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Abstract

We study the effect of European reforms targeted at stricter enforcement of dividend-withholding taxation. We initially zoom in on Scandinavia to study a Danish reform enacted in 2016 meant to counteract DWT arbitrage. Our main outcome of interest is the quantity of stocks on loan. For identification we rely on a triple-difference strategy in which we compare stocks on loan between i.) different Scandinavian countries, ii.) normal-trading days and a 31-day window centered around the ex-dividend day and iii.) before and after the reform. Before the reform all countries have a strong spike in stocks on loan centered around the ex-dividend day. This spike is consistent with the most popular DWT arbitrage schemes. The magnitude is large: on average excess stocks on loan peak at around 4 percent of the public float. After the reform, this spike disappears in Denmark, but continues in the other countries indicating that the reform was successful at eliminating DWT arbitrage. We consider the welfare effects of the reform in terms of foreign investment and dividend policy. We find that the reform discourages foreign investment in Denmark, but has no negative impact on dividend payments of Danish firms. We then zoom out using data from 14 European countries and verify that our analysis has external validity across Europe.

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1 Introduction

Over the last years, intensive media coverage has been dedicated to the cum-ex and cum-cum deals and especially on the major players involved in these schemes, which include US pension funds, and US and European investment banks (Times, 2018). Cum-cum and cum-ex are short-sell trading strategies that allow investors to exploit loopholes around the dividend-withholding tax (DWT). Several investigations have been conducted over the last years to quantify the size of both cum-cum and cum-ex deals. Back-of-the-envelope estimates of revenue losses for cum-ex alone are 69.2 billion euro EU-wide (CORRECTIV, 2018), and 150 billion euro when considering cum-ex and cum-cum transactions together across 12 countries, including the United States (CORRECTIV, 2021). Thus, according to the above mentioned estimates, this type of dividend tax arbitrage constitutes the largest tax arbitrage scheme ever uncovered in the world.

To date, the empirical literature on this type of dividend arbitrage scheme is surprisingly limited. Buettner et al. (2019) (for Germany) and Dixon et al. (2021) (for the US) document the existence of spikes in trading and lending volume around dividend payout dates, respectively. No study has considered the effect on welfare of reforms which aimed at preventing such tax arbitrage scheme. Therefore, whether stricter enforcement of DWT affects e.g. tax revenue, foreign investment and dividend policy remains an open question. In this paper, we empirically document the extent to which these DWT arbitrage strategies have been used across Europe, and the welfare effects of recent countermeasures against DWT arbitrage strategies.

We address these questions by studying DWT arbitrage through the lens of security lending data from Markit. Cum-cum transactions typically take the form of a foreign investor lending its shares to a domestic party. Most cum-ex transactions require a short sale, in which, the short-seller must borrow a stock[1]. Therefore, security lending data should provide the

[1]Both schemes are described in more detail in section 2

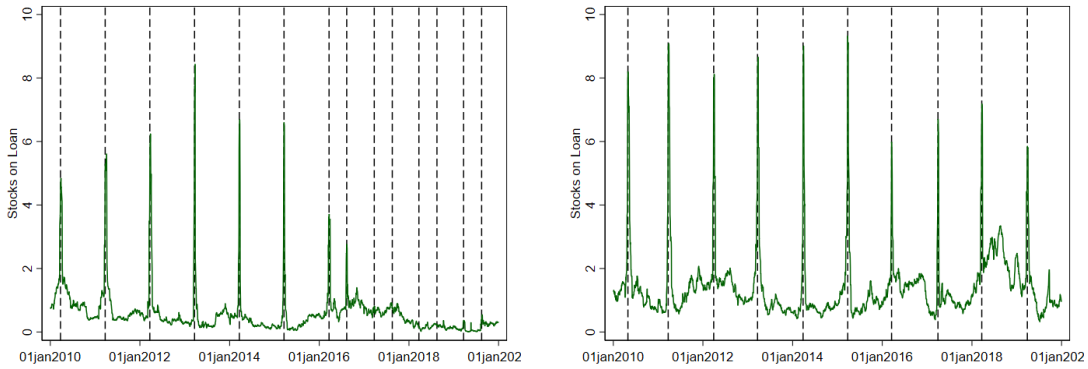
clearest insight into DWT arbitrage schemes and patterns consistent with cum-cum and cum-ex transactions.

For the first part of our analysis, we zoom in on three Scandinavian countries: Denmark, Norway and Sweden. Scandinavia provides an ideal laboratory for our study for two reasons. First, in 2016 Denmark introduced a reform that targets DWT arbitrage, but leaves other non-tax related arbitrage schemes unaffected.[2] Norway and Sweden have not yet introduced a similar reform, and thus form a control group. Second, the three countries provide us with detailed tax revenue data that includes both annual tax receipts and reimbursements. This allows us to capture the effects of the reform on DWT reimbursements. Our identification strategy can be characterized as a triple difference-in-difference. We compare the percentage of stocks on loan between i.) regular trading days, and a 31-day window centered around the ex-dividend date, ii.) Denmark and the other two countries, and iii.) before and after the 2016 reform.

A raw-data example can be seen in Figure 1, which compares the stocks on loan over time for the Danish pharmaceutical company Novo Nordisk (panel A), and the Swedish bank Svenska Handelsbanken (panel B). Prior to 2016 both companies see abrupt spikes in stocks on loan around each dividend payment, constituting up to 8 percent of the public float. After the reform, the spikes for Novo Nordisk disappear, but they continue for Svenska Handelsbanken. We interpret this as clear causal evidence that the Danish reform is successful in targeting the most common forms of cum-cum and cum-ex.

Our formal analysis confirms these findings. Before the reform, on average, around 4 percent of the public float of Danish companies was on loan in the dividend period. This spike disappears in Danish companies, but continues in Norwegian and Swedish companies. For reference, for the US Dixon et al. (2021) find a spike in stock lending of 0.6 percent of the public float. The effect we find is about 6.5 time larger. This indicates that DWT arbitrage in Europe is much more pronounced than in the US. In addition, we find that the spike we identify in stock lending is much larger than the spike in regular transaction volume, which has been used as a proxy for DWT arbitrage by Buettner et al. (2019). This indicates that

[2]For instance, Ang et al. (2019) find evidence that spikes in lending in Australia around the ex-dividend date are not related to DWT-arbitrage but to Dividend Reinvestment Plans.



a. Novo Nordisk b. Svenska Handelsbanken

Figure 1: Stocks on loan vs ex-dividend dates over time

Notes: The Y-axis denotes the stocks on loan as a share from public float. The dashed lines represent dividend disbursement events. The Danish reform came into effect on the 18 March 2016 and affected stocks of Novo Nordisk.

lending data, rather than transaction volume, is likely the best lens through which to view DWT arbitrage.

DWT arbitrage primarily targets the largest companies. Prior to the reform, spikes are consistently largest in the quartile of companies with the largest market valuation. This is likely driven by the fact that larger companies are more likely to be included in the portfolio of foreign investors. We do not find a strong relationship between dividend yield and DWT arbitrage, indicating that investors engage in DWT arbitrage even if the potential benefits are relatively small.

Using Markit data on lender and borrower concentration, we do not find that spikes in lending are associated with an increase in concentration. This implies that the market for DWT arbitrage is not driven by a few large parties, but instead is more spread out among investors. Likely related, we do not see a clear relationship between the spikes and the cost of borrowing a stock.

For the second part of our analysis, we consider the welfare effects of the reform. Intuitively, we expect that the reform increases tax revenue mechanically, by reducing the amount of reimbursements the Danish government provides to investors. However, those mechanical gains can be crowded out by behavioral responses of foreign investors and issuing companies. Specifically, foreign investors might prefer not to invest if the DWT is more strictly enforced. In addition, issuing companies might respond to stricter enforcement by reducing dividend

payments, and rewarding shareholders in a different form.

[PM Tax revenue effects]

Surprisingly, we find that the reform in Denmark has an positive effect on dividend policy. A DiD-specification, where we compare dividend yield on Danish companies to dividend yield on Norwegian and Swedish companies, controlling for industry-time effects, yields a significant positive effects. This indicates that stricter DWT enforcement in Denmark did not result in firms substituting dividends for other firms of shareholder compensation.

Finally, we compare the investment decision of US managers of investment funds between the three Scandinavian countries in a DiD framework. As expected, we find that on average foreign investors decrease their investment in Denmark after the reform.

The third part of our analysis zooms out to consider 14 European countries that levy a DWT and have a well-developed and large financial market. We find that the spike in stock lending around dividend payment is ubiquitous across European countries that levy a DWT. However, there is also strong heterogeneity. Germany has the most excess lending in the dividend period, reaching up to 10 percent of the public float. On the other hand, effects in Southern Europe and Ireland are more muted. Importantly, the effect of the 2016-reform in Germany aimed at reducing DWT arbitrage was successful. After this reform, the spikes in Germany disappear entirely.

Related Literature Buettner et al. (2019) is the first paper to study the effect of DWT arbitrage in Europe following the revelation by CORRECTIV (2018). They show that a 2012 reform in Germany, targeted against cum-ex, was effective at reducing the spike in stock turnover in Germany. Relative to this paper we make several contributions. First, the reform in Denmark targets both cum-cum and cum-ex, allowing us to provide a a more complete picture of DWT arbitrage. Second, we use security-lending data rather than turnover as our outcome variable. In a robustness analysis, we show that for most countries excess security-lending is significantly larger than excess turnover in the event window surrounding a dividend payment. Third, we consider the tax revenue effects, thereby directly assessing the effectiveness of the reform. Finally, we consider the effect of the reform on dividends and foreign investment.

To our knowledge there are two papers in the literature that study tax arbitrage with security lending data: Christoffersen et al. (2005) for the UK and Canada, and Dixon et al.

(2021) for the US. We contribute to this literature by studying the effect of a reform, which allows us to isolate DWT arbitrage from potential other forms of arbitrage. For instance, Ang et al. (2019) show that in Australia spikes in stocks on loan around the ex-dividend date are caused by Dividend Reinvestment Plans (DRIP) arbitrage, rather than DWT arbitrage (see the next section for more details on DRIP arbitrage). Our reform allows us to rule out that this type of arbitrage plays a significant role in Europe. In addition, we contribute by considering the impact of the reform on welfare. [3][4]

There is a large literature that studies arbitrage mechanisms around dividend payments (e.g. Elton and Gruber, 1970; Lakonishok and Vermaelen, 1986; Karpoff and Walkling, 1990; McDonald, 2001; Dhaliwal and Li, 2006; Akhmedov and Jakob, 2010; Hartzmark and Solomon, 2013; Henry and Koski, 2017). We contribute to this literature by quantifying the extend to which dividend-arbitrage is driven by enforcement of the DWT.

We also contribute to the literature that links dividend taxation to corporate pay-out policy (e.g. Blouin et al., 2004; Poterba, 2004; Chetty and Saez, 2005; Chetty and Saez, 2010; Jacob and Jacob, 2013). Most papers in this literature find that dividend taxation negatively affects the amount of dividends a firm pays out. Contrary, we find that stronger enforcement of DWT does not appear to have a negative impact on dividend payments.

Finally, there is a small literature that looks at the effect of DWT on foreign investment (e.g. Weyzig, 2013; Van't Riet and Lejour, 2018; Jacob and Todtenhaupt, 2020). Here we contribute by showing that stronger enforcement of DWT has a negative impact on investment by US investors.

[3]Several studies in finance explores the relationship between short selling and future returns of a share (e.g. Aitken et al., 1998; Desai et al., 2002; , n.d.; Engelberg et al., 2012; Kaplan et al., 2013; Rapach et al., 2016. In this literature, short-selling is approximated by stock lending volume. Within this literature, recent papers that work with European data are aware of the spikes in stocks on loan around dividend dates, but they do not study DWT arbitrage directly.

[4]A technical report by European Securities and Markets Authority (2020) reports findings on security lending around dividend payments in Europe. However, this study aggregates data by country. It documents a seasonal effect consistent with DWT arbitrage. The reason is that dividends in Europe are typically paid out in Spring (and sometimes in Autumn), and therefore, lending spikes in these periods. However, this method is not sensitive enough to quantify the causal effect of DWT arbitrage which is focused especially on the ex-dividend day.

2 Institutional Setting

2.1 Dividend Withholding Tax Arbitrage

2.1.1 Dividend Withholding Tax

In several countries around the world, dividend payments from corporations give rise to tax liabilities within the source country via a withholding tax.[5] The DWT is withheld at source from the corporation when it distributes the profits to its shareholders. The corporation remits directly to the respective tax authority of the source country. Applying a DWT is typically justified by the necessity to ensure the collection of taxes on assets, which due to their mobile nature would otherwise easily escape taxation (Petkova, 2020).

DWT represents a salient cost for investors (e.g., Cooper and Kaplanis, 1994, Cooper and Kaplanis, 1986). For example, across EU member states or in the United States, DWT rates can be as high as 30%.[6] Foreign investors can be particularly penalized by the existence of a DWT since besides the foreign DWT, they are also potentially taxed on their worldwide capital income at the applicable rate in their country of residence. Thus, to guarantee that cross-border investment is not discouraged, bilateral double tax agreements often grant a reduced rate on DWT at source and a full credit for the DWT in the residence country of the investor. However, there is a high compliance costs for claiming foreign tax credits (Jacob and Todtenhaupt, 2020) and not every country has signed a bilateral double tax agreement.

DWT arbitrage strategies have been designed to permit foreign investors to remove such costs or even to exploit the system to turn such cost in extra returns from holding shares in foreign corporations. DWT arbitrage strategies consist in the transfer of shares around the dividend record date. Following such a transaction, the right to the dividend is separated from the underlying share. Depending on when the transfer of the ownership of the shares with a dividend entitlement occurs and when the delivery of the shares occurs, one would speak of a cum-cum or a cum-ex transaction.

Cum-Cum Transactions. In these transactions, the owner transfers the shares with attached dividend rights just before the dividend record date to an acquirer. The acquirer is a

[5] For an overview, see Endres and Spengel (2015).

[6] For a complete overview of DWT rates around the world, see https://taxsummaries.pwc.com/quick-charts/withholding-tax-wht-rates.

resident in the same country as the corporation paying the dividend. Shortly after the dividend record date, the shares are returned to the original owner. The owner and acquirer exploit the different tax treatment for capital income of resident taxpayers subject to unlimited tax liability and non-resident taxpayers subject to limited tax liability. An example will clarify how the above described DWT arbitrage strategy can lead to the avoidance of the DWT.[7]

At t-1, a foreign investor, who is the legal owner of a share in corporation A, sells that share to a domestic bank. At t-1, the share is traded at price P and it entitled a dividend in the amount D, payable at t. The country where the corporation and the bank are residents of levy a DWT of T. At t, the domestic bank receives the dividend of the amount D-T and at the same time, it also receives a capital gain tax certificate. The gain from the taxable dividend of D is reduced by a capital loss in the same amount once at t+1, the local bank sells the share back to the foreign investor at a price equal to P-D, which is the price at the ex-dividend tax. Since at t+1, the local bank has a zero taxable profit, a full refund for T is granted. In this way, the foreign investor has a net gain equal to the tax-free dividend, D, which is typically shared with the local bank.

The predominant case of cum-cum transaction involves securities lending to a local bank. The same mechanism as the one described above applies when instead of a selling/re-purchasing agreement, the two parties enter into a non-cash lending agreement. The local bank borrows the shares from the foreign investor and agrees to return the shares of the same quantity, quality and type upon termination of the security loan. In this case, there is no capital loss from resale but there is the deduction of the security lending fee as business expense. In many countries, the securities lending fee is not considered a taxable income, the foreign investors obtain a tax-free income of D.

In all of these versions of cum-cum transactions, the transfer of the share around the ex-divident day would be recorded as a data point where the share is loaned. This variable is the main dependent variable in our analysis.

Cum-Ex Transactions Cum-ex transactions involve a transfer of shares around the dividend record date where the sale of shares occurs with dividend rights, but the delivery of the shares occurs after the record date and thus without dividend rights. This is possible because there

[7]For a detailed explanation of cum-cum transactions, see Spengel (2016)

is a time lag (typically two days) between the delivery of the shares and the conclusion of the transaction. The example below will clarify the mechanism of this dividend arbitrage strategy.[8]

Investor A owns a share in a corporation. The share is traded at price P and it is entitled a dividend in the amount D, payable at t. At time t-1, investor B makes a short sale of a share in the corporation to investor C, at price P. Delivery of the agreed transfer takes place at t+1, i.e. two day after the agreement took place as is standard in the stock market. On the ex-dividend day, t+1, A receives the dividend and a DWT credit as at t, she/he is the legal owner of the share in the corporation. On the same day, investor B borrows the share from investor A and delivers it to C. Since after the ex-dividend day, the share is worth P-D, investor B is required to compensate investor C for the net-of-tax dividend with the delivery. For this transaction, C receives a DWT credit, because tax authorities treat dividend compensation and actual dividends identically. Finally, C sells the shares back to A. Both investor C and A can request a tax refund for a DWT paid only once. The short seller, investor A, makes a profit equal to the DWT, which is de facto financed by the tax authority. This profit is conditional on the issuance of a second tax certificate. Absence such condition, investor B would incur a loss by engaging in the above described cum-ex transaction as he/she would incur in costs related to setting up such a transaction.[9]

Similar to the cum-cum, the cum-ex transactions are going to be reflected in the stocks on loan variable. However, evidence for these transactions could be also present in trading volumes, as investigated by Buettner et al. (2019).

2.1.2 Danish Reform: Increasing Ownership Information as a Countermeasure

In recent years different EU countries have put in place several reforms to curb DWT arbitrage strategies. In our main analysis, we focus on the reform from Denmark, which became effective in March 17, 2016 and abolished the possibility to apply for a tax refund at source.[10] Instead dividend income is distributed net of the DWT applies and a tax refund can be subsequently

[8]For a detailed explanation of the cum-ex transactions, see Collier (2020).

[9]This example describes what appears to have been the most common form of a cum-ex transaction. However, there are other types of cum-ex transactions that do not require a short-sale. See Wigan (2019) for some examples.

[10]See `https://www.ey.com/en_gl/tax-alerts/denmark-proposes-new-withholding-tax-regime-for-dividends`.

requested upon the submission of relevant documentation. This includes among others the evidence of beneficial ownership of the shares, and only the beneficial owner would receive a tax refund. If the shares were involved in a share-lending agreement, then the lender, (and only the lender) of the shares will be recognized as the beneficial owner. If the borrower can document that he/she has been holding the stocks for more than six months, then he/she becomes the beneficial owner for tax reimbursement purposes.

The legislation in Denmark differs from the anti-arbitrage legislation introduced in Germany in 2016 and in France and Belgium in 2019. In Germany and France (and Belgium) after the reform, investors can only receive DWT reimbursement if they hold the shares for a 45(60)-day window around the dividend payment.[11] This legislation should bring a halt to DWT arbitrage, but it also potentially increases the cost of non-tax arbitrage around the dividend day. This implies that when analyzing these reforms, there could be confounding forces that can bias quantifying the effect of the reform. Contrary, in Denmark for short-term loans the lender of the stock remains eligible for reimbursement, and hence, potentially non-tax arbitrage can remain profitable in Denmark after the reform. We offer a more details overview of the above mentioned legislations in section 6.1

2.2 Other Dividend Arbitrage

2.2.1 Lending Incentives in the US versus Scandinavia

An important difference in the institutional setting between Scandinavia and the US is the holding period which is present in the US, but absent in Scandinavia and a different tax treatment of dividend and dividend compensation payments. Specifically, in the United States, the Jobs and Growth Tax Relief Reconciliation Act of 2003 introduced a reduced DWT rate of 15% for qualified dividends, i.e. those paid by US companies and held for at least 60 days.

First, this holding period alters the incentives for borrowing/lending to some extent. Specifically, in Europe foreign investors have a strong incentive to transfer their shares to domestic parties essentially overnight in order to benefit from DWT reimbursement. In the US, some foreign investors may still face this incentive. However, on the other hand, many domestic US investors face a disincentive to lend. For these investors, lending a share over the record day

[11] Similar legislation is in place in Australia and the US.

effectively breaks the holding period. Moreover, even if the dividend compensation payment and the dividend itself are nominally equivalent, they are subject to different tax treatments. Specifically, the dividend compensation payment is subject to the investors' marginal income tax rate, which could be up to 37%. To enjoy the reduced tax rate, domestic investors in the US might refrain from lending their shares over dividend record dates or recall outstanding loans.

Evidence of a temporary reduction in the supply of lendable shares has been documented in the literature (Thornock (2013)). Similarly, Dixon et al. (2021) find that during a dividend payment, the demand for borrowing increases, whereas at the same time the stocks available for lending decrease. They show that this temporary excess demand in the lending market harms market efficiency.

We do not expect to observe a similar crunch in Scandinavia. The reason is that DWT legislation in Scandinavia does not specify a holding period in order to qualify for a DWT reimbursement and there is no preferential tax treatment for dividend compared to dividend compensation payment. Therefore, we expect that the supply for lending remains constant during the dividend period, both before and after the reform in Denmark. We explore this hypothesis in more detail in section 4.2.

2.2.2 DRIP arbitrage

Ang et al. (2019) identify a type of non-tax related arbitrage that involves share lending around the dividend date. Specifically, some companies offer Dividend Reinvestment Plans (DRIP) that allow shareholders to exchange their cash dividends for newly issued shares. The new shares are typically sold at a discount relative to the market price. This makes it attractive for investors to participate in a DRIP.[12] There is an incentive for an investor to borrow shares with a DRIP before the dividend period, as it allows the borrower to participate in the DRIP. Ang et al. (2019) show that in Australia, only DRIP-dividends see a spike in share lending, whereas this spike is absent for non-DRIP dividends.

[12]Sometimes the term DRIP is also used to describe an agreement between an investor and a broker to invest cash dividends into new shares. The key difference is that such an agreement with the broker does not result in newly issued shares, since the broker simply buys the shares from the market. As a result, there is also no discount relative to the market price, and no arbitrage opportunity for these DRIPs.

In our analysis, we rule out this important confounder in two ways. First, the Danish tax reform does not affect DRIP arbitrage. Therefore, if the spike in lending in Denmark is the result of DRIP rather than DWT arbitrage, it should remain in place after the reform. Second, in a robustness analysis we focus on firms for which the public float remains constant. Since a DRIP involves the issuing of new shares, we can be certain that for these dividend events no DRIP took place.

3 Data

3.1 Financial Market Data

Our primary dataset comes from Markit which collects data on security lending and borrowing from over-the-counter (OTC) transactions. We combine our data with daily securities data from Compustat Global. Our panel extends from 2010-2020.

We merge the data of Compustat and Markit on the basis of the International Securities Identification Number (ISIN) and/or the Stock Exchange Daily Official List (SEDOL) code which are present in both data sources. In the event where we cannot match observations on either ISIN or SEDOL we merge on the basis of the company name. This allows us to match 96% of the Markit data, and Y percent of the Compustat data.

Both Compustat and Markit data have a daily frequency. However, Compustat data comes from stock exchanges, whereas Markit data is derived from OTC transactions. Therefore, the business calendar between the two data sources may not match. An additional complication is that we are combining data from multiple exchanges across different countries, all of which have different holidays.

To deal with this, we first create a business calendar for each exchange. We define business days as follows. If on a stock exchange at least one of the stocks in our dataset is traded in the Compustat data we consider that day a business day. If no trade occurs we consider that day a non-business day for that particular exchange. We verify manually that all non-business days correspond to known holidays or weekends. We then drop all observations that do not occur on business days. Note that outcome variables of Markit are stock variables. For example, the number of stocks on loan, rather than the change in the number of stocks on loan. Therefore,

if there is a large increase or decrease in this stock on a holiday, we are very likely to still pick it up on the next working day.

We drop companies that do not pay dividends throughout the sample period. In addition, we drop secondary listings in case a stock is listed on multiple stock exchanges. Note that we do keep secondary stocks in the event where a company issues two different type of stocks. Therefore, we focus our analysis company-stock level.

Table 1 provides summary statistics for the 3 Scandinavian countries, before and after the reform, and inside and outside of the event window. Our main outcome variable is stocks on loan as a percentage of the public float. In addition, we consider the quantity of stocks that are available for lending as a percentage of the public float. Note that the market for securities lending is slow, as the number of shares available for lending typically exceeds the number of shares actually on loan. In Table 1 this can be seen in the last column, where the average stocks on loan are about 1.2 % of public float, while the stocks available for lending is around 14.7% of public float on average for the three Scandinavian countries. In column (1), in Denmark, before the reform, the average stocks on loan around the ex-dividend day are 4.6%, while the stocks available is 15%, showing that around the ex-dividend day the market becomes more active. In addition, columns (1) and (2) reveal that stocks on loan decreased on average by 3 percentage points as a result of the reform. Looking at Norway and Sweden, there seems to be a corresponding decrease of stocks on loan in Sweden, but not in Norway. It is notable that stocks on loan in column (2) decrease to a value similar to the reference column (7), while the after-reform value for Sweden in column (4) decreases to pre-reforms levels from Denmark, to 4% of stocks on loan. As a preview of the results, we observe that Swedish stocks on loan start decreasing already from 2015, which is before the reform in Denmark was considered.

We also consider turnover in the stock market. This variable denotes the trading volume as percentage of the public float. Across all columns in Table 1 it is visible that the turnover increases around the dividend event in the same way as the stocks on loan. However, the turnover decrease is smaller in levels and magnitude than the decrease of stocks on loan. Our next outcome variable is the cost of borrowing, which is an index variable for the cost of borrowing calculated by an algorithm of Markit. Values range from 1-10, with 1 indicating usual borrowing cost, and 10 indicating that the cost of borrowing are extremely high. Notably,

this variable has similar means across all columns. Finally, the last two variables of interest are Herfindahl indices for lender and borrower concentration provided by Markit. Almost all averages are similar across column, except in Denmark before the reform. In columns (1) and (2) we observe that lender concentration increased after the reform. Overall, Table 1 reveals that stocks on loan have a very strong pattern related to the dividend-window, whereas most of the other variables do not exhibit a similar pattern.

Dividend and Foreign Investment Data: For the welfare analysis, we use dividend payment data from Compustat and we rely on the data from the U.S. Securities and Exchange Commission (SEC) Form 13F available from Thomson Reuters. Under Form 13F, all U.S. institutional investors with at least USD 100 million in assets under management are obliged to report their equity holdings at a quarterly cadence. Not all equity holdings have to be reported, only those in certain securities listed under the SEC website.[13] We gather information on the investor, the filing period and the equity holding. We obtain information on the country location of the equity holdings from Compustat. We merge the data from Thomson Reuters and Compustat using the Compustat/CRSP linking table where the stock identifiers for both databases are available.

Descriptive statistics on variables used in the analysis are presented in Table 2. Dividend yield is the total annual gross dividend paid over the average annual market capitalization while I(Dividends)>0 is an indicator variable equal to 1 if the company paid a dividend and zero otherwise. Across all Scandinavia countries, we can observe a small reduction in the average amount of dividend paid after 2015. In Denmark, post-reform, more companies pay dividend while in Sweden and Norway the average number of companies paying dividend decreases.

3.2 Data on Tax Revenue

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[13]For a complete list of reportable stocks, see https://www.sec.gov/divisions/investment/13flists.htm

4 Results from Scandinavia

4.1 Event Study

We study formally whether the pattern of Novo Nordisk and Svenska Handelsbanken shown in the introduction is representative for all publicly traded stock. Our methodology is an event-study, in which we treat the ex-dividend date as our event. We organize our data as a three-way panel where i denotes the stock, t denotes the calendar date and τ denotes event time.

We consider 31-day windows centred around the ex-dividend date. Therefore, around dividend events event time runs from $\tau \in [-15, 15]$. We also keep observations outside of the event window and set $\tau = -16$ for those observations. $\tau = -16$ serves as the omitted variable in our analysis, and thus allows us to control for the "regular" stocks on loan.

We estimate the following equation for each country:

$$y_{it\tau} = \sum_{k=2010}^{2020} (\beta_{\tau k} + \eta_{ik}) I(t \in k) + \varepsilon_{it\tau}, \tag{1}$$

where $I(t \in k)$ is a dummy that takes value 1 if date t is in year k. Our coefficient of interest is $\beta_{\tau k}$ which measures stocks on loan on event day τ in year k. We expect that $\beta_{\tau k} > 0$ for dates very close to the ex-dividend date, and in years prior to the reform.

η_{ik} represents security-year fixed effects which are identified by stocks on loan outside of the event window. We estimate (1) using weighted least squares, where we use the market value of the security as weights. Effectively, this weighting implies that our results can be interpreted as the average excess lending per dollar of market value traded on the stock exchange. We cluster standard errors at the issuing company level.

Figure 2 and 3 provide results for Denmark (panel A), Norway (panel B) and Sweden (Panel C). Figure 2 plots all coefficients of the event-study over the 10 years in our sample. The figure provides clear evidence of excess stock on loan around the ex-dividend day. Loans typically peak on day 1, which is the record date. The peak ranges between 3-6 percent, with, typically, slightly more lending in Sweden than in the other two countries. In 2016 the peak in Denmark shrinks consistent with the fact that the reform was introduced in mid-2016.

After 2016, the evidence for excess lending in Denmark disappears, whereas a peak in lending remains present in the other countries.

Figure 3 zooms in on the day-1 coefficients, and plots them by year, together with a 95-percent confidence interval. The figure shows that for all country-year pairs prior to reform excess lending is significantly positive on day 1 in our window. After the reform, the peak in Denmark is no longer significant.

The magnitude of the effect we find is large. Prior to 2016 the average peak in excess stocks on loan is around 4 percentage points of the public float. Outside of the event window the average stocks on loan represent 0.9 percent of the public float (see 1). Therefore, the peak represents a $4/0.9 \approx 444$ percent increase in loans relative to regular trading days.

For comparison, in the US Dixon et al. (2021) find that stocks on loan peaks by 0.6 percent point of the public float. Thus the peak in Scandinavia is around 6.5 times larger than in the US.

4.1.1 Heterogeneity

We consider heterogeneity in the effect size by market capitalization and dividend yield. Intuitively, since larger companies are more likely to be included in the portfolio of international investors, we expect a stronger effect for larger companies. Additionally, arbitrage should be more profitable for shares with a higher dividend yield.

Figure 4 show results by market cap. The Figure is consistent with our hypothesis that DWT is most prominent for the largest companies. Specifically, the day-1 coefficients are not significant for the first quartile, and appear to increase, more or less, monotonically with the market cap of the underlying firm.

We find little evidence that excess stocks on loan is sensitive to dividend yield (see figure 5). This finding is consistent with the idea that DWT arbitrage is relatively cheap from the point of view of the investors. If that is the case then for any dividend payment, no matter how small, it is profitable for foreign investors to engage in DWT.

4.2 Event Study for other Outcome Variables

We rerun equation (1) using stocks available for lending as an outcome variable. The market for share lending typically does not clear. That is, with regular fees the number of stocks available for lending is usually significantly larger than the stocks actually on loan.

Markit records how many stocks are available for lending. Dixon et al. (2021) find that in the US stocks available for lending reduce significantly around the ex-dividend day. The reason is that the US tax system provides strong tax incentives against lending out shares for US investors. As discussed in section X.X Scandinavian tax systems do not provide the same incentive. Therefore, we expect that in Scandinavia the supply for stocks does not drop.

Figure 6 panel A is consistent with this hypothesis. If anything, in Sweden stocks available for lending are slightly above normal in the early years. In Denmark and Norway excess stocks available for lending are not significantly different from zero during most years.

In Figure 6 panel B we consider whether stock market turnover in Scandinavia is elevated during the dividend period. Buettner et al. (2019) uses turnover as a measure of cum-ex arbitrage. Consistent with their results, we also find that turnover is slightly elevated on day 1 for most country-year pairs. In addition, we find that after the reform, excess turnover vanished in Denmark. However, when comparing 3 to 6 panel B, the most important difference is in the scale. Excess turnover concerns, at most, 0.3 percent of the public float. Excess lending is, at least, one order of magnitude larger. We conclude that DWT arbitrage has a much larger effect on the lending market than on the regular stock market.

In Figure 6 panel C we plot the cost of borrowing. Dixon et al. (2021) find that the cost of borrowing is significantly higher during a dividend payment. Using Markit's 10-point scale for the borrowing fee as a measure, we confirm this outcome for Sweden during the early years. However, we find no excess cost of borrowing for Denmark and Norway.

Finally, in panel D and E we consider whether DWT arbitrage is a limited phenomenon that only involves a few big players, or whether it is a more spread out event. We use a Herfindahl index for borrower and lender concentration, calculated by Markit, to see whether dividend periods are associated with an increase in borrower and/or lender concentration.

The Figures clearly show that DWT is a wide-spread phenomenon. If anything, borrower

and lender concentration are slightly below their regular values during the dividend period.

4.3 Effect on Reimbursements

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4.4 Dividend policy and Foreign Investment

We study the effect of the reform in Denmark on dividend policy and foreign investment. Intuitively, additional enforcement of the DWT could make it less attractive for foreign investors in Danish companies to receive dividend payments and/or, in general to hold a Danish stock. Issuing companies may in turn respond to this by substituting dividends with an alternative method of shareholder compensation such as share buybacks. For instance, on the basis of a 2003 US reform, Poterba (2004); Chetty and Saez (2005) find that dividend taxation has a strong effect on corporate-payout policy. Jacob and Jacob (2013) provide similar findings on the basis of world-wide data.

In the absence of such a response by corporations, foreign investors might sell their shares in Danish companies and rather hold stocks in similar companies in other EU markets which are not affected by the 2016 reform.

To test the hypothesis on dividend policy, we collapse our Compustat data from Denmark, Norway and Sweden by year. We calculate the dividend yield of company i, in sector j and year k, $DividendYield_{ijk}$, as the total annual dividend divided by the average share price. We run the regression:

$$Dividend_Yield_{ijk} = \alpha_i + \eta_{jk} + \beta I(i \in Denmark) After_k + \epsilon_{ijk}, \tag{2}$$

where $I(i \in Denmark)$ is an indicator function that equals 1 if a company is located in Denmark and $After_k$ is a variable that equals 1 after 2016 and 0 before. α_i represents a firm-fixed effect, and η_{jk} are sector-time fixed effects which control for non-reform related changes in dividends within a sector. The sector of a company is defined as the four digit Standard Industrial Classification (SIC) code available from the Compustat. Alternative, we also consider a binary indicator equal to 1 if $Dividend\_Yield_{ijk}$ is above zero ($I(Dividends) >$

0).

To test the hypothesis on foreign investment, we aggregate the data from the F13 filings at the investor-country level. We first calculate the total amount of shares of investor i, in country c and quarter k. We restrict our sample to investors, who have owned at least once over our sample period a share in Denmark, Sweden or Norway. We set to zero all observations when the investor i has no share in either Denmark, Sweden or Norway in quarter k. The variable of interest, $USInstitutionalOwnership_{ijk}$, is a binary indicator which is equal to one if investor i has at least a share in country j in quarter k and zero otherwise. We run the regression:

$$USInstitutionalOwnership_{ick} = \alpha_i + \eta_k + \beta I(i \in Denmark) After_k + \epsilon_{ick}, \qquad (3)$$

where $I(i \in Denmark)$ and $After_k$ are defined as above. α_i represents a investor-fixed effect, and η_{jk} are time fixed effects which control for non-reform related changes in US institutional investor portfolio composition.

Overall, contrary to our hypothesis we find that post-reform, Danish companies pay more dividends, and pay dividends more frequently (Column 1,2 of Table 3). One potential explanation on why Danish companies did not reduce their dividend payments is that the share of investors that is affected by the DWT reform.

When considering foreign investors, we document a statistically significant decrease in US institutional investors holding Danish stocks post-reform. As expected, absent the DWT arbitrage possibilities, foreign investors finds holding Danish stocks less attractive and eventually turn to other EU stock markets where cum-cum and cum-ex deals can still be performed.

5 Results from other European countries

5.1 Reforms in other European Countries

In this section, we offer a summary of all reforms introduced in European countries over our sample period. Two types of countermeasures have been legislated to date, those targeting more cum-cum transactions via minimum ownership periods and those targeting more cum-ex

transactions asking for more documentation to prove entitlement of the relief.

With respect to the set of reforms around minimum owenership periods, as of July 1, 2019, France introduced stricter rules for obtaining a DWT credit.[14] The full DWT applies to dividend payment where a transfer of ownership for the underlying share occurred in a 45-day period that includes the distribution date. The refund of DWT might be granted only afterwards upon evidence from the beneficiary that the main purpose of the underlying transaction was not tax related. Similarly in Germany, since January 1, 2016, a refund for the DWT is granted only if the beneficiary has been the legal and economic owner of the underlying shares for at least 45 days around the dividend record date.[15] Finally in Belgium, since January 22, 2019, pension funds (both domestic and foreign ones) are eligible for a refund of the DWT only if they can prove they held the underlying securities for an uninterrupted period of at least 60 days in full ownership at the date the dividend distribution.[16]

When considering the latter group of reforms, Austria requires the submission of an electronic pre-application for obtaining the refund from a DWT.[17] Specifically, until December 31, 2018, foreign investors could have request the refund from the DWT in the same year when the DWT is deducted. From January 1, 2019 on, the pre-application and thus also the actual refund request can only be filed after the end of the year when the DWT is deducted. In this way, the beneficiaries incur in a liquidity cost which was absent before the requirement to fill in pre-application form. Similarly, beginning on January 22, 2019, Belgium introduced the requirement to provide full ownership of the share as a pre-condition to obtain a refund for the DWT.[18] Finally, in Germany, since January 1, 2012, the obligation to withhold the DWT is no longer on the dividend-distributing German corporation but rather on the custody bank of the final beneficiary.[19] Prior to the reform, the entity remitting the dividend tax was separated from the entity issuing the tax certificate. Upon this change, a tax voucher is required for claiming the refund of a DWT and such tax vouchers can be obtained upon submission of extensive documentation from the beneficiary to central tax office.

[14]See Finance law no. 218- 1317 of 28 December 2018 codified in art 119 bis A of the General Tax Code.
[15]See Official Gazette of 26 July 2016 (BGBl. I 36/2016 at 1730).
[16]See articles 266(4) and 281/1 of Belgian Income Tax Code.
[17]See Sec. 240a of the Federal Fiscal Procedures Act.
[18]See articles 266(4) and 281/1 of Belgian Income Tax Code.
[19]See Act on the Implementation of Directive 2009/65/EC on the coordination of laws, regulations and administrative provisions relating to undertakings for collective investments in transferable securities.

5.2 Results

Figure 7 shows the size of the effect on the ex-dividend day for the excess stocks on loan for 14 European countries. In panel a. we show the map with the effect size in 2015, just before the Danish reform. In panel b. we show the map with the effect size in 2017. It is notable, that both Denmark and Germany revert to the darkest color in our gradient, which denotes the smallest effect sizes. Consistent with the evidence above, we observe that post reform both Denmark and Germany register a drop in excess stocks on loan.

6 Conclusion

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Table 1: Summary Statistics

	Denmark		Sweden		Norway		Outside
	Before	After	Before	After	Before	After	Event Window
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Stocks on Loan	4.584	1.507	6.860	4.036	4.895	3.992	1.165
	(2.304)	(1.586)	(3.748)	(2.611)	(2.482)	(2.518)	(1.807)
Stocks Available for Lending	14.99	16.62	17.44	15.62	9.416	10.65	14.51
	(6.410)	(5.915)	(8.263)	(6.597)	(4.329)	(5.511)	(6.839)
Turnover	0.239	0.190	0.360	0.285	0.252	0.173	0.248
	(0.252)	(0.136)	(0.344)	(0.274)	(0.281)	(0.144)	(0.355)
Cost of Borrowing	1.158	1.275	1.468	1.280	1.321	1.179	1.235
	(0.714)	(1.012)	(1.419)	(1.020)	(1.211)	(0.771)	(0.818)
Lender Concentration	0.163	0.254	0.205	0.236	0.162	0.181	0.257
	(0.155)	(0.176)	(0.174)	(0.184)	(0.151)	(0.158)	(0.188)
Borrower Concentration	0.218	0.258	0.191	0.242	0.150	0.242	0.261
	(0.162)	(0.158)	(0.171)	(0.162)	(0.153)	(0.142)	(0.171)
Observations	812	749	3355	3655	1170	1106	619885
Number of Events	219	185	871	944	303	284	0

Notes: The first six columns show the mean of the variable in an event window (0,3), where 0 is ex-dividend date. The last column shows the summary statistics outside a (15,15) - 30 day event window around the ex-dividend date. The variables Stocks on Loan, Quantity available for lending and Turnover are represented as a percentage of public float. Statistics are weighted by market capitalization.

Table 2: Summary Statistics on Dividend and Foreign Investment

	Denmark		Sweden		Norway	
	Before	After	Before	After	Before	After
	(1)	(2)	(3)	(4)	(5)	(6)
Dividend Yield	0.0167	0.0157	0.0322	0.0211	0.0321	0.0211
	(0.0142)	(0.0160)	(0.0166)	(0.0200)	(0.0166)	(0.0200)
I(Dividends)>0	0.825	0.867	0.918	0.807	0.918	0.807
	(0.380)	(0.340)	(0.274)	(0.394)	(0.275)	(0.395)
Observations	885	640	2805	3692	2813	3701

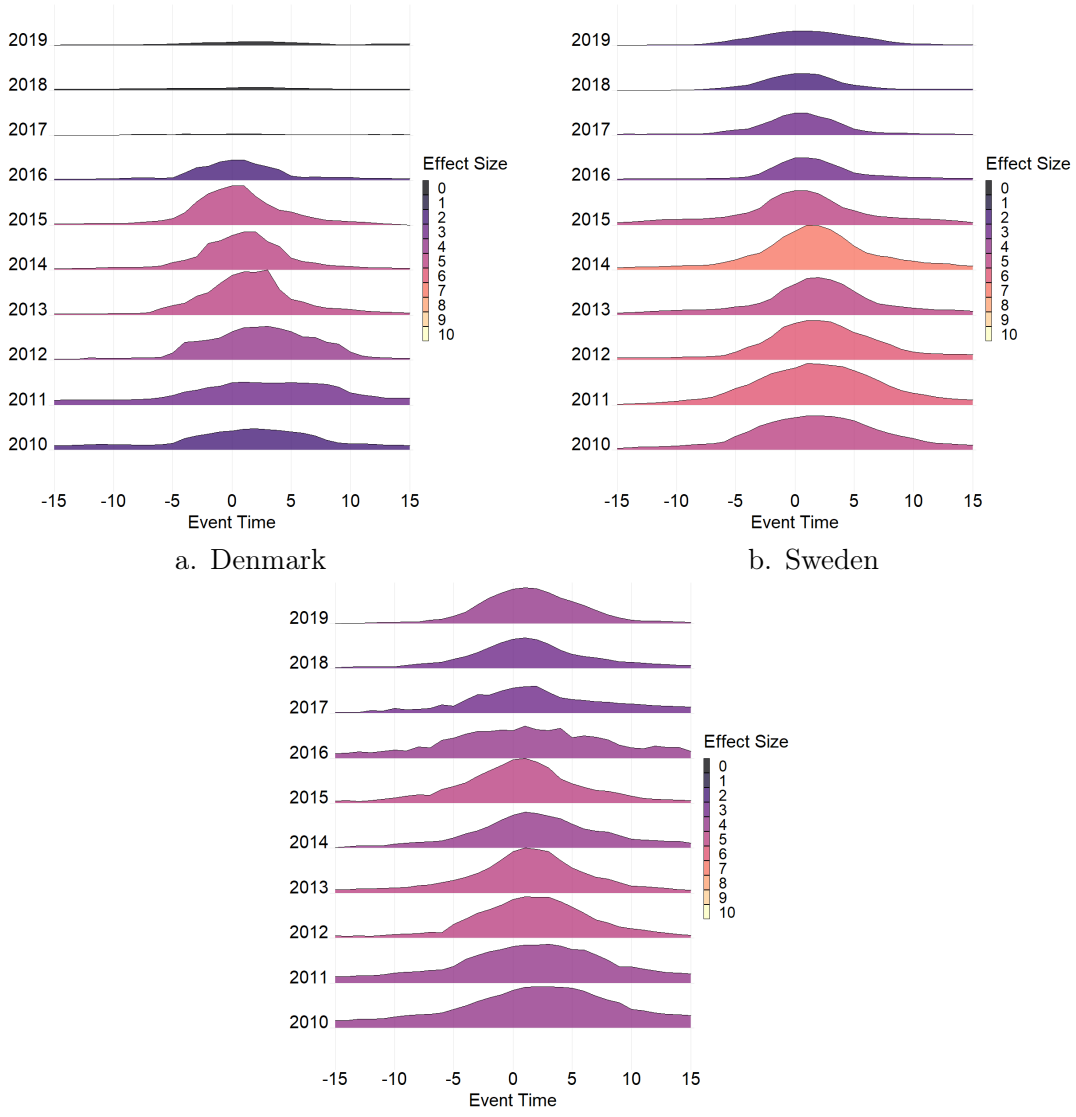
Notes: Each column show the mean of the variable. Dividend Yield is is the total annual amount of gross dividend paid in year t over the average annual market capitalization in year t. I(Dividends)>0 is a binary indicator equal to 1 if the firm paid dividend in year t and zero otherwise. Statistics are weighted by market capitalization.

Table 3: The Effect of the Reform on Dividend Policy and Foreign Investment

	(1)	(2)	(3)
VARIABLES	Dividend Yield	I(Dividends)>0	US Institutional Ownership
Denmark			0.717***
			(0.010)
Denmark*Post	0.014**	0.229*	-0.045***
	(0.006)	(0.120)	(0.007)
Observations	6,674	6,674	111,775
R-squared	0.795	0.819	0.417
Firm FE	Yes	Yes	
Industry-Year FE	Yes	Yes	
Year FE			Yes
Investor FE			Yes
Clustering	Firm	Firm	Manager

Notes: The table reports the main DiD estimates. In column 1 and 2, the unit of observation is firm's level while in column 3 is investor-country level. In column 1, the dependent variable is the total annual amount of gross dividend paid in year t over the average annual market capitalization in year t. In column 2, the dependent variable is a binary indicator equal to 1 if the firm paid dividend in year t and zero otherwise. In column 3, the dependent variable is a binary indicator equal to 1 if the investor i has shares in country j. Standard errors are clustered at firm-level (column 1 and 2) and at investor-level (column 3) and are reported in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Figure 2: Event study on excess stocks on loan around the ex-dividend day



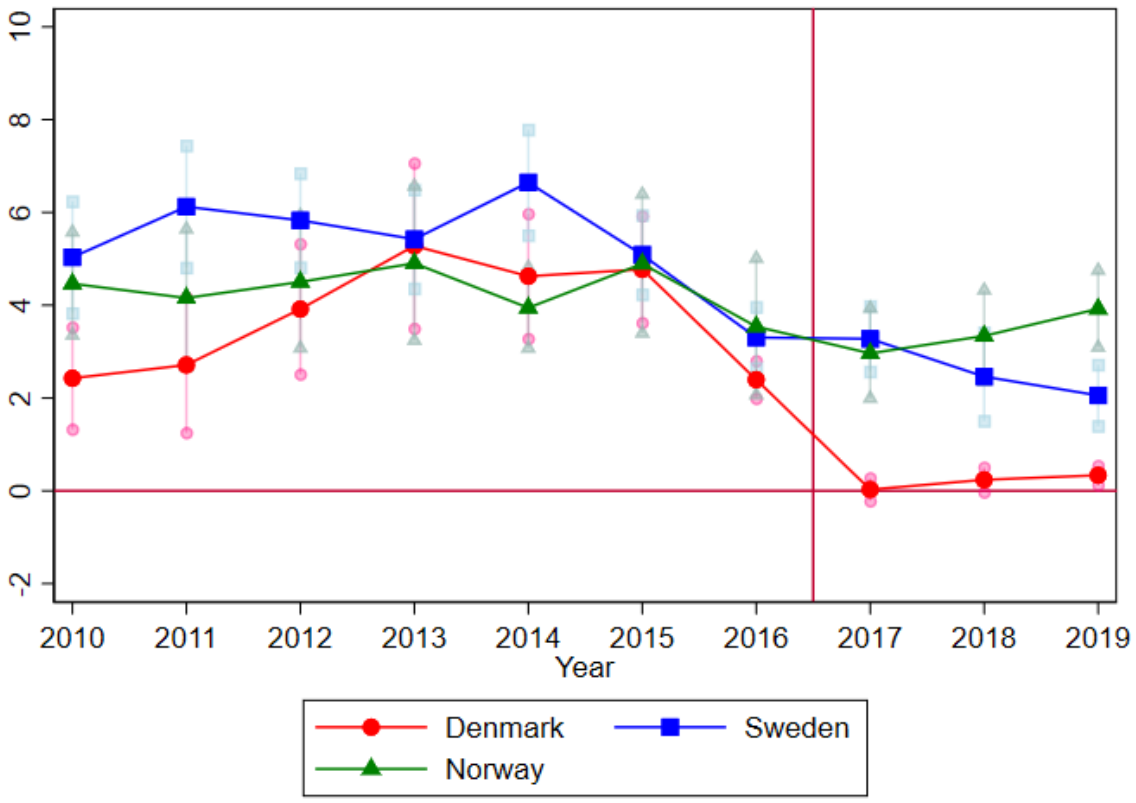
a. Denmark

b. Sweden

c. Norway

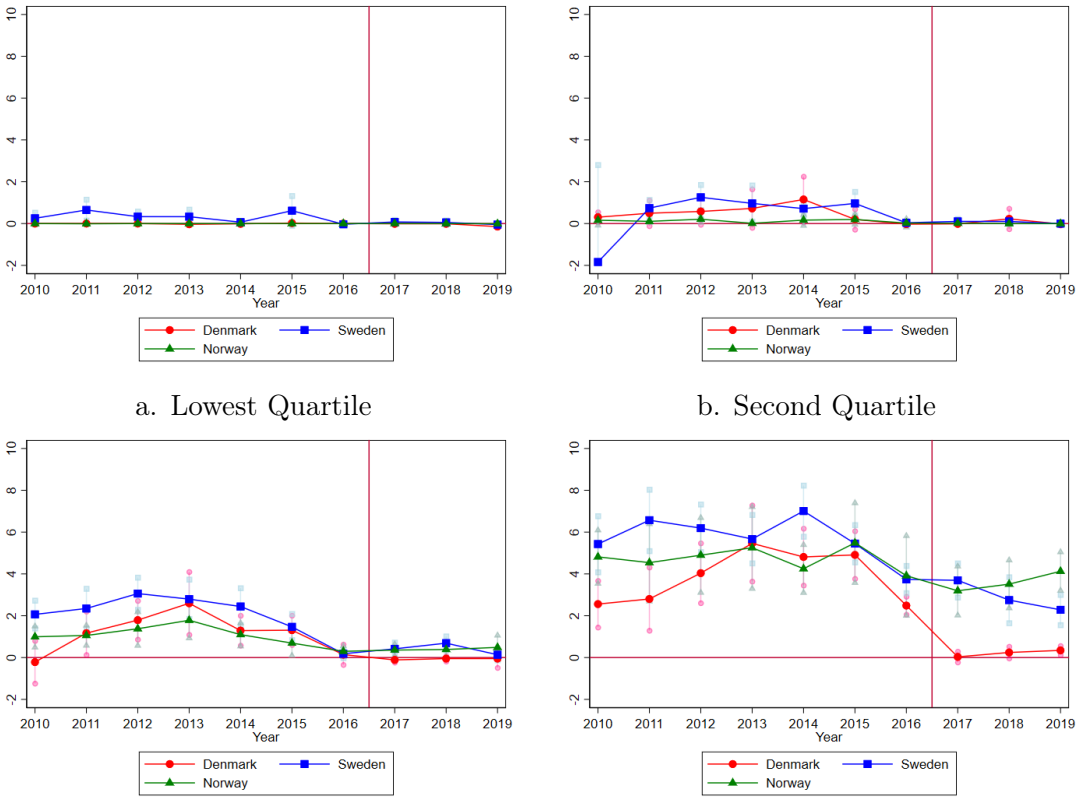
Notes: Each plot represents the profile of the event study from Equation 1 per year. The effect sizes are color coded, with lighter colors representing larger effects and darker colors representing lower effects. The exact effect sizes for Day 1 can be seen in Figure 3.

Figure 3: Yearly event study of excess stocks on loan on ex-divident dates by country and year



Notes: The Y-axis denotes the stocks on loan as a share from public float on day 1 of the event study from Equation 1. The vertical red line represents the Danish reform came into effect on the 18 March 2016. Note that the coefficient on 2016 reflects both the first 4 months of 2016 without a reform and the rest of the year.

Figure 4: Heterogeneity in the excess stocks on loan around the ex-dividend day with respect to quartiles of market capitalisation



a. Lowest Quartile

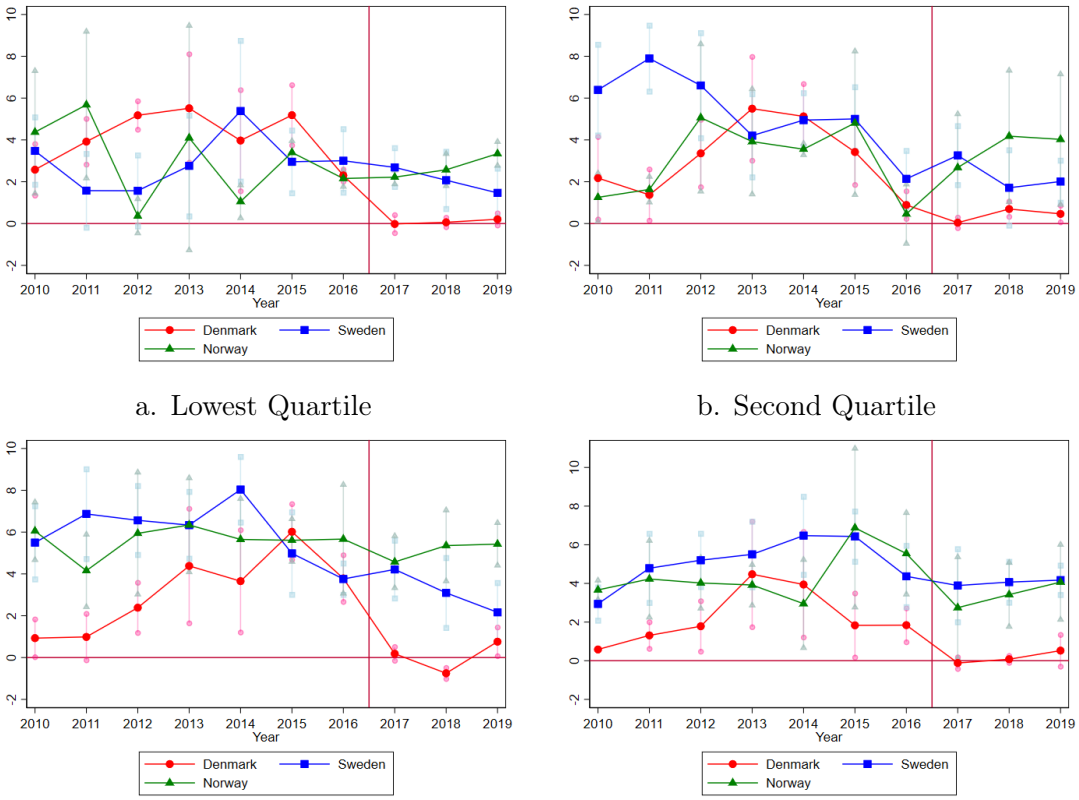
b. Second Quartile

c. Third Quartile

d. Highest Quartile

Notes: Each plot represents the effect on Day 1 from Equation 1 per year and per country. The dependent variable is stocks on loan.

Figure 5: Heterogeneity in the excess stocks on loan around the ex-dividend day with respect to quartiles of divident yield



a. Lowest Quartile

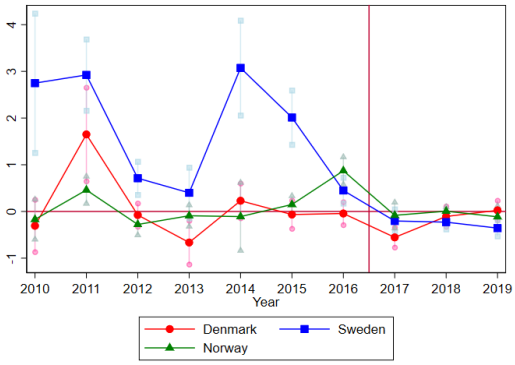
b. Second Quartile

c. Third Quartile

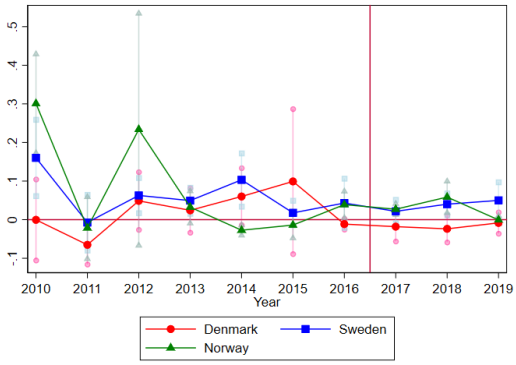
d. Highest Quartile

Notes: Each plot represents the effect on Day 1 from Equation 1 per year and per country. The dependent variable is stocks on loan.

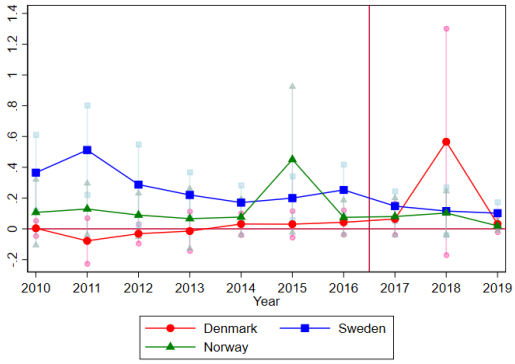
Figure 6: Event study around the ex-dividend day with respect to additional dependent variables



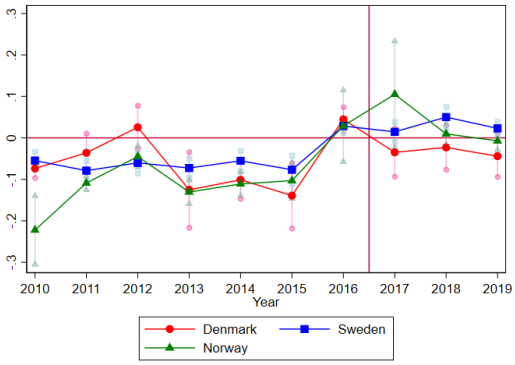
a. Quantity Available for Lending



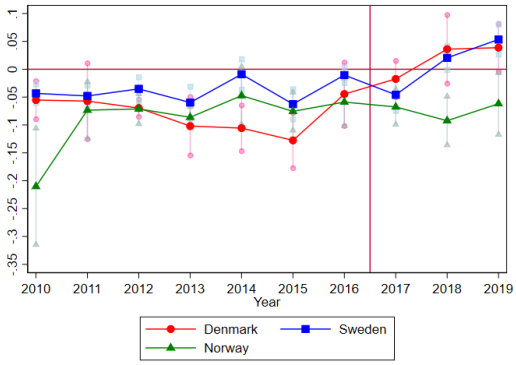
b. Turnover



c. Cost of Borrowing



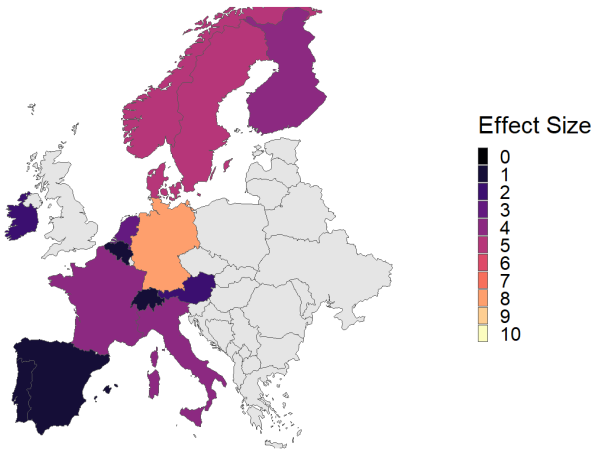
d. Borrower Concentration



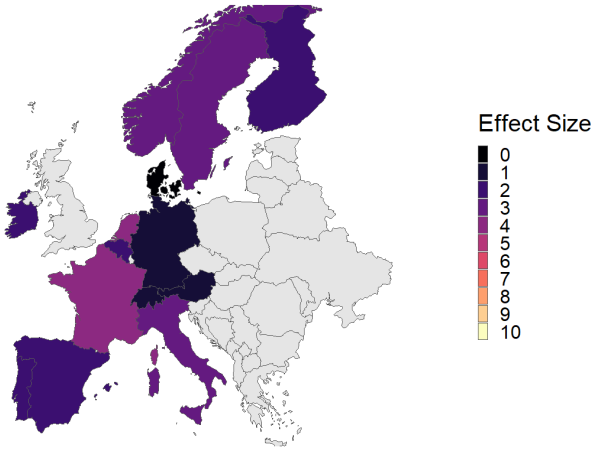
e. Lender Concentration

Notes: Each plot represents the effect on Day 1 from Equation 1 per year and per country. The dependent variable is described in the title of each subpanel.

Figure 7: Snapshot of effect sizes in 15 European countries pre-reform and post-reform



a. 2015



b. 2017

Notes: Each country on the map is colored according to the effect on Day 1 from Equation 1. The effect sizes are color coded, with lighter colors representing larger effects and darker colors representing lower effects. The scale is the same as in Figure 2.