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Taxing Income in the Oil and Gas Sector - Challenges of International and Domestic Profit Shifting

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This paper provides specific estimates on the scale of profit shifting among hydrocarbon MNEs. We estimate a lower-bound semi-elasticity of reported profits to sector specific income taxation of -1.88. To assess the importance of domestic profit-shifting channels, we take advantage of domestic tax differentials among hydrocarbon producers facing additional rent taxes and find that domestic profit shifting accounts for about one third of total income concealed. Overall, we estimate revenue losses in the sector due to profit-shifting amount to 12% - 35% of the income tax base, depending on the characteristics of a country's tax regime. We also observe a higher vulnerability of non-OECD economies to profit shifting in our sample, which consists of 294 domestic and multinational parents and subsidiaries during the period from 2004-2012. Finally, our analysis confirms the mitigation effect of documentation requirements for internal transactions. However, we also find that increased enforcement prompts MNEs in the Oil and Gas sector to rely more heavily on the reallocation of profits at the domestic level.

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1. Introduction

Income from natural resource endowments is substantial for many economies, frequently accounting for more than half of government revenue (IMF 2011). Yet, concerns about the ability of governments to collect a fair share of revenue have led to more scrutiny, starting with transparency to combat corruption,[1] and increasingly targeting the misuse of tax planning and transfer pricing structures of Multinational Enterprises (MNEs) to shift profits out of source countries.

A wide body of evidence on general profit shifting has been developed in recent years, comprehensively summarized by Heckemeyer and Overesch (2013) and Dharmapala (2014). Using the tax differential of multinational group members (Hines and Rice, 1994; Huizinga and Laeven, 2008), exogenous earning shocks at the parent level (Dharmapala and Riedel, 2013), or exploring difference in reported sales and earnings of US MNEs (Dyreng and Markle, 2014) as an identification device, studies typically provide strong evidence of MNEs taking advantage of differences in taxation among their group members. To date, these analytical efforts were mainly based on economy-wide information, while initial work on potential drivers suggests important sectoral differences (Beer and Loeprick, 2015).

To inform the debate on the appropriate taxation of the sector, this paper aims at providing more specific evidence on the scale of observable profit shifting in the Oil and Gas sector. In our sample, which consists of 294 domestic and multinational parents and subsidiaries during the period from 2004-2012, profit shifting is substantial with an estimated semi-elasticity of reported profits of -1.88. We estimate that this translates into revenue losses between 12% and 35% of the tax base, depending on the characteristics of a country's tax regime. Our results also indicate a higher vulnerability of non-OECD economies to profit shifting in the hydrocarbon sector.

Actual and perceived vulnerabilities to profit re-allocation may be one source of the noticeable global variation in fiscal regimes for extractive industries. Our findings are therefore not only relevant in the context of the ongoing global debate on the risks of tax base erosion, but have implications for the broader design of fiscal regimes for the Oil and Gas sector: The susceptibility of profit based instruments to international and national tax loopholes may justify more reliance on less exposed instruments such as volume based royalties.[2]

A second major contribution of our work is the identification of a domestic profit-shifting channel. The petroleum sector is peculiar in often facing additional profit-based instruments added to regular income taxation. The result is an important domestic tax differential for multi-sector companies. Redirecting profits from Oil and Gas subsidiaries towards

[1] The extractive industries have been the first target of tightened transparency requirements in the US and EU, demanding disclosure of transfers to governments on a country by country basis.

[2] An observation that has potential relevance beyond the Oil and Gas sector. Brockmeyer et al. (2013) illustrate that imperfect observation of costs provides justification for turnover rather than profit based firm taxation in Pakistan.

affiliates facing just the corporate income tax can thus result in tax gains at the domestic level. We develop an analytical framework to assess the relevance of this specific profit misallocation channel, which has thus far been neglected in the profit-shifting literature. Using a tax differential of domestic Oil and Gas producers with related domestic businesses in other sectors[3] we do indeed find a significant association with reported profits; Domestic profit shifting reduces reported profits of the petroleum companies in our sample by about 13 percent. Our identification of this shifting channel is based on a novel approach, extending the cost function of tax planning activities with a fixed cost component as suggested by Dharmapala (2014).

The findings presented in this paper have practical relevance given that domestic transfer mispricing often seems to be an administrative afterthought in countries' compliance management strategies. Documentation requirements for related-party transactions are, for instance, frequently limited to cross-border transactions.[4] To inform administrative responses, we also investigate the adjustment of firm-level evasion strategies following regulatory enforcement efforts by national tax administrations. Following Beer and Loeprick (2015), we look at the effects of introducing transfer pricing documentation requirements as a proxy for administrative enforcement. We assess the impact of regulation, differentiating between domestic and international shifting channels, and find that increased enforcement prompts MNEs in the Oil and Gas sector to rely more heavily on the reallocation of profits at the domestic level. This may be an indication of administrators focusing solely on controlling international tax planning activities. The finding also underlines the need for dynamic analysis of taxpayer responses to anti-avoidance measures.

2. Fiscal Regimes for the Oil and Gas Industry

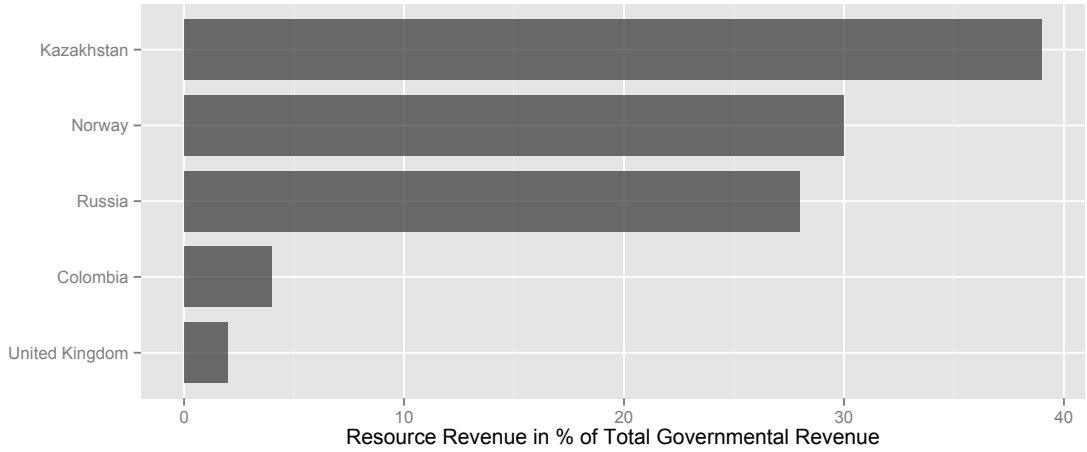
Revenue from the hydrocarbon sector accounts for more than 70% of government revenue for most countries on the Arabian Peninsula and several African economies. In the producing countries represented in our sample, such as Colombia, Kazakhstan, Norway, Russia, and the UK collections from the sector represent a smaller, but still significant share in total revenue (see Figure 1).

Fiscal regimes for the sector tend to be complex and have a range of country-specific features. Most common are corporate income taxes, rent taxes, royalties, export duties and bonus payments. While corporate income taxes usually apply uniformly, sector-specific instruments are typically contingent upon distinct factors such as market conditions, the maturity and quality of the field developed, or production volumes. There is some indi-

[3] Depending on the position of affiliates within an MNE group in the value-chain we differentiate extraction and support service activities.

[4] The UK did not include domestic transactions in the scope of its transfer pricing legislation until 2004 (PricewaterhouseCoopers, 2014), Romania includes domestic transactions in the scope of its provisions since 2010 (KPMG, 2014), India only recently, in 2012, extended the scope of transfer pricing to specified domestic transactions (PricewaterhouseCoopers, 2014).

Figure 1



Source: Natural Resource Governance Institute, 2014

cation that countries with resource endowments tend to have higher standard corporate income tax rates (Keen and Mansour, 2010) and a number of resource rich countries are using differentiated tax rates for the sector. In addition to tax instruments, ownership arrangements play an important role in government efforts to gain a fair share of resource rents. Given initial capital requirements, oil fields are frequently developed in joint ventures of multiple investors. Governments can take part in these, typically through a national oil company. Alternatively, concessions, used in the majority of OECD economies or production sharing contracts (PSCs), which have been adopted in many developing economies starting in 1960 (for an overview see Bindemann, 1999) specify returns to transfers of development or ownership rights.[5] Several studies indicate that countries using PSAs are getting a larger share of resource rents than those relying on concession contracts (Johnston, 1994; Ravagnani et al., 2012; Luo and Yan, 2010). Even where PSCs are accounting for the majority of government take, regular income taxes, however, typically remain an important source of revenue. Consequently, profit shifting to lower the income tax base remains a concern for all hydrocarbon producing countries, across different fiscal regime designs.

It is sometimes argued that manipulations of related-party transactions is less of a risk when observable market prices, such as spot markets for crude oil, are readily available. This perspective has been challenged by efforts to detect mispricing of crude oil imports[6]

[5] Specifying the share of production retained by a private developer to cover cost and a formula for dividing profits with the government

[6] Comparing declared values for crude petroleum imports into the European Union and the United States

and neglects the multitude of other internal transactions that may allow MNEs to over- or undercharge affiliates in order to optimize global tax liabilities. While the profit shifting opportunities for a non-diversified producing entity would indeed be limited, insourcing of services from third parties, related and unrelated, is common among upstream exploration and production and frequently involves the deployment of highly valuable assets such as specialized drilling equipment. Similarly, a multiplicity of midstream (refining and transportation) transactions and further services supporting downstream retailing may provide opportunities for profit reallocation.

Table 1 summarizes the profit- and production-based tax instruments for a range of countries in our sample for the year 2012. The first column shows CIT rates which apply to all sectors of the economy. The second column presents sector-specific marginal taxes on profits which apply in addition to the regular CIT; Due to progressive schedules, cost uplift, or exemption thresholds, this figure deviates in some instances from the statutory rate applied.[7] In Norway, for example, the additional tax rate is 50%, implying that the combined tax rate on profits of the sector is 78%. Columns (3) to (5) present production-based instruments which are either linked to a price measure (Column 4), aimed at safeguarding rents; or simply the production volume (Column 5), to forestall distortions on marginal fields;[8] or both. Further details on the derivation of rent tax rates is provided in Appendix D.

The complexity of Oil and Gas regimes requires a few assumptions to determine the applicable total income tax rate. In the UK, differentiation is needed to separate extraction projects approved before and after 1996. Reforms in the mid-90s, abolished the Petroleum Revenue Tax which lowered the total marginal tax rate from 81% to 62%. Based on HMRC statistics (Joomeen, 2014), we estimate that during the time period covered by our analysis roughly 25% of profits in the Oil and Gas sector derive from fields given development consent before 1996. As we are not able to match development consent with our micro-level database, we employ a weighted average of the rates in the empirical analysis.[9]

In the case of Kazakhstan, an Excess Profit Tax increases with firm profitability. A reform in 2009, decreased both general corporate income tax rates and the application threshold for additional rent taxation from 20% to 25% of profits after taxation as a share

from 2000 - 2010 to market prices, Pak (2012) estimates a total volume of mispricing exceeding 100 Billion USD

[7] More specifically, we calculate the marginal reduction in tax payments given an incremental decrease in accounting profits and denote the implied rate by τ. This tax rate may be decomposed into two components: the regular CIT and a rate associated with additional tax obligations, $\tau = \tau^{CIT} + \tau^{Add}$. Column (1) presents τ^{CIT} and column (2) presents τ^{Add}. If τ^{Add} depends on whether the change in profits is caused by a change in costs or a change in income, we assume that a unit increase in profits is caused by changes in both components to a similar degree.

[8] The mechanism is aimed at more efficient extraction over the life cycle of a field. With lower volumes of production towards exhaustion of a well, the share of rents captured through royalties is reduced when marginal rents of the enterprise approach marginal costs.

[9] In a series of robustness checks we vary the weight attached to older fields from 1/3 to 1/5 and do not find an effect on our results.

Table 1: Taxation of oil and gas

Tax Base	Profit-based instruments		Production-based instruments		
Instrument	regular CIT	Additional tax	Royalty	P	Q
	(1)	(2)	(3)	(4)	(5)
Colombia	33.00%	–	8%-25%		✓
France	33.33%	–	–		
Italy	31.40%	10.50%	4%-10%		✓
Kazakhstan	20.00%	10.50%	2.5%-18%	✓	✓
Netherlands	25.00%	27.50%	0%-8.25%	✓	✓
Norway	28.00%	50.00%	–		
Poland	19.00%	–	–		
Romania	16.00%	–	3%-13.5%	✓	
Russia	20.00%	–	35%-60%[1]	✓	✓
Ukraine	21.00%	–	Yes*	✓	✓
United Kingdom	24.00%	42.75	–		

Notes: CIT rates are drawn from PwC. We provide details on the calculation of additional tax rates in Appendix D. * Production royalties have been abolished in 2013 and replaced by subsoil use payments.

of deductible costs. We therefore divide Kazakh firms in two sub-samples, above and below the mean profitability level of 30% for each year in our sample and calculate the applicable marginal income tax for these sub-samples.[10] For Italian firms in our sample, we account for a supplementary income tax of 6.5% which was applied to firms in the sector with annual revenues of more than 25 Million Euro. In 2011, this threshold was lowered to 10 Million Euro and the additional rate increased to 10.5%.

Figure 2 illustrates the development of corporate, sector specific, and combined tax rates since 2004. While corporate income tax rates decreased significantly within the timeframe analyzed – slightly more than half a percentage point per year – the combined taxation of the oil and gas industry remained broadly stable as sector specific rates increased. Major changes in sector-specific, profit-based tax instruments are summarized in Table 6, in Appendix B.[11]

Tax policy for the hydrocarbon sector is endogenous with a strong influence of global price trends and reserve discoveries on tax regimes. Kazakhstan, for instance, introduced important changes with a tax reform in 2009 following discoveries, which quadrupled known

[10] Our results are robust to the variation of thresholds and the number of brackets used. For the sake of clarity, we only present one specification.

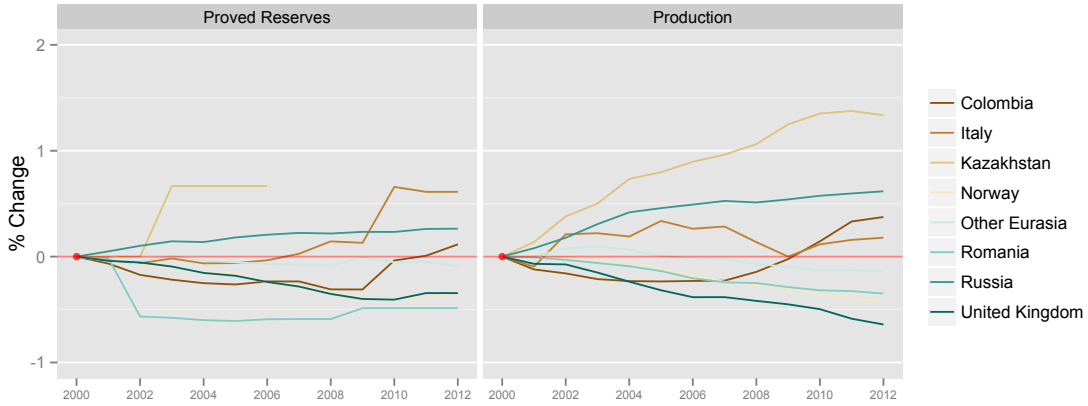
[11] The table presents reforms of sector-specific instruments. The figure, on the other hand, depicts the differential of the combined tax rate and the corporate tax rate in the middle panel. This differential also changes in response to a changing CIT rate if the combined rate is fixed at some level; as is the case in the Netherlands.

Figure 2

Notes: The graph illustrates the development of various tax rates since 2004. Equations of time trends are given on top of each panel with *se* denoting the standard error of the coefficient.

reserves in 2007. Since oil prices tripled since 2000, many countries reviewed their fiscal regimes. We therefore need to control for both global price developments and proven Oil and Gas reserves, depicted in Figure 3, as reported in British Petroleum's Statistical Review of World Energy (British Petroleum Company, 2014).

Figure 3



Notes: Proved reserves and production for selected regions between 2000 and 2012. The dashed line depicts the oil price. Kazakhstan's proved reserves quadrupled in 2007 and are not depicted.

3. Theoretical considerations

Huizinga and Laeven (2008), extending initial work of Hines and Rice (1994), provide a stylized model to guide our understanding of global profit shifting dynamics. Taking the perspective of an MNE group with the ability to reallocate profits, they offer a useful reference in interpreting empirical research. In the context of our work, this model has an important limitation: It does not offer the possibility to account for differences in transaction costs across affiliates in different jurisdictions. The heterogeneity in enforcement capabilities across countries suggests otherwise. Domestic shifting, for instance, may be less of a concern for tax administrations and thus be associated with lower overall costs to a firm. The model also assumes that costs only accrue once profits are being manipulated. This is questionable, given that firms may be used as intermediaries to reallocate profits between two other subsidiaries; an activity likely associated with non-negligible costs.

We aim to incorporate these aspects into a simple model to guide our analysis of profit reallocation in the hydrocarbon sector by using a modified cost function. While domestic profit shifting is also relevant for other sectors, the hydrocarbon sector is peculiar in often facing a different statutory tax rate than other sectors. This provides us with an identification device. More specifically, we consider a firm in the oil and gas industry which may adjust taxable profits by shifting income S_i to subsidiary $i = 1, \ldots, N$. This activity is associated with costs C, we allow to depend on the specific channel (affiliate) used as well as on the total volume of income concealed $S = \sum S_i$,

$$C = \frac{1}{2P}\left(\frac{S^2}{\delta} + \sum_{i=1}^{N} \frac{S_i^2}{\gamma_i}\right).$$

In our cost function, we add a vector of transaction-specific cost parameters γ_i, which we allow to depend on regulatory efforts. By distinguishing transaction-specific from the complementary, local cost parameter, δ, which is not affected by regulation, we account for the importance of size, suggesting that overall shifting costs are decreasing in the number of MNE affiliates for a given amount of redirected income. The related notion of a minimum size threshold for efficient tax optimization, due to a fixed cost component, is frequently highlighted among practitioners (Dharmapala, 2014, see e.g.). Both transaction-specific cost parameters and the complementary, local cost parameter are strictly positive. In line with previous papers (Huizinga and Laeven, 2008; Hines and Rice, 1994), we assume that marginal costs increase proportionally with the ratio of shifted to actual income, P.

The corporation chooses transactions S_i to minimize the tax burden while accounting for shifting costs. Relevant affiliates of the Oil and Gas producer operate both in the same jurisdiction but in different sectors and abroad. By letting t_i denote the tax rate applied to profits of affiliate i and t_0 the strictly higher rate of the oil and gas producer, we summarize

the problem with:[12]

$$\max_{\{S_i\}_{i=1}^N} (1-t_0)[P-S] + \sum_{i=1}^{N}(1-t_i)S_i - C. \tag{1}$$

Due to the convexity of the cost function, after-tax profits attain a maximum at

$$P(t_0 - t_i) = S_i/\gamma_i + S/\delta \quad \text{for all } i, \tag{2}$$

implying that marginal gains from any reallocation of true profits, $P(t_j - t_i)$, between affiliate i and j must balance the associated, transaction-specific costs $S_i/\gamma_i - S_j/\gamma_j$. Accordingly, once the overall magnitude of profit reallocation is determined, its distribution among affiliated subsidiaries is only influenced by transaction-specific costs and incentives. The overall magnitude, however, is also a function of the producer's local cost parameter δ. Summing (2) over i and rearranging gives an explicit expression for income concealed at the oil and gas industry level:

$$S = \frac{P\delta}{\delta + \sum_j \gamma_j} \sum_{i=1}^{N} \gamma_i (t_0 - t_i). \tag{3}$$

suggesting that the logarithm of reported profits, $P - S$, in the oil and gas industry is approximately given by

$$\ln(P-S) \approx \ln P - \mu \sum_{i=1}^{N} \frac{\gamma_i}{\gamma} \tau^i \tag{4}$$

where $\tau^i = N^{-1}(t_0 - t_i)$ is the tax differential between the oil and gas sector and affiliate i, divided by the total number of affiliates, $\mu = \delta N \gamma/(\delta + \sum_i \gamma_i)$ is the (approximate) semi-elasticity of reported profits with respect to a country's taxation of the Oil and Gas sector and γ is an average transaction-specific cost parameter.

The model provides a range of intuitive and useful insights. First, it predicts that larger corporations will conceal a larger share of true profits. This is obvious from (4) and noting that μ is increasing in N. We will use this observation in our identification strategy below. Second, it clarifies the internal response to increasing transaction-specific costs following, for instance, government efforts to counter transfer mispricing. Using the first order condition together with (3), we find

$$-\frac{\partial S_k}{\partial \gamma_k} = -\frac{S_k}{\gamma_k}\left(1 - \frac{\gamma_k}{\delta + \sum_j \gamma_j}\right), \quad -\frac{\partial S_i}{\partial \gamma_k} = \frac{\gamma_i}{\gamma_k}\frac{S_k}{\gamma_k}\frac{\gamma_i}{\delta + \sum_j \gamma_j} \quad \text{for all } k, i, \text{ such that } k \neq i.$$

[12] A more general framework would treat all affiliates symmetrically and relate costs to each potential pair of subsidiaries within the group. Such a model, however, would not provide further insights. We therefore rely on this simple asymmetric approach.

Increasing transactions-specific costs between affiliate k and the firm in the oil and gas industry will thus, as expected, result in a smaller magnitude of income shifted through this channel. The second expression reveals compensatory adjustments in firm behavior. Rising costs of one channel will increase the reliance on shifting opportunities with unaffected affiliates in the MNE group.

4. Empirical analysis

4.1. Estimation Approach

In our empirical analysis, we seek to determine (i.) the overall magnitude of income concealed, (ii.) the relative importance of domestic and foreign profit shifting, and (iii.) the consequences of intensified enforcement efforts. To investigate these issues, we rely on the framework derived above and set transaction-specific costs at the same level across foreign jurisdictions, i.e $\gamma_i = \bar{\gamma}$ for $i \neq 1$ (affiliate 1 is located domestically). Furthermore, we allow transaction-specific costs to be driven by tax administrations' regulatory efforts, depicted by the variable ϕ, while we treat the local cost parameter as fixed. With our estimation equation 5 below, we thus aim to find approximations of $\gamma_1 = f(\phi)$, $\bar{\gamma} = g(\phi)$, and δ to determine the magnitude and distribution of income concealed.

Our baseline specification builds on a linearization of (4) and is based on the premise that there exists an intermediate level of regulation, $\bar{\phi}$, at which transaction-specific costs are approximately uniform ($f(\phi) = g(\phi)$, for $\phi = \bar{\phi}$). We present details on the linearization and identification of parameters in Annex A.[13]

$$\ln(EBIT)_{it} = \beta_1 \tau_{it} + \beta_2 \tau_{it}(N_{it} - \bar{N}) + \beta_3 \tau_{it}^D(\phi_{it} - \bar{\phi}) + \beta_4 \tau_{it}^F(\phi_{it} - \bar{\phi}) + \mathbf{x}_{it} + \nu_i + \epsilon_{it}. \tag{5}$$

We use Earnings before Interest and Taxes (EBIT) as a measure for reported profits ($P-S$). Tax differentials at the domestic level are denoted as $\tau^D = N^{-1}(t_0 - t_1)$ and international differences are captured by $\tau^F = N^{-1} \sum_{i \neq 1}(t_0 - t_i)$. The composite tax differential is defined as $\tau = \tau^F + \tau^D$ and its coefficient, the estimated semi-elasticity of reported profits, is expected to take a negative sign. We use the number of countries of an MNE's operation as a measure for N. Our model predicts the elasticity of reported profits to increase in the number of affiliates and we therefore expect to observe a negative coefficient.

We capture the change in transaction-specific costs by interacting the tax differentials with the number of years since the introduction of mandatory documentation requirements in a firm's jurisdiction, the variable ϕ. Given that stricter enforcement should increase transaction-specific costs to a similar degree, we expect positive coefficients for these interactions. As illustrated in Annex A, a difference in the estimated coefficients indicates

[13] We estimate various unrestricted versions and cannot reject the assumption $\gamma_1 = \bar{\gamma}$ in any of our specifications.

varied effectiveness of documentation in increasing the costs of profit shifting of domestic and international channels.

Finally, the vector $\mathbf{x}$ contains firm-specific controls such as the value of fixed and other assets, the number of employees, time-specific variables including the average annual price of crude oil,[14] as well as country-specific variables including GDP, population size, the unemployment rate, inflation, the amount of proved reserves, and the tax to GDP ratio. Other time invariant characteristics of firms are captured by ν_i and ϵ_{it} are idiosyncratic errors.

4.2. Data and sample selection

Our firm-level micro data on MNEs in the Oil and Gas industry are extracted from the ORBIS database. We download all available firms, with affiliates in other sectors domestically or abroad,[15] and restrict the downloaded sample to firms providing at least three years information on EBIT, fixed assets and total assets. We drop observations whose ownership structure is not known. In line with previous research (Heckemeyer and Overesch, 2013), we restrict the sample to profitable entities and only include observations with reported assets.

We summarize the distribution of our baseline sample across countries in Table 2. Around 40% of the observations are located in the UK, followed by Russia (20%), Norway, and the Netherlands (10%). To differentiate observations according to group structure we depict foreign (MNE) and domestic (Intra) separately. The last column of Table 2 summarizes observations with both domestic and foreign affiliates. With fewer domestic relationships captured in our sample, we expect less accuracy for estimates relying on intra-national tax differentials. It is notable that about 24% of the affiliates in our sample are part of an MNE that has operations in a tax haven.

The number of employees is not reported for around 43% of all observations. We impute missing values based on estimates of the function $Labor = f(EBIT, K, \mathbf{z})$ subject to $Labor \geq 1$, where K denotes the value of total assets, and $\mathbf{z}$ contains country-specific variables. Using a censored regression model we obtain

$$\widehat{\ln(Labor)} = \underset{(3.04)}{-2.98} + \underset{(0.02)}{0.59}\ln(Assets) + \underset{(0.55)}{1.18}\ln(GdpPc) - \underset{(0.95)}{2.22}\ln(Inflation),$$

[14] We include this control variable for two reasons. First, we avoid an endogeneity problem as the price of crude affects both tax policy and profits. Second, capital and labor are likely not the only inputs used in the hydrocarbon sector. Several unobserved factors are likely linked to global price levels. The inclusion of market prices thus adds to the precision of our true profits estimate. Note that we can not use time-fixed effects as a result of using time specific continuous variables.

[15] We categorize observational units as affiliates if they own each other – directly or totally – by at least 70%.

Table 2

Distribution of Baseline Sample					
		Observations			
Country	Firms	Total	MNE	Intra	Both
Great Britain	122	669	348	48	273
Russia	60	306	306	0	0
Norway	23	125	100	23	2
Netherlands	29	118	19	0	99
France	9	64	64	0	0
Ukraine	11	60	60	0	0
Italy	9	50	15	35	0
Colombia	7	38	38	0	0
Spain	6	37	37	0	0
Kazakhstan	8	25	16	9	0
Poland	4	16	16	0	0
Romania	6	15	15	0	0
Total	294	1523	1034	115	374

Notes: Descriptive statistics. Column *Firms* gives the number of independent multinationals (N). Columns labeled *Total*, *MNE*, *Intra* and *Both* give the total number of observations (N×T), the number of observations on MNEs without domestic subsidiaries, domestic firms with associated entities in another sector, and MNEs with associated entities in the same country but other sector.

with $Infl$ denoting an inflation index. Standard errors are in parentheses. A set of time and country fixed effects is included in the regression and used in predicting values.[16]

As part of our robustness checks, we re-estimate our main specification based on observations with reported staffing levels. We thus investigate the magnitude of a potential bias stemming from the omission of firm-fixed effects and measurement error.[17]

4.3. Results

Table 3 presents our baseline results. With a magnitude of -3.15 and -1.26 our tax differential coefficients are significantly negative. Reported profit of an Oil and Gas firm in our sample is thus partly driven by the difference in the tax rates of both its domestic and foreign affiliates. In line with our theoretical framework, the interaction of the tax differentials with the number of affiliated companies facing a different income tax treatment is negative. Larger networks thus seem to lend themselves to more effective tax planning.

[16] We do not include firm-specific fixed effects in order to improve out-of-sample forecasting.

[17] Note that the coefficient on capital is inconsistent with customary production functions. If labor and capital are the only productive factors one should, holding output fixed, expect a negative coefficient on capital for its ability to substitute for labor. Introducing firm-specific fixed effects does not change the sign of the estimated coefficient.

The observed coefficients on the factors of production indicate slightly decreasing returns to scale. As expected, global market dynamics matter: We find a significantly positive price effect for crude oil with a magnitude of around one. To provide insights into the importance of royalty regime design, we interact the price variable with a dummy taking the value of one if the specific observation is located in a country with price dependent royalty regimes (Kazakhstan, the Netherlands, Romania, Russia, or Ukraine). The coefficient is negative with a magnitude of around -0.5 implying that profits in these countries are less affected by movements in global prices; the difference likely bolstering public coffers in times of booming oil markets. On average profits fell from 2004-2012 as indicated by our time trend; this effect is likely driven by the impact of the financial crisis in 2008.

Our country level controls follow standard assumptions. The expected risk-reward relationship likely explains higher profit levels observed among companies operating in countries with lower GDP per capita and higher macroeconomic volatility. Overall economic performance captured via unemployment levels does seem to affect our findings. Higher levels of unemployment are linked to higher observed profit levels, possibly also indicating a remuneration for macro-risks or depressed input prices.

Given that the coefficients on the tax differentials are not statistically different, we replace our foreign and domestic tax differential with a composite variable in specification (2). The coefficient of -1.62 suggests that reported profits decrease by 1.62 percent in response to a one percentage point increase of the combined tax rate. This finding is substantial and in line with previous cross-sectoral analysis. Studies on profit-shifting summarized in a recent meta-survey by Heckemeyer and Overesch (2013) typically find estimated semi-elasticities of around -1.

In the following specifications, we investigate the effectiveness of regulation to mitigate profit-shifting behavior by interacting the tax differentials with our documentation variable. We alternate between an unrestricted approach, testing the uniformity of transaction-specific costs, and a restricted version where we increase the efficiency of our estimates by using the composite tax differential. Throughout, we observe a negative coefficient on the foreign tax differential interaction, suggesting that documentation has an impact on profit shifting activity. While the coefficients cannot be directly interpreted to derive the magnitude of mitigation, the observed difference already allows us to conclude that enforcement efforts are more successful for foreign affiliates.[18] The increase in costs of shifting profits to affiliates abroad is significantly higher than for the mispricing of internal domestic transactions.

We introduce time fixed effects in specifications (5) and (6). While the magnitude of observed effects tends to be slightly lower, our findings remain consistent across both specifications. Overall, the elasticity of observable profit shifting in the Oil and Gas sector

[18]The coefficients capture a combination of effects: The overall change in profit shifting as well as the adjustment in the mix of shifting channels employed by firms with both domestic and foreign affiliates. Their difference, however, indicates the partial effect of documentation on transaction-specific costs, as shown in Annex A.

depends both on the size of entities and the regulatory regimes they are facing. Our preferred specification (6), which we later use for a more detailed discussion of effects, implies an approximate semi-elasticity of around -1.88 for an average MNE with operations in 2.8 income tax regimes (domestic and/or foreign) in a country that has introduced mandatory transfer pricing documentation 1.6 years ago.

Table 3

Within Estimation, 2004–2012						
Dependent: logarithm of EBIT						
Explanatory variable	(1)	(2)	(3)	(4)	(5)	(6)
τ^D	-3.15**	-1.62***	-2.86**	-2.12***	-2.53*	-1.88***
	(1.26)	(0.55)	(1.38)	(0.59)	(1.47)	(0.70)
τ^F	-1.26**		-1.92***		-1.73**	
	(0.60)		(0.65)		(0.74)	
τ^D:zN	-1.92		-2.35		-2.18	
	(2.05)		(2.09)		(2.10)	
τ^F:zN	-0.58		-0.42		-0.42	
	(0.66)		(0.67)		(0.66)	
τ						
τ:zN		-0.90**		-0.84*		-0.80*
		(0.45)		(0.46)		(0.46)
zDoc			0.00	0.00	0.00	0.00
			(0.05)	(0.05)	(0.05)	(0.05)
τ^DzDoc			-0.05	-0.08	-0.04	-0.07
			(0.18)	(0.17)	(0.19)	(0.18)
τ^FzDoc			0.25**	0.24**	0.24**	0.23**
			(0.10)	(0.10)	(0.11)	(0.11)
$\ln(\widehat{\text{Labor}})$	0.13***	0.13***	0.13***	0.13***	0.14***	0.13***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
ln(Fixed Assets)	0.15***	0.15***	0.16***	0.16***	0.15***	0.15***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
ln(Other Assets)	0.41***	0.41***	0.41***	0.41***	0.41***	0.41***
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
ln(Price)	0.91***	0.90***	1.04***	1.02***		
	(0.18)	(0.18)	(0.19)	(0.19)		
ln(Price):Royalty	-0.42	-0.42*	-0.61**	-0.61**	-0.63**	-0.63**
	(0.25)	(0.25)	(0.30)	(0.30)	(0.30)	(0.30)
ln(GDP)	-0.24	-0.21	-0.16	-0.16	-0.04	-0.04
	(0.30)	(0.30)	(0.32)	(0.32)	(0.35)	(0.35)
ln(Population)	-4.28	-4.36	-7.81**	-7.84**	-7.62**	-7.63**
	(2.73)	(2.70)	(3.56)	(3.55)	(3.71)	(3.71)
ln(Unemployment)	0.40*	0.41*	0.53**	0.53**	0.49**	0.48**
	(0.21)	(0.21)	(0.22)	(0.22)	(0.23)	(0.23)
Inflation	-0.03**	-0.03**	-0.03**	-0.03**	-0.03*	-0.03*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Tax/GDP	0.04	0.04	0.05*	0.05*	0.04	0.04
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Reserves	0.02	0.02	0.03	0.02	0.02	0.02
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Timetrend	-0.03	-0.03	-0.04	-0.04		
	(0.03)	(0.03)	(0.03)	(0.03)		
Time fixed effects					✓	✓
Observations	1523	1523	1523	1523	1523	1523
Adj. R^2	0.19	0.19	0.20	0.20	0.20	0.20

Notes:*,**, and *** indicate significance at the 10%, 5% and 1% level. Robust standard errors in parentheses. The tax differentials τ^D, τ^F, and τ are defined in the text. All specifications are estimated with a sample including 331 non-zero observations on the domestic, and 1140 non-zero observations on the foreign tax differential.

4.4. Robustness Checks

Table 4 presents a series of robustness checks. We start by investigating differences in the vulnerability of OECD and non-OECD economies to profit shifting in the hydrocarbon sector. The variable NonOECD takes the value of one for observations not located in a member state of the OECD. We interacted this variable with the entire vector of tax-variables, including the domestic and foreign tax differential as well as their interaction with size and documentation requirements. For simplicity, however, we only present a restricted version with significant coefficients in column (1). The interaction between NonOECD and the composite tax differential is negative, suggesting that profit shifting is more of a risk in less developed economies. Moreover larger networks seem to matter even more in facilitating tax minimization outside of the OECD.

In our second and third specification, we contrast profit shifting behavior amongst MNEs which have an affiliate in a tax haven and those which do not. We find that the latter group, around 23% of our sample, is substantially more responsive to variations in the tax rate. Since tax differentials of these entities are larger on average, MNEs with tax haven operations also report less profit, in absolute terms, than their non-haven peers.

We investigate the potential of measurement problems in specifications (4) and (5). Current, unweighted, statutory tax differentials may be a crude proxy for actual tax minimization opportunities and various other measures, including weighted statutory tax rates (Huizinga and Laeven, 2008) and effective tax rates (Collins et al., 1998) have been used instead. Klassen and Laplante (2012) suggest that profit shifting incentives are more stable over time due to adjustment costs of established operations. To quantify the magnitude of attenuation bias introduced by relying on current rates, we employ weighted average tax differentials where we take the average over two (specification 4) and three years (specification 5), respectively. This increases the estimated semi-elasticity of reported profits considerable. However, it also inflates related standard errors.

Another concern is that contemporaneous tax rates, particularly in the oil and gas sector, may be correlated with time varying unobservables, other than the oil price or proven reserves, also affecting profits of the sector. If current tax differentials are endogenous in our baseline specification, so are the weighted average tax differentials used above. In the following specifications, we thus re-estimate our baseline equation using last year's tax differentials (specification 6) and the tax differentials of the last two years (specification 7), respectively, as instruments. If actual tax minimization incentives are stable over time, these instruments also forestall potential measurement bias. With increased coefficients on the composite tax differential, the results indeed suggest some form of measurement problem. However associated standard errors do not provide relevant estimation limits.

Table 4

Within Estimation, 2004–2012												
Dependent: logarithm of EBIT												
	OECD and Tax Havens			Measurement Error and Endogeneity				Outliers, Imputation and Weights				
Explanatory Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
τ	-1.83**	-1.51**	-1.70**	-2.30***	-2.35**	-1.69**	-3.23***	-2.21***	-2.17***	-1.30	-1.87***	-1.90***
	(0.71)	(0.72)	(0.71)	(0.79)	(0.94)	(0.67)	(0.76)	(0.71)	(0.71)	(1.04)	(0.69)	(0.72)
τ:zN	-0.61	0.35	-0.37	-0.93*	-0.82	-1.53***	-1.67***	-0.71	-0.86*	-1.89***	-0.77*	-0.84*
	(0.47)	(0.76)	(0.52)	(0.49)	(0.57)	(0.51)	(0.64)	(0.46)	(0.46)	(0.58)	(0.45)	(0.47)
zDoc	0.02	-0.01	-0.01	0.00	0.01	0.05	0.04	-0.02	0.00	-0.12*	0.00	
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.07)	(0.06)	(0.06)	(0.07)	(0.05)	
τ^DzDoc	-0.07	-0.04	-0.03	-0.05	-0.07	-0.23	-0.27*	-0.05	-0.07	0.07	-0.07	-0.07
	(0.17)	(0.18)	(0.18)	(0.18)	(0.18)	(0.15)	(0.14)	(0.18)	(0.18)	(0.29)	(0.18)	(0.17)
τ^FzDoc	0.23**	0.29**	0.28***	0.25**	0.24**	0.08	0.20	0.30***	0.29**	0.30**	0.23**	0.22**
	(0.11)	(0.11)	(0.11)	(0.11)	(0.12)	(0.10)	(0.12)	(0.11)	(0.11)	(0.15)	(0.11)	(0.11)
NonOECD:τ	-5.67*											
	(3.15)											
NonOECD:τ:zN	-9.30***											
	(3.20)											
TaxHaven:τ		-1.79*	-2.09**									
		(1.08)	(1.02)									
TaxHaven:τ:zN		-1.24										
		(1.04)										
DLabor									0.12			
									(0.22)			
ln($\widehat{\text{Labor}}$)	0.13***	0.13***	0.13***	0.13***	0.14***	0.08**	0.10***	0.56***	0.13***	0.21***	0.13***	0.14***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)	(0.19)	(0.04)	(0.06)	(0.04)	(0.04)
ln($\widehat{\text{Labor}}$):DLabor									0.00			
									(0.05)			
ln(Fixed Assets)	0.15***	0.16***	0.16***	0.15***	0.15***	0.12***	0.12**	0.06	0.17***	0.17***	0.15***	0.15***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)	(0.06)	(0.04)	(0.06)	(0.04)	(0.04)
ln(Other Assets)	0.42***	0.42***	0.42***	0.41***	0.41***	0.36***	0.29***	0.26***	0.40***	0.40***	0.41***	0.41***
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.06)	(0.07)	(0.05)	(0.06)	(0.05)	(0.05)
Macro Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Time fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	1523	1523	1523	1523	1523	1151	883	1488	1488	819	1523	1523
Adj. R^2	0.20	0.20	0.20	0.20	0.20	0.15	0.14	0.20	0.20	0.17	0.20	0.20

Notes:*,**, and *** indicate significance at the 10%, 5% and 1% level. Robust standard errors in parentheses.

In specification (8), we remove observations with EBIT margins in excess of 82 percent, amounting to 5% of our sample. The estimated magnitude of profit shifting increases to -2.21 as a result, with other effects remaining largely unchanged. Subsequently, in the ninth specification, we interact the labor variable with a dummy taking the value of one if the number of employees was not available for this observation to test for a potential bias introduced by imputing staff numbers for about half of our observations. Both the dummy variable and its interaction with the labor variable are not statistically significant. In specification (10), we further restrict our sample to firms which provide information on the number of employees. The coefficient on labor input and our point estimate of the elasticity of taxable profits (-1.30) decrease slightly as a result. Importantly, due to a reduction in the sample size of around 43% the quality of the estimate is significantly reduced. However, we continue to find a significantly positive interaction between documentation requirements and the foreign tax differential. Finally, in specification (11) and (12) we test our assumption that 1/3 of profits in the UK derive from fields given development consent before 1996. In column (11) we decrease this share to 1/5 and in column (12) we increase it to 1/3. Our results remain unchanged.

5. Interpretation

To identify the relative importance of domestic and international profit shifting channels and their response to regulatory enforcement efforts, we employ the theoretical framework established above (Section 3). More specifically, we combine our estimation results with a linearized version of our model and resolve the resulting set of equations. We may thus retrieve the hypothesized cost parameters (Annex A presents details), which allows us to calculate both the magnitude and distribution of income concealed for each firm in our sample.

Based on specification (7) of our baseline results (Table 3), we obtain the following estimates of our structural cost parameters:

$$\widehat{\delta} = 8.48, \quad \widehat{f(\bar{\phi})} = \widehat{g(\bar{\phi})} = 1.33, \quad \widehat{g'(\bar{\phi})} = -0.17. \quad \widehat{f'(\bar{\phi})} = 0.04. \tag{6}$$

We thus find that the costs of transfer mispricing are increasing in the number of years since mandatory documentation requirements have been introduced for transactions with foreign affiliates. However, they are slightly decreasing for domestic affiliates. This result seems counterintuitive. It could, however, be linked to two related challenges in practical enforcement efforts to counter transfer mispricing. First, in many cases the scope of transfer pricing legislation is restricted to international transactions. The UK, for instance, extended its transfer pricing legislation to cover domestic arrangements only in 2004. Second, scarce resources in tax administrations are likely to be focused on international transactions, given their high potential for revenue losses. This focus of attention on international

affiliates following the introduction of mandatory documentation requirements could mean that the costs associated with domestic arrangements are actually decreasing.[19]

In order to investigate the actual extent of profit shifting, we combine our structural parameter estimates with firm-level data and simulate optimal reallocation strategies for each firm in our sample. Table 5 summarizes our findings. It depicts average values for the entire sample as well as two subsamples, differentiating firms located in countries using additional profit based rent taxes for the sector. We calculated standard errors of these average values by repeating the estimation and averaging process 750 times with random subsamples of our baseline sample.[20] Profit shifting is substantial, but varies noticeably among firms in our sample. The mean value of concealed income is around 43% among firms that are located in countries with additional income based instruments (Column 2), and just about 12% when the sector is not facing additional income taxes (Column 3). Tax minimization activities come with considerable expenses. We estimate that, on average, 5% of before tax profits are spent to relocate income. This share is considerably higher in countries with additional income-based instruments (7%), than in countries with regular corporate income taxation (1%).

Table 5

Simulated profit shifting across subsamples

	Average Level (in %)			Average Semi-elasticity (in%)		
Subsample	All firms	Add. profit tax	CIT only	All firms	Add. profit tax	CIT only
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Share of profits concealed	31.61	42.83	12.83	-8.86	-7.17	-11.64
	(1.52)	(1.47)	(2.07)	(0.49)	(0.48)	(0.94)
Concealment costs as share of profits	4.61	6.68	1.14	-8.77	-7.04	-11.64
	(0.28)	(0.36)	(0.14)	(0.48)	(0.48)	(0.94)
Domestic Share of profit shifting	21.21	33.46	0.00	6.36	6.36	–
	(2.35)	(3.30)	(0.00)	(0.49)	(0.49)	
Revenue Loss	27.30	35.95	12.83	-9.75	-8.61	-11.64
	(1.36)	(1.41)	(2.07)	(0.44)	(0.44)	(0.94)

Notes: Table depicts mean levels and semi-elasticities with respect to an additional year of documentation requirements, in percent, for the entire sample (All firms) and two subsamples: Firms which are located in countries with additional profit based tax instruments in the Oil and Gas sector (Rent based) and those which are just subject to the standard income tax regime (CIT-based). Standard errors, calculated by bootstrapping, are depicted in parentheses.

For our sample of firms located in countries with additional income-based taxes, we estimate that around one third of total income concealed is shifted to domestic affiliates. Domestic shifting does, however, only constitute a partial loss of tax revenues. Profits

[19] It is also plausible that our estimate is imprecise, with a more likely - though still remarkable - scenario being unchanged costs of domestic shifting activities.

[20] Note that firm structures are taken as given in this process and average values may thus not be extrapolated on a different set of firms.

will still be taxed in the same jurisdiction, albeit at a lower rate. In order to contrast the revenue impact of profit shifting across our subsamples, we define revenue losses as

$$\text{Revenue Loss} = 1 - \frac{\text{Tax Payments}}{\text{Tax Obligation}}.$$

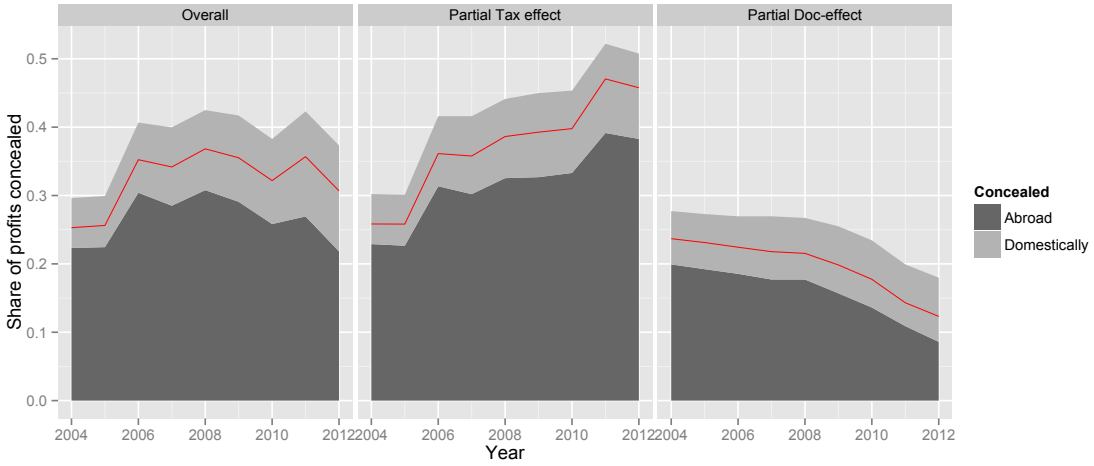
Given that redirected income invariably ends up abroad for MNEs without domestic shifting opportunities, the figure corresponds to the share of profits concealed in regular CIT countries. For countries with additional income-based instruments, tax payments are given by $(P-S)\tau + S_1\tau^1$, where $(P-S)$ are reported profits in the oil and gas industry, τ is the combined tax rate on profits of the sector and S_1 are profits concealed domestically with the associated tax rate denoted by τ^1. Using this definition, we find that, on average, a third of the Oil and Gas sector's income tax obligations are not collected.

Increased enforcement efforts change both the magnitude and distribution of income concealed. Columns (4)-(6) present the corresponding average semi elasticity of each variable of our subsamples. We find that an additional year of documentation requirements decreases the total volume of income concealed by 9% across all firms in our sample. In line with our cost estimates, transfer-pricing enforcement is significantly more successful in curbing international reallocation strategies. The reduction is around 12% in countries without additional rent taxes; it is only 7% in high tax regimes with domestic shifting channels. However, the lower elasticity of income shifting for the latter group is also due to an increased reliance on domestic affiliates. Increasing documentation requirements by one year inflates the share of domestic profit shifting by around 6%. The combined effect implies a 9% reduction of governmental revenue losses.

The estimated increase in the gap between international and domestic profit shifting costs suggests that MNEs with both foreign and domestic affiliates have, in the last decade, increased their reliance on domestic channels while those with only foreign affiliates could not. To further investigate the impact of transfer pricing regulation, we plot the estimated distribution and magnitude of profit shifting between 2004 and 2012 in Figure 4. The first panel depicts the actual extent of profit shifting, differentiating domestic and international profit reallocation for our sample of firms located in countries with additional income based tax instruments. The red line depicts revenue losses. In our sample, the level of international profit misallocation remains relatively constant while domestic shifting activities increased.

Notably, the observed distribution is driven by both a changing tax environment and regulatory reforms. To separate these effects, we provide a high-level depiction of counterfactuals in the following panels. First, in panel 2, we estimate profit shifting if documentation requirements would have remained at the level of 2004 when only 5% of firms in our sample had to comply with reporting obligations. With decreasing CIT rates, particularly pronounced in non oil-producing countries, international profit-shifting would have surged by around 15 percentage points of true profits. The third panel depicts the partial effect of documentation if tax rates had remained unchanged. In 2004, firms in our sample were on

Figure 4



Notes: First panel depicts the amount of intra- and inter-national profit shifting, for income-based tax regimes, in percent of real profits. The second (third) panel depict partial effects of taxation (documentation) by keeping documentation rules (taxation) constant based on values observed in 2004. The red line depicts revenue losses.

average required to submit documentation for just 2 months. By 2012 this figure increased to 3.8 years, with over 90% of firms facing regulation.

6. Conclusion

Our analysis provides specific estimates of the scale of profit shifting among hydrocarbon MNEs. Looking at firms in the Oil and Gas sector with domestic and multinational affiliates, we estimate a lower-bound semi-elasticity of reported profits to sector specific income taxation of -1.88. We use the existence of domestic tax differentials among hydrocarbon producers to assess the importance of domestic profit-shifting channels. Amid firms facing additional rent taxes in our sample, domestic profit shifting accounts for about one third of total income concealed.

Our analysis suggests that profit shifting has non-negligible revenue effects, amounting to a reduction of the corporate income tax base between 12% up to 35%, the later number applying to firms operating in countries using supplementary rent-taxes. We also find that less developed economies are more vulnerable to profit shifting in the sector. Finally, we confirm earlier findings on the contribution of documentation requirements in countering aggressive international transfer-mispricing. Notably, however, we also find that increased enforcement prompts MNEs in the Oil and Gas sector to rely more heavily on the reallocation of profits at the domestic level.

Our results are relevant for the ongoing debate regarding the optimal design of fiscal regimes for the sector. Reliance on production based royalties and, to a lesser extent, ring-fencing arrangements, limiting the scope for profit consolidation and deductions across projects and activities, can help reduce vulnerabilities. The tax base for royalties - unless they are profit based - tends to be easier to observe and thus preferable from an administrative perspective;[21] being less exposed to tax planning arrangements, including the reallocation of profits through transfer mispricing of debt shifting by MNEs. In a number of countries, a higher revenue take from hydrocarbon income would likely require more investment into enforcement capacity, more reliance on less vulnerable instruments, or a combination of both.

[21] Noting that the observation of the volume and/or value of production does still pose numerous challenges (see Calder, 2010) and information asymmetries remain, though arguably at a lower level.

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A. Identification

We let subsidiary 1 be domiciled domestically and restrict transaction-specific costs to be constant across foreign jurisdictions, $\gamma_i = \bar{\gamma}$, for $i = 2, \ldots, N$. We may thus write the proportional amount of income concealed as

$$S/P = z(\gamma_1 \tau^D + \bar{\gamma}\tau^F) \equiv \Gamma, \tag{7}$$

where $\tau^D = (t_0 - t_1)/N$ and $\tau^F = 1/N \sum_{i \neq 1}(t_0 - t_i)$ will be referred to as domestic and foreign tax differentials and $z = \delta N/(\delta + \sum_i \gamma_i)$ is a function of the cost parameters and a group's size.

We assume that transaction-specific costs are affected by enforcement efforts, ϕ, and aim to find approximations of $\gamma_1 = f(\phi)$ and $\bar{\gamma} = g(\phi)$ in order to calculate the impact of increased enforcement on the magnitude and distribution of income concealed. Note that the proportional amount of income concealed is a nonlinear function of both a group's size and regulatory efforts, $\Gamma(\phi, N)$, two observables. Given that there exists some level of regulation $\bar{\phi}$ at which $f(\bar{\phi}) = g(\bar{\phi}) = \gamma$ – an assumption we test in the empirical analysis – we can linearize Γ as follows

$$\Gamma(\phi, N) \approx \underbrace{\frac{\gamma\delta\bar{N}}{\delta + \bar{N}\gamma}\tau}_{\Gamma(\bar{\phi},\bar{N})} + \underbrace{\frac{\gamma\delta^2}{(\delta + \bar{N}\gamma)^2}\tau}_{\Gamma_N(\bar{\phi},\bar{N})}\tilde{N} + \underbrace{\left[\left(\frac{\partial z}{\partial \phi}\gamma + z f'(\bar{\phi})\right)\tau^D + \left(\frac{\partial z}{\partial \phi}\gamma + z g'(\bar{\phi})\right)\tau^F\right]}_{\Gamma_\phi(\bar{\phi},\bar{N})}\tilde{\phi}, \tag{8}$$

where $\tilde{X} = (X - \bar{X})$, the composite tax differential[22] is defined as $\tau = \tau^D + \tau^F$ and the change in z is given by

$$\frac{\partial z}{\partial \phi} = -\frac{\delta\bar{N}}{(\delta + \bar{N}\gamma)^2}\left[f'(\bar{\phi}) + (N-1)g'(\bar{\phi})\right]. \tag{9}$$

In the empirical analysis, we employ the relation $\ln(P - S) = \ln(P) - \Gamma + \epsilon$ and estimate

$$\ln(P - S) = \beta_1\tau + \beta_2\tau\tilde{N} + \beta_3\tau^D\tilde{\phi} + \beta_4\tau^F\tilde{\phi} \tag{10}$$

to identify the model's parameters. According to (8) we expect negative coefficients on both the composite tax differential and its interaction with the number of affiliates N. Furthermore, we expect positive coefficients on both $\tau^F\tilde{\phi}$ and $\tau^D\tilde{\phi}$ if mandatory documentation increases domestic and foreign transaction costs to a similar degree.[23]

Note that the model's parameters are nonlinear functions of the estimated coefficients. We may therefore not apply linear tests to identify any of these. However, approximation

[22] We use $\partial\tau/\partial N = 0$ in this approximation, which holds if the average tax rate across affiliated jurisdictions is independent of the number of jurisdictions.

[23] Specifically, assuming that $f()$ and $g()$ are non-increasing functions of ϕ, both tax differential interactions

(8) reveals that $\beta_4 - \beta_3$ is an estimate for $z(f'(\bar{\phi}) - g'(\bar{\phi}))$. We may thus conclude that documentation requirements were significantly more effective in increasing the costs of foreign profit shifting if the linear restriction $\beta_4 - \beta_3 \leq 0$ must be rejected.

We obtain the model's parameters by combining (8) with (10) and solving the implied system of equations. The point estimates of the cost parameters are given by

$$\widehat{\gamma} = \frac{\beta_1^2}{\beta_2 \bar{N}^2}, \quad \text{and} \quad \widehat{\delta} = \frac{\beta_1^2}{\beta_1 - \bar{N}\beta_2}. \tag{11}$$

The estimates of the partial derivatives $f()$ and $g()$ around this point are more complex functions of the estimated coefficients and implicitly defined by

$$\widehat{g'(\bar{\phi})} = \frac{\beta_3 - (\beta_3 - \beta_4)(1-x)}{(1-Nx)\hat{z}}, \quad \text{and} \quad \widehat{f'(\bar{\phi})} = \frac{\beta_3 - \beta_4}{\hat{z}} + \widehat{g'(\bar{\phi})}, \tag{12}$$

where $\hat{z} = \beta_2 \bar{N}^2/\beta_1$ and $x = (\hat{\delta} + \bar{N}\hat{\gamma})^{-1}$.

B. Reforms of Sector-specific Tax Instruments

Table 6

Reforms of sector-specific profit instruments for selected countries, 2004–2012			
Year	Country	Tax instrument	Change
2006	United Kingdom	Supplementary Charge to Income Tax	Rate increased from 10% to 20%.
2008	Italy	Surcharge on oil, gas and energy sector	Instrument introduced as part of fiscal consolidation at a rate of 5.6%
2009	Kazakhstan	Excess Profit Tax	Threshold for exempted amount changed.
2011	United Kingdom	Supplementary Charge to Income Tax	Further increase to 32%.
2011	Italy	Surcharge on oil, gas and energy sector	Increase in rate to 10.3% until 2013.

are positive if and only if the relative change in transaction-specific costs lies within the following bounds

$$\frac{\gamma}{\delta + \gamma} < \frac{g'(\bar{\phi})}{f'(\bar{\phi})} < 1 + \frac{\delta}{(N-1)\gamma}.$$

The first inequality ensures that documentation requirements were sufficiently effective in raising the relative costs of foreign profit shifting. If it holds, we expect a positive coefficient on the foreign tax differential interaction. The second inequality is satisfied whenever regulatory efforts were not overly efficient in increasing the relative costs of international profit shifting and is linked to a positive coefficient on the other tax differential.

C. Documentation Requirements

Reporting obligations			
Country	Year effective	Relevant rulings	Penalty
Colombia	2004	Law 788 and 863, enacted in 2002 and 2003, established transfer pricing practice in Tax Code. Regulatory Decree 4340 published in 2004 provides transfer pricing guidelines, including the contents of statutory transfer pricing documentation.	Penalties for partial non-compliance with transfer pricing documentation. Reduction in penalties if documentation is presented within the prescribed time limit.
Spain	2009	Law 36/2006 on Measures for Preventing Tax Fraud was approved in 2006. Law enacted by Royal Decree 1793/2008, and the documentation requirements specified therein, are applicable as from 2009.	Penalty for incomplete documentation.
France	2010	Transfer pricing regulation established in CGI, Article 57 and enacted in 1933. Reversal of the burden of proof in certain audit situations in 1996. Documentation requirements, codified as Article L 13 AA, enacted into law in December 2009. These requirements apply after January 2010.	Penalty protection for complying with the requirements.
United Kingdom	2009	Current transfer prancing rules, enacted in 2010, represents a restatement of the previous rules which were contained in ICTA 1988 and which took effect in 1999. Since 2004 rules apply to UK-to-UK transactions. Changes to HMRC's general information powers introduced with effect from 1 April 2009.	Since 2009 HMRC can require any person to provide them with information. Penalties may arise for failing to comply with an information notice.
Italy	2010	Basic transfer pricing rule contained in Article 110(7) of the Italian Income Tax Code, enacted in 1986. Penalty protection regime for taxpayer preparing documentation converted into Law 122 in 2010.	Documentation not mandatory but a a condition required to prevent application of penalties.
Kazakhstan	2009	Transfer pricing and the arm's length concept introduced as a separate law in January 2009. The law sets out formal transfer pricing documentation requirements for transactions eligible for the authorities' control.	Special penalties are in place for failure to comply with documentation requirements.

Documentation requirements			
Country	Year effective	Relevant rulings	Penalty
Netherlands	2002	Specific transfer pricing provision included in Article 8b of the Duth Corporate Income Tax Act since 2002. The legislation also contains the requirement to maintain data that demonstrates the arm's length nature of the transfer prices and how these prices have been derived.	In the absence of sufficient documentation, the burden of proof shifts from the Dutch Tax Authority to the taxpayer.
Norway	2008	Transfer pricing rules incorporated into the General Tax Act 1999. Transfer pricing documentation and reporting requirements became effective from fiscal year 2008. If the taxpayer does not submit the requested information, the tax authorities may base an assessment on the available facts.	Sufficient information about uncertain transactions should be filed in order to avoid use of penalty tax.
Poland	2001	Arm's length principle introduced by Article 11 of the Corporate Income Tax Act in 1992. Statutory transfer pricing documentation requirements are stipulated in Article 9a and enacted in 2001.	Documentation provides for penalty protection.
Romania	2008	Transfer pricing rules introduced in 1994 and clarified in 2004. The obligation to have specific transfer pricing documentation available was enforced in 2008. Since 2010 obligation to document domestic intra-group transactions.	Failure to comply with documentation requirements is punished. Tax authorities may establish arm's length price if documentation incomplete.
Russia	2012	Transfer pricing provisions in force since 1999. New rules, containing documentation requirements, became effective in 2012.	Penalty relief for taxpayers having complied with reporting requirements in a timely manner.
Ukraine	2013	Transfer pricing provisions came into force in 2013. Regime is currently being revised	–

D. Derivation of Rent Tax Rates

D.1. UK

UK's fiscal regime for the oil and gas sector is a combination of three profit-based instruments: The ring-fenced Corporation Tax (CT); the Supplementary Charge to Corporation Tax (SCT); and, the Petroleum Revenue Tax (PRT). PRT applies on a field-by-field basis to fields given development consent before 16 March 1993. For CT and SCT purposes,

PRT payments are deductible, implying combined tax rates of

$$\begin{aligned}\tau_{\text{ before 1996}} =& \tau_c + \tau_s + \tau_p(1 - \tau_c + \tau_s),\\ \tau_{\text{ after 1996}} =& \tau_s + \tau_c\end{aligned}$$

for firms given development consent before and after 1996, respectively, where rates of the various instruments are denoted by τ_i. In 2012, these combined rates were 81% and 62%.

As we are not able to match development consents given on specific fields with firms in our dataset, we need to rely on a weighted average combined tax rate in our empirical analysis.[24] In order to guide our understanding of appropriate weights, we employ HMRC statistics and estimate the share of aggregate profits stemming from fields that received development consent before 1996.

To facilitate the exercise, we assume that average profits P of firms given development consent before and after 1996 are the same. Letting the share of firms belonging to the former group be denoted by x, aggregate receipts by tax instrument are given by

$$\begin{aligned}PRT^A &= P\tau_p x,\\ SC^A &= P\tau_s(1 - x\tau_p),\\ CT^A &= P\tau_c(1 - x\tau_p),\\ Total &= P\left[x\tau_p(1 - \tau) + \tau\right],\end{aligned}$$

where $\tau = \tau_c + \tau_s$. Next, divide the first three equations above by total receipts and denote these shares by lower-case letters to find three estimates of x

$$\begin{aligned}x &= (\frac{\tau_s}{sc} - \tau)\left[\tau_p(1 - \tau) + \frac{\tau_s\tau_p}{sc}\right]^{-1},\\ x &= (\frac{\tau_c}{ct} - \tau)\left[\tau_p(1 - \tau) + \frac{\tau_c\tau_p}{ct}\right]^{-1},\\ x &= \tau\left[\frac{\tau_p}{prt} - \tau_p(1 - \tau)\right]^{-1}.\end{aligned}$$

Using data on revenue shares and tax rates for the years 2004–2012, we estimate this set of equations by OLS and find $\hat{x} = 0.25$, (se=0.02).

The estimated share of 1/4 is obtained under the unlikely assumption that profits are independent of when the field was developed. If marginal costs increase with the maturity of the field, the estimated coefficient is more likely a lower bound of the actual share. In the empirical analysis, we nevertheless use 1/4 as a baseline specification and define

$$\tau_{uk}(0.25) = 0.25\tau_{\text{ before 1996}} + (1 - 0.25)\tau_{\text{ after 1996}}$$

but perform robustness-checks with x equal to 1/5 and 1/3.

[24] All firms in our sample were incorporated before 1996. However, this does not imply on which share of profits PRT applies.

D.2. Netherlands

In taxing the oil and gas sector, the Netherlands rely on two income-based instruments, the CIT and the State Profit Share (SPS), and a production based royalty.

The SPS is a deductible expense for CIT purposes and for SPS purposes, a CIT credit is given. Additionally, there is 10% cost-uplift for SPS purposes. This leads to

$$CIT = \tau_c(P - SPS) \quad \text{and} \quad SPS = \tau_s(P - rC) - CIT, \tag{13}$$

where reported profits are denoted by P, costs by C and the cost uplift by r. Some algebra reveals that the combined tax rate is given by

$$\tau_{NL} = \tau_s \left[1 - r\frac{C}{P}\right],$$

and thus increasing in the profit margin. The combined tax rate is equal to the rate of the SPS, currently 50%, for a profit margin of 100%. Marginal savings by shifting income, however, are constant and given by

$$\frac{\partial \tau_{NL} P}{\partial P} = \frac{\partial [P + r(P - I)]\tau_s}{\partial P} = \tau_s(1 + r),$$

if income is held constant. It is τ_s if costs are held constant. In the empirical analysis we assume marginal savings of $\tau_s(1 + r/2)$.

D.3. Kazakhstan

The fiscal regime in Kazakhstan is a combination of two profit-based instruments, the CIT and the Excess Profit Tax (EPT), as well as production-based instruments, taxes on exports and bonuses.

The EPT is levied at increasing rates – between 0% and 60% – on the share of net income after CIT that exceeds some threshold of allowable deductions.[25] Profits satisfying

$$\frac{P(1 - \tau)}{C} = \frac{PM(1 - \tau)}{1 - PM} \leq z,$$

where τ denotes the CIT rate, P are profits, C deductible expenses, PM is the profit margin, and z the threshold, are thus not taxed. In 2009, the threshold increased from 20% to 25% and, concurrently, the CIT rate decreased from 30% to 20%. This translates into full exemption for the purpose of EPT if the profit margin was below 22% before 2009 and below 23% thereafter.

[25] In our derivation of the EPT, we assume that deductions for CIT and EPT purposes are the same.

We demonstrate the derivation of marginal savings for a firm with a profit margin between 30% and 36%. Denote total income by $P = P(x_0 + x_1 + x_2)$, with $\sum x_i = 1$. The share x_0 of total income, defined implicitly by

$$\frac{x_0 P(1-\tau)}{C} = z, \tag{14}$$

where C are allowable deductions, τ the CIT rate and z the threshold, is not taxed. The share of excess profits that exceeds z of allowable deductions but not 30%, is taxed at a marginal rate of $\tau_1 = 10\%$. It is implicitly defined by

$$\frac{(x_0 + x_1)P(1-\tau)}{C} = 0.3, \tag{15}$$

and (14). Finally, x_2 is taxed at a marginal rate of $\tau_2 = 20\%$ and defined by the requirement that shares sum to one. With these definitions, the EPT can be expressed as

$$EPT = P(1-\tau)[x_0\tau_0 + x_1\tau_1 + x_2\tau_2].$$

Substituting the expressions above, using $C = I - P$, and differentiating with respect to P, we obtain

$$\frac{\partial EPT}{\partial P} = (1.4 - \tau)\tau_2 - (0.3 - z)\tau_1 \tag{16}$$

which translates into marginal savings of 21% before 2009, and 23.5% thereafter. For a profit margin below 30% we calculate marginal savings to be 9% and 10.5% for the years before 2009 and thereafter, respectively.

The mean profit margin in our entire sample is slightly above 30%; for Kazakhstan it is around 24%. In the empirical analysis, we split the Kazakh sample into firms with a profit margin below and above 30% and apply the rates derived above.

D.4. Italy

Italy's fiscal regime is a combination of CIT, royalties and a surcharge to corporation tax for companies exceeding certain thresholds.

The surcharge was introduced at a rate of 6.5% in 2008 and imposed on companies with gross revenues, in the preceding year, of more than Euro 25 million. In 2011, the rate was increased to 10.5% and the scope extended to capture companies with gross revenues of more than Euro 10 million or taxable income of more than Euro 1 million in the same year.

In calculating the combined rate, we incorporate the surcharge only for companies meeting these conditions.