Debt Reallocation in Multinational Firms: Evidence from the UK Worldwide Debt Cap

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Katarzyna Bilicka
Yaxuan Qi, Jing Xing

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Katarzyna Bilicka* Yaxuan Qi** Jing Xing***

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Abstract: How do multinational firms respond to reforms that limit interest deductibility? In this paper, we analyze debt reallocation of multinationals after the implementation of a worldwide debt cap in the UK in 2010. We find that multinationals affected by the cap significantly reduced the tested debt ratio, suggesting the cap is effective. Affected multinationals increased debt holdings and the fraction of subsidiaries in non-UK subsidiaries facing a high corporate tax rate, while shrank operations in low tax countries. Although the cap allowed the UK tax authority to collect more tax revenue from affected multinationals, it did not change their worldwide effective tax rate. There is also evidence that the debt cap induced non-UK headquartered multinationals to shrink their operation in the UK. Our findings provide causal evidence for tax-motivated debt reallocation within multinationals, and shed light on how multinationals can circumvent regulations via adjusting their debt policies and organizational structures.

JEL: H25, H26

Keywords: Debt Shifting, Tax Avoidance, Multinational Companies, Debt Allocation

* Utah State University and Oxford University Centre for Business Taxation, John Huntsman Business School, Logan, United States; katarzyna.anna.bilicka@gmail.com.

**City University of Hong Kong, Department of Economics and Finance, Hong Kong, yaxuanqi@cityu.edu.hk

*** Antai College of Economics and Management, Shanghai Jiao Tong University, 1954 Huashan Road, Shanghai 200030, China, jing.xing@sjtu.edu.cn

1. Introduction

Interest expenses are tax deductible, but dividends are not. This tax bias toward debt financing implies that firms generally have stronger incentive to use debt financing that might exceed the socially optimal level. This issue is exacerbated in a multijurisdictional setting where multinational corporations (MNCs) can take advantage of the differences in interest deduction rules and corporate tax rates across jurisdictions to minimize their tax bill (Desai, Foley, and Hines (2004), Minz and Weichenrieder (2010), Huzinga, Leaven and Nicodeme (2008), and Dharmapala and Riedel (2013)). The action plan of OECD's Base Erosion and Profit Shifting initiative (OECD 2013) has called to develop rules "to prevent base erosion through the use of interest expense" and to achieve this goal, various anti-tax avoidance measures have been adopted by countries. However, it remains unclear empirically how effective these measures are and how multinationals' debt policy responds to limitations on interest deductibility.

In this study, we use the UK worldwide debt cap rule (WDC) implemented in 2010 as a quasi-natural experiment to study the effect of interest deduction limitation on debt allocation and organizational structures of multinational firms. The WDC requires multinational groups to conduct the gateway test and disallows interest deduction on UK net debt exceeding 75% of the multinational group's worldwide gross debt. Employing a carefully matched group-subsidiary dataset of multinationals with operations in the UK, we first examine the effects of WDC on the gateway test ratio of multinationals. We compare affected and unaffected multinationals in terms of their UK net debt and consolidated worldwide gross debt. We find that the ratio of UK net debt to worldwide debt of the affected companies declined significantly following the reform. This suggests that the worldwide debt cap is effective in curbing excess borrowing in the UK.

We uncover an interesting heterogeneity underlying this baseline result. UK-headquartered and foreign-headquartered multinationals employ different strategies to reduce their gateway test ratio. Specifically, UK-headquartered multinationals reduce their UK net debt holdings (i.e. the numerator of the gateway test ratio) more than foreign-headquartered multinationals. In contrast, foreign-headquartered multinationals increase their worldwide debt holdings more

than UK-headquartered multinationals. This finding echoes concerns that the worldwide debt cap may encourage multinationals to raise more external debt.[1]

Furthermore, we find strong evidence of debt shifting to non-UK subsidiaries by the affected MNCs following the WDC, relative to the unaffected MNCs. In particular, affected MNCs are more likely to shift debt to subsidiaries which are located in countries with a higher statutory tax rate. This result indicates that the UK worldwide debt cap has a strong spill-over effect on other countries. Combined with the finding that WDC has no impact on the overall effective tax rate of affected MNCs, our study shows that multinationals manage to shed the extra tax burden due to the worldwide debt cap by reallocating debt across subsidiaries.

We also provide novel evidence on the effect of interest deduction limitations on organizational structures of MNCs, which has rarely been considered in previous studies. Our data allows us to track changes in organizational structures for each MNC over time. More specifically, we examine whether the percentage of subsidiaries located in high-tax-rate and low-tax-rate countries changed after an MNC failed the gateway test. We find that in addition to shifting debt from existing UK subsidiaries to non-UK subsidiaries, multinationals also adjust the location of affiliates to offset the negative impact of interest deduction limitation rules.

Finally, we provide some evidence that the WDC may have had consequences for MNCs operations in the UK. We find that after the reform affected foreign-headquartered multinationals have reduced their activities in the UK by shrinking the size of the total assets held in their UK subsidiaries and by lowering their revenue. The affected UK-headquartered MNCs did not do so and as consequence their tax payments in the UK have increased significantly.

Our findings provide strong evidence that multinationals utilize the allocation of debt across their subsidiaries for earning stripping and tax avoidance purposes. Previous empirical studies show that differences in corporate tax rates between the home and host countries significantly affect debt allocation of multinationals (Desai et al., 2004; Huizinga and Leaven, 2008). These

[1] In April 1 2017 UK has introduced new rules on interest deductibility, where the worldwide debt denominator was replaced by EBITDA. This change likely reflects the concern that multinationals may be using worldwide gross debt manipulations to achieve the desired gateway test ratios. Our result shows that this concern was valid at least for some types of multinationals.

studies usually rely on cross-country differences in tax rates to identify debt allocation of MNCs. We adopt a different approach by studying MNCs' debt shifting in response to a tax policy change that restricted debt deductibility. Hence, we provide more direct and casual evidence on the relation between MNCs' debt allocation and tax motivations. As far as we know, this is the first study to provide direct evidence on debt shifting of multinationals in response to anti-tax avoidance rule, such as interest deduction restriction.

In December 2017, the US passed the Tax Cuts & Jobs Act in which proposals were outlined to put limit on net interest expense deductions of multinational companies in the US.[2] This proposed US reform adopts the worldwide approach similar to the WDC in the UK, which is different from existing regulations such as the thin capitalization rules. We are the first paper to examine the effectiveness of such "worldwide approach" as a new anti-tax avoidance measure. It is likely that more countries will adopt the worldwide approach to tackle MNCs' tax avoidance in the near future. Our study highlights possible spillover effects when only a handful of countries adopt the worldwide approach.

2. Policy background

Many countries have attempted to curb the extent of debt shifting of multinationals by implementing anti-tax avoidance policies such as the thin-capitalization rules. Unlike the WDC, the thin-capitalization rules usually set up a fixed ratio, such as the debt-to-equity ratio, or the interest coverage ratio, and interest expense associated with debt exceeding the ratio are often disallowed for tax deduction. The thin capitalization rules are *stand-alone rules* in the sense that they consider each subsidiary of the multinational as a separate entity. Despite some evidence that thin capitalization rules reduce multinational companies' incentives to use internal debt for tax planning purposes (Buetnner et al., 2012; Blouin et al., 2014), the limitation of the fixed ratio thin capitalization rule has also become apparent over the years. For example, the financing policies of multinationals are likely to be highly centralized and the thin capitalization rule can be easily circumvented. [3] More recently, the OECD has

[2] The proposal put a limit on net interest expense deduction of the U.S. borrower at 110% of the U.S. borrower's share of the group's overall earnings. https://www.clearygottlieb.com/~/media/files/updated-tax-reform-12-7-17/3423467v9tcja-summary--nonus-debt-capital-markets-dec-7.pdf

[3] For example, multinationals can inject equity to subsidiaries with a high debt-equity ratio to avoid exceeding the fixed ratio. Webber (2010) provides the survey on the thin-capitalization and interest deductibility rules around the world.

recommended to use the "worldwide approach" to supplement thin capitalization rules.[4] The *worldwide approach* evaluates the allocation of debt across multinational affiliates by comparing the amount of debt located in each country to the total amount of consolidated debt or EBITDA held by the multinationals. It has been advocated that the worldwide approach is a more effective method than the thin capitalization rules in addressing the earning stripping and debt shifting by multinational firms, as it is more difficult to circumvent (Desai and Dharmapala (2014) and Brunett (2015)).

The UK has led the field by introducing the "worldwide debt cap" (WDC) reform as early as 2010. In January 2010, the UK tax authority, the HMRC, introduced the "worldwide debt cap" to restrict the generous tax deductions for financing expenses enjoyed by multinational firms. HMRC's aim is that the UK should not bear interest expense that, in aggregate, exceeds the amount of interest actually borne by a worldwide group. As a measure to tackle the earning stripping and tax avoidance by multinationals, the worldwide debt cap was also motivated by the 2009 territorial tax system reform in the UK (Arena and Kutner, 2017; Egger et al., 2015). After the 2009 tax reform, the HMRC needed to compensate tax revenue losses as it no longer taxed dividends repatriated by multinationals under the new territorial tax regime.[5] The UK WDC was applicable for periods beginning on or after January 1 2010 and up until April 1 2017. To apply this rule, the net debt of all UK relevant subsidiaries of a multinational company is first added together, and a gateway test based on the ratio of total UK net debt to the multinational's worldwide gross debt is calculated for each multinational group that has operations in the UK. The worldwide debt cap applies to company groups that have a corporate tax residence in the UK[6], except those in the financial sector. A qualifying worldwide group is one that has more than 250 employees, above €50m turnover and/or above €43m balance sheet total assets. The rule is not optional and requires companies to calculate the so-called gateway ratio—the ratio of UK net debt relative to the group's worldwide gross debt. If this ratio exceeds 75%, interest deduction is disallowed for the exceeding level of debt.

When calculating the gateway test ratio, the numerator is defined as the average of the opening and closing net debt of each company that was a relevant group company (75% subsidiary) at

[4] See, BEPS Action 4 report (2015).
[5] Miller (2017) estimates that the anti-tax avoidance measures, especially the restriction on relief for interest, have been the main way UK tax revenues have been raised since 2010.
[6] This means either a UK company or a UK permanent establishment of a non-UK company.

any time during the period. The opening and closing dates are the beginning and end of the accounting period for the company. The UK net debt is the difference between relevant liabilities and relevant assets. The type of borrowings that would be treated as relevant liabilities includes short term loans, overdrafts and long-term debt. Trade credit and liabilities in the form of share capital, such as preference shares, are not treated as relevant liabilities for the purposes of the gateway test, even if they are accounted for in financial liabilities. Relevant assets include cash and cash equivalents, lending, investment in government or company securities, and net investment in financial leases. Worldwide gross debt is measured by looking at amounts disclosed in the balance sheet of the worldwide group. It is based on the average of the consolidated liabilities of the worldwide group, calculated at the end of the current and preceding periods. Worldwide gross debt only considers external debt, while the UK net debt figure includes intra-group debt amounts.[7]

Our study aims to identify the causal effect of the 2010 UK worldwide debt cap on MNCs' debt allocation policies. It is worth noting that the UK experienced other tax policy changes during the same period of time. First, the UK moved from the worldwide tax system to the territorial tax system in 2009 and thereafter it exempts dividend repatriation by MNCs from being taxed in the UK. This reform has shown to lead to more dividend repatriation (Egger et al. (2015)) and higher payouts to shareholders (Arena and Kutner (2017)). Second, the UK government gradually lowered the statutory corporate income tax rate from 28% in 2010 to 20% by 2015. The reduction in the statutory rate is a byproduct of the territorial tax system reform and it is a measure to increase UK's competitiveness. Importantly, these two tax changes apply to all UK companies and are not specific to a certain group of MNCs. In contrast, the 2010 worldwide debt cap targets large MNCs with exceeding debt holdings in the UK *alone*. There are also other smaller tax policy changes in the UK, such as the Annual Investment Allowances with the aim to stimulate business investment, and the corporate tax surcharge on banks. However, these other tax changes should have little impact on non-financial MNCs' debt policies.

3. **Data and sample construction**

To examine the effects of the worldwide debt cap reform on debt reallocation of multinationals, we need to collect matched multinational group level (i.e. parent level) and their subsidiary

[7] See the HMRC's website https://www.gov.uk/hmrc-internal-manuals/corporate-finance-manual/cfm90160 for more detailed information.

level data. We use several databases to construct our sample. First, we use Osiris by the Bureau van Dijk (BvD) to extract a sample of multinational firms. It is worth noting that the worldwide debt cape rule only applies to "*worldwide groups*" that own a relevant UK subsidiary. The rule defines a *relevant subsidiary* as 75% owned subsidiary and the net UK debt is calculated using only these relevant subsidiaries. Thus, we use the historical, 2010, version of Osiris to identify a sample of parent companies that own at least one UK subsidiary with 75% or more shares in 2010, when the UK worldwide debt cap became effective. This procedure yields a sample of 1,609 multinational groups. We then use the 2005-2014 CDs of ORBIS to extract subsidiaries affiliated with those parent companies with at least 50% controlling shares. Ownership structures of multinational groups change frequently, and our approach allows us to trace changes in organizational structures during the period 2005-2014.

Next, we obtain consolidated financial data from Osiris for the parent company, which allows us to construct the multinational group's consolidated gross debt. We obtain unconsolidated financial data for multinationals' UK subsidiaries from FAME, which allows us to construct these subsidiaries' UK net debt. Further, to analyze debt allocation between UK and non-UK subsidiaries, we use Orbis database to obtain financial data for the multinational groups' non-UK subsidiaries. In our benchmark sample, we obtain financial information for these multinational groups during the period 2008 – 2014.[8]

We follow HMRC's definition to calculate the UK net debt and worldwide gross debt using Osiris and FAME. We calculate the net UK debt and the worldwide gross debt for multinational groups in our sample by aggregating the total UK net debt of all *relevant* subsidiaries. Once we construct the annual UK net debt and worldwide gross debt for each multinational group, we use the HMRC guideline to construct the gateway test ratio for multinational i in year t, $\text{Gateway}_{i,t}$, as $[UK\ net\ debt_{i,t-1} + UK\ net\ debt_{i,t}]/[Gross\ debt_{i,t-1} + Gross\ debt_{i,t}]$. A multinational failed the gateway test, if its gateway ratio exceeded 75% in 2010. We find that 197 multinational groups in our sample failed the gateway test. 148 of these failed multinationals are headquartered in the UK and the rest are headquartered elsewhere.

[8] Note that the organizational structure information that we have ends in 2014 and that is when we cut our analysis sample as well.

To account for the differing characteristics of various multinational groups, we perform propensity score matching. We match companies using the one-to-one matching algorithm without replacement by industries, the location of the group parent and group size in 2010. After matching, we obtain 188 groups that failed the gateway test in 2010 and 188 groups that did not fail the gateway test.[9] As a comparison, we also provide results using the full sample and alternative matching technique.

Table 1 provides descriptive statistics for the matched sample before and after the 2010 UK debt cap reform. Here, we only include years 2008 and 2009 as pre reform years and years 2011 and 2012 and post reform years. The median gateway test ratio for the multinational groups that failed the gateway test was 1.51 before the reform and 1.38 after the reform.[10] This suggests that a median multinational firm that failed the gateway test did reduce its gateway ratio, although the post-2010 gateway ratio is still above the required level. The corresponding gateway test ratios were 0.03 and 0 for the firms that did not fail the gateway test in 2010. Multinationals that failed the gateway test had on average higher total net UK debt and lower worldwide debt than firms that did not fail the gateway test, both before and after the 2010 reform.

4. Empirical strategy

We use the Difference-in-Differences methodology to investigate the responses of multinationals to the 2010 UK worldwide debt cap. Multinationals that failed the gateway test in 2010 are in our treated group, while those that passed the test are in the control group. We conduct three sets of experiments.

4.1 Effect on gateway ratio, UK net debt and group gross debt

We first estimate the effect of the cap on multinationals' gateway ratio based on the following specification:

[9] We do not find a match for every affected multinational in our sample. We have missing profitability and group size for some affected firms. Also, matching simply did not find comparable control companies.
[10] The number of firms that were above gateway test ratio was 136 in 2010, 137 in 2011, 144 in 2012, 143 in 2013, 128 in 2014. Clearly firms reduced their gateway ratios but not below the required threshold.

$$Gateway\ test_{i,t} = \alpha_1 + \beta_1 \times \text{Failed}_i \times \text{Post}_t + \gamma_1 \text{Failed}_i + \delta_1 \times X_{it}^{'} + \vartheta_t + \varphi_i + \varepsilon_{i,t} \quad (1)$$

where $Gateway\ test_{i,t}$ is the ratio of total UK net debt and the consolidated group gross debt (i.e. the gateway test ratio); $\text{Failed}_{i,t}$ is a dummy variable that equals 1 if multinational *i* failed the gateway test in 2010, and 0 otherwise; Post_t is a dummy variable that equals 1 from 2010 onwards; $X_{it}^{'}$ is a set of group-level control variables, including group size; ϑ_t is the time fixed effect, φ_i is the parent-specific fixed effect, and $\varepsilon_{i,t}$ is the error term. The coefficient of interest is β_1, which captures the treatment effect of the worldwide cap rule on the multinational companies' UK net debt ratio. If high levels of UK net debt observed among failed multinationals are mainly used to reduce UK taxable income, we should observe a decline in the gateway test ratio after the implementation of the worldwide debt cap. In this case, we expect the coefficient β_1 to be negative.

There are two ways to reduce the gateway test ratio either by reducing the numerator (net UK debt) or by increasing the denominator (worldwide gross debt). We therefore study the net UK debt and worldwide gross debt respectively in equations (2) and (3). First, a MNC can reduce the gateway test ratio by reducing the level of UK net debt while keeping the worldwide gross debt unchanged. In this case, we expect the coefficient β_2 to be negative. As reducing internal debt holdings in specific host countries is the goal of the "worldwide approach", it is of policy importance to investigate whether the debt cap achieved this goal. More specifically, we estimate Equation (2):

$$UK\ net\ debt_{i,t} = \alpha_2 + \beta_2 \times \text{Failed}_i \times \text{Post}_t + \gamma_2 \text{Failed}_i + \delta_2 \times X_{it}^{'} + \vartheta_t + \varphi_i + \varepsilon_{i,t} \quad (2)$$

One criticism of the "worldwide approach" to tackle multinationals' debt shifting behaviour is that it may lead to higher level of external borrowing. Indeed, the second way for the multinationals to pass the gateway test is to increase external borrowing while keeping the UK net debt unchanged. To investigate this possibility, we replace $UK\ net\ debt_{i,t}$ with the group consolidated gross debt, $Gross\ debt_{i,t}$, and estimate Equation (3):

$$Gross\ debt_{i,t} = \alpha_3 + \beta_3 \times \text{Failed}_i \times \text{Post}_t + \gamma_3 \text{Failed}_i + \delta_3 \times X_{it}^{'} + \vartheta_t + \varphi_i + \varepsilon_{i,t} \quad (3)$$

4.2 Effect on debt allocation within groups

To fully understand the impact of the UK worldwide debt cap, we also need to investigate possible reallocation of debt between UK and non-UK subsidiaries for the multinationals that failed the gateway ratio test. It is possible that the multinational compensates the loss of interest deduction by shifting debt from its UK subsidiaries to non-UK ones, where no similar debt cap has been imposed. Hence, we examine the financial leverage of non-UK subsidiaries of failed multinationals, relative to those of unaffected multinationals. Based on the subsidiary level data from Orbis, we estimate Equation (4):

$$Leverage_{i,j,s,t} = \alpha + \beta \times \text{Failed}_i \times \text{Post}_t + \gamma \text{Failed}_i + \delta \times X'_{ijst} + \vartheta_t + \mu_i + \varphi_j + \varepsilon_{i,j,s,t} \quad (4)$$

where $Leverage_{i,j,s,t}$ is the net-of-cash leverage ratio of non-UK subsidiary *j* that belongs to multinational *i*, located in host country *s*, in year *t*. The net-of-cash leverage ratio is defined as the ratio of [Total debt-Cash] to [Total assets-Cash]. If β is positive, this indicates that failed multinationals will shift debt to non-UK subsidiaries after the implementation of the UK worldwide debt cap. Moreover, to understand whether debt shifting is tax sensitive, we interact $\text{Failed}_i \times \text{Post}_t$ with the statutory corporate income tax rate that the non-UK subsidiary *i* faces in year *t* in country *s* ($\text{CIT}_{i,s,t}$). In order to use interest expense to reduce the tax liability, a group is more likely to shift debt to high-tax countries. If the debt reallocation is driven by tax motives, we expect the interaction between $\text{CIT}_{i,s,t}$ and $\text{Failed}_i \times \text{Post}_t$ to be positive.

4.3 Effect on organisational structure of multinational groups

Another way that multinational group can adapt to reduce the effect of UK worldwide debt cap is to change the location of its subsidiaries. For example, it could sell the relevant subsidiaries in the UK to avoid the gateway test failure. Hence, we investigate the effects of the UK worldwide debt cap on organizational structures of failed multinationals. The Osiris sample of firms includes all 1,609 multinational groups which had at least one relevant UK subsidiary in 2010. Our data allows us to trace those subsidiaries ownership changes in the years 2005 –

2014. We calculate the time-varying number of subsidiaries located in high tax and low tax countries, as a ratio of the multinational's total number of subsidiaries.[11] We then estimate Equation (5):

$$\%Subsidiary_{j,s,t} = \alpha + \beta \times \text{Failed}_i \times \text{Post}_t + \gamma \text{Failed}_i + \delta \times X'_{jst} + \vartheta_t + \mu_i + \varphi_i + \varepsilon_{j,s,t} \quad (5)$$

where $\%Subsidiary_{j,s,t}$ is the percentage of the number of subsidiaries belong to group *j* located in host country *s* in year *t*. In particular, we group countries *s* into high tax and low tax. Similar to debt reallocation, in order to use interest expense to reduce tax liability, a group may be more likely to increase the fraction of subsidiaries located in high tax countries following the reform at the expense of subsidiaries located in low tax rate countries. Hence, we expect the coefficient β to be positive for high tax countries and negative for low tax counties.

5. Results

5.1 Graphical evidence

In this section, we present graphical evidence on the effect of the UK worldwide debt cap. Figure 1a plots the average gateway test ratio together with confidence intervals for the treated and the control groups during the period 2008-2014. The treated firms are those failed the gateway test in 2010 and they are firms affected by the worldwide cap rule. The control group contains firms with the gateway test ratio below the threshold in 2010. Figure 1a indicates that our treated firms reduced the ratio of UK net debt to worldwide gross debt from 2011 onwards. In contrast, firms in the control group experienced almost no change in their gateway test ratios after 2011. Note that for the multinationals that failed the gateway ratio test, the average gateway ratio is much larger than for those that did not fail the gateway test. Further, the average gateway ratio does not fall below the required 75% throughout the sample. The evidence from descriptive statistics in Table 1 indicates that the gateway test ratio does not fall below 75% for a median firm after the 2010 reform either.

[11] Note that we do not analyze the absolute number of multinational subsidiaries. This is because there has been a change in the way that ORBIS records subsidiaries during our sample period.

Since the gateway ratio is defined as the UK net debt divided by worldwide gross debt, we plot the average of UK net debt and worldwide gross debt respectively in Figure 1b and 1c. First, note that the firms that failed the gateway test had on average higher UK net debt and lower worldwide debt than firms that did not fail the test. We find that treated firms have reduced their UK net debt gradually after the 2010 reform, while the control group firms did not change their UK net debt much. In contrast, the worldwide gross debt of both control and treated groups have moved together throughout the sample period, with worldwide gross debt of treated group growing slightly faster after the 2010 debt cap reform. Overall, Figure 1 provides preliminary evidence that UK's worldwide debt cap rule has real impact on debt holdings of multinationals.

In Figure 2, we distinguish between UK headquartered and non-UK headquartered multinational companies. In figures 2a and 2b present UK headquartered MNCs while figures 2c and 2d report foreign MNCs. Both UK and non-UK headquartered firms that failed gateway ratio test reduce the UK net debt while control groups do not change their UK net debt by much. However, UK and non-UK headquartered MNCs adjust their worldwide debt very differently. UK headquartered MNCs do not adjust their worldwide debt after 2010 and there is no significant difference between the treated and control groups in Figure 2b. In contrast, non-UK headquartered MNCs that failed gateway ratio test sharply increase their worldwide debt in year 2011 while those that did not fail gateway ratio test maintain relatively stable worldwide debt. Overall, Figure 2 suggests UK-headquartered and non-UK headquartered multinationals respond to the worldwide debt cap in different ways. It seems that non-UK headquartered firms have more flexibility to adjust worldwide debt in response to the reform.

5.2 Impact of the worldwide debt cap on group-level debt policies

In Table 2, we report estimation results from Difference-in-differences analyses based on Equations 1-3. To increase the comparability between the treated and control groups, we use 1-to-1 nearest neighbour matching technique to select the multinationals. In each specification we control for group size (the natural logarithm of group total assets). We also include a common set of year dummies to control for the business cycle effects. In the odd numbered columns we control for industry-specific fixed effects, while in the even numbered columns we control for group fixed effects.

In Columns 1 and 2, we report the estimation results based on Equation (1) where the dependent variable is the logarithm of the gateway ratio. Column 1 shows that before the reform, treated multinationals had a significantly higher level of gateway ratio with an estimated coefficient of 1.635. However, treated firms experienced a significant reduction in the gateway ratio after the implementation of the worldwide debt cap. The estimated treatment effect is -0.396 with statistical significance at the 1 percent level. Controlling for group fixed effects in column 2, we continue to find that after the reform, treated multinationals significantly reduced their gateway test ratio relative to multinationals in the control group. The economic magnitude of the effect is very large here. Since the dependant variable is in logarithms, we can interpret the estimated coefficients as percentage changes. We find that after the reform the multinationals that failed the gateway test have reduced the gateway ratio by 34% on average.

In Columns 3 and 4, we use the natural logarithm of UK net debt as the dependent variable and report the estimation results based on Equation (2). First, treated multinationals had much higher UK net debt holdings than the control group before the reform. After the reform, treated multinationals significantly reduced their UK net debt holdings relative to the control group. We obtain similar result in Column 4 with group-specific fixed effects. Column 4 indicates that after the reform, the affected multinational groups lowered their holdings of net UK debt by 138% relative to the control group. This reduction is statistically significant at the 1 percent level.

In Columns 5 and 6, we report estimation results based on Equation (3) where the dependent variable is the natural logarithm of group consolidated gross debt. It is important to note that the treated multinational groups have on average statistically significantly lower gross debt than the control group. This is consistent with the evidence from Figure 1c. The point estimates on the interaction term $\text{Failed}_i \times \text{Post}_t$ are both positive and statistically significant at 5 percent level in Column 5 and at 1 percent level in Column 6. This result is consistent with the conjecture that the worldwide debt cap may encourage multinational firms to increase external borrowing.

In the Appendix, we provide analogous results when we use the unmatched full sample (Table A1) and the matched sample using the alternative kernel matching technique (Table A2). Results are broadly similar based on the alternative samples.

Figure 2 suggests that UK-headquartered and non-UK headquartered multinationals respond to the UK worldwide debt cap in different ways. To formally test this, we split the sample into two sub-samples: UK headquartered MNCs and non-UK headquartered MNCs. We report the results in Table 3. Throughout Table 3, we control for group-specific fixed effects, a common set of year dummies and group size.

Results from Table 3 confirm the heterogeneities revealed in Figure 2. While both UK headquartered and foreign-headquartered affected multinationals significantly reduced their gateway ratio relative to control group, this adjustment is achieved in slightly different ways. The affected UK headquartered multinationals reduced their UK net debt by about 154% (column 3), with a small 25% increase to their worldwide gross debt (column 5). On the other hand, non-UK headquartered multinationals significantly reduced their UK net debt by about 99% (column 4) but increased their worldwide gross debt by almost 54% (column 6).

This heterogeneity is not entirely surprising for the following reason. The worldwide debt measure usually includes mainly external debt borrowing from third parties. Companies tend to borrow externally using the headquarter, rather than their affiliates. This is because there is some evidence that external borrowing is sensitive to tax incentives (Arena and Roper, 2010; Moen et al, 2018). This is because headquarters usually have higher credit rating than affiliates and hence are able to get cheapest borrowing cost and most favourable terms. Consequently, the UK headquartered MNCs are relatively limited in reducing their gateway ratios—if such MNCs increase external borrowing in the UK, this will automatically increase their UK net debt. In contrast, a foreign headquartered MNC can complement the reduction of its UK net debt by substantially increasing external debt elsewhere.

5.3 Debt reallocation across subsidiaries

We have shown that multinationals that failed the gateway test in 2010 subsequently reduced their UK net debt holdings. In this section, we examine whether these changes are accompanied by debt reallocation across subsidiaries.

First, since only subsidiaries owned at least 75% by the MNC are considered in the gateway test, multinationals that failed the gateway test could reallocate debt from at least 75% owned UK subsidiaries to other UK subsidiaries that are less than 75% owned. We find only very

weak evidence that MNCs shift debt from relevant subsidiaries with 75% or above control to UK subsidiaries with 50%-75% control (results not reported here). The leverage ratio among the 50%-75% owned UK subsidiaries has increased after the MNC failed the gateway test. However, the effect is not statistically significant. The reason for that may be twofold. First, the sample is small here, so it is possible that the coefficients are estimated imprecisely. Second, relocating debt to subsidiaries within the same country brings smaller tax advantage to those affected multinationals than moving debt to more tax advantageous location outside of the UK.

Firms that failed the gateway test in 2010 could also reallocate debt from UK to other high tax countries to offset the loss of interest deduction in the UK. We expect the overall leverage ratio to increase among the non-UK subsidiaries of treated MNCs, if affected firms have reallocated their debt away from the UK. Further, we expect the increase in the leverage ratio to be more substantial in subsidiaries located in countries with higher corporate income tax rates.

We test our hypotheses by estimating Equation (4) and the results are reported in Table 4. Throughout all columns in Table 4, we control for common business cycle effects and subsidiary-specific fixed effects. In columns 1-4, we use the full sample of MNCs. In column 1, we estimate Equation (4) without adding any control variables. We find that multinationals which failed the gateway test have on average increased the leverage ratio of their non-UK subsidiaries by 0.2 after the reform relative to multinationals in the control group. Controlling for subsidiaries' size and profitability, parent size (column 2) and host country year fixed effects (column 3), we continue to find a significant increase in the leverage ratio of non-UK subsidiaries of affected MNCs, relative to that of the control group. The magnitude of the effect falls to 0.147 increase in leverage ratio of non-UK subsidiaries when we include all the controls. These results show that the UK worldwide debt cap led to reallocation of debt from UK to non-UK subsidiaries of affected MNCs.

To test our second hypothesis that affected MNCs have stronger incentives to reallocate debt to subsidiaries facing a higher corporate income tax rate, we multiply $\text{Failed}_i \times \text{Post}_t$ by each host country's statutory corporate income tax rate.[12] Result based on this specification is reported in column 4. The point estimate for $\text{Failed}_\text{i} \times \text{Post}_\text{t} \times CIT_{i,j,s,t}$ is positive and

[12] We obtain each host country's statutory corporate income tax rate from the Oxford University Centre for Business Taxation.

statistically significant at the 1 percent level. This suggests that leverage increased more in non-UK subsidiaries located in countries with a higher corporate income tax rate. The coefficient of 0.561 means that leverage increases by 11 percent in non-UK subsidiaries with 20% tax rate and by 22 percent in non-UK subsidiaries with 40% tax rate. The results in column (4) suggest that affected MNC are more likely to reallocate their UK debt to countries with high tax rates. Hence, this debt reallocation may be motivated by tax planning.

In columns 5 and 6, we repeat the estimations based on the specifications in columns 3-4 using the sub-sample of subsidiaries that belong to a UK-headquartered MNC. In columns 7 and 8, we analyse debt reallocation using the sub-sample of subsidiaries that belong to a non-UK-headquartered MNC. We find that both types of multinational firms increased leverage in their non-UK subsidiaries following the reform relative to the control group (Columns 5 and 7), although the point estimate is only significant for non-UK headquartered MNCs. Similarly, for both types of MNCs, leverage increases when the host countries' tax rate increases, but again this effect is only significant for non-UK headquartered MNCs (Columns 6 and 8).

These results point towards an interesting pattern in debt reallocation for the two types of multinational firms. The UK-headquartered firms that failed the gateway test have reduced their net UK debt while making small changes to their worldwide gross debt holdings. At the same time, they did not significantly change leverage of their non-UK subsidiaries. This suggests that they may bear more burden of the imposed WDC. In contrast, non-UK-headquartered multinationals increased their worldwide gross debt and significantly increased leverage in their non-UK subsidiaries. Thus, foreign headquartered MNCs are likely to have increased both internal and external borrowing outside of the UK.

5.4 Impact of the worldwide debt cap on organizational structures

Another way to offset the impact of the UK worldwide debt cap is to adjust the firm's organisational structure. The gateway test requires calculation of the UK net debt ratio using relevant UK subsidiaries. Hence, an MNC can sell out shares of its UK subsidiary to avoid including the subsidiaries' debt in the gateway test calculation. A more extreme solution would be to shut down its business in the UK and acquire new affiliates in other countries. These

organizational structure changes could be a costly but an effective method of offsetting the impact of the tax reform without changing the overall tax bill.

Changes in organizational structure have rarely been discussed in previous studies, due to two reasons. First, organizational structure adjustment is more dramatic and more costly than simple debt reallocation across existing subsidiaries. Hence, it has been considered to be less likely to change in response to tax reform. Second, researchers need to obtain time-varying ownership structures of the multinational to conduct such analysis. Our unique data permits us to do this novel test.

Specifically, for each group-year, we calculate the percentage of subsidiaries located in the UK relative to all controlled subsidiaries in the group. This ratio measures the relative importance of UK business in the group. Similarly, we also calculate the percentage of subsidiaries located in countries with higher and lower statutory tax rate than the UK. We then estimate the effect of the reform on the percentage of subsidiaries held in each of the groups of countries. We use percentages rather than numbers of subsidiaries because we are interested in the shifts in the importance of geographical locations for multinational business activities.

Table 5 presents the results.[13] In columns (1), (3) (5) and (7) we control for year fixed effects, while in columns (2) (4) (6) and (8) we further control for parent fixed effects. We find that that treated groups, compared to groups which are not affected by the gateway test, have relatively more UK subsidiaries (column 5) and fewer subsidiaries in other counties (columns 1 and 3). We find support for the hypothesis that multinationals not only reallocate their debt holdings but are also likely to change the firm structure following the 2010 reform. Consistent with tax-motivated hypothesis, treated groups have increased the fraction of their subsidiaries located in higher tax regimes by 4.2 percentage points (column 1 and 2), and reduced the fraction of subsidiaries located in lower tax regimes by 3.7 percentage points (column 3 and 4). These changes are statistically significant in 1 percent level. The increase in the fraction of subsidiaries held in higher tax regimes is not perfectly offset by the reduction in the fraction of subsidiaries held in lower tax regimes. Failed multinationals may also reduce the fraction of relevant (over 75% held) subsidiaries in the UK. We test this hypothesis in Columns 5-8, and

[13] Note that we use all multinational groups with at least one relevant subsidiary in the UK in 2010 and trace them across the 10 years sample period here, 2005 – 2014. Using the much smaller (220 groups) matched sample yields negative but insignificant point estimates.

the results indicate that affected MNCs reduce the percentage of relevant UK subsidiaries in response to the UK worldwide debt cap although these results are not always statistically significant.

Our results show that the affected MNCs increase the proportion of subsidiaries held in higher tax rate regimes following the UK worldwide debt cap. Thus, affected MNCs reallocate debt to other countries so that the negative impact of the UK tax reform would be minimized for the MNC as a whole. Our results show a possible spill-over effect if only one or very few countries adopts the worldwide approach—MNCs can shift debt to countries where no similar anti-tax avoidance policies are in place. Consequently, while the worldwide debt cap may help increase tax revenue for the HMRC, it may reduce tax payment by the affected MNCs in other countries. Therefore, the worldwide approach would be more effective in curbing the overall earning stripping by MNCs, if more countries adopt it.

5.5 Impact on multinationals' tax payments

In this paper, we show that multinationals responded to the UK worldwide debt cap with debt reallocation and organizational adjustments. Did these adjustment help affected multinationals offset the extra tax burden due to the debt cap? To answer this question, we calculate the effective tax rate at the group level and compare affected MNCs to those unaffected by the reform. We report the result in Table 6.

In Table 6, we do not find any significant change in group-level effective tax rates for the affected MNCs, relative to those in the control group. This result holds for both UK-headquartered and non-UK-headquartered MNCs. The pattern is also robust to whether we use the matched sample or the full sample for the analysis. Taken together, our findings suggest that multinationals managed to fully offset the impact of the loss of interest deduction in the UK on their effective tax burden. In unreported exercises, we find no changes in affected multinationals' investment behaviour following the introduction of the worldwide debt cap.

In Table 7, we investigate whether the WDC had any impact on tax payments of multinational firms to the HMRC. Miller (2017) shows that the only recent tax policies in the UK that bring positive revenues to the HMRC are those that tackle tax avoidance practices of multinational companies, especially those policies that are related to interest deductibility restrictions. We

therefore investigate the effect of WDC on total tax payment of multinational firms to the UK authorities. In particular, we aggregate the tax payments across all UK subsidiaries of each multinational firm.[14] The results indicate that the reform has significantly increased tax payments of UK HQ multinationals only. Their tax payments have increased by 25%.[15] In turn, there is some weak evidence that tax payments of non-UK HQ multinationals have decreased.

In Tables 8 and 9, we explore whether this negative change in non-UK MNCs tax payments is related to the size of their operations in the UK. We find that non-UK headquartered MNCs significantly reduced the size of their total assets in the UK following the reform by about 31% and reduced their revenues by 23%. These results are consistent with the debt re-allocation results, which point to the fact that most of the adjustment is driven by foreign-headquartered MNCs which increased their leverage abroad significantly, while the UK-headquartered MNCs did not.

Further, the organizational structure results are also mainly driven by foreign-headquartered MNCs which increased the fraction of subsidiaries they hold in high tax countries and reduced the fraction of their relevant UK subsidiaries (results not reported here). Together, these results suggest that foreign-headquartered MNCs reduced their presence in the UK as a result of the reform. This resulted in no increase in tax payments of foreign-headquartered MNCs in the UK. In contrast, since UK-headquartered MNCs have not adjusted their operations in the UK, they also bore the burden of the WDC in terms of increased tax payments. These results highlight the differential effect that the worldwide debt cap reform had on multinational firms depending on whether they were UK-headquartered MNCs or foreign-headquartered MNCs.

5.6 Robustness checks

Our baseline test on the UK debt is based on the data from FAME, while our test for non-UK subsidiaries is based on data from Orbis. FAME provides detailed internal and external debt for UK firms, which allows us to construct the gateway ratio test following exactly the method that the HMRC has applied to multinational firms. However, FAME only contains UK

[14] Note that the results using UK ETRs are very similar.
[15] The UK corporate tax revenues as reported by the HMRC have increased from GBP 30.8 billion in 2009/10 to GBP 35.3 billion in 2010/2011 (excluding revenues from North Sea oil companies). The HMRC does not report the breakdown of corporate tax receipts by ownership type of companies. Evidence from Habu (2017) suggests that net tax payments of multinational firms has increased between the two tax years.

subsidiaries. That is why we have to rely on Orbis data to study the debt reallocation hypothesis. In order to ensure that our test on non-UK firms using Orbis and the study on UK firms using FAME are comparable, we redo the baseline analysis on the UK firms using Orbis data and net of cash leverage ratio measure. As before, we cannot observe whether the debt is internal or external in Orbis. Therefore, the measure of leverage using Orbis is noisy.

We report these test in Table 10. Column 1 uses the whole sample of UK multinationals, column 2 considers UK headquartered multinationals only, while column 3 looks at non-UK headquartered multinational firms. Even with this noisy measure, we are able to confirm our conclusion from Tables 1 and 2. Treated groups significantly reduce the leverage of their UK subsidiaries by 0.059 (column 1) in response to the tax reform. This effect is only significant for the foreign-headquartered MNCs (column 3), but not for MNCs headquartered in the UK (column 2). Foreign-headquartered MNCs reduce both their relevant net UK debt and their UK leverage ratio following the reform. In contrast, UK-headquartered MNCs adjust their net UK debt but not their UK leverage ratio.

We repeat our test on debt reallocation to non-UK affiliates, as reported in Table 4, by aggregating subsidiaries leverage to a multinational group - country level. We add up net of cash leverage and total assets of all subsidiaries belonging to the same multinational parent in a given host country and divide one over the other to obtain multinational group - country leverage ratios. We do not report those result here as the coefficients are not statistically significantly different from the ones obtained in Table 4.

6. Conclusions

This paper analyzes how multinationals adjust debt allocation in response to tax policy change that restricts interest deductibility. We use the UK worldwide debt cap reform in 2010 as a natural experiment to examine debt policy changes of affected multinationals. The reform restricted tax deductions available to the UK subsidiaries of multinational companies to be within a certain threshold of the multinational group's worldwide debt holdings. Unlike the widely adopted thin capitalization rule, the worldwide approach should be more difficult to circumvent and thus, should have a more substantial effect on earning stripping by multinationals. We collect matched subsidiary and group-level financial and ownership

structure information and conduct a difference-in-differences analysis. We provide causal evidence for a negative and substantial effect of the UK worldwide debt cap on the ratio of UK net debt to the multinational worldwide debt holdings. We show that multinational companies reduced their net UK debt in response to the debt cap, and the reform led to increasing external borrowing only among multinationals headquartered in foreign countries.

We show that the UK worldwide debt cap may have generated some spillover effect on other countries that did not adopt the same anti-tax avoidance approach. Specifically, multinational firms reallocate debt from their UK subsidiaries to non-UK subsidiaries, especially those in high tax countries. We also find that the affected multinationals substitute their low tax subsidiaries with high tax subsidiaries to be able to use the high tax jurisdictions as debt hubs. This replaces UK as a previous debt hub. These two put together suggest that the worldwide debt cap approach, without collaboration between countries, can lead to debt reallocation and does not effectively curb multinationals' earning stripping.

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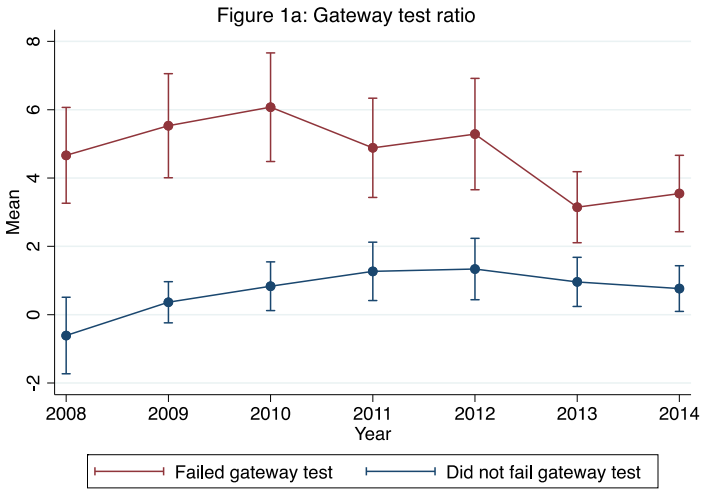
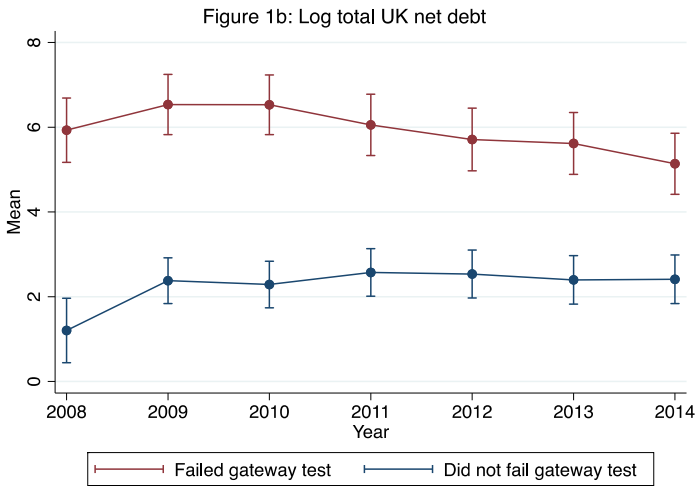
Figure 1. Time-series evolution of the gateway test ratio, net UK debt. and worldwide gross debt of the treated and the control groups.





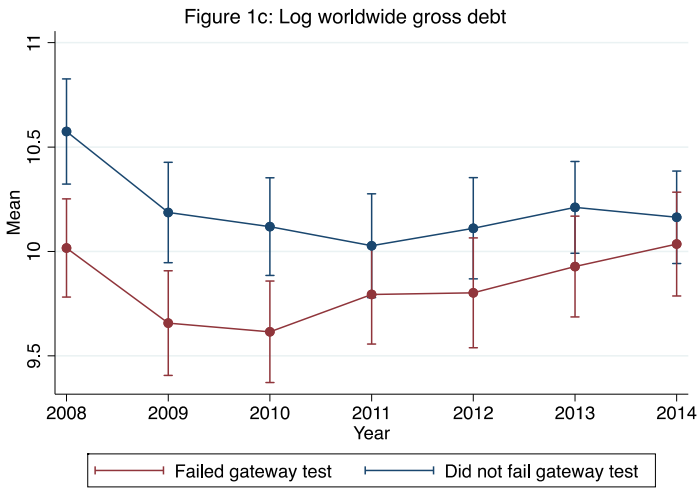
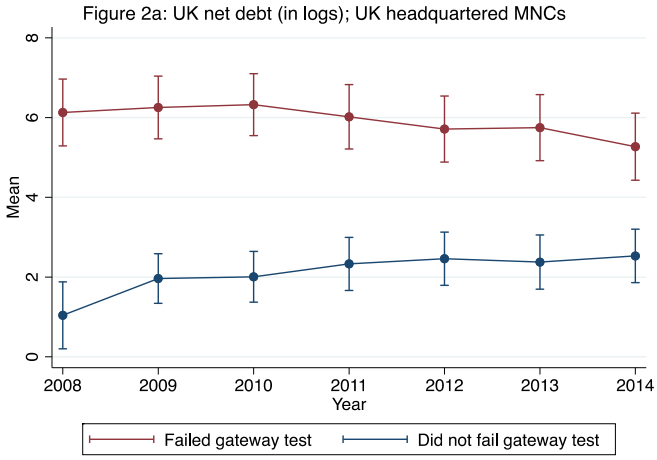
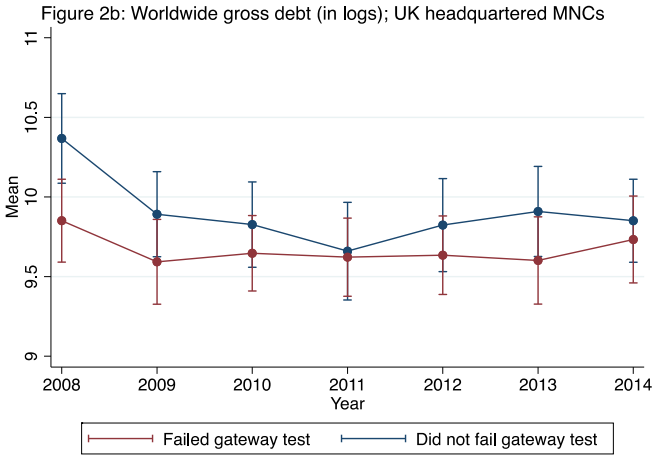
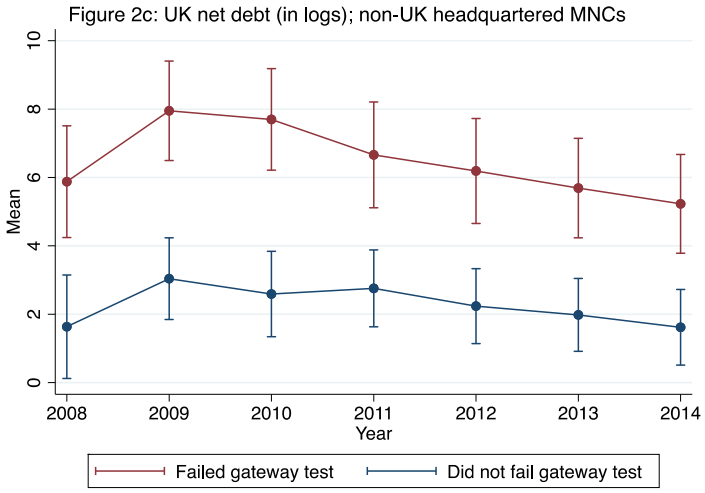


Figure 2. Time-series evolution of the gateway test ratio, net UK debt and worldwide gross debt– UK headquartered and non-UK headquartered MNCs.







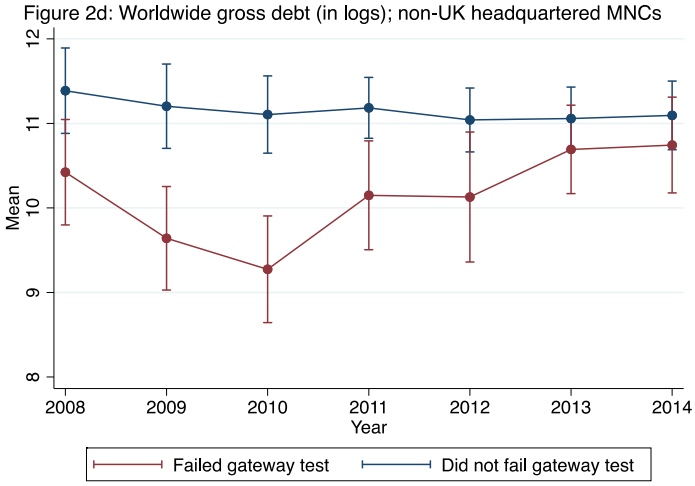


Table 1: Impact of the worldwide debt cap on group-level debt holdings

		Treated group					
		gateway test	debt ratio	total UK Debt	worldwide debt	log GU0 assets	GUO profitability
before 2010	mean	3.53	-4.50	365,976	698,718	13.42	0.07
	median	1.51	-0.28	55,001	29,873	13.21	0.07
	sd	4.54	13.51	660,519	3,791,304	1.65	0.12
after 2010	mean	3.51	-3.15	358,037	686,071	13.27	0.04
	median	1.38	0.13	58,877	46,832	13.08	0.06
	sd	4.86	11.98	645,878	3,758,954	1.64	0.15
		Control group					
before 2010	mean	0.56	-4.31	99,414	1,145,676	13.49	0.06
	median	0.03	-0.69	5,787	74,147	13.27	0.07
	sd	2.14	10.86	359,316	4,069,773	1.75	0.11
after 2010	mean	0.15	-3.87	89,273	1,045,441	13.39	0.05
	median	0.00	-0.53	3,691	110,170	13.17	0.06
	sd	0.28	10.36	330,597	3,254,207	1.71	0.12

Note: This table reports the summary statistics of selected variables before and after the implementation of UK WDC rule, decomposed into treated and control groups. Treated group includes firms that failed the gateway ratio test in 2010. Control group contains firms that didn't fail the gateway ratio in 2010 and propensity score matched on industry, GUO location, GUO size and, matching one-to-one without replacement. Before 2010 include data in 2008 and 2009, and after 2010 refers to data in 2011 and 2012.

Table 2: Impact of the worldwide debt cap on group-level debt holdings

	Gateway ratio		UK net debt		Gross debt	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Failed_i	1.635***		6.313***		-0.455***	
	(0.093)		(0.258)		(0.118)	
$\text{Failed}_i \times \text{Post}_t$	-0.396***	-0.341***	-1.612***	-1.384***	0.269**	0.318***
	(0.108)	(0.079)	(0.296)	(0.198)	(0.136)	(0.084)
Group size	-0.300***	-0.542***	0.949***	0.258	1.056***	0.980***
	(0.019)	(0.075)	(0.049)	(0.185)	(0.023)	(0.087)
Industry FE	YES	NO	YES	NO	YES	NO
Year FE	YES	YES	YES	YES	YES	YES
Group FE	NO	YES	NO	YES	NO	YES
No. of groups	376	376	376	376	376	376
Observations	2,054	2,054	2,054	2,054	2,054	2,054

Note: Baseline results using the 75% ownership criteria, excluding financial services companies. Propensity score matching on industry, GUO location and GUO size in 2010, matching one-to-one without replacement. Gross debt is worldwide gross debt of a whole multinational group, UK debt is net UK debt holdings for all UK subsidiaries, and gateway is the ratio of net UK debt to worldwide gross debt. Here ownership structure varies across years. Standard errors are clustered at parent and year level.

Table 3: Impact of the worldwide debt cap on group-level debt holdings--headquarter heterogeneities

	Gateway ratio		UK net debt		Gross debt	
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	UK	Non-UK	UK	Non-UK	UK	Non-UK
$\text{Failed}_i \times \text{Post}_t$	-0.279***	-0.539***	-1.537***	-0.990***	0.248***	0.538***
	(0.085)	(0.187)	(0.233)	(0.378)	(0.093)	(0.192)
Group size	-0.459***	-1.156***	0.249	-0.033	0.890***	1.616***
	(0.079)	(0.162)	(0.211)	(0.333)	(0.091)	(0.229)
Year FE	YES	YES	YES	YES	YES	YES
Group FE	YES	YES	YES	YES	YES	YES
Number of groups	278	98	278	98	278	98
Observations	1,531	523	1,531	523	1,531	523

Note: UK vs foreign owned multinationals with parent as a unit of observation; using the 75% ownership criteria; excluding financial services companies. Propensity score matching on industry, GUO location, and GUO size in 2010, matching one to one without replacement. Gross debt is worldwide gross debt of a whole multinational group, UK debt is net UK debt holdings for all UK subsidiaries, and gateway is the ratio of net UK debt to worldwide gross debt. Standard errors are clustered at parent and year level.

Table 4: Impact of the worldwide debt cap on non-UK subsidiaries' leverage ratio

VARIABLES	(1) lev3	(2) lev3	(3) lev3	(4) lev3	(5) UK HQ	(6) UK HQ	(7) non-UK HQ	(8) non-UK HQ
$\text{Failed}_i \times \text{Post}_t$	0.186***	0.156***	0.138***		0.073**		0.216***	
	(0.030)	(0.029)	(0.030)		(0.035)		(0.065)	
$\text{Failed}_i \times \text{Post}_t \times CIT_{i,j,s,t}$				0.543***		0.253**		0.908***
				(0.104)		(0.119)		(0.210)
Subsidiary profitability		-0.003	-0.003	-0.003	-0.003	-0.002	-0.129	-0.137*
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.083)	(0.078)
Subsidiary size		0.161***	0.166***	0.162***	0.166***	0.164***	0.180***	0.177***
		(0.025)	(0.023)	(0.025)	(0.026)	(0.029)	(0.043)	(0.044)
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Host country-year FE	NO	NO	YES	NO	YES	NO	YES	NO
Subsidiary FE	YES	YES	YES	YES	YES	YES	YES	YES
Observations	11,827	11,198	11,198	11,193	6,693	6,691	4,505	4,502
R-squared	0.008	0.027	0.084	0.027	0.109	0.029	0.139	0.036
Matching	YES	YES	YES	YES	YES	YES	YES	YES

Note: Dependent variable is net-of-cash leverage ratio. All multination and UK vs foreign owned multinationals with parent as a unit of observation; using the 75% ownership criteria; excluding financial services companies. Propensity score matching on industry, GUO location, GUO size in 2010, matching one to one without replacement. Standard errors are clustered at subsidiary and year level.

Table 5: Impact of the worldwide debt cap on organizational structure

VARIABLES	(1) higher	(2) higher	(3) lower	(4) lower	(5) UK	(6) UK	(7) UK 75+	(8) UK 75+
Failed_i	-0.226***		-0.063***		0.368***		0.357***	
	(0.010)		(0.006)		(0.013)		(0.013)	
$\text{Failed}_i \times \text{Post}_t$	0.043***	0.042***	-0.028***	-0.037***	-0.016	-0.002	-0.028	-0.016*
	(0.014)	(0.007)	(0.009)	(0.006)	(0.019)	(0.009)	(0.019)	(0.009)
Observations	11,983	11,983	11,983	11,983	11,983	11,983	11,983	11,983
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Parent FE	NO	YES	NO	YES	NO	YES	NO	YES

Note: Dependent variable in columns 1 and 2 is proportion of subsidiaries in countries with statutory tax rate higher than UK relative to total subsidiaries in the group. Dependent variable in columns 3 and 4 is proportion of subsidiaries in countries with statutory tax rate lower than UK. In columns (5) and (6), dependent variable is the proportion of UK subsidiaries with control share above 50%. In columns (5) and (6), dependent variable is the proportion of UK subsidiaries with control share above 75%. Standard errors are clustered at parent and year level.

Table 6: Impact of the worldwide debt cap on consolidated level effective tax rates

	All MNCs		UK-headquartered MMNCs		Non-UK-headquartered	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
$\text{Failed}_i \times \text{Post}_t$	-0.005	-0.008	0.021	-0.022	-0.072	-0.051
	(0.025)	(0.018)	(0.031)	(0.024)	(0.045)	(0.035)
Group size	-0.038	-0.017	-0.001	-0.015	-0.106***	-0.015
	(0.027)	(0.017)	(0.035)	(0.024)	(0.040)	(0.022)
Year FE	YES	YES	YES	YES	YES	YES
Parent FE	YES	YES	YES	YES	YES	YES
No of groups	241	1,162	171	319	70	843
Observations	1,271	6,167	907	1,717	364	4,450
Matched sample	YES	NO	YES	NO	YES	NO

Note: Dependent variable is the ratio of tax payments to profit and loss before tax calculated at the parent level. Columns 1 and 2 consider all MNCs, columns 3 and 4 UK headquartered MNCs only, and columns 5 and 6 non-UK headquartered MNCs only. Parent is a unit of observation: excluding financial services companies. Propensity score matching on industry, GUO location and GUO size in 2010, matching one to one without replacement. Standard errors are clustered at parent and year level.

Table 7: Impact of the worldwide debt cap on UK subsidiaries tax payments.

	All MNCs		UK-headquartered MMNCs		Non-UK-headquartered	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
$\text{Failed}_i \times \text{Post}_t$	0.119	-0.019	0.257**	0.152*	-0.225	-0.050
	(0.093)	(0.071)	(0.103)	(0.089)	(0.203)	(0.158)
Group size	0.453***	0.245***	0.521***	0.522***	0.249	0.116
	(0.115)	(0.065)	(0.122)	(0.105)	(0.325)	(0.074)
Year FE	YES	YES	YES	YES	YES	YES
Parent FE	YES	YES	YES	YES	YES	YES
No of groups	317	1,761	237	473	80	1,288
Observations	1,338	7,324	1,010	1,925	328	5,399
Matched	YES	NO	YES	NO	YES	NO

Note: Dependent variable is the logarithm of total tax payments calculated for all UK subsidiaries of each multinational group. Columns 1 and 2 consider all MNCs, columns 3 and 4 UK headquartered MNCs only, and columns 5 and 6 non-UK headquartered MNCs only. Parent is a unit of observation; using the 75% ownership criteria to include subsidiaries; excluding financial services companies and excluding UO, UO- and JO ownership categories. Propensity score matching on industry, GUO location and GUO size in 2010, matching one to one without replacement. Standard errors are clustered at parent and year level.

Table 8: Impact of the worldwide debt cap on UK subsidiaries size of total assets.

	All MNCs		UK-headquartered MMNCs		Non-UK-headquartered	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
$\text{Failed}_i \times \text{Post}_t$	-0.075**	-0.122***	-0.006	-0.002	-0.344***	-0.306***
	(0.037)	(0.027)	(0.033)	(0.028)	(0.113)	(0.080)
Group size	0.409***	0.398***	0.299***	0.337***	0.977***	0.450***
	(0.049)	(0.033)	(0.041)	(0.041)	(0.150)	(0.050)
Year FE	YES	YES	YES	YES	YES	YES
Parent FE	YES	YES	YES	YES	YES	YES
No of groups	376	2,078	278	580	98	1,498
Observations	2,054	10,807	1,531	2,944	523	7,863
Matched sample	YES	NO	YES	NO	YES	NO

Note: Dependent variable is the logarithm of total asset size calculated for all UK subsidiaries of each multinational group. Columns 1 and 2 consider all MNCs, columns 3 and 4 UK headquartered MNCs only, and columns 5 and 6 non-UK headquartered MNCs only. Parent is a unit of observation; using the 75% ownership criteria to include subsidiaries; excluding financial services companies. Propensity score matching on industry, GUO location and GUO size in 2010, matching one to one without replacement. Standard errors are clustered at parent and year level.

Table 9: Impact of the worldwide debt cap on UK subsidiaries revenues.

	All MNCs		UK-headquartered MMNCs		Non-UK-headquartered	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
$Failed_i$	-0.044	-0.007	0.041	0.097**	-0.348***	-0.225***
	(0.040)	(0.033)	(0.044)	(0.040)	(0.096)	(0.069)
Group size	0.261***	0.259***	0.216***	0.260***	0.546***	0.264***
	(0.042)	(0.028)	(0.042)	(0.038)	(0.118)	(0.040)
Year FE	YES	YES	YES	YES	YES	YES
Parent FE	YES	YES	YES	YES	YES	YES
No of groups	365	2,005	270	552	95	1,453
Observations	1,983	10,420	1,484	2,806	499	7,614
Matched	YES	NO	YES	NO	YES	NO

Note: Dependent variable is the logarithm of turnover calculated for all UK subsidiaries of each multinational group. Columns 1 and 2 consider all MNCs, columns 3 and 4 UK headquartered MNCs only, and columns 5 and 6 non-UK headquartered MNCs only. Parent is a unit of observation; using the 75% ownership criteria to include subsidiaries; excluding financial services companies. Propensity score matching on industry, GUO location and GUO size in 2010, matching one to one without replacement. Standard errors are clustered at parent and year level.

Table 10: Cross check of the impact of worldwide debt cap on UK debt using Orbis data

	(1) All MNCs	(2) UK-headquartered MNCs	(3) foreign-headquartered MNCs
$\text{Failed}_i \times \text{Post}_t$	-0.059***	-0.041**	-0.301***
	(0.020)	(0.021)	(0.085)
Subsidiary profitability	-0.134***	-0.124***	-0.371**
	(0.029)	(0.027)	(0.164)
Subsidiary size	0.072***	0.073***	0.076*
	(0.017)	(0.019)	(0.043)
Year FE	YES	YES	YES
Sub FE	YES	YES	YES
Host country-year FE	NO	NO	NO
Observations	8,029	6,801	1,228
R-squared	0.017	0.016	0.065
matching	YES	YES	YES

Note: Dependent variable is net-of-cash leverage ratio. Column 1 use all subsidiaries located in UK. Column 2 uses the subsidiaries controlled by parent group with more than 75% shares. Columns 3 and 4 examines subsidiaries affiliated to parent group, which is headquartered in UK. Columns 5 and 6 examines subsidiaries affiliated to parent group, which is headquartered outside of UK. Standard errors are clustered at subsidiary and year level.

Appendix A: Benchmark results based on alternative samples

Table A1: Impact of the worldwide debt cap on group level debt based on the full sample.

	¤ Gateway ratio		UK net debt		Gross debt	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Failed_i	1.589***		6.974***		-0.711***	
	(0.082)		(0.157)		(0.100)	
$\text{Failed}_i \times \text{Post}_t$	-0.215**	-0.112*	-0.991***	-0.927***	0.100	0.031
	(0.097)	(0.062)	(0.198)	(0.132)	(0.118)	(0.066)
Group size	-0.471***	-0.580***	0.878***	0.323***	1.119***	1.089***
	(0.009)	(0.054)	(0.022)	(0.111)	(0.008)	(0.070)
Industry FE	YES	NO	YES	NO	YES	NO
Year FE	YES	YES	YES	YES	YES	YES
Group FE	NO	YES	NO	YES	NO	YES
No. groups	1,609	1,609	1,609	1,609	1,609	1,609
Observations	9,631	9,631	9,631	9,631	9,631	9,631

Note: Baseline results using the 75% ownership criteria, excluding financial services companies. Gross debt is worldwide gross debt of a whole multinational group, UK debt is net UK debt holdings for all UK subsidiaries, and gateway is the ratio of net UK debt to worldwide gross debt. Here ownership structure varies across years. Standard errors are clustered at parent and year level.

Table A2: Impact of the worldwide debt cap on group level debt based on the kernel-matched sample.

VARIABLES	(1) Gateway ratio	(2) UK net debt	(3) Gross debt
$\text{Failed}_i \times \text{Post}_t$	-0.381***	-1.303***	0.268***
	(0.068)	(0.170)	(0.074)
Group size	-0.578***	0.220	1.047***
	(0.067)	(0.162)	(0.083)
Industry FE	NO	NO	NO
Year FE	YES	YES	YES
Group FE	YES	YES	YES
No. of groups	1,373	1,373	1,373
Observations	7,785	7,785	7,785

Note: Baseline results using the 75% ownership criteria, excluding financial services companies. Propensity score matching on industry, GUO location and GUO size in 2010, matching using kernel. Gross debt is worldwide gross debt of a whole multinational group, UK debt is net UK debt holdings for all UK subsidiaries, and gateway is the ratio of net UK debt to worldwide gross debt. Here ownership structure varies across years. Standard errors are clustered at parent and year level.

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