INTERNATIONAL TRANSFER PRICING AND TAX AVOIDANCE: EVIDENCE FROM LINKED TRADE-TAX STATISTICS IN THE UNITED KINGDOM

Li Liu, Tim Schmidt-Eisenlohr, and Dongxian Guo*

Abstract—This paper employs unique data on export transactions and corporate tax returns of UK multinational firms and finds that firms manipulate their transfer prices to shift profits to lower-taxed destinations. It shows that the 2009 tax reform in the United Kingdom, which changed the taxation of corporate profits from a worldwide to a territorial system, led to a substantial increase in transfer mispricing. It also provides evidence for a trade creation effect of transfer mispricing and estimates substantial transfer mispricing in non-tax-haven countries with low- to medium-level corporate tax rates, and in R&D intensive firms.

I. Introduction

GLOBALIZATION has led to the concentration of economic activity within a small number of multinational corporations (MNCs), a development that has made it more challenging for governments to raise revenue from corporate income tax, as MNCs can shift their profits across borders to reduce their worldwide tax bills.[1] A key instrument that MNCs use to shift profits is undercharging or overcharging transfer prices on transactions between related parties within the MNC group (transfer mispricing). For example, to reduce its pretax profits (and hence corporate taxes), an MNC can charge artificially low prices for exports sold to a related party in a low-tax country or can pay artificially high prices when buying from a related party in a low-tax country. Tax-motivated transfer mispricing can take place in trade in real goods as well as in services and, in particular, in the form of royalty and licensing payments on intellectual property rights held abroad.

In recent years, policymakers have become increasingly concerned about this issue as the extent of profit shifting has intensified and the potential revenue at stake is substantial (Zucman, 2014; Beer et al., 2020). At the same time, there is a trend among countries to change from a worldwide to a territorial taxation of profits.[2] Both the United Kingdom and Japan switched to territorial taxation in 2009. Following the passage of the Tax Cuts and Jobs Act (TCJA) in December 2017, the United States has also moved toward a territorial system, excluding from US taxation the active business income that is earned abroad.[3]

This paper presents new evidence on tax-motivated transfer mispricing in real goods. It uses a unique data set that combines the tax records of UK MNCs in manufacturing and their international trade transactions from 2005 to 2011. We use two distinct approaches to identify the causal effect of the corporate income tax differential between the destination country and the United Kingdom on the unit price of exports by UK MNCs. The first empirical approach exploits variation from the differential change in the price charged by a UK multinational with a subsidiary relative to the price charged by a UK MNC without a subsidiary in the same country in response to a change in the tax rate difference between the destination country and the United Kingdom. It controls for omitted variable bias by including a full set of firm–market–product fixed effects, product–market–year fixed effects, and firm–product–year fixed effects in a triple-difference regression. The second approach relies on a different source of variation, namely, the larger incentives to shift profit following the 2009 UK territorial tax reform, to quantify the effects of a shift from a worldwide to a territorial treatment of foreign profits on transfer mispricing.

We find strong evidence for tax-motivated transfer mispricing in manufacturing exports to low-tax destinations. A 1 percentage point increase in the UK-destination country tax differential reduces related-party export prices relative to arm's-length export prices by 3%. The extent of tax-motivated transfer mispricing increased substantially after the UK territorial tax reform in 2009. Under the territorial tax system, a 1 percentage point increase in the tax difference

[1] See, among others, Harris, Morck, and Slemrod (1993), Hines and Rice (1994), and Desai, Foley, and Hines (2006) for evidence of general profit shifting by MNCs to low-tax countries. Heckemeyer and Overesch (2017) and Beer, de Mooij, and Liu (2020) review recent empirical evidence on profit shifting and provide consensus estimate on the magnitude of the semi-elasticity of reported profits by MNCs in response to an international tax differential of around 0.8 to 1, respectively.

[2] The worldwide approach taxes the worldwide income of MNCs, typically with a nonrefundable credit for foreign taxes paid, and liability to domestic tax being deferred until dividends are paid from the foreign subsidiary to the parent company in the home country. The territorial approach does not tax foreign earnings of MNCs in the home country.

[3] The move in the United States is subject to important caveats, including a one-time transition tax on unrepatriated profits and a minimum tax on overseas income that is in excess of 10% of the return on tangible assets abroad.

reduces related-party export prices relative to arm's-length export prices by another 1.5%. Our findings uncover heterogeneous transfer mispricing across countries and firms: we uncover transfer mispricing in countries that are not classified as tax havens and have low to intermediate tax rates.[4] Moreover, there is more transfer mispricing in firms with high R&D intensities, with the marginal effect of the tax differential rising to 6.4% for those undertaking the most R&D.

Our benchmark findings are comparable to the size of the tax effects on transfer prices estimated in Clausing (2003), Bernard, Jensen, and Schott (2006), and Flaaen (2017) but are larger than the effects found in Davies et al. (2018), Vicard (2015), and Cristea and Nguyen (2016). We show that some of the differences can be attributed to omitted variable bias, as previous studies used smaller sets of fixed effects in the empirical analysis and other differences in the empirical approach such as the way that the key variables of interest are measured and the type of variation that is exploited for identification. Ultimately, the semielasticity of transfer prices (and, more generally, reported profits by MNCs) with respect to the international tax differential is not a structural parameter and can vary with the design of the corporate and the overall tax system in a country. Our paper adds to the literature in five distinct ways. First, we show in a simple model that a shift from a worldwide to a territorial system leads to stronger transfer mispricing, and we provide empirical evidence that corroborates the theoretical prediction. Second, we find substantial transfer mispricing in tangible goods by UK MNCs to non-tax-haven countries. Third, we show theoretically that tax incentives can lead to trade creation for tax purposes and find evidence for this channel around the 2009 tax reform. Fourth, our results suggest that transfer mispricing is concentrated in the most R&D-intensive firms, a finding that is robust to controlling for differential effects by firm size and the type of product traded and holds that R&D investment facilitates transfer mispricing by making goods more specific. Finally, thanks to the rich data and the relatively large number of MNCs headquartered in the United Kingdom, our regression specifications include more fixed effects than previous studies and allow for a clean identification of tax-motivated transfer mispricing. Moreover, the 2009 UK reform in the taxation of cross-border corporate income provides us with a quasi-natural experiment that introduced exogenous changes in the tax incentives of profit shifting that are unrelated to the level of the tax rate differential, corroborating the causal effect of taxes on transfer prices.

Our findings have several implications for tax policy design. First, transfer mispricing in tangible goods by UK MNCs is an area of revenue leakage that warrants further attention by the UK tax authority. While the quantitative evidence is UK specific, the empirical analysis can be ex-

tended to other countries with the suitable data in order to help uncover the extent of tax-motivated transfer mispricing elsewhere. Second, increases in tax-motivated transfer mispricing represent a relevant revenue cost of moving from a worldwide to a territorial system. Third, policymakers should be mindful of potential revenue losses to any trading partners that have lower statutory corporate income tax rates, including those that are not tax havens. Finally, tax-motivated transfer mispricing is not uniform across firms; it is concentrated in the most R&D-intensive ones, which provides useful guidance to tax authorities.

Several papers have analyzed transfer-pricing behavior of multinational firms. Early work, including Grubert and Mutti (1991), Harris, Morck, and Slemrod (1993), Hines and Rice (1994), and Collins, Kemsley, and Lang (1998), provided indirect evidence for tax-motivated profit shifting by MNCs, showing that their pretax profits are systematically correlated with tax differentials across countries. Heckemeyer and Overesch (2017) and Beer et al. (2020) survey the recent empirical literature on tax-motivated profit shifting, quantifying the consensus estimate of the semielasticity of reported profits with respect to the international tax differential of around 0.8% and 1%, respectively.

Clausing (2003) was the first to provide direct evidence on manipulated prices, using item-level data on prices of US international trade. In another seminal paper, Bernard et al. (2006) employed transaction-level data from the US Census to study a wide set of factors that can lead to manipulated transfer prices, including corporate taxes and tariffs. More recently, Flaaen (2017) uses the same data to study transfer-price manipulation by US multinationals in response to the 2004 Home Investment Act.

Closely related to our work are three papers that also use detailed trade data to study transfer-price manipulations for a set of different countries. Davies et al. (2018) and Vicard (2015) exploit information on French firms, whereas Cristea and Nguyen (2016) employ Danish data. We discuss differences across these papers in detail in section V. Finally, Hebous and Johannesen (2015) analyze firm-level trade data on German MNCs, providing evidence that they shift profits to tax havens through services trade.

The remainder of the paper is structured as follows. Section II provides background on transfer pricing and the 2009 tax reform. Section III explains the empirical approach, section IV describes the data, section V presents the main empirical results, and section VI presents the heterogeneity results. Section VII concludes with a discussion of policy implications and avenues for future research.

II. Institutional Background

This section provides an overview of transfer pricing, explaining the arm's-length principle that generally guides the setting of transfer prices and several weaknesses of this approach. It then discusses the 2009 tax reform that changed

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[4] The classifications of tax haven countries are based on Hines (2005), Dharmapala and Hines (2009), and OECD (2000) (see Table A.4 for the full list), and do not imply endorsement by the IMF.

the UK taxation of foreign profits from a worldwide to a territorial system.

A. Transfer Pricing

Transfer pricing is the setting of prices for internal (intrafirm) transactions in goods, services, intangibles, and capital flows within an MNC. This pricing affects the allocation of pretax profits that each party earns from a cross-border transaction within an MNC and the amount of corporate tax that is due in both countries. Consider a UK pharmaceutical group that buys raw material from a subsidiary in China. How much the UK parent pays its Chinese subsidiary for each unit of the raw material—the transfer price—affects how much profit the Chinese affiliate earns and how much local tax it pays and the amount of profit and corporate tax that the UK parent company faces.

Most tax authorities, including Her Majesty's Revenue & Customs (HMRC) in the United Kingdom, use the arm's-length principle to guide transfer pricing.[5] The principle stipulates that a transfer price should be the same as if the two parties involved were two independent companies, that is, the same as a comparable market transaction. Given the nature of related-party transactions, a range of arm's-length prices may exist for the same transaction. Conceptually, there may even be no "correct" arm's-length price if there are no comparable third-party transactions. Comparable transactions may also be costly to observe for the tax authority due to information asymmetry. If comparable arm's-length prices are not accessible, they may be difficult to infer. Given these weaknesses in the implementation of the arm's-length principle, MNCs may be able to charge artificially low prices for exports sold to low-tax countries or artificially high prices for inputs coming from low-tax countries to reduce their global tax liability.

Many countries implement transfer-pricing regulations as a countermeasure to mitigate revenue losses from transfer mispricing. The tightness of these regulations varies from mere acknowledgment of the arm's-length principle to required detailed transfer-pricing reports. Rigid regulations increase the cost of transfer mispricing and are found to be somewhat effective in curbing the extent of profit shifting in developed countries.[6] In the United Kingdom, transfer-pricing documentation requirements are set out in the domestic law, specifying that documentation must be available on request. Unlike most other OECD countries, the United Kingdom does not have a prescribed list of documentation requirements, and detailed disclosures are not currently required as part of corporate tax records.

B. The 2009 Tax Reform

Worldwide versus territorial taxation. Domestic taxation of foreign earnings is a key consideration for MNCs when setting their transfer prices, as it affects their global corporate tax bill. Countries typically use one of two predominant approaches, worldwide or territorial, in taxing foreign earnings of their MNCs. Under worldwide taxation, an MNC pays taxes on its active business income that is earned domestically and abroad, though taxation of foreign earnings is usually deferred until they are brought back to the home country and a credit is often given for foreign taxes paid to avoid double taxation. Under territorial taxation, an MNC pays taxes only on profits in the source country, with no tax levied on profits repatriation.[7]

The 2009 reform of taxing foreign profits. Until 2009, UK-based MNCs were taxed on their worldwide income, although taxation of foreign income was deferred until repatriation as dividends. In 2009, the United Kingdom switched from worldwide to territorial taxation by exempting UK-based MNCs from UK tax for all dividends and distributions received from foreign affiliates. This fundamental change of the tax system made repatriation of profits less costly and should therefore increase the extent of transfer mispricing by UK MNCs. Note that it is plausible that before 2009, part of the foreign earnings were already brought back to the United Kingdom in some other complicated, nontaxable way. To the extent that tax planning activities are costly, it remains the case that the amount of tax savings from profit shifting net of costs is larger under the territorial tax system.

The territorial regime was a key element of the foreign profits package that was introduced in the 2009 Finance Bill, with exemptions applying to dividends received from July 1, 2009, onward. Unlike the TCJA, which imposed a deemed repatriation tax on undistributed foreign earnings of US MNCs, the exemption in the UK reform was 100% and did not impose any tax on undistributed foreign profits. In addition to dividend exemptions, the package included two other elements that carried important implications for UK MNCs. First, a worldwide debt cap on the finance expenses of companies was introduced as an extension to the thin UK capitalization rules. The debt cap limits tax deductions for interest expenses by these MNCs to the external gross interest expense of the worldwide group. The worldwide debt cap rule became effective on January 1, 2010, and is expected to restrict the extent of debt shifting by a small number of companies for which the debt cap is binding.

The other change was a tightening of the controlled foreign company (CFC) regime. Under the existing CFC regime, both active and passive income were liable to UK taxation if a subsidiary was defined as a CFC. However, among a series

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[5]The arm's-length principle is established in Article 9 (1) of the OECD Model Double Tax Treaty.

[6]For example, Riedel, Zinn, and Hofmann (2015) show that transfer pricing rules raise (lower) reported operating profits of high-tax (low-tax) affiliates and reduce the sensitivity of their pretax profits to corporate tax rate changes. Transfer pricing regulation may also lower real investment by MNCs (de Mooij & Liu, 2020).

[7]This statement only applies to active income of foreign affiliates, which is essentially earnings through business activity. Taxes on passive income, such as investment income or royalty income, are typically due when the income is earned.

of exemptions from being defined as a CFC was an exemption for actively trading subsidiaries. One way to avoid UK taxes was to mix passive income with active income in a trading subsidiary so that the former goes untaxed in the United Kingdom. Under the newly proposed CFC regime, all passive income is liable for UK taxation, including all passive income in active subsidiaries. The reform of the CFC regime, however, was perceived as hurting the ability of the United Kingdom to attract MNCs. In response to these concerns, only minimal changes were made to the CFC regime in 2009; the new CFC regime took effect only in January 2013, after our period of analysis. While the United Kingdom first shifted to a territorial system and only later strengthened its antiavoidance rules, the recent US territorial reform directly included a series of antiavoidance measures to limit profit shifting under the new regime.

Neither of the two rules discussed is expected to have a first-order effect on MNCs' transfer mispricing behavior. The full reform strengthening CFC rules took place only after our sample period and the worldwide debt cap had a negligible effect as it affected only a very small fraction of UK MNCs. To the extent that the worldwide debt cap had an effect, it likely strengthened the incentive to shift profits through transfer pricing (as a substitute for debt shifting) and thus might explain a small part of the increase in transfer mispricing that we observe.

Finally, a great feature of the territorial reform is that its exact announcement and implementation dates were not known in advance. We can therefore exploit variation in the tax incentives to shift profits generated by the reform to study transfer mispricing in a quasi-experimental setting.

C. Testable Predictions

In the following, we discuss the three main testable predictions that we take to the data and briefly explain the intuition behind them. In online appendix C we show how to formally derive these predictions in an extension of the standard transfer-pricing model.

Prediction 1. Transfer Mispricing. The transfer price for exports to low-tax destinations is below the arm's-length price and falls in the tax rate difference.

Suppose a MNC sells the same product to a lower-tax destination at arm's length and to a related party. To lower its tax bill, the MNC has an incentive to underprice its related-party exports. The government applies the arm's-length principle and imposes a fine on the MNC that increases in the difference between the arm's-length price and the related-party price. The MNC selects a transfer price that optimally trades off the tax savings from underpricing related-party exports with the expected size of the fine imposed by the government.

Prediction 2. Tax Systems. For the same tax rate difference, when selling to lower-tax destinations, MNCs misprice their transfer prices by more under a territorial system than under a worldwide system.

Now consider a tax reform that changes the treatment of corporate profits from a worldwide system with deferral to a territorial system. Under the worldwide system, repatriating profits back to the headquarters is costly due to repatriation taxes. While tax payments can be deferred by reinvesting profits abroad, this still represents a second-best solution. For this reason, under worldwide taxation, a pound of posttax profits abroad is less valuable than a pound of posttax profits at home. In contrast, under territorial taxation, repatriation is costless, and after-tax profits abroad and after-tax profits at home are equally valuable to the MNC. A shift from a worldwide system with deferral to a territorial system should therefore increase the incentives for profit shifting and thus for transfer mispricing.

Prediction 3. Trade Creation. Suppose transfer mispricing incentives are sufficiently strong. Then MNCs export more than the first-best quantities (in the absence of taxation) to destinations where their transfer mispricing incentives are the strongest.

Finally, notice that the amount of profits shifted through transfer mispricing is proportional to the quantity of goods shipped to a destination. A challenge for an MNC that wants to shift profits may be that it has relatively small trade flows to countries that have low tax rates. As the extent of transfer mispricing is limited by the fine imposed by the government, a solution to that problem would be to create artificial trade flows to low-tax destinations. As delivering too large quantities to a market reduces the MNC's profit margin there, an MNC creates an artificially large trade flow only if transfer mispricing incentives are sufficiently strong, that is, if the tax rate difference is large.

III. Empirical Strategy

In this section, we present two distinct empirical specifications that are employed in testing the three predictions on transfer mispricing.

A. Baseline: Testing Prediction 1

Our baseline specification estimates the transfer pricing behavior of MNCs in a triple-difference regression. Specifically, we estimate

$$\ln p_{ijkt} = \alpha_{ijk} + \alpha_{jkt} + \alpha_{ikt} + (\beta_1 \Delta \tau_{jt} \times I_{low,t} + \beta_2 \Delta \tau_{jt} \times I_{high,t}) \times Aff_{ij} + \epsilon_{ijkt}, \qquad (1)$$

where p_{ijkt} is the average unit price of exports of product k to country j by firm i in year t. $\Delta \tau_{jt} \equiv |\tau_{jt} - \tau_{UK,t}|$ is the absolute difference in statutory corporate tax rates between the destination country j and the United Kingdom in year t. $I_{low,t}$ ($I_{high,t}$) are indicators that take the value of 1 if the

destination country has a lower (higher) statutory tax rate than the United Kingdom in year t and 0 otherwise. Aff_{ij} is a dummy indicator that takes a value of 1 if the MNC firm i has at least one affiliate in country j and 0 otherwise. α_{ijk} is a firm–market–product fixed effect, α_{jkt} is a product–market–year fixed effect, and α_{ikt} is a firm–product–year fixed effect.

With inclusion of the fixed effects, identification relies on the differential change in the price charged by a multinational on exports with a subsidiary in a country relative to the price charged by a multinational without a subsidiary in the same country in response to a change in the tax rate difference between that country and the United Kingdom.[8] Taking the full set of fixed effects is crucial for insulating the causal effect of tax differences. More specifically, α_{ijk} takes out the average price a firm charges for a product in a given market. This fixed effect is essential, as firms often supply goods of different quality to different destination markets. The second fixed effect, α_{jkt}, controls for the average price of a product in a year across all firms, taking out all shocks to the supply and demand of a product that are common across firms. Finally, α_{ikt} controls for the average price a firm charges for a product in a given year. This fixed effect controls for all shocks to the supply or demand of a firm's product that are common across markets. The coefficients β_1 and β_2 therefore capture the causal effect of tax differences on transfer prices, controlling for all of the main supply and demand factors that could confound the effect of taxes on prices.

As discussed in prediction 1, we expect β_1 to be negative if MNCs systematically *reduce* the export prices for transactions with their foreign affiliates to shift more profits into low-tax countries in response to an *increase* in $\Delta\tau_{jt}$. Similarly, we expect β_2 to be positive when MNCs systematically increase the export prices for transactions with their foreign affiliates to shift more profits out of high-tax countries in response to an increase in $\Delta\tau_{jt}$. However, predictions with respect to the high-tax countries are less clear-cut. For example, if MNCs could claim full tax credits for taxes paid on profits abroad to offset their domestic tax liability under the worldwide system, we expect β_2 to be 0. Alternatively, UK MNCs can shift profits directly from subsidiaries in high-tax countries into subsidiaries in low-tax countries, which makes profit shifting into the United Kingdom unnecessary and implies a 0 β_2. Following Davies et al. (2018), our baseline regression controls for a pricing-to-market determinant by including the interaction between Aff_{ij} and the log of per capita GDP of the foreign country ($ln\ GDPPC_{jt}$). This variable is also useful to control for the extent of vertical FDI, which is likely to be larger in countries with lower corporate tax rates. Our baseline regression does not include any firm-level or country-level controls, as any variation at that

level is absorbed by the fixed effects. To account for possible correlation in export prices among all the UK multinationals trading with the same destination market, we cluster the standard errors by country-year pairs.

B. Tax Reform: Testing Prediction 2

We exploit the regime change in the United Kingdom's taxation of foreign profits in 2009 to check whether a shift from worldwide to territorial taxation indeed created stronger incentives for UK multinationals to shift profits into lower-tax destinations. For this, we run the following regression,

$$\ln p_{ijkt} = \alpha_{ijk} + \alpha_{jkt} + \alpha_{ikt} + (\beta_1 \Delta\tau_{jt} \times I_{low,t} + \beta_2 \Delta\tau_{jt} \\ \times I_{high,t}) \times Aff_{ij} + (\beta_3 \Delta\tau_{jt} \times I_{low,t} + \beta_4 \Delta\tau_{jt} \\ \times I_{high,t}) \times Aff_{ij} \times Post_t + \epsilon_{ijkt}, \quad (2)$$

where $Post_t$ is an indicator that takes the value of 1 if year t is after the tax reform and 0 otherwise. Given that the reform took place in the second half of the fiscal year, we drop observations in 2009 for cleaner identification.[9] The main coefficients of interest are now β_3 and β_4. If the reform increased incentives for transfer price manipulation, as discussed in prediction 2, we would expect a negative β_3. We expect the coefficient β_4 to be either 0 if MNCs avoid shifting profits from high-tax countries to the United Kingdom, or to be positive as the territorial system eliminates tax credits on foreign taxes paid and thus might induce UK MNCs to shift profits into the United Kingdom.

C. Trade Creation: Testing Prediction 3

Finally, we test whether UK MNCs trade more with countries into which they shift profits. For this purpose, we rerun specifications (1) and (2), replacing the dependent variable by the log of quantities. Prediction 3 implies a positive and significant coefficient for β_1 in specification (1) and for β_3 in specification (2), respectively.

IV.　Data

A. Data Sources

Our data set is constructed by merging three databases.[10] The first database includes transaction-level export data from 2005 to 2011 provided by the HMRC. Specifically, each record includes, among others, the firm's trader ID (anonymized), the product code (fifteen-digit HMRC Integrated Trade Tariff Code), the destination country, the export value in British pounds, and the weight in kilograms. The unit

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[8]We implicitly assume that the share of intrafirm trade of an MNC to a country where it has a subsidiary is independent of tax rate changes. While there are no data to directly test this assumption, our second identification strategy that relies on the 2009 tax reform does not depend on this assumption.

[9]That is, $Post_t$ is equal to 0 until 2008 and equal to 1 from 2010 onward.
[10]Appendix D in the online appendix provides a detailed description of the data sources, the matching procedure, and the summary statistics for the sample.

of observation in our empirical analysis is a firm–product–destination–year price. We collapse the transaction data to that level, computing total export value, total quantity, and average unit price.

The second database, the FAME ownership database of Bureau Van Dick, is also at the firm level and provides information for each company on the name and location of its ultimate parent and subsidiaries, if applicable. Based on the ownership information, we group the population of UK companies into one of the following categories: (a) domestic or unknown,[11] (b) stand-alone exporters, (c) subsidiaries of a foreign parent company, and (d) parent companies and subsidiaries of UK-headquartered MNC groups with at least one subsidiary outside the United Kingdom. In the online appendix, panel A in figure B.1 shows the number of UK affiliates in each of the 108 countries that had UK exporting partners in 2011. Table A.1 presents for each category the number of firms, their share in total exports, and their share in total assets within manufacturing. Overall, UK MNCs account for 39% of exports and hold about 13% of total assets within the manufacturing sector.

The third database, also provided by the HMRC on an anonymized basis, consists of firm-level corporation tax records that provide detailed information on the tax position of each company and how it is determined. A lookup table that cross-references the trader IDs and taxpayer identifiers allows us to merge the two databases. We exploit information from this database to test for differential transfer pricing behavior across firms with different R&D intensities and to assess the magnitude of tax revenue loss from transfer mispricing relative to total CIT revenue collected from UK MNCs in manufacturing.

B.   Focus on UK Multinationals

We restrict our comparison to pricing differences between UK multinationals in group (d), as our data are best suited to study their transfer pricing behavior. Domestic firms do not set transfer prices for cross-border transactions. As the typical domestic firm differs substantially from the typical MNC, their arm's-length export prices are also less comparable to those charged by MNCs. Subsidiaries of foreign parents set transfer prices but have to solve a very different tax planning problem. Their transfer pricing decisions in the United Kingdom likely depend not only on the tax rate in the country that they are exporting to but also on the tax rate and tax system in their parent country.

C.   Proxying Related-Party Trade

We use the location of foreign affiliates as a proxy for related-party trade, similar to Vicard (2015), Hebous and

Johannesen (2015), and Cristea and Nguyen (2016). By definition, a UK MNC can have related-party trade only with countries where it has an affiliate. Of course, it may also trade with unrelated parties in these countries. Therefore, the price we observe for an MNC that has an affiliate in a given country is the weighted average of the prices charged in all intrafirm and arm's-length transactions. Importantly, this measurement error biases results against us finding any effects, as it makes it harder to identify systematic differences between pure arm's-length prices and our related-party price proxy.[12]

The FAME database provides a snapshot of the ownership structure of UK firms in 2015. A potential caveat of using the static information to define the location of foreign affiliates is that one needs to assume that the affiliate status of firms remained constant over the sample period. Therefore, the static definition of foreign affiliates location does not reflect changes in destination countries in which UK MNCs established their first affiliate between 2005 and 2015. To address this limitation, we complement the FAME data on the network of foreign affiliate locations with information on mergers and acquisitions (M&As) by all UK companies between 2005 and 2015 from the Zephyr database, which is also provided by Bureau Van Dijck. The detailed procedure for updating the location of foreign affiliates for all company-years recursively between 2005 and 2015 is described in online appendix D. Overall, 102 UK MNCs established a first affiliate in a new country during our sample period across more than thirty countries. After merging in the information from Zephyr, we create a new time-varying dummy indicator (Aff_{ijt}) that takes the value of 1 if company i has an affiliate in country j in year t.

D.   Other Data Sources

We augment the data set with additional data on destination country characteristics and statutory corporate tax rates.[13] We obtain information on country-level variables from the World Bank (World Databank, World Development Indicators) and the PennWorld Table 8.1. The statutory tax rates are headline corporation tax rates drawn from KPMG Corporate Tax Rate Tables.

E.   Definitions and Descriptive Statistics

Define $\Delta\tau_{jt} \equiv |\tau_{jt} - \tau_{UK,t}|$ as the absolute value of the difference in the statutory tax rate between the United Kingdom ($\tau_{UK,t}$) and the destination country (τ_{jt}). Furthermore, define a country as a low-tax destination if its statutory corporate tax rate is lower than the UK rate ($\tau_{jt} < \tau_{UK,t}$) and as

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[11]Domestic companies include stand-alone companies, parent companies of a domestic group with all subsidiaries in the United Kingdom, subsidiaries of a domestic group, and firms with no match in FAME.

[12]Interestingly, for France, Davies et al. (2018), using data with direct information on related-party trade, found very similar results to Vicard (2015), who proxied related-party trade through affiliate information.

[13]Given that we include an extensive set of fixed effects in the baseline regression, we utilize the firm and destination country characteristics mainly to replicate and compare with specifications in existing studies on transfer pricing in online appendix, section E.

TABLE 1.—SUMMARY STATISTICS

	Mean (1)	SD (2)	P25 (3)	P50 (4)	P75 (5)	Observations (6)
Product characteristics						
Export value (GBP)	181,507	601,514	1,140	8,083	57,627	387,709
Net mass (in kilogram)	24,498	104,324	12	132	2,280	387,709
Average value (per kilogram)	337	930	8.0	34.8	199	387,709
Firm characteristics						
Log sales	16.6	1.8	15.4	16.4	17.5	7,420
Intrafirm trade	0.72	0.45	0	1	1	7,420
Profit making	0.39	0.49	0	0	1	7,420
Country characteristics						
Low-tax country dummy	0.54	0.50	0	1	1	686
Low-tax wedge ($\tau_{UK} - \tau j, \%$)	7.44	5.68	2.5	6	11.5	187,795
High-tax wedge ($\tau j - \tau_{UK}, \%$)	5.36	4.16	2	5	7.25	199,914

This table lists the summary statistics for the key variables in this paper's main estimation sample from 2005 to 2011.

a high-tax country if its statutory tax rate is equal to or higher than the UK rate ($\tau_{jt} \geq \tau_{UK,t}$). Following this definition, a country can switch from a low-tax to a high-tax destination (and vice versa) when its own tax rate or the UK tax rate changes.

The merged data set includes 931,773 observations at the firm–product–year level for 1,256 unique companies in manufacturing between 2005 and 2011. Table 1 provides summary statistics for the baseline estimation data set, which has 387,709 observations after inclusion of the full set of fixed effects.[14]

In online appendix B, we present several figures that further illustrate the data. Panel B of figure B.1 shows the number of countries classified as low tax and high tax, respectively, over the sample period of 2005 to 2011. Figure B.2 reports the overall annual exports, as well as the share of MNC exports, to countries where the respective MNC has a majority-owned affiliate; on average, around 39% of MNC exports fall in this category.[15] Figure B.3 shows the substantial variation in corporate tax rates in both the time series and the cross section. Specifically, panel A shows the histogram of the corporate tax differential for the estimation sample. Panel B shows the number of countries that experienced some change in the corporate tax differential for each year in the sample, separately for the low-tax and high-tax country groups.

V.   Main Empirical Results

This section presents results from our baseline fixed effects regression, results on the 2009 UK tax reform, and on trade creation. We then quantify the results in terms of forgone tax revenues, present a set of robustness checks, and compare our findings to previous studies. Finally, we look at the heterogeneity of effects in destination country tax rates, destination country tax haven status, and firms' R&D intensities.

TABLE 2.—EFFECT OF THE TAX DIFFERENTIALS ON TRANSFER PRICING BY UK MNCS: BASELINE RESULTS

$AFF_{ij(t)} \times$	(1)	(2)	(3)	(4)
$\Delta_{\tau_{jt}} \times I_{low,t}$	−0.030***	−0.029***	−0.029***	−0.030***
	(0.011)	(0.011)	(0.011)	(0.011)
$\Delta_{\tau_{jt}} \times I_{high,t}$	−0.007	−0.007	−0.007	−0.007
	(0.006)	(0.006)	(0.006)	(0.006)
$lnGDP\ PC_{jt}$		−0.058	−0.059	−0.005
		(0.133)	(0.133)	(0.088)
Adjusted R^2	0.91	0.91	0.91	0.91
N	387,709	384,525	312,174	384,525

This table presents our baseline results, based on equation (1). The dependent variable, lnp_{ijkt}, is the average unit price of exports of product k to country j by firm i in year t. $\Delta\tau_{jt}$ is the absolute tax rate difference between country j and the United Kingdom in year t. $I_{low,t}$ ($I_{high,t}$) indicates whether a country has a lower (higher) tax rate than the United Kingdom in year t. $AFF_{ij(t)}$ indicates if MNC i has at least one affiliate in country j in year t. $lnGDP\ PC_{jt}$ is the log of per capita GDP in country j in year t. Standard errors clustered by country-year pairs are in parentheses. Significant at ***1%, **5%, and *10%.

A.   Baseline Results

Table 2 presents our baseline regression results based on equation (1). Column 1 shows that the coefficient on the triple interaction for low-tax destinations is negative and highly significant, indicating that MNCs shift profits out of the United Kingdom by underpricing related-party exports to low-tax countries.[16] In contrast, the triple interaction for high-tax destinations is insignificant. That is, there is no evidence that MNCs shift profits into the United Kingdom from higher-tax countries through transfer prices. Column 2 controls for pricing-to-market by including an interaction term between destination country per capita GDP and the related-party dummy indicator. The results are very similar. Column 3 checks the robustness of the results to potential mismeasurement in the time-invariant ownership indicator by dropping observations with changing ownership. Column 4 uses the dynamic affiliate indicator. The results are almost identical to the previous columns. Furthermore, results in table A.2, which are discussed in detail shortly, show significant transfer

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[14]Table D.1 in online appendix D reports summary statistics for the full data set.

[15]Note that this share represents an upper bound of the actual share of related-party trade as MNCs may also be selling at arm's length to destinations where they have a majority-owned affiliate.

[16]Table 2 presents results based on the full sample, including the pre- and postreform period. Results are robust to restricting the sample to the prereform period as shown in online appendix table A.2, column 1. In the placebo exercise presented there, the coefficient for low-tax destinations is unchanged from the baseline in table 2.

FIGURE 1.—EFFECT SIZES IN THE LITERATURE
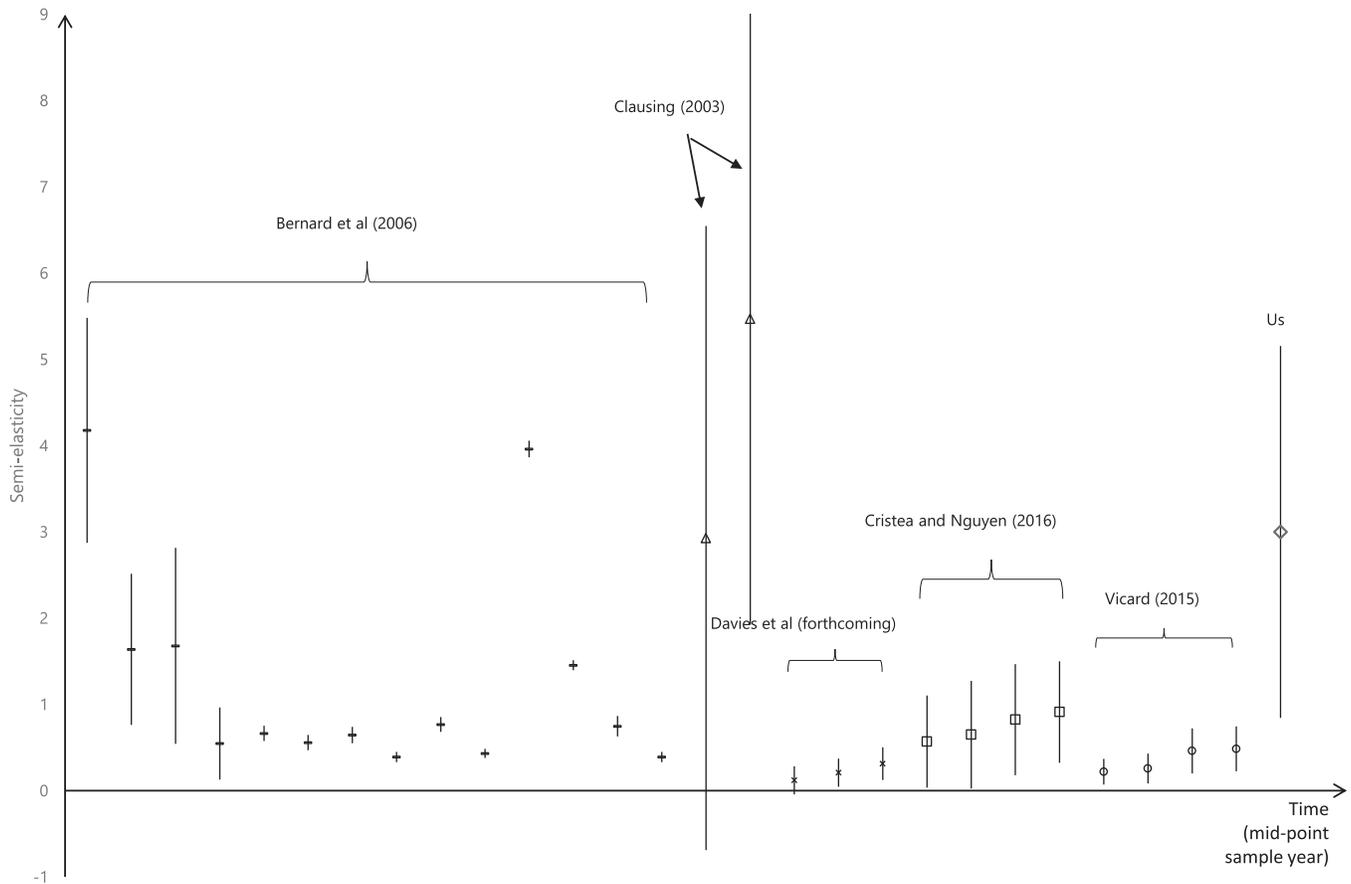
This figure plots coefficients and confidence bands of the semielasticity of log unit price for intragroup exports for past studies and our sample. The studies are ordered on the *x*-axis by the midyear of their sample period. Source: Author's calculation based on studies cited in online appendix table A.6.

mispricing prior to the territorial tax reform when the sample is restricted to the 2005–2008 prereform period.

Effects for low-tax destinations are large. A 1 percentage point larger tax difference, on average, reduces related-party export prices relative to arm's-length export prices by around 3%. Figure 1 illustrates the size of our main estimate relative to those found in previous studies: the magnitude of the tax effect is substantially larger than the effects found in Vicard (2015), Cristea and Nguyen (2016), and Davies et al. (2018), which report price responses between 0.12% and 0.6%. It is more comparable to Clausing (2003) and Bernard et al. (2006), the latter reporting effects between 0.4% and 4.2% depending on the specification.

There are many differences that could explain the heterogeneity in estimates across the studies. First, it is important to note that for a given firm, the semielasticity of intragroup prices (and, more generally, the semielasticity of reported profits) is not an immutable parameter but depends critically on the tax system. Features of the tax system, including the corporate tax base, taxation of foreign profits, the extent of integration between the corporate and personal tax base, and the strength of antiavoidance regulations all play a role in determining the net benefit from transfer mispricing. For ex-

ample, credits on corporate income taxes are passed through to shareholders only if a domestic tax has been paid at the corporate level, which provides French firms with an incentive to incur domestic income and alleviate outward profit shifting from France (Clausing, 2003). Given that existing papers cover several countries (France, Denmark, the United States, and the United Kingdom), one reason for the relatively wide range of estimates may be genuine differences in the tax sensitivity of MNCs' transfer pricing across these countries, reflecting differences in the underlying corporate and overall tax systems.

Another potential explanation is omitted variable bias due to differences in specifications across papers. We study this in detail in section E in the online appendix, showing that this channel can account for some of the differences in estimates (table E.1). As a first pass, table A.9, also in the online appendix, shows coefficients obtained for our baseline estimation when gradually adding more fixed effects that controls for alternative confounding factors of the tax effect. Doing so varies our main coefficient of interest between 0.7% and 6.1%.

Differences in the empirical approach used in different studies, including whether they distinguish related-party

from arm's-length trade, the way that related-party trade is measured, the type of variation exploited (cross-section versus time-series), and the tax rate variable used to measure incentive for profit shifting, can each lead to differences in the estimates. For example, Davies et al. (2018) use a precise measure of related-party trade but rely on a cross-section of French firms in a single year for identification. Our paper follows Cristea and Nguyen (2016) and proxies related-party trade by the presence of a majority-owned affiliate. Despite the differences in the data employed, our estimates are quite comparable to the preferred estimates in Bernard et al. (2006), whose table 5 shows price effects between 1.6% and 4.2% per percentage point of tax rate difference.[17] Moreover, with the same specification, estimates based on an effective tax rate measure are often two to three times smaller than those based on the statutory tax rate in Bernard et al. (2006). This also highlights the importance of using the latter for profit-shifting analysis: effective tax rates in part reflect endogenous choices made by firms, including the amount of profit shifted. In contrast, statutory tax rates are determined by governments and are thus generally exogenous to the firm's decisions, making them a more credible source of identification for profit-shaping analysis (Dharmapala, 2014).

To summarize, our coefficient estimates are substantially larger than those estimated for France and Denmark in the studies cited above and, depending on the interpretation, are more comparable to those estimated by Clausing (2003) and Bernard et al. (2006) for the United States. We hope that future research will shed more light on the question of how much of this heterogeneity in coefficients is driven by genuine differences in the aggressiveness of transfer pricing across countries of varying tax systems and how much of it can be explained by the empirical methods employed in earlier studies.

B. The Territorial Tax Reform

Graphical evidence. Figure 2 provides graphical evidence on the effects of the tax reform on average unit price residuals.[18] Panel A depicts mean residual prices over time for low-tax destinations, separately for related party and arm's-length trade transactions. Before the tax reform, these residual prices show similar trends. In 2010, the average related-party price residual drops substantially, whereas the average arm's-length residual is unaffected. In 2011, the related-party residual rebounds but is still below its prereform level. A similar pattern holds in panel B, which compares price residuals for related-party exports between low-tax and high-tax countries. While the pattern is slightly less clear-cut than in panel A, there is a strong drop in residual prices in 2010 with a partial recovery in 2011. This graphical evidence suggests a

[17]When adding more controls and product-fixed effects, their coefficient estimates decline to values between 0.6% and 6.1%.
[18]As the raw price data are very noisy and there are many sources of price heterogeneity across firms, products, destination and time, controls include all three-way fixed effects from equation (2).

FIGURE 2.—LOG UNIT PRICE RESIDUALS AND THE TAX REFORM

(a) Low tax destinations

(b) Related-party trade
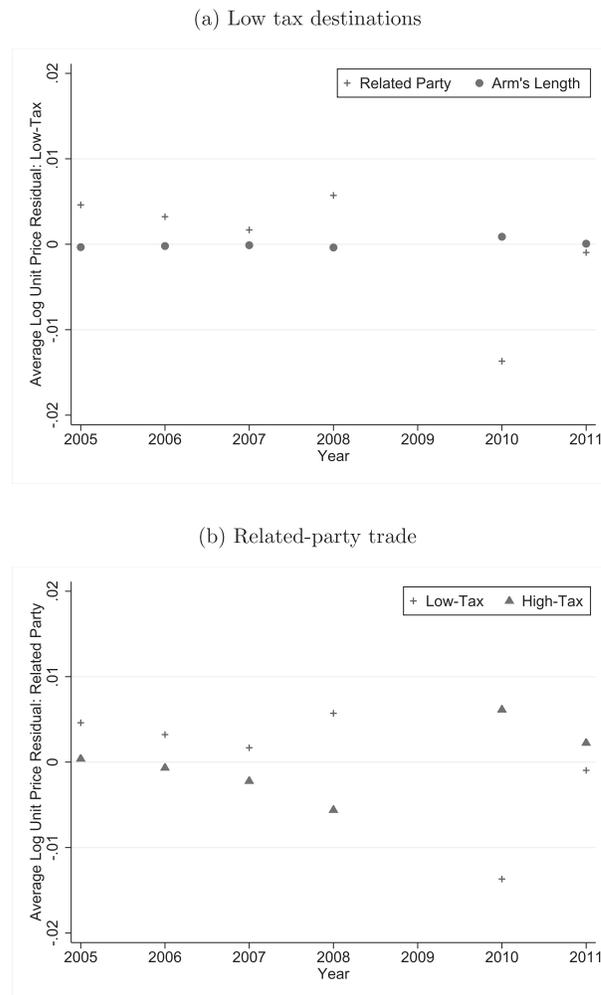
This figure shows mean log unit price residuals by year. Panel a shows mean residuals for low-tax destinations separately for related party and arm's-length transactions. Panel b shows mean residuals for related-party trade separately for low-tax and high-tax destinations.

positive impact of the tax reform on transfer mispricing by UK MNCs. In the following, we test this relationship more formally by estimating equation (2).

Main results. Table 3 presents our regression results on the territorial tax reform. Column 1 shows that the extent of profit shifting through transfer mispricing is larger under the territorial tax system. Before the reform, on average, a 1 percentage point increase in the tax difference led to a 2.7% decrease in the price of related-party exports relative to the price of arm's-length exports. After 2009, the tax effect is more pronounced, reducing the relative export price for low-tax destinations by another 1.5% per 1 percentage point lower tax rate difference. The increase in the strength of transfer pricing following the UK tax reform is significant at the 1% level.[19] Column 2 adds the interaction term

[19]This finding is consistent with existing studies based on OECD countries that establish that firms with worldwide parents tend to shift less income than firms with territorial parents (Markle, 2016). Given that we only have two

TABLE 3.—EFFECT OF THE TAX DIFFERENTIALS ON TRANSFER PRICING BY UK
MNCs: TAX REFORM

$AFF_{ij(t)} \times$	(1)	(2)	(3)
$\Delta_{\tau_{jt}} \times I_{low,t}$	−0.027**	−0.027**	−0.028**
	(0.011)	(0.011)	(0.011)
$\Delta_{\tau_{jt}} \times I_{high,t}$	−0.000	−0.001	−0.000
	(0.006)	(0.006)	(0.006)
$Post_t$	0.132***	0.130***	0.131***
	(0.043)	(0.043)	(0.044)
$\Delta_{\tau_{jt}} \times I_{low,t} \times Post_t$	−0.015***	−0.015***	−0.015***
	(0.005)	(0.005)	(0.005)
$\Delta_{\tau_{jt}} \times I_{high,t} \times Post_t$	−0.008	−0.008	−0.008
	(0.007)	(0.007)	(0.007)
$lnGDP\ PC_{jt}$		−0.046	0.004
		(0.135)	(0.090)
Adjusted R^2	0.91	0.91	0.91
N	315,330	312,274	312,274

This table presents our results on the 2009 tax reform, based on equation (2). $Post_t$ is a dummy indicator equal to 0 until 2008 and equal to 1 from 2010 onward. All other variables are defined in table 2. Standard errors clustered by country-year pairs are in parentheses. Significant at ***1%, **5%, and *10%.

between destination country per capita GDP and the related-party dummy indicator. Column 3 tests the robustness of the results by replacing AFF_{ij} with the time-varying ownership indicator Aff_{ijt}. The results remain very similar.

Placebo test. The identification for the effect of the territorial tax reform on transfer mispricing rests critically on the assumption that there are no differential changes in the pricing behavior between the two comparison groups prior to the reform other than the main supply and demand factors that are already controlled for with the full set of fixed effects. We perform a placebo test to check this assumption, restricting the data sample to the prereform period of 2005 to 2008. We assume a counterfactual year for the switch in the tax regime, which is captured in the $Post_t$ dummy indicator that takes the value of 1 for all years after 2006, 2007, and 2008 in columns 1 to 3 of table A.2, respectively. We estimate equation (2) on this restricted sample and report the results in table A.2. The estimated coefficients concerning the effect of the tax reform (β_3 and β_4) are not statistically different from 0.

This placebo test also helps us to assess the potential bias that the time-invariant ownership status imposes on the triple interaction term with the tax policy change indicator. The misrepresentation of arm's-length pricing as being related-party pricing should be a more frequent occurrence in the first part of the sample compared to the later sample years, given that the network of foreign affiliates in the later periods is more likely to resemble the network observed in 2015. To rule out that the estimated effect of the tax reform merely reflects a gradual improvement in the measurement of related-party trade over time, the estimated coefficients should be 0 in any of the prereform periods. This is indeed the case in table A.2.

years of postreform data, we are unable to examine in depth the dynamics of transfer mispricing under the territorial tax regime.

C. Trade Creation and Quantification

Trade creation. Table 4 examines the effect of the tax differential on the quantity and value of exports by UK MNCs. The dependent variable in columns 1 and 2 of table 4 is the quantity of exports measured by weight, whereas columns 3 to 4 and 5 to 6 focus on the unit price and the total value of transactions, respectively.

Column 1 shows that overall, there is a weak negative effect of the tax differential interacted with affiliate status on export quantities, which is significant at the 10% level. While this negative correlation goes against the trade creation channel (prediction 3), results concerning the tax reform in column 2 provide some evidence in favor of the trade creation mechanism: the interaction with the postreform dummy is positive and highly significant. That is, UK MNCs increased their related-party export quantities to low-tax countries, in line with their profit-shifting incentives, following the reform. For ease of comparison, columns 3 and 4 reproduce the main results on transfer prices in, respectively, table 2 column 4, and table 3 column 2.

Due to the offsetting price and quantity effects on total export value, columns 5 shows that overall, the effect of the tax differential on the value of related-party exports is negative. Column 6 disentangles the effect before and after the tax reform, showing that a 1 percentage point increase in the tax differential on average depresses the value of intrafirm exports to low-tax countries by 4.3% relative to arm's-length exports prior to the reform. The effect of the tax differential on total related-party export values to low-tax countries did not change significantly after the tax reform. In summary, while we find mixed evidence on the trade creation channel, the effect is quite intriguing and merits further study.[20]

Quantification of effects. We now discuss the quantitative importance of our findings, computing estimates of total shifted profits and forgone tax revenues to the United Kingdom based on our preferred coefficient estimates in table 3, column 3. Specifically, we calculate total shifted profits as

$$\sum_{c=1}^{C} (\hat{\beta_1} + \hat{\beta_3}) \times I_{low,c} \times \Delta\tau_c \times \exp_c, \qquad (3)$$

where $\hat{\beta_1}$ and $\hat{\beta_3}$ are the coefficient estimates from equation (2) (estimated at −0.028 and −0.015, respectively), $\exp_c$ is the volume of related-party exports to country c, and $\Delta\tau_c$ is the tax difference between the United Kingdom and country c.

We estimate that in 2010, UK multinationals shifted about 840.97 million pounds toward low-tax jurisdictions via transfer mispricing, with Ireland being the top destination. At the 2010 tax rate of 28%, this finding implies forgone tax revenues of 235.5 million pounds due to transfer mispricing in

[20]In a recent paper, Lassmann and Zoller-Rydzek (2019) indeed provide further empirical support for the trade creation channel, employing detailed data from Switzerland.

TABLE 4.—EFFECT OF THE TAX DIFFERENTIALS ON TRADE DIVERSION BY UK MULTINATIONALS

Dependent Variable:	ln(*Weight*)		ln(*Unit Price*)		ln(*Total Value*)	
$AFF_{ij}\times$	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta_{\tau_{jt}} \times I_{low,t}$	−0.034*	−0.016	−0.029***	−0.027**	−0.063***	−0.043**
	(0.020)	(0.020)	(0.011)	(0.011)	(0.023)	(0.022)
$\Delta_{\tau_{jt}} \times I_{high,t}$	−0.010	−0.004	−0.007	−0.001	−0.018*	−0.005
	(0.009)	(0.011)	(0.006)	(0.006)	(0.010)	(0.012)
$Post_t$		0.120		0.130***		0.249**
		(0.101)		(0.043)		(0.102)
$\Delta_{\tau_{jt}} \times I_{low,t} \times Post_t$		0.018**		−0.015***		0.003
		(0.009)		(0.005)		(0.010)
$\Delta_{\tau_{jt}} \times I_{high,t} \times Post_t$		−0.001		−0.008		−0.009
		(0.013)		(0.007)		(0.013)
$lnGDP\ PC_{jt}$	0.381	0.465	−0.058	−0.046	0.323	0.420
	(0.292)	(0.291)	(0.133)	(0.135)	(0.304)	(0.292)
Adjusted R^2	0.92	0.92	0.91	0.91	0.89	0.89
N	384,525	312,274	384,525	312,274	384,525	312,274

This table presents regression results on the effect of the tax differential on the quantity of exports (columns 1 and 2), the transfer prices (columns 3 and 4), and the total value of exports (columns 5 and 6) by UK multinationals, respectively. All other variables are defined in table 2. Standard errors clustered by country-year pairs are in parentheses. Significant at ***1%, **5%, and *10%.

exports by UK MNCs in manufacturing. The forgone tax revenues represent about 7.8% of the total corporate tax revenue collected from the UK MNCs in manufacturing in 2010. As a share of total corporate income tax revenues, our estimates are comparable to those of Davies et al. (2018), who calculate that French firms would have paid about 1% (333 million euros out of 36 billion euros) more corporate income tax in the absence of tax-motivated transfer mispricing.

VI. Heterogeneous Effects in Transfer Mispricing

This section presents evidence for heterogeneity in transfer mispricing across countries with different tax rates and tax haven statuses and across firms with different R&D intensities.

A. Transfer Mispricing and the Destination Country

Tax rate groups. We first study whether transfer mispricing is concentrated in the lowest-tax destinations. For this analysis, we split the estimation sample into quintile bins based on the difference in tax rates between the United Kingdom and the destination country. We then replace our main variable of interest ($\Delta \tau_{jt} \times I_{low,t} \times AFF_{ij}$) by interactions with dummy indicators for each quintile ($Q_\tau \times I_{low,t} \times AFF_{ij}$). Results are presented in panel A of figure 3. The left *y*-axis shows the estimated coefficients with the corresponding 90% confidence interval. The right *y*-axis shows the fraction of countries that changed their CIT rate at least once within each quintile. Panel B splits countries into tax havens and non–tax havens and shows that the extent of transfer price manipulation is roughly proportional to the tax difference. However, for countries with the largest tax wedge, the standard error is large, and the tax effect is not statistically different from 0. Again, we find significant effects only for nonhaven countries. For tax havens, there is so little variation (i.e., changes in tax rates) in the data that we are not able to

estimate coefficients for the two groups with the highest tax rate differences.

Tax haven status. In a recent study on transfer mispricing, Davies et al. (2018), found that price manipulation by French firms is concentrated in trade with tax havens and very low-tax countries. We test to what extent the same patterns hold for UK MNCs by splitting the sample into tax havens and countries that are not tax havens following the classification in Hines (2005).[21] Results are presented in columns 1 and 2 of table A.3. Interestingly, we find significant effects for nonhaven countries but no significant effects for the tax-haven-only sample. These results remain unchanged when pooling the data and interacting the variable of interest with the tax haven indicator (column 3).

The fact that we do not find any effects for tax havens is not necessarily inconsistent with Davies et al. (2018) due to the different empirical strategies that are used to identify the effects of taxes. Our empirical strategy relies on variation in the tax rates over time. Given that tax rates were already quite low in most tax havens at the beginning of our sample (and have remained low during our sample period), there was limited variation in the tax differential within that set of countries, making it difficult to identify our coefficient of interest for these countries. In fact, 67% of countries that were classified as tax havens in Hines (2005) did not experience any change in their statutory CIT rate throughout our sample period, while only 32% of nonhaven countries had no change in their CIT rate (online appendix table A.7). Davies et al. (2018), in contrast, exploited cross-sectional variation in France, allowing them to identify effects even for countries

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[21]This is the same classification used in Davies et al. (2018). Online appendix table A.4 lists the countries that are classified as tax havens in Hines (2005), Dharmapala and Hines (2009), and OECD (2000), whereas online appendix table A.5 lists the tax haven countries that are included in our estimation sample under the various definitions of tax havens.

Figure 3.—Nonlinear Transfer Mispricing in Low-Tax Countries

(a) All Countries
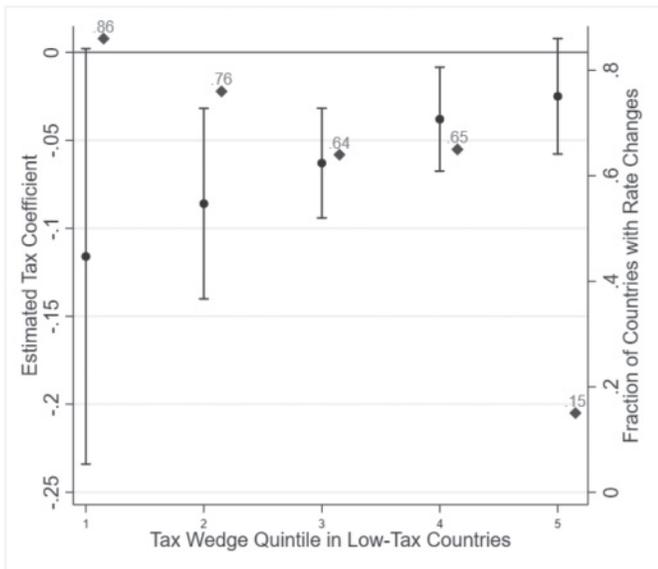
(b) Haven vs. Non-Haven
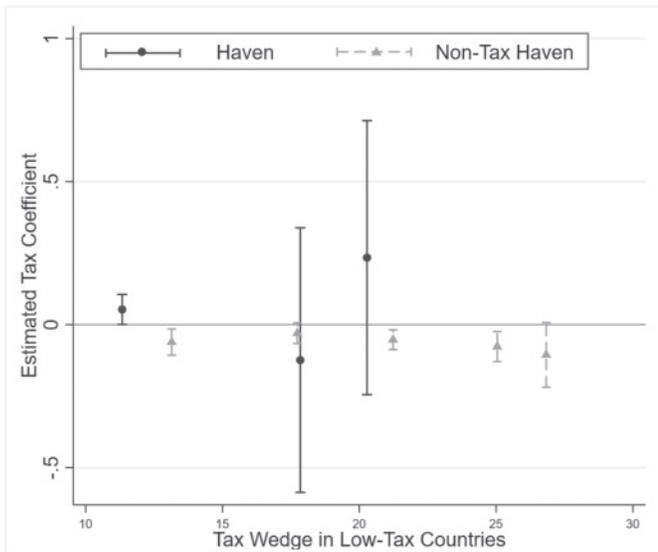
This figure plots the point estimate of the tax coefficient β_1 as in equation (1) and the corresponding 90% confidence intervals at each quintile of the tax wedge $\Delta\tau_{jt}$ in the low-tax countries. Panel a also shows the fraction of countries that changed tax rates at least once on the right y-axis. Panel b shows the results separately for haven and nonhaven countries. The x-axis denotes the average value of the tax wedge in each quintile.

Table 5.—Heterogeneous Transfer Mispricing in R&D

$AFF_{ij} \times$	(1)	(2)	(3)	(4)
$\Delta_{\tau_{jt}} \times I_{low,t}$			−0.032	−0.034
			(0.028)	(0.030)
$\Delta_{\tau_{jt}} \times I_{low,t} \times R\&D_{low,i}$	−0.009	−0.031*		
	(0.015)	(0.018)		
$\Delta_{\tau_{jt}} \times I_{low,t} \times R\&D_{medium,i}$	0.000	−0.023	0.014	0.016
	(0.017)	(0.019)	(0.015)	(0.015)
$\Delta_{\tau_{jt}} \times I_{low,t} \times R\&D_{high,i}$	−0.063***	−0.086***	−0.043*	−0.040*
	(0.017)	(0.023)	(0.024)	(0.023)
$\Delta_{\tau_{jt}} \times I_{low,t} \times Size_{medium,i}$		0.034**		−0.021
		(0.017)		(0.026)
$\Delta_{\tau_{jt}} \times I_{low,t} \times Size_{large,i}$		0.024		−0.015
		(0.022)		(0.022)
$\Delta_{\tau_{jt}} \times I_{low,t} \times Diff_i$			0.019	0.033
			(0.034)	(0.032)
Adjusted R^2	0.91	0.91	0.91	0.91
N	384,525	384,525	328,941	318,484

This table shows results on R&D intensities and transfer pricing. R&D intensity and size indicators refer to terciles of the distribution of firm-level R&D expenses over sales and of tangible assets, respectively. Additional controls are $\ln GDP\,PC_{jt}$ and $AFF_{ij} \times \Delta\tau_{jt} \times I_{high,t}$. $Diff_i$ indicates if a product is differentiated. All other variables are defined in table 2. Standard errors clustered by country-year pairs are in parentheses. Significant at ***1%, **5%, and *10%.

tax havens as in Dharmapala and Hines (2009) and as suggested in OECD (2000) and using the exact set of tax haven countries as in Davies et al. (2018).

To summarize, our results show substantial transfer price manipulation by UK MNCs in exports to non-tax-haven countries with low to intermediate CIT rates.

B. Transfer Mispricing and R&D Intensity

Do firms that undertake more investment in R&D engage in more transfer price manipulation? A priori, the relation could go either way. On the one hand, R&D increases the intangible capital of a firm, some of which can be allocated to low-tax jurisdictions to facilitate profit shifting. On the other hand, R&D can make a firm's products more specialized, which makes finding comparable prices harder and in turn makes it easier to shift profits through transfer mispricing.

Column 1 of table 5 presents the results from a regression that interacts $\Delta\tau_{jt} \times I_{low,t} \times AFF_{ij}$ with three indicators of R&D intensity based on the average firm-level R&D spending in the sample.[23] The results suggest that transfer mispricing is concentrated in firms with the highest R&D intensity. Their coefficient is highly significant and has double the size of the average baseline effect estimated earlier. In contrast, there is no evidence for any systematic transfer price manipulations of firms outside the highest R&D group. However, given the large standard errors for the other two coefficients, we cannot reject the null hypothesis that the three coefficients are statistically equal to one another. Nonetheless, the findings

with no change in their tax rates in recent years.[22] Columns 4 to 9 verify that our results are mainly driven by transfer mispricing in nonhaven countries, using alternative lists of

[22]An economic factor limiting transfer pricing to tax havens is that trade volumes with tax havens are not that large (they have declined substantially in our sample period and represent slightly over 10% of UK exports in manufacturing since 2008). To the extent that there is sizable profit shifting to tax havens, it must therefore happen through channels other than transfer mispricing in real goods (e.g., transfer mispricing on service trade and intangibles).

[23]We compute a time-invariant measure of firm-level R&D intensity as the ratio between total qualifying R&D expenditure and total turnover during the sample period. We then group firms by their R&D intensity into low, medium, and high categories.

are suggestive that R&D makes goods more specific, facilitating profit shifting through mispricing.

It is plausible that large companies are more likely to invest in R&D so that indicators of R&D intensity may be highly correlated with firm size. Column 2 therefore includes both sets of interaction terms and shows that, controlling for firm size, companies with the highest R&D intensity strongly manipulate their transfer prices.[24] Column 3 instead controls for the type of goods based on the classification in Rauch (1999) by adding an interaction term between a dummy indicator that distinguishes between homogeneous and differentiated goods and the main variable of interest $\Delta \tau_{jt} \times I_{low,t} \times AFF_{ij}$ to the regression. Column 4 includes both the firm size and the goods-type interactions as controls. The basic finding that the most R&D-intensive firms manipulate their transfer prices more remains unchanged in these alternative specifications.

VII. Conclusion

In this paper, we use linked trade-tax administrative records on UK multinationals in manufacturing to estimate the extent of tax-motivated transfer mispricing in exports of real goods. Our findings suggest that, on average, a 1 percentage point tax difference reduces related-party export prices to low-tax countries by 3% relative to the prices charged at arm's length. The extent of tax-motivated transfer mispricing has increased in the post-2009 territorial tax regime, is present in nontax havens with relatively low and medium tax rates, and is substantially larger in R&D-intensive firms.

The new evidence on transfer mispricing has several implications for policy and future research. First, given our findings, tax authorities should keep paying attention to transfer pricing in tangible goods as an area of revenue leakage. Second, our observation that transfer mispricing is concentrated in the most R&D-intensive firms provides tax authorities with useful guidance for risk assessment. Third, our evidence that transfer mispricing incentives are stronger under a territorial system highlights a key cost of moving away from worldwide taxation.[25] Finally, in contrast to earlier research on France by Davies et al. (2018), we find evidence for transfer mispricing in exports to countries that are not tax havens. Our results imply that policymakers should not focus on tax havens alone but should also pay attention to other low-tax and medium-tax countries as destinations for profit shifting.

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[24]Indicators of firm size are defined based on the tercile of the distribution of firm-level fixed assets in the sample. The correlation between the levels of R&D intensity and fixed assets is -0.01, suggesting that collinearity should not be a major concern here. This low correlation between R&D intensity and firm size is in line with US evidence in Cohen, Levin, and Mowery (1987).

[25]This finding does not necessarily imply that worldwide taxation is preferable to territorial taxation, as the latter may have other desirable effects such as increasing the efficiency of outbound investment allocation.

REFERENCES

Beer, Sebastian, Ruud A. de Mooij, and Li Liu, "International Corporate Tax Avoidance: A Review of the Channels, Magnitudes, and Blind Spots," *Journal of Economic Surveys* 34 (2020), 660–688.

Bernard, Andrew B., J. Bradford Jensen, and Peter K. Schott, "Transfer Pricing by U.S.-Based Multinational Firms," NBER working paper 12493 (2006).

Clausing, Kimberly A., "Tax-Motivated Transfer Pricing and US Intrafirm Trade Prices," *Journal of Public Economics* 87 (2003), 2207–2223.

Cohen, Wesley M., Richard C. Levin, and David C. Mowery, "Firm Size and R&D Intensity: A Re-Examination," *Journal of Industrial Economics* 35 (1987), 543–565.

Collins, Julie, Deen Kemsley, and Mark Lang, "Cross-Jurisdictional Income Shifting and Earnings Valuation," *Journal of Accounting Research* 36 (1998), 209–229.

Cristea, Anca, and Daniel Nguyen, "Transfer Pricing by Multinational Firms: New Evidence from Foreign Firm Ownerships," *American Economic Journal: Economic Policy* 8 (2016), 170–202.

Davies, Ronald B., Julien Martin, Mathieu Parenti, and Farid Toubal, "Knocking on Tax Haven's Door: Multinational Firms and Transfer Pricing," this REVIEW 100 (2018), 120–134.

de Mooij, Ruud, and Li Liu, "At a Cost: The Real Effect of Transfer Pricing Regulation on Multinational Investment," *IMF Economic Review* 68 (2020), 268–306.

Desai, Mihir A., C. Fritz Foley, and James R. Hines, "The Demand for Tax Haven Operations," *Journal of Public Economics* 90 (2006), 513–531.

Dharmapala, Dhammika, "What Do We Know about Base Erosion and Profit Shifting? A Review of the Empirical Literature," *Fiscal Studies* 35 (2014), 421–448.

Dharmapala, Dhammika, and James R. Hines, "Which Countries Become Tax Havens?" *Journal of Public Economics* 93 (2009), 1058–1068.

Flaaen, Aaron, "The Role of Transfer Prices in Pratt-Shifting by U.S. Multinational Firms: Evidence from the 2004 Homeland Investment Act," Board of Governors of the Federal Reserve System working paper 2017-055 (2017).

Grubert, Harry, and John Mutti, "Taxes, Tariffs and Transfer Pricing in Multinational Corporate Decision Making," this REVIEW 73 (1991), 285–293.

Harris, David, Randall Morck, and Joel B. Slemrod, "Income Shifting in US Multinational Corporations" (pp. 277–308), in Alberto Giovannini, R. Glenn Hubbard, and Joel Slemrod, eds., *Studies in International Taxation* (Chicago: University of Chicago Press, 1993).

Hebous, Shafik, and Niels Johannesen, "At Your Service! The Role of Tax Havens in International Trade with Services," CESifo working paper series 5414 (2015).

Heckemeyer, Jost H., and Michael Overesch, "Multinationals' Profit Response to Tax Differentials: Effect Size and Shifting Channels," *Canadian Journal of Economics* 50 (2017), 965–994.

Hines, James R., "Do Tax Havens Flourish?" *Tax Policy and the Economy* 19 (2005), 65–99.

Hines, James R., and Eric M. Rice, "Fiscal Paradise: Foreign Tax Havens and American Business," *Quarterly Journal of Economics* 109 (1994), 149–182.

Lassmann, Andrea, Benedikt Marian, and Maximilian Zoller-Rydzek, "Decomposing the Margins of Transfer Pricing," KOF working papers 450 (2019).

Markle, Kevin, "A Comparison of the Tax-Motivated Income Shifting of Multinationals in Territorial and Worldwide Countries," *Contemporary Accounting Research* 33 (2016), 7–43.

OECD, "Towards Global Tax Co-operation: Progress in Identifying and Eliminating Harmful Tax Practices," *Progress Report to the* G20 (2000).

Rauch, James E., "Networks versus Markets in International Trade," *Journal of International Economics* 48 (1999), 7–35.

Riedel, Nadine, Theresa Zinn, and Patricia Hofmann, "Do Transfer Pricing Laws Limit International Income Shifting? Evidence from Europe," CESifo working paper series 4404 (2015).

Vicard, Vincent, "Profit Shifting through Transfer Pricing: Evidence from French Firm Level Trade Data," Banque de France working paper 555 (2015).

Zucman, Gabriel, "Taxing across Borders: Tracking Personal Wealth and Corporate Profits," *Journal of Economic Perspectives* 28 (2014), 121–148.