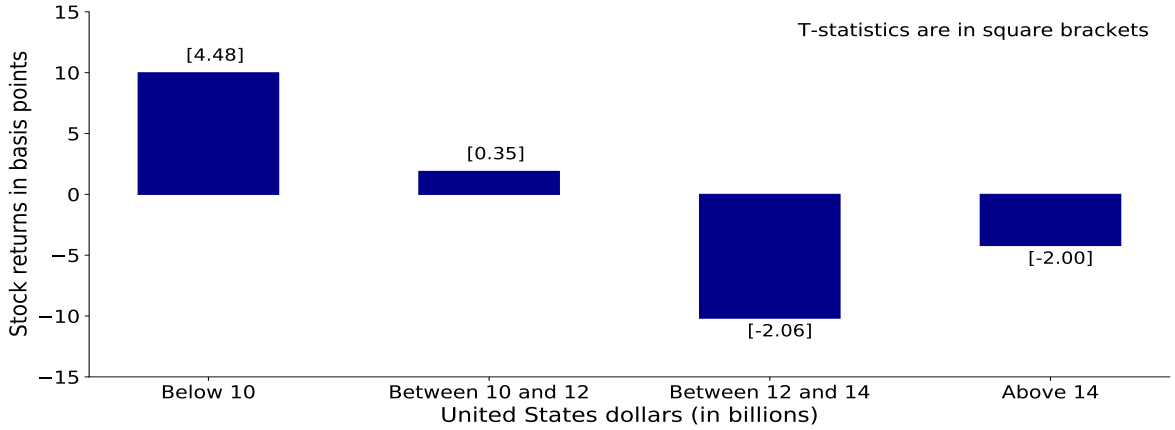
Notes: These figures plot the results for daily internet searches for the term 'global minimum tax' from Google trends for the event dates on July 1 and October 8 and the ten days before and after the event.

Fig. A.3. **Density of company observations around EUR 10 (USD 12) billion sales threshold**



Notes: This figure plots point estimates and their 95% confidence intervals of local polynomial densities over the running variable (sales in fiscal year 2020) around the threshold of USD 12 billion following McCrary (2008).

Fig. A.4. **High-frequency stock prices responses around the EUR 10bn sales threshold on October 8, 2021**



Notes: The figure shows average stock price responses in an 80-minute window surrounding 2021-10-08 13:01 EDT. At this time, the OECD released that 136 countries had agreed on the specific rules of the global tax reform. At this time, it was announced for the first time that companies with sales of greater than EUR 10 billion would be subject to the new rules of a market-based taxation of profits under Pillar 1.

Table A.2. **Summary statistics for firm-level exposure variables**

	Count	Mean	SD	p5	p25	p50	p75	p95
Panel A: *Foreign Earnings Ratio*								
Total	1113	34.74	29.38	0.69	8.36	27.51	55.85	91.50
Not disclosed (Earnings Calls)	1038	34.08	29.32	0.65	8.24	26.35	54.95	91.44
Disclosed (Earnings Calls)	75	43.85	28.86	3.54	22.99	38.18	68.47	93.58
Panel B: *Foreign Low Tax Benefit to Assets*								
Total	1504	0.07	0.60	-0.72	-0.07	0.01	0.15	1.00
Not disclosed (Earnings Calls)	1406	0.06	0.60	-0.72	-0.07	0.01	0.14	0.98
Disclosed (Earnings Calls)	98	0.12	0.62	-0.48	-0.07	0.03	0.32	1.08
Panel C: *MNC Tax Rate Differential*								
Total	2810	9.25	9.66	0.00	0.00	7.35	16.72	26.58
Not disclosed (Earnings Calls)	2667	9.08	9.63	0.00	0.00	7.17	16.34	26.58
Disclosed (Earnings Calls)	143	12.58	9.63	0.00	2.57	12.02	22.74	26.51
Panel D: *Tax Haven Subsidiaries Ratio*								
Total	2839	5.80	16.07	0.00	0.00	0.00	3.65	31.75
Not disclosed (Earnings Calls)	2691	5.68	16.07	0.00	0.00	0.00	3.43	30.38
Disclosed (Earnings Calls)	148	7.87	15.96	0.00	0.00	1.51	6.94	42.71
Panel E: *Intangible Ratio*								
Total	3543	17.53	20.90	0.00	0.54	7.75	30.04	62.55
Not disclosed (Earnings Calls)	3352	17.32	20.78	0.00	0.48	7.60	29.50	62.27
Disclosed (Earnings Calls)	191	21.27	22.62	0.00	1.14	11.78	39.06	65.53

Notes: This table reports summary statistics for the company-level exposure variables for the full sample of companies and the sub-samples of companies that mention and did not mention the global tax reform in their earnings conference calls. To create the indicator variable *Disclosed*, we parse the earnings call conference transcripts and search for mentioning of the terms 'International tax', 'Global tax', 'Minimum tax', 'Pillar 1', 'Pillar one', 'Pillar 2', 'Pillar two', 'taxation of multinational corporations'. We also search for the mentioning of 'OECD' and 'Organization for Economic Cooperation and Development' but impose the restriction that they appear in proximity to the term 'tax'.

Table A.3. **Summary statistics for firm-level exposure variables**

	Count	Mean	SD	p5	p25	p50	p75	p95
Panel A: *Foreign Earnings Ratio*								
Total	1165	33.80	29.40	0.61	7.70	25.71	54.69	90.49
Not disclosed (10-K)	748	28.78	28.32	0.48	5.31	19.02	44.45	87.32
Disclosed (10-K)	417	42.80	29.19	1.71	16.12	42.52	66.59	91.86
Panel B: *Foreign Low Tax Benefit to Assets*								
Total	1779	0.05	0.88	-0.90	-0.08	0.01	0.15	1.12
Not disclosed (10-K)	1170	0.04	0.87	-0.83	-0.08	0.00	0.12	0.95
Disclosed (10-K)	609	0.08	0.92	-1.05	-0.09	0.02	0.27	1.27
Panel C: *MNC Tax Rate Differential*								
Total	3139	7.98	9.55	0.00	0.00	2.60	13.08	26.53
Not disclosed (10-K)	2383	6.72	9.07	0.00	0.00	0.51	10.86	26.48
Disclosed (10-K)	756	11.97	9.96	0.00	0.94	10.84	23.03	26.56
Panel D: *Tax Haven Subsidiaries Ratio*								
Total	3140	2.34	5.57	0.00	0.00	0.00	1.74	13.69
Not disclosed (10-K)	2381	1.94	5.29	0.00	0.00	0.00	0.66	12.00
Disclosed (10-K)	759	3.61	6.21	0.00	0.00	0.67	4.64	17.14
Panel E: *Intangible Ratio*								
Total	4406	15.02	20.40	0.00	0.00	3.85	24.74	60.81
Not disclosed (10-K)	3482	13.74	19.75	0.00	0.00	2.92	21.27	58.93
Disclosed (10-K)	924	19.84	22.04	0.00	0.62	10.52	35.57	65.28

Notes: This table reports summary statistics for the company-level exposure variables for the full sample of companies and the sub-samples of companies that mention and did not mention the global tax reform in their risk factor disclosures in Item 1A (risk factor disclosures) in the 10-K annual reports. To create the indicator variable *Disclosed*, we parse the Item 1A section of the 10-K filings and search for mentioning of the terms 'International tax', 'Global tax', 'Minimum tax', 'Pillar 1', 'Pillar one', 'Pillar 2', 'Pillar two', 'taxation of multinational corporations'. We also search for the mentioning of 'OECD' and 'Organization for Economic Cooperation and Development' but impose the restriction that they appear in proximity to the term 'tax'.

Table A.4. **High-frequency stock prices responses to the global tax reform**

Panel A: *Intangible Ratio*		
	(1)	(2)
Intangible Ratio	-3.27	-3.78
	[-2.55]	[-1.81]
Foreign Earnings Ratio		-6.87
		[-3.56]
Foreign Low Tax Benefit to Assets		-4.32
		[-2.50]
MNC Tax Rate Differential		-5.86
		[-2.66]
Constant	-1.80	-2.17
	[-1.33]	[-1.06]
R-squared (%)	0.05	0.98
Observations	13012	3950
Panel B: *Tax Haven Subsidiaries Ratio*		
	(1)	(2)
Tax Haven Subsidiaries Ratio	-1.35	1.78
	[-1.93]	[0.69]
Foreign Earnings Ratio		-6.52
		[-3.35]
Foreign Low Tax Benefit to Assets		-4.99
		[-3.09]
MNC Tax Rate Differential		-8.79
		[-3.78]
Constant	1.66	-1.74
	[1.12]	[-0.83]
R-squared (%)	0.01	1.00
Observations	9355	3817

Notes: The table reports the regression estimates for the following Equation:

$$\Delta p_{i,t} = a + b \cdot CompanyExposure_i + \epsilon_{it},$$

where $\Delta p_{i,t}$ denotes the change in log stock prices for stock i around the tax event t. To compute these price changes, we use an 80-minute window around the tax event t (60 minutes before and 20 minutes after). $CompanyExposure_i$ denotes the exposure of company i to the tax event. In column (1) of Panel A, $CompanyExposure_i$ denotes the book value of intangible assets of company i scaled by total assets. In column (1) of Panel B, $CompanyExposure_i$ is defined as the number of an MNC's subsidiaries incorporated in tax haven countries scaled by the total number of legal entities in an MNC's corporate group. *Foreign Earnings Ratio* , *Foreign Low Tax Benefit To Assets* , and *MNC Tax Rate Differential* are defined in Table A.1 in the Appendix. We cluster the standard errors at the firm-tax-event level. T-statistics are in squared brackets. The $CompanyExposure_i$ is standardized and in percentage, while $\Delta p_{i,t}$ is in basis points. R^2 statistics are in percentage.

Table A.5. **Daily stock prices responses: Additional Results**

Panel A: Daily CAPM-adjusted returns				
	(1)	(2)	(3)	(4)
TaxEvent × *Foreign Earnings Ratio*	-34.11			-21.31
	[-4.93]			[-2.84]
TaxEvent × *Foreign Low Tax Benefit to Assets*		-19.32		-26.11
		[-4.09]		[-3.17]
TaxEvent × *MNC Tax Rate Differential*			-37.67	-27.59
			[-4.46]	[-2.96]
Foreign Earnings Ratio	5.51			3.32
	[1.66]			[1.86]
Foreign Low Tax Benefit to Assets		-0.35		-0.82
		[-0.49]		[-0.49]
MNC Tax Rate Differential			4.33	4.54
			[2.11]	[1.39]
TaxEvent	72.21	67.42	82.08	60.19
	[2.57]	[2.57]	[3.29]	[2.50]
Constant	-7.32	-4.52	-0.56	-5.45
	[-10.86]	[-7.17]	[-0.93]	[-9.42]
Observations	245,511	495,471	507,232	189,912
Panel B: Daily Four-factor-adjusted returns				
	(1)	(2)	(3)	(4)
TaxEvent × *Foreign Earnings Ratio*	-14.26			-12.05
	[-2.62]			[-2.18]
TaxEvent × *Foreign Low Tax Benefit to Assets*		-12.48		-16.48
		[-2.87]		[-2.47]
TaxEvent × *MNC Tax Rate Differential*			-18.14	-3.42
			[-2.77]	[-1.50]
Foreign Earnings Ratio	3.50			2.33
	[1.19]			[1.23]
Foreign Low Tax Benefit to Assets		-0.71		-0.90
		[-1.27]		[-0.68]
MNC Tax Rate Differential			0.22	2.07
			[0.13]	[2.31]
TaxEvent	-0.12	0.71	17.87	-0.87
	[-0.01]	[0.04]	[1.07]	[-0.05]
Constant	-6.55	-5.64	-2.72	-5.93
	[-13.67]	-[13.84]	[-6.79]	[-13.04]
Observations	245,511	495,471	507,232	189,912

The table reports the regression estimates for the following Equation:

$$r_{i,t,t+1} = +b \cdot TaxEvent_d + c \cdot CompanyExposure_i + d \cdot (CompanyExposure_i \times TaxEvent_d) + \epsilon_{i,t},$$

where $r_{i,t,t+1}$ denotes the company i's abnormal stock return from day t to day $t+1$, $TaxEvent_d$ is a dummy variable equal to one if there was a tax announcement day d (shown in Figure 2) and zero otherwise. We use all trading days during 2021. In all regressions, we include industry fixed effects and use double clustered standard errors at the stock and day level. T-statistics are in squared brackets.

Table A.6. **Summary statistics: Alternative measures of countries' exposure**

Panel A: *MNC Taxable Income to Market Size*								
	Count	Mean	SD	p5	p25	p50	p75	p95
Total	130	0.04	0.0945	0.0000	0.0002	0.0043	0.0291	0.2060
Non-tax haven	119	0.0304	0.0760	0.0000	0.0001	0.0039	0.0235	0.1229
Tax haven	11	0.1527	0.1785	0.0000	0.0024	0.1137	0.2305	0.4609
Panel B: *MNC Taxes Paid to Market Size*								
	Count	Mean	SD	p5	p25	p50	p75	p95
Total	128	0.0061	0.0104	0.0000	0.0003	0.0017	0.0082	0.0261
Non-tax haven	118	0.0054	0.0089	0.0000	0.0003	0.0014	0.0064	0.0239
Tax haven	10	0.0149	0.0198	0.0001	0.0009	0.0073	0.0191	0.0498
Panel C: *MNC Entities to Population*								
	Count	Mean	SD	p5	p25	p50	p75	p95
Total	127	89.48	184.75	0.1876	2.28	10.86	77.40	455.57
Non-tax haven	118	76.09	157.58	0.16	2.20	10.45	63.77	387.46
Tax haven	9	264.95	370.28	2.0645	8.20	91.10	198.66	910.99

Notes: This table reports summary statistics for the country-level variables for the full sample of countries and the sub-samples of non-tax haven and tax haven countries. Panel A presents values for the reported taxable income to market size ratio. This variable is defined as the sum of all global companies' pre-tax earnings reported in the CbC files for a given country k scaled by this country's total household consumption. Panel B presents values for the taxes paid to market size ratio. This variable is defined as the sum of all global companies' cash taxes paid reported in the CbC files for a given country k scaled by this country's total household consumption. Panel C presents values for the multinational entities to population ratio. This variable is defined as the sum of all global companies' legal entities incorporated in a given country according to the CbC files k scaled by this country's number of inhabitants.

Table A.7. **Summary statistics: CDS spreads**

Panel A: Percentage daily change in CDS spreads in percent								
	Count	Mean	SD	p5	p25	p50	p75	p95
Total	22620	0.06	3.10	-3.27	-0.70	-0.00	0.57	3.49
Non-tax haven	19760	0.07	3.09	-3.26	-0.73	-0.00	0.60	3.49
Tax haven	1560	-0.02	3.70	-3.80	-0.78	0.00	0.63	4.04
Panel B: CDS spreads in basis points for selected countries								
	Count	Mean	SD	p5	p25	p50	p75	p95
USA	3162	25.9	11.8	11.6	16.6	21.8	34.5	49.3
Germany	3162	26.8	22.9	8.9	11.3	18.0	33.6	85.5
Mexico	3162	121.3	32.5	81.1	99.5	115.0	137.2	175.8
India	2173	120.9	55.1	65.0	78.2	99.3	157.2	231.9
Ireland	3162	162.0	224.0	15.1	31.1	52.9	164.6	698.1
Hong Kong	3162	44.4	13.7	28.3	35.1	42.4	48.0	73.9

Notes: Panel A reports summary statistics for the daily change in CDS spreads for the full sample of countries and the sub-samples of non-tax haven and tax haven countries. Panel B presents summary statistics for CDS spreads for selected countries. The sample period ranges from January 2021 to December 2021.

Table A.8. **Alternative measures: Changes CDS spreads in response to the global tax reform**

	ΔCDS		
Country Exposure Variable:	*MNC Taxable Income to Market Size*	*MNC Taxes Paid to Market Size*	*MNC Entities to Population*
	(1)	(2)	(3)
$CountryExposure \times TaxEvent$	30.15	25.29	29.77
	[2.53]	[1.91]	[2.11]
$CountryExposure$	-2.12	-1.12	-3.02
	[-0.79]	[-0.47]	[-1.02]
$TaxEvent$	47.80	47.80	45.50
	[3.09]	[3.07]	[2.88]
Constant	4.31	4.31	5.24
	[0.62]	[0.62]	[0.75]
R-squared (%)	0.08	0.07	0.07
Observations	19,228	19,228	20,746

Notes: The table reports the regression estimates for the following equation.

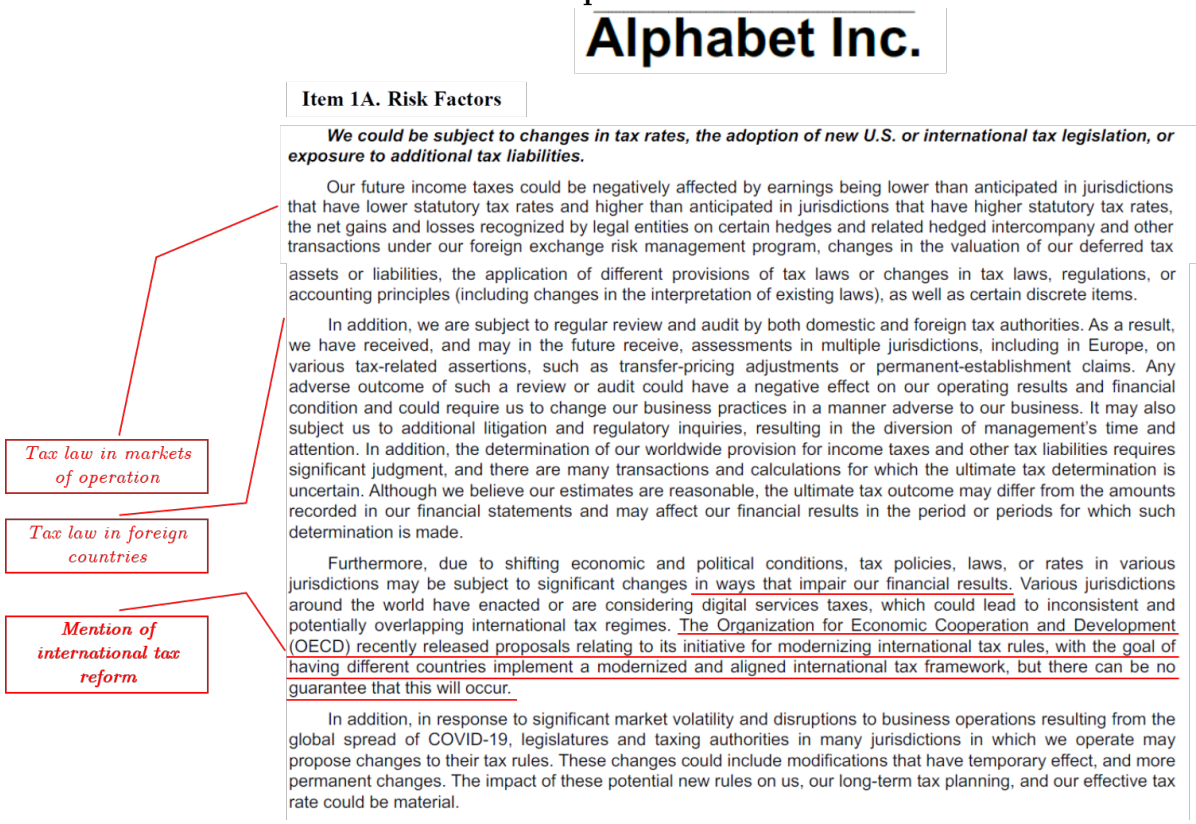
$$\Delta CDS_{k,d} = a + b \cdot TaxEvent_d + c \cdot CountryExposure_k + d \cdot (CountryExposure_k \times TaxEvent_d) + \epsilon_{kd},$$

where $\Delta CDS_{k,d}$ refers to the change in CDS spreads for country k on day d (in basis points); $TaxEvent_d$ is a dummy variable equal to one if day d happens to be on the day of a tax event (shown in Figure 2) and 0 otherwise; $CountryExposure_k$ denotes the standardized exposure of country k to the tax event. In column (1), $CountryExposure_k$ is the MNCs' aggregate reported pre-tax earnings scaled by the consumer market size in country k. In column (2), $CountryExposure_k$ is MNCs' aggregate taxes paid scaled by the consumer market size in country k. In column (3), $CountryExposure_k$ is MNCs' aggregate number of legal entities incorporated in country k scaled by the number of inhabitants. We use all trading days during 2021. We cluster the robust standard errors at the country-tax-event level. T-statistics are in squared brackets.

A.4 Selected company disclosures

Fig. A.5. **Exemplary companies' annual report disclosures regarding the potential effects of the tax reform**

Panel A: **Item 1A. Risk Factor disclosure in Alphabet Inc.'s 10-K annual report**



Panel B: **Tax footnote disclosure in Apple Inc.'s 10-K annual report**



10k Tax footnote disclosure

Note 5 – Income Taxes

Provision for Income Taxes and Effective Tax Rate

The provision for income taxes for 2021, 2020 and 2019, consisted of the following (in millions):

	2021	2020	2019
Federal:			
Current	$ 8,257	$ 6,306	$ 6,384
Deferred	(7,176)	(3,619)	(2,939)
Total	1,081	2,687	3,445
State:			
Current	1,620	455	475
Deferred	(338)	21	(67)
Total	1,282	476	408
Foreign:			
Current	9,424	3,134	3,962
Deferred	2,740	3,383	2,666
Total	12,164	6,517	6,628
Provision for income taxes	$ 14,527	$ 9,680	$ 10,481

The foreign provision for income taxes is based on foreign pretax earnings of $68.7 billion, $38.1 billion and $44.3 billion in 2021, 2020 and 2019, respectively.

A reconciliation of the provision for income taxes, with the amount computed by applying the statutory federal income tax rate (21% in 2021, 2020 and 2019) to income before provision for income taxes for 2021, 2020 and 2019, is as follows (dollars in millions):

	2021	2020	2019
Computed expected tax	$ 22,933	$ 14,089	$ 13,805
State taxes, net of federal effect	1,151	423	423
Impacts of the U.S. Tax Cuts and Jobs Act of 2017	—	(582)	—
Earnings of foreign subsidiaries	(4,715)	(2,534)	(2,625)
Foreign-derived intangible income deduction	(1,372)	(169)	(149)
Research and development credit, net	(1,033)	(728)	(548)
Excess tax benefits from equity awards	(2,137)	(930)	(639)
Other	(300)	111	214
Provision for income taxes	$ 14,527	$ 9,680	$ 10,481
Effective tax rate	13.3 %	14.4 %	15.9 %

Panel C: **Item 1A. Risk Factor disclosure in Walmart Inc.'s 10-K annual report**



Notes: These figures show exemplary excerpts of U.S. companies' 10-K annual report disclosures in fiscal year 2020. The first figure in Panel A shows that Alphabet Inc. discussed the potential global tax reform (the OECD's framework relating to Pillars 1 and 2) as a potential risk to its business with likely negative consequences for their cash flows. The second figure in Panel B shows the tax rate reconciliation tables from the tax footnote for Apple. The third figure in Panel C shows that Walmart Inc. did not discuss the potential global tax reform (the OECD's framework relating to Pillars 1 and 2) as a potential risk to its business.

Table A.9. **Examples of earnings conference calls mentioning the global tax reform**

Company	Date	Speaker	Statement
Alexandria Real Estate Equities, Inc.	April 27, 2021	Joel S. Marcus, Executive Chairman and Founder	And I think the administration's comments about, well, they're going to try to arrange a kind of a global tax kind of arrangement where everybody is charging the same rate, it's done through what's called the Organization for Economic Cooperation and Development, a global minimum tax. Well, okay, that's a total joke. There's no one that's going to sign on to that. But – so yes, bad news.
The Bank of N.T. Butterfield & Son Limited	July 27, 2021	Michael Collins, Chairman and Chief Executive Officer,	Sure. So all of our jurisdictions actually doing the agreement, so we're trying to be as helpful as possible. Pillar 1, I guess, is really targeted at tech companies, which we don't have. Generally offshore, so that's not going to affect us. Pillar 2, in terms of the 15% minimum tax may have some impact. But we still think the tax differential between offshore and onshore will be good enough to keep companies here."

Notes: The table reports provides excerpts of quarterly earnings conference call transcripts of two example companies that mentioned the global tax reform in their earnings conference calls.