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Searching for profit-shifting in China

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Abstract
This paper investigates profit-shifting behavior among multinational corporations (MNCs) in China. The authors exploit the flat-rate structure of China's corporate income tax, along with its system of targeted, preferential rates, to estimate the relationship between profits and tax rates. Their sample consists of approximately 60,000 observations of foreign-owned MNCs from the years 2005–2009. Using the traditional approach of regressing before-tax profits on tax rates, the authors find evidence consistent with profit-shifting. However, this approach is suspect because the nature of China's tax preferences makes it especially vulnerable to omitted variable bias. Accordingly, the authors employ finite mixture modelling to search for the existence of a group of profit-shifting MNCs. While their analysis identifies two types of firms, subsequent investigation failed to produce any evidence linking these to profit-shifting behavior. Robustness checks exploiting the panel nature of the dataset, along with further investigation of investment-tax elasticities, confirm the authors´ null finding of profit-shifting. One reason for the lack of profit-shifting among Chinese MNCs may be that corporate tax rates were relatively low during this period.

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Keywords Multinational corporations (MNCs); profit shifting; tax elasticity; finite mixture model; China

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1 Introduction

This study investigates profit-shifting by multinational corporations (MNCs) in China. A large literature has established that MNCs arrange their financial affairs across multiple jurisdictions to lessen their tax liability. Almost all of this literature has concentrated on the U.S. and Europe. A recent report by the OECD highlighted the problem of "base erosion and profit shifting" (BEPS) for developing countries.[1] Even so, relatively little is known about the existence and extent of this behavior within developing countries. To address this gap of knowledge, this study uses a large dataset of MNCs in China to search for evidence of profit-shifting in that country.

To date, there has been only one study of profit-shifting in China. An & Tan (2014, henceforth A&T) exploit a natural experiment that took place in China in 2008. For many years prior to that, foreign investment enterprises (FIEs) enjoyed preferential tax treatment vis-a-vis domestic enterprises (DEs). On January 1, 2008, a new corporate income tax law introduced changes with the intent of equalizing the tax rates of FIEs and DEs. A&T used data from 2002–2008 and a difference-in-differences approach to identify the effect of the law change on firms' profits. They found that FIEs' profits relative to DEs' profits were lower in 2008. Their explanation is that FIEs shifted profits overseas in response to the tax increase.

However, there are contextual issues with the new corporate income tax law that diminish its usefulness as a natural experiment. Most importantly, 2008 was also the first year that the global financial crisis (GFC) greatly impacted world economies. As A&T note, this would be expected to negatively impact FIEs more than DEs. As a result, it is possible that their results reflect the impact of the GFC rather than the law change.[2] For these reasons, further investigation of profit-shifting in China is warranted.

A significant challenge to studying profit-shifting in developing countries is the lack of appropriate data. We use the Annual Industrial Survey Database from the China National Bureau of Statistics (CNBS), supplemented by data from the *China Urban Statistical Yearbook.* The advantage of these data is that they provide expansive coverage of a large number of MNCs over multiple years. Our main sample has almost 60,000 observations. However, the data are not ideal and do not rise to the level of some previous studies that have taken advantage of high-quality data from US or European countries. To overcome this deficiency, we employ an innovative approach used by Egger, Merlo, and Wamser (2014, henceforth EM&W).

EM&W use a two-component, finite mixture model (FMM) to estimate the tax elasticity of FDI by overseas affiliates of German MNCs. Two things are needed for EM&W's approach to

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[1] OECD, 2014, *Part 1 of A Report to G20 Development Working Group on the Impact of BEPS in Low Income Countries*. http://www.oecd.org/tax/tax-global/part-1-of-report-to-g20-dwg-on-the-impact-of-beps-in-low-income-countries.pdf .

[2] An & Tan (2014: 595): "The 2008 global financial crisis might have an impact on our estimates. Although the crisis originated in western economies, it also had a serious impact on the Chinese economy and on Chinese domestic enterprises. However, FIEs might be likely to be more exposed to the crisis, which implies that our results might overestimate the magnitude of the response of FIEs to the law."

successfully uncover profit-shifting. First, the FMM needs to identify two distinct types of MNCs, with profit-shifting firms having different tax elasticities than non-profit-shifting firms. Second, the firms identified as "profit-shifting firms" should display characteristics that are typically associated with these firms. EM&W use this approach to identify the existence of profit-shifting by German MNCs. In contrast, when we apply this approach to our Chinese data, we fail to uncover any evidence of profit-shifting.

Our paper proceeds as follows. Section 2 provides a brief review of the literature that sets the context for our study. Section 3 discusses the corporate income tax law of China that was in place during our sample period. Section 4 describes our data and presents preliminary results using the most common approach for estimating profit-shifting. While we find evidence consistent with profit-shifting, this approach is unable to distinguish profit-shifting from other plausible explanations for the results. Section 5 presents EM&W's FMM approach for identifying profit-shifting and then applies it to our Chinese data. This approach fails to find any evidence of profit-shifting. Section 6 performs robustness checks by estimating a fixed effects version of the FMM, and examining investment-tax elasticity rather than profit-tax elasticity. Section 7 summarizes and concludes our analysis. We note that all the data and code necessary to reproduce the results in this paper can be downloaded from Dataverse.[3]

2 Literature review

Profit-shifting is an accounting strategy used by firms located in multiple tax jurisdictions. Costs and revenues are allocated across business operations so that profits are disproportionately located in low tax jurisdictions. It is usually distinguished from the allocation of real resources. However, the line separating decisions made for real versus accounting reasons is not always clear. For example, the location of MNC headquarters in so-called tax havens is often given as evidence of profit-shifting even though it involves the allocation of real resources. In contrast, the location of manufacturing plants in low tax jurisdictions is generally not considered profit-shifting. While profit-shifting may affect the allocation of resources, the main concern is erosion of tax bases and subsequent loss of public revenues.

There is little doubt that profit-shifting by MNC's occurs, though its extent is debated. An indication that profit-shifting can be economically significant is given by the ratio of profits to GDP in G7 countries versus tax havens.[4] In 2010, profits of foreign subsidiaries of U.S. MNCs located in G7 countries were approximately 0.7% of foreign countries' GDP. In the same year, profits of foreign subsidiaries of U.S. MNCs as a share of the host country's GDP were 41.9% for Ireland, 127% for Luxembourg, 1,614% for Bermuda, 1,803% for the British Virgin Islands, and 2,065.6% for the Cayman Islands, to give just a few examples (Gravelle, 2016). There is

[3] The respective files are posted here:
https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/YDMADC

[4] For a definition of tax haven, see Gravelle (2009).

some concern that profit-shifting has increased over time.[5] As a result, this subject has received increased interest from policy makers in recent years.

A straightforward way to measure profit-shifting is to study the relationship between profit rates and tax rates across jurisdictions. All things constant, one would expect the marginal return on capital to be lower in low tax jurisdictions. Under the right conditions, this should cause average profits to be lower. Many studies have looked at profit rates, or the ratio of income to sales, for MNCs in high and low tax jurisdictions and found the opposite to be true: Profits/income rates are higher in low tax jurisdictions (Grubert and Mutti, 1991; Hines and Rice, 1994; Huizinga and Laeven, 2008; Clausing, 2009; Weichenrieder, 2009; Dharmapala and Riedel, 2013). This is taken as evidence that MNCs shift profits from high to low tax jurisdictions.

It is generally agreed that there are two main avenues by which MNCs shift profits. The first involves borrowing and debt shifting. Given a decision to borrow money, a firm can minimize its tax liability by borrowing funds in a high tax jurisdiction, since the associated interest rate payments are tax deductible. For the same reason, there is an incentive for firms to engage in internal borrowing, where the affiliate in the low tax jurisdiction lends funds to the affiliate in the high tax jurisdiction. As a result, MNCs with affiliates in low tax countries will carry more debt and engage in more borrowing than MNCs who do not have affiliates in low tax countries. Evidence that this occurs is given by Desai et al. (2004), Huizinga et al. (2008) and Buettner et al. (2012).

A second way firms can shift profits is through transfer pricing. Transfer pricing affects sales between affiliates of an MNC. MNCs can avoid taxes by having the low tax affiliate sell goods and services at high prices to the high tax affiliate. Alternatively, MNCs can produce expensive goods and services in the high tax jurisdiction and sell them at low prices to their low-tax jurisdiction affiliates. While there are regulations that regulate the prices that firms can charge affiliates ("arm's length pricing"), there is scope for firms to game the tax differential when it is difficult to identify matching products outside the firm. Evidence of profit shifting through transfer pricing is provided by Clausing (2003) and Bartelsman and Beetsma (2003).

Using transfer prices to shift profits is more likely to occur when goods and services are difficult to price, such as is the case with intangibles and highly specialized products. Grubert (2003) concludes that R&D-related intangibles are responsible for half of the income shifted from high- to low-tax countries. Relatedly, Gravelle (2009) reports that overseas income from U.S. MNCs are disproportionately concentrated in the pharmaceutical, medical, computer, and electronic equipment industries. This is consistent with intellectual property/R&D/specialized products being produced in the U.S. and then sold to affiliates in low tax rate countries at below "cost" prices.

[5] Not all are convinced that profit-shifting has increased over time. For a recent review of the literature, see Dharmapala (2014).

3 China's corporate income tax law from 1991–2009

Prior to the tax law change of 2008, the Chinese corporate income tax system was regulated by the Income Tax Law of The People's Republic of China for Enterprises with Foreign Investment and Foreign Enterprises" ("中华人民共和国外商投资企业和外国企业所得税法"), which was "adopted at the Fourth Session of the Seventh National People's Congress on April 9, 1991, promulgated by Order No. 45 of the President of the People's Republic of China on April 9, 1991 and effective as of July 1, 1991." An English translation of the law can be found here: http://www.law-lib.com/law/law_view.asp?id=7536

A key feature of the Chinese corporate income tax system from 1991–2007 is that it was a 100% flat tax, with tax liability determined by a constant statutory tax rate multiplied by the firm's profits. However, the relevant statutory tax rate depended on a number of factors, including the type of business the firm was engaged in, its geographic location, and other characteristics of the firm. To support this claim, Table 1 reports excerpts from the "Income Tax Law of the People's Republic of China for Enterprises with Foreign Investment and Foreign Enterprises."

Article 4 defines taxable income as "the amount remaining from its gross income in a tax year after the costs, expenses and losses have been deducted." Note that there is no profit threshold below which firms are exempt from taxation. Article 5 identifies the relevant tax rate on corporate income to be 33 percent, which is the tax rate applicable to domestic firms. Article 7 then identifies a number of circumstances that cause adjustments in firms' tax rates. Adjustments are made for firms located in, or affiliated with other firms located in, "Special Economic Zones" and "Economic and Technological Development Zones". Reduced rates are available for firms in "coastal economic open zones" or "old urban districts" or "other regions defined by the State Council", where the State Council is China's chief administrative authority. Other reductions include, but are not limited to, enterprises in the energy and communications industries, or firms engaged in "harbour, wharf or other projects." Article 8 identifies further reductions. Firms "scheduled to operate" for ten years or longer are entirely exempted from taxes in the first two years when they begin to make profit, and are "allowed a fifty percent reduction in the third to fifth years." The article goes on to mention, but not define, further reductions for firms "engaged in the exploitation of resources such as petroleum, natural gas, rare metals, and precious metals".

While our original dataset included the years 1998–2011, for reasons discussed below, our working sample is restricted to the years 2005–2009. The law described above was in place for the first three years of our sample period. On January 1, 2008, the law was changed, with the base rate being gradually increased over the period 2008 to 2012 to equalize rates faced by foreign and domestic firms. However, the 100% flat tax nature of China's corporate income tax system did not change.

Table 1: Key features of the "Income Tax Law of the People's Republic of China for Enterprises with Foreign Investment and Foreign Enterprises"

Article 4
The taxable income of an enterprise with foreign investment and an establishment or a place set up in China to engage in production or business operations by a foreign enterprise, shall be the amount remaining from its gross income in a tax year after the costs, expenses and losses have been deducted.
Article 5
The income tax on enterprises with foreign investment and the income tax which shall be paid by foreign enterprises on the income of their establishments or places set up in China to engage in production or business operations shall be computed on the taxable income at the rate of thirty percent, and local income tax shall be computed on the taxable income at the rate of three percent.
Article 7
The income tax on enterprises with foreign investment established in Special Economic Zones, foreign enterprises which have establishments or places in Special Economic Zones engaged in production or business operations, and on enterprises with foreign investment of a production nature in Economic and Technological Development Zones, shall be levied at the reduced rate of fifteen percent. The income tax on enterprises with foreign investment of a production nature established in coastal economic open zones or in the old urban districts of cities where the Special Economic Zones or the Economic and Technological Development Zones are located, shall be levied at the reduced rate of twenty-four percent. The income tax on enterprises with foreign investment in coastal economic open zones, in the old urban districts of cities where the Special Economic Zones or the Economic and Technological Development Zones are located or in other regions defined by the State Council, within the scope of energy, communications, harbour, wharf or other projects encouraged by the State, may be levied at the reduced rate of fifteen percent. The specific measures shall be drawn up by the State Council.
Article 8
Any enterprise with foreign investment of a production nature scheduled to operate for a period of not less than ten years shall, from the year beginning to make profit, be exempted from income tax in the first and second years and allowed a fifty percent reduction in the third to fifth years. However, the exemption from or reduction of income tax on enterprises with foreign investment engaged in the exploitation of resources such as petroleum, natural gas, rare metals, and precious metals shall be regulated separately by the State Council.

Source: "Income Tax Law of The People's Republic of China for Enterprises with Foreign Investment and Foreign Enterprises" ("中华人民共和国外商投资企业和外国企业所得税法") as "adopted at the Fourth Session of the Seventh National People's Congress on April 9, 1991, promulgated by Order No. 45 of the President of the People's Republic of China on April 9, 1991 and effective as of July 1, 1991." An English translation of the law can be found here: http://www.law-lib.com/law/law_view.asp?id=7536

This feature of China's tax system allows us to infer statutory tax rates from the effective tax rate (*ETR*) that the firm pays:

$$ETR = \frac{Taxes\ Paid}{Before{-}Tax\ Profits} = \frac{Before{-}Tax\ Profits \times Statutory\ Tax\ Rate}{Before{-}Tax\ Profits}$$
$$= Statutory\ Tax\ Rate. \quad (1)$$

We exploit this feature of China's tax code in the analysis below.

4 Description of data and preliminary results

4.1 Data overview

The major data source for this study is the Annual Industrial Survey Database from CNBS. This database contains the most comprehensive information about domestic and foreign corporations in China (Chang & Xu, 2008; Tian, 2007). Coverage is supposed to include all state-owned corporations, and all non-state-owned corporations (including foreign ones) with annual sales of at least RMB 5 million (about USD $725,000 at the prevailing exchange rate at the time of this writing). The database includes key firm-level financial information such as sales, capital, and employment. We supplement the CNBS data with data from the *China Urban Statistical Yearbook*. The latter provides information about the business environments in which the MNCs were located.

We restrict our sample to MNCs that have some degree of foreign ownership, as this is where we most expect to find profit-shifting if it exists. We exclude MNCs whose foreign capital is recorded as negative, or for whom the ratio of foreign capital over total capital is less than 0.25. Firms whose foreign investors were located in Hong Kong, Macau, and Taiwan are also excluded, as this complicates the notion of "foreign".

Our working sample covers the years 2005–2009, with three years under the old law (2005–2007); and two years under the new law, when rates started to gradually increase (2008–2009). While data were available prior to 2005, several key variables were unavailable, causing us to drop all observations from these years.[6] Likewise, data were available after 2009, but, as others have noted, these years are characterized by poorer quality (Huang and Chen, 2017; Wang, 2017). This was clearly evident in our data.

Table 2: ETR by year, all observations

Year	ETR	95% CI	Observations
1998	17.5	(17.0, 18.0)	2,218
1999	16.8	(16.4, 17.3)	2,647
2000	16.8	(16.4, 17.2)	3,192
2001	17.0	(16.6, 17.3)	3,771
2002	17.2	(16.9, 17.6)	4,555
2003	17.5	(17.1, 17.8)	5,552
2004	17.6	(17.3, 17.9)	9,088
2005	17.9	(17.7, 18.2)	9,779
2006	17.8	(17.5, 18.0)	11,670
2007	17.7	(17.5, 17.9)	13,152
2008	18.4	(18.2, 18.6)	14,836
2009	19.2	(19.0, 19.4)	14,401
2010	12.8	(12.6, 12.9)	13,971
2011	14.0	(13.8, 14.1)	20,825

Note: *ETR* is defined as Taxes Paid / Before-Tax Profits (see equation (1)). The sample includes all available observations for which tax and profit data are available. The shaded rows highlight the precipitous drop in average *ETR* in 2010 and 2011.

[6] Inclusion of variables for ETR, firm sales and number of employees, and local GDP eliminates all observations prior to 2005.

Our initial dataset covered the years 1998 to 2011 and included over 140,000 observations. We used this dataset to regress the firm's *ETR* on a series of year dummy variables. The results are presented in Table 2. *ETR*s for the years 1998 to 2007 ranged between upper 16 to upper 17 percent, with overlapping 95% confidence intervals. In 2008, *ETR*s started to increase, consistent with the change in China's corporate income tax law. They increased further in 2009, again consistent with the gradually increasing rates. Then for some unexplained reason, the average *ETR* in our sample dropped precipitously to 12.8 and 14.0 percent in 2010 and 2011, respectively. Because this is inconsistent with what we know was happening to tax rates in China during this period, we deleted all observations from those years.

4.2 Variables

The main dependent variable in our analysis is MNC profits, *PROFITS*. As a robustness check, we also follow EM&W and look at the effect of taxes on investment, as measured by *ASSETS*. The key explanatory variable in our analysis is *ETR*, defined as the ratio of an MNC's total corporate income tax payments over its before-tax profits. MNCs that are able to profit-shift have the capacity to avoid taxes when faced with higher rates. As a result, we expect to find that profits by profit-shifters will be more responsive to tax changes than that by non-profit-shifters.

The literature on multinational enterprises predicts that size of the firm, skilled labor endowments, capital-labor ratios and other variables related to trade and investment are important determinants of MNC behavior (Carr et al., 2001; Markusen and Maskus, 2002; Blonigen et al., 2003; Bergstrand and Egger, 2007). Accordingly, our analysis includes the log of the value of MNC sales, *lnSALES;* the log of the number of MNC employees, *lnEMP;* and the log of the capital-labor ratio, *lnKLRAT*.

We also include a number of variables to control for the MNC's business environment. These include features of the city where the MNC is located, such as the log of real GDP (*lnGDP*)*;* the log of tertiary school enrolment (*lnSKILL*); the log of labor cost (*lnLABOR*)*;* the log of the ratio of total public sector expenditures over real GDP (*lnMARK*), intended to measure the degree of marketization; the log of population density (*lnPOPDEN*)*;* the log of the ratio of total number of employees in the transportation, warehousing, postal, and communications sectors over the population (*lnINFRAS*), which measures the quality of infrastructure; the log of the ratio of total number of employees in the finance and insurance sectors over the population (*lnFINANCE*); and the log of effective foreign investment (*lnINVFOR*).

Our main sample consists of 57,802 observations. Table 3 reports corresponding descriptive statistics for all the variables used in the analysis. Profits are measured in units of thousands of RMB and are measured before tax. The mean value of MNCs' before-tax profits in our main sample is 25.5 million RMB. The difference in the minimum and maximum values of *PROFITS* indicates substantial disparity in profits across MNCs, ranging from a minimum of 2 thousand RMB to a maximum of 14.7 billion RMB. *ASSETS* also range widely, from a minimum of 1,000 RMB, to a maximum of 25.3 billion RMB, with an average value of 68.7 million.

Table 3: Descriptive statistics

Variable	*Obs*	*Mean*	*Std. dev.*	*Min*	*Max*
		Dependent variables			
PROFITS	57,802	25,455	160,240	2	14,700,000
ASSETS	57,799	68,771	417,674	1	25,300,000
		Explanatory variables			
ETR	57,802	18.26	12.72	0.00	99.99
SALES	57,802	326,979	2,389,984	41	192,000,000
EMP	57,802	424	1,799	9	198,971
GDP	57,802	45,400,000	38,500,000	981,093	150,000,000
KLRAT	57,802	193	1,021	0	91,084
SKILL	57,802	286	205	4	1,228
LABOR	57,802	32,741	11,410	6,410	118,685
MARK	57,802	0.107	0.044	0.043	1.936
POPDEN	57,802	0.089	0.057	0.000	0.266
INFRAS	57,802	0.012	0.012	0.000	0.056
FINANCE	57,802	0.008	0.006	0.001	0.036
INVFOR	57,802	330,854	295,131	22	1,053,835
Year2005	57,802	0.17	0.37	0	1
Year2006	57,802	0.20	0.40	0	1
Year2007	57,802	0.23	0.42	0	1
Year2008	57,802	0.20	0.40	0	1
Year2009	57,802	0.21	0.41	0	1

Note: Descriptive statistics are for the main sample used in the analysis. Variables are described in the text. Observations are restricted to the years 2005–2009.

The mean *ETR* across our sample of MNCs is 18.3%. Figure 1 reports the distribution of *ETR*s for the main sample. For the most part, the distribution is consistent with what we know about the corporate tax system in China during this period. The exception is the high (larger than 33 percent) tax rates observed in the data. These clearly represent errors arising from the tax and/or profit numbers self-reported by the firms.

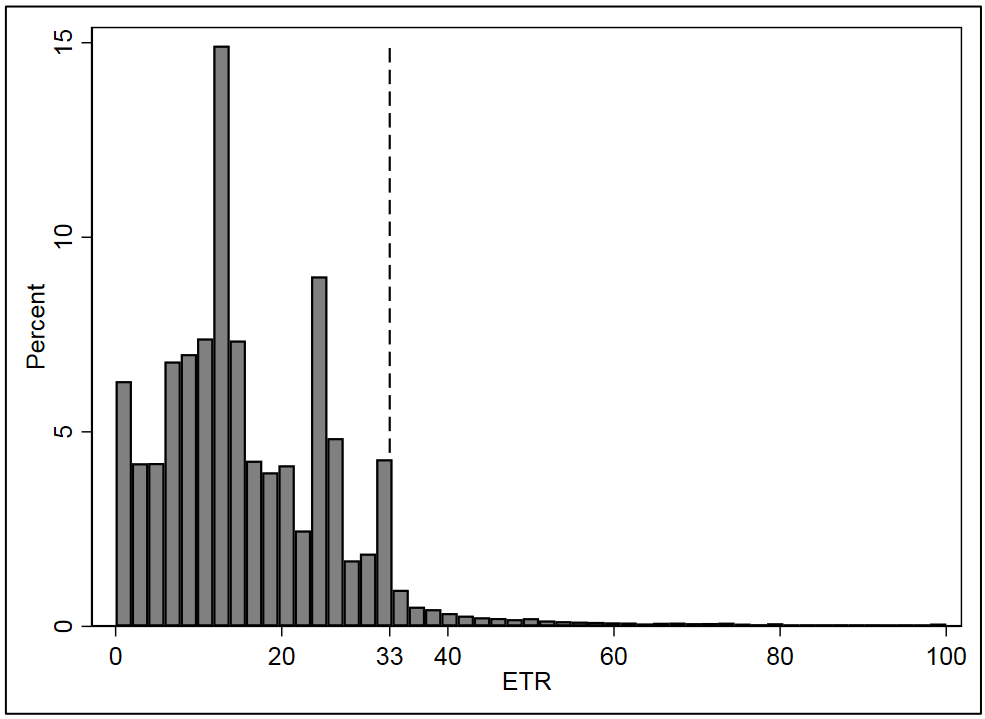
The danger with dropping these observations is that there are likely errors that underreport *ETR* that we cannot identify. To delete the former observations while retaining the latter introduces a sample selection that might not be random. As a result, we keep these observations in our main sample. We note, however, that we obtain the same qualitative results when we drop all observations with *ETR* values larger than 33 percent. This is easily confirmed from the data and code that we make publicly available with this paper.

With respect to the other explanatory variables used in our analysis, the mean value of *SALES* across firms is 327 million RMB, and, like *PROFITS* and *ASSETS*¸ *SALES* vary greatly across firms. *EMP* measures the number of MNC employees. It ranges from 9 to 198,971 persons, with a mean number of employees equal to 424. GDP is measured in units of 10,000 RMB. Real *GDP* of cities hosting the respective MNCs in our sample has an average value of approximately 454 billion RMB. The capital-labor ratio variable, *KLRAT*, is measured in units of 10,000 RMB/employee. It has a mean value of 1.93 million RMB per worker. *SKILL* measures the tertiary school enrolment of the city hosting the MNCs. It has a mean value of

286,000 persons and ranges from 4,000 to about 1.2 million students. Labor costs are measured in units of 10,000 RMB, and has a mean value of approximately 327 million RMB.

MARK is the ratio of total public sector expenditures over city GDP. It has a mean value of approximately 0.11. *POPDEN* measures population density of the city hosting the MNC and has a mean value of 890 persons per square kilometer. *INFRAS*, the ratio of total number of employees in the transportation, warehousing, postal, and communications sectors over the host city population, has a mean value of 0.012. The ratio of total number of employees in the finance and insurance sectors over the population is measured by *FINANCE* and has a mean value of 0.008. *INVFOR* measures effective foreign investment and is measured in units of 10,000 U.S. dollars. It has a mean value of 3.3 billion USDs. Our sample is fairly evenly split across the five years, 2005–2009.

Figure 1: Distribution of ETR for the main sample



Note: *ETR* is defined as Taxes Paid / Before-Tax Profits (see equation (1)). *ETR* values are from the main sample of 57,802 observations. The maximum tax rate applicable during the sample period was 33 percent. *ETR* values larger than that represent coding errors.

4.3 Preliminary results

As noted in Dharmapala's (2014) review of the literature, the primary approach for identifying the existence and extent of profit-shifting consists of estimating how before-tax profits of an MNC affiliate *i* are affected by the difference in the tax rates between the affiliate and its parent. A standard specification is given by:

$$\log(Profits)_i = \beta_0 + \beta_1(\tau_i - \tau_{pi}) + \beta_2 \log(K_i) + \beta_3 \log(L_i) + \boldsymbol{X}_i\boldsymbol{\gamma} + \varepsilon_i \quad (2)$$

where K_i and L_i are the affiliate's capital and labor inputs, and $\boldsymbol{X}_i$ is a vector of control variables that affect the affiliate's profits. The key variable is $(\tau_i - \tau_{pi})$, which measures the difference in tax rates faced by the affiliate and its parent. Evidence of profit-shifting is given by the sign and significance of β_1. In particular, $\beta_1 < 0$ suggests that MNCs shift profits out of affiliates towards the parent or other affiliates when taxes in the given affiliate jurisdiction increase.

Unfortunately, as discussed below, our data are not ideal for estimating equation (2) because we only have data on the firms located in China, and not on any associated parents or affiliates. Nevertheless, if we are willing to assume that changes in non-Chinese parent and affiliate tax rates are uncorrelated with tax changes in China, then evidence of profit-shifting would be provided by a negative and significant coefficient on the tax variable in a regression where the dependent variable was MNC profits.

Table 4 reports the results of this preliminary analysis. The first two columns report OLS estimates of the following specification:

$$\log(Profits)_i = \beta_0 + \beta_1\tau_i + \boldsymbol{X}_i\boldsymbol{\gamma} + Year\ Dummies + \varepsilon_i \quad (3)$$

Column (1) restricts the explanatory variables to *ETR* and the year dummies. Column (2) adds the other explanatory variables. The coefficient on the tax variable in Column (1) is interpreted as a one-percentage-point increase in the firm's *ETR* is associated with a reduction in that firm's before-tax profits of 3.8 percent. When additional variables are added to the equation, the corresponding estimate falls to 2.4 percent.

It has been recently noted that count models possess a number of attractive features that make them preferable to log-linear models such as equations (2) and (3) (Silva and Tenreyro, 2006; Wooldridge, 2010; Cameron and Trivedi, 2010).[7] For this reason, and because it provides a smooth transition to the analysis of the next section, we also report the results for negative binomial regression of the model where the dependent variable is *PROFITS*, and the explanatory variables in Columns (3) and (4) are the same as those in Columns (1) and (2), respectively. According to these estimates, a one-percentage-point increase in an MNC's *ETR* is associated with a 1.0 percent decrease in their profits.

While these results are consistent with profit-shifting, they also are open to the criticism that the tax variable is correlated with excluded variables that are also correlated with profits, inducing omitted variable bias. This is particularly likely to be the case with our Chinese MNCs, for, as we saw in Table 1 and the corresponding discussion, tax rates depend on a number of firm and environmental characteristics (type of industry, location of firm, business environment, etc.) that may also be associated with profits. The fact that the estimated tax elasticity is smaller in Column (2) of Table 4 compared to Column (1), where the latter does not include firm and environmental characteristics, is consistent with this concern.

Table 5 provides further support for this concern. The left hand side of the table reports OLS results of regressing *ETR* on the other explanatory variables. These indicate a strong relationship

[7] See also the Stata blog by William Gould, "Use poisson rather than regress; tell a friend". http://blog.stata.com/2011/08/22/use-poisson-rather-than-regress-tell-a-friend/

Table 4: The estimated relationship between PROFITS and ETR

	OLS Regression		*Negative Binomial Regression*	
	Dep. Variable = ln(PROFITS)		*Dep. Variable = PROFITS*	
	(1)	(2)	(3)	(4)
ETR	–0.0381***	–0.0237***	–0.0107***	–0.0104***
	(–43.82)	(–49.79)	(–43.82)	(–20.22)
lnSALES	----	1.0398***	----	0.5825***
		(129.61)		(39.99)
lnEMP	----	–0.0137	----	0.0452***
		(–1.43)		(3.91)
lnGDP	----	0.2137***	----	0.1480***
		(10.31)		(6.00)
lnKLRAT	----	0.1298***	----	0.0864***
		(22.52)		(10.78)
lnSKILL	----	0.0802***	----	0.0231
		(5.41)		(1.18)
lnLABOR	----	–0.2718***	----	–0.0637
		(–4.99)		(–0.84)
lnMARK	----	0.3276***	----	0.1513***
		(12.00)		(4.04)
lnPOPDEN	----	–0.0130	----	–0.0584**
		(–0.74)		(–2.60)
lnINFRAS	----	0.0236	----	0.0486*
		(1.12)		(1.89)
lnFINANCE	----	–0.2560***	----	–0.1718***
		(–9.89)		(–5.41)
lnINVFOR	----	–0.0301**	----	–0.0511***
		(–2.67)		(–3.88)
R-squared	0.057	0.660	----	----
Observations	57,802	57,802	57,802	57,802

Note: In addition to the variables listed in the table, all regressions include year dummy variables. *t*-statistics are reported in parentheses and are based on clustered robust (by firm) standard errors. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

between tax rates and firm and environmental characteristics (the associated *F* test of no relationship is rejected with a *p*-value of 0.0000). Of course, as these variables are included in the profit regressions of equations (2) and (4), these relationships cannot contribute to omitted variable bias. But their significance makes it plausible that other firm and environmental characteristics, not included in these equations, could bias the coefficient on the tax rate variable, producing a spurious, negative estimate.

Unfortunately, we are unable to distinguish between these alternative explanations using conventional regression procedures. However, EM&W suggests another approach. We discuss this in the next section.

Before proceeding to that, we make one more observation about firms' *ETR*s. Under the corporate income tax laws in effect during our sample period 2005–2009, *ETR*s should have been stable before the law change on January 1, 2008, and increasing afterwards. The right side of Table 5 provides evidence of this. Column (2) reports the results of a regression where *ETR* is regressed on dummy variables for the years 2006–2009, where the omitted category is observations from 2005. A test of the hypothesis that *ETR*s did not change in the 2005–2007

period produces an *F*-statistic of 1.47 with a corresponding *p*-value of 0.23. In contrast, *ETR*s are significantly higher in 2008 and 2009, as would be expected from the change in the corporate income tax law.

Table 5: Determinants of ETR

Variables	*Dep. Variable = ETR* (1)	*Variables*	*Dep. Variable = ETR* (2)
lnSALES	–1.0855*** (–15.49)	*Constant*	17.9416 (137.44)
lnEMP	0.2666*** (3.13)	*y2006*	–0.2391 (–1.53)
lnGDP	1.6660*** (8.65)	*y2007*	–0.2473 (–1.53)
lnKLRAT	–0.1378*** (–2.65)	*y2008*	0.5642*** (3.25)
lnSKILL	–0.0432 (–0.33)	*y2009*	1.4574*** (8.46)
lnLABOR	0.4103 (0.75)		
lnMARK	–0.0377 (–0.15)		
lnPOPDEN	–0.4346*** (–2.89)		
lnINFRAS	–0.1098 (–0.59)		
lnFINANCE	–1.1570*** (–4.96)		
lnINVFOR	–0.9253*** (–8.61)		
R-squared	0.022	*R-squared*	0.0027
Observations	57,802	*Observations*	57,802

Note: In addition to the variables listed in the table, the regression in Column (1) also includes year dummy variables. *t*-statistics are reported in parentheses and are based on clustered robust (by firm) standard errors. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

5 A finite mixture model approach for identifying profit-shifting

EM&W presents an innovative approach for identifying profit-shifting. They analyze foreign direct investment (FDI) by affiliates of German MNCs, where firm's total fixed assets are used to measure FDI. They hypothesize that FDI will be adversely affected by higher tax rates. However, not all firms will respond the same to higher tax rates. Some firms will be able to shield themselves from higher taxes by shifting profits to overseas affiliates. These profit-shifting firms will be less responsive to changes to tax rates compared to MNCs which lack low-tax, overseas options.

Accordingly, EM&W present a model of MNC investment in which the population of MNCs is composed of two underlying groups. While the group-affiliation of MNCs is

unobserved, it can be inferred by how they respond to changes in tax rates. Profit-shifters are expected to display a lower investment-tax elasticity than non-profit-shifters.

To estimate this model, EM&W employ a FMM in which the investment behavior of firms is estimated using negative binomial regression. The two-component feature of their approach allows them to exploit the fact that not all MNCs will have the resources and opportunities to profit-shift. Using this approach, EM&W distinguish profit-shifters from non-profit-shifters, where profit-shifters are characterized by higher profits, are larger in size, and consist of a minority of the total number of MNCs.

The attraction of EM&W's approach is that the identification strategy relies on the different tax elasticities of the two groups. The existence of two groups can be tested against the alternative of one group to confirm whether this modelling approach is appropriate. If the two-group modelling approach is warranted, then one can compare the characteristics of firms identified to be profit-shifters with those of non-profit-shifters to see if they match what we would expect to see from profit-shifting firms. Before proceeding with testable hypotheses, we provide further details on EM&W's approach and discuss how we modify it for our analysis. Whereas EM&W used MNCs' total fixed assets as their dependent variable, the subsequent discussion substitutes profits, which provides a more direct measure of profit-shifting.

Let y_i denote profits observed for MNC i. Let $\boldsymbol{x}_i$ be a vector of explanatory variables including a measure of taxes; and $\boldsymbol{\theta}^l$, $l = \{1,2\}$, a vector of parameters that are assumed to be the same for all firms within a given group of MNCs, but different across the two groups ($\boldsymbol{\theta}^1 \neq \boldsymbol{\theta}^2$). The distribution of y_i is assumed to be governed by one of two density functions, $f^l(y_i|\boldsymbol{x}_i, \boldsymbol{\theta}^l)$, $l = \{1,2\}$, depending to which group the MNC belongs.

Given that there is uncertainty regarding the group identity of firms, the density function for y_i adopts the following probabilistic, two-component finite mixture:

$$f(y_i|\boldsymbol{x}_i, \boldsymbol{\theta}^1, \boldsymbol{\theta}^2, \pi^1) = \pi^1 f^1(y_i|\boldsymbol{x}_i, \boldsymbol{\theta}^1) + (1 - \pi^1) f^2(y_i|\boldsymbol{x}_i, \boldsymbol{\theta}^2) \tag{4}$$

where π^1 is the probability that the firm belongs to Group 1, given by,

$$\pi^1 = \frac{exp(\boldsymbol{\delta})}{[1+exp(\boldsymbol{\delta})]} \text{ .}^8 \tag{5}$$

We assume the density function, $f^l(y_i|\boldsymbol{x}_i, \boldsymbol{\theta}^l)$, can be appropriately modelled by the negative binomial distribution. The associated likelihood function is then used to estimate the parameters $\boldsymbol{\theta}^l$ via maximum likelihood. Note that estimation of f^1 and f^2 allows one to identify separate tax elasticities for each of the two groups.

The posterior probability that an observation y_i belongs to Group 1 is given by

$$\Pr(y_i \in 1) = \frac{\pi^1 f^1(y_i|\boldsymbol{x}_i, \boldsymbol{\theta}^1)}{\pi^1 f^1(y_i|\boldsymbol{x}_i, \boldsymbol{\theta}^1) + (1-\pi^1) f^2(y_i|\boldsymbol{x}_i, \boldsymbol{\theta}^2)} \tag{6}$$

It is easily confirmed that $0 \leq \Pr(y_i \in 1) \leq 1$, and $\Pr(y_i \in 2) = 1 - \Pr(y_i \in 1)$. MNCs for which $\Pr(y_i \in 1) \geq 0.5$ are characterized as belonging to Group 1. Equation (6) allows post-estimation categorization of observations into Groups 1 and 2 by replacing π^1, f^1, and f^2 with

[8] π^1 is easily generalized to include explanatory variables that are assumed to affect the probability of belonging to a given group of MNCs, but do not directly affect the dependent variable, y_i.

their respective estimates. Once individual firms are classified into one or the other group, they can be further studied to determine if their associated characteristics match the characteristics we expect profit-shifting MNCs to display.

With the basics of EM&W's FMM approach in place, we can propose four testable hypotheses consistent with the existence of profit-shifting:

Hypothesis 1.1: FMM should identify two groups of firms.

Hypothesis 1.2: Profit-shifters should be more tax elastic than non-profit-shifters.

Hypothesis 1.3: Profit-shifters are expected to be larger firms, as measured by PROFITS, ASSETS, EMPLOYEES, and SALES. Further, we expect the number of profit-shifters to be smaller than the number of non-profit-shifters.

Hypothesis 1.4: Profit-shifters should evidence a greater tax elasticity effect from the 2008/2009 tax increase than non-profit-shifters.

Hypotheses 1.1 and 1.2 should be self-explanatory. With respect to Hypothesis 1.3, firms with larger profits have a greater incentive to profit-shift, since the costs of profit-shifting are fixed relative to the benefits, which are increasing in the size of profits. Further, larger firms are more likely to have overseas connections, which are necessary if one is to shift income and costs to other locations. Finally, we expect the number of profit-shifters to be smaller than the number of non-profit-shifters, as most MNCs have neither the opportunities nor the resources to engage in profit-shifting. The predictions about profits, size and number of firms are all supported in EM&W's analysis of German MNCs. Hypothesis 1.4 is similar to Hypothesis 1.2 except that it allows profit-shifting behavior to change with the change in China's tax law, effective at the beginning of 2008.

Column (1) of Table 6 reproduces the negative binomial (NB) regression model results of Column (4) of Table 4. The next two columns report the results of estimating the 2-component, finite mixture negative binomial (FMNB) model. This allows us to test the first of our four hypotheses; namely, that our sample of Chinese MNCs consist of two, distinct groups.

Indeed, we find strong evidence of the existence of two distinct groups. The FMNB model has lower AIC and BIC values, indicating a better overall fit, even with the penalty for the extra parameters that must be estimated: AIC and BIC values for the FMNB model are 1,137,240 and 1,137,572, compared to 1,170,665 and 1,170,827 for the NB model. Further, noting that the single-component NB model is nested within the 2-component FMNB model, we strongly reject the NB model in favor of its 2-component alternative. These results confirm Hypothesis 1.1.

Table 7 tests Hypotheses 1.2 and 1.3. The top part of the table reports that Group 1 MNCs have an estimated profit-tax elasticity of –0.0146, while Group 2 MNCs have an elasticity of -0.0106. A test of equal elasticities is strongly rejected. The greater sensitivity of Group 1 firms to tax rates suggests that this group is comprised of profit-shifters.

However, the next set of estimates does not support this interpretation. According to Hypothesis 1.3, profit-shifting MNCs should have greater profits than non-profit-shifting MNCs. In contrast, Group 1 is characterized by substantially smaller profits. Average profits among Group 1 firms are 7.6 million RMB, compared to 152.8 million RMB for Group 2 firms. Similarly,

Table 6: The estimated relationship between PROFITS and ETR

Variables	*NB Model* (1)	*FMNB Model* *Group 1* (2)	*Group 2* (3)
ETR	–0.0104***	–0.0146***	–0.0106***
	(–20.22)	(–28.97)	(–9.85)
LnSALES	0.5825***	0.7137***	0.4751***
	(39.99)	(53.50)	(21.31)
LnEMP	0.0452***	–0.0238**	0.0963***
	(3.91)	(–2.40)	(5.01)
LnGDP	0.1480***	0.1694***	0.1354***
	(6.00)	(8.57)	(3.06)
LnKLRAT	0.0864***	0.0953***	0.0885***
	(10.78)	(14.75)	(6.33)
LnSKILL	0.0231	0.0585***	0.0158
	(1.18)	(3.35)	(0.47)
LnLABOR	–0.0637	–0.2239***	0.0518
	(–0.84)	(–3.87)	(0.40)
LnMARK	0.1513***	0.2291***	0.1163*
	(4.04)	(7.46)	(1.82)
LnPOPDEN	–0.0584**	–0.0157	–0.0646*
	(–2.60)	(–0.79)	(–1.78)
LnINFRAS	0.0486*	0.0181	0.0382
	(1.89)	(0.77)	(0.87)
LnFINANCE	–0.1718***	–0.2070***	–0.1272**
	(–5.41)	(–6.98)	(–2.31)
LnINVFOR	–0.0511***	–0.0174	–0.0840***
	(–3.88)	(–1.42)	(–3.57)
Observations	57,802	57,802	
AIC	1,170,665	1,137,240	
BIC	1,170,827	1,137,572	
Hypothesis test (NB vs. FMNB): $\chi^2(19)$ =33,462.8, p-value = 0.000			

Note: "NB" and "FMNB" represent the negative binomial and (2-component) finite mixture negative binomial models, respectively. The dependent variable is *PROFITS*. In addition to the variables listed in the table, all regressions include year dummy variables. *t*-statistics are reported in parentheses and are based on clustered robust (by firm) standard errors. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

Table 7: Comparison of characteristics for Groups 1 and 2

	Group 1		*Group 2*	
Estimated profit-tax elasticity:	-0.0146		-0.0106	
Hypothesis test (Tax elasticities the same): $\chi^2(1)$ =9.09, p-value = 0.003				
Variables	*Mean*	*Std. dev.*	*Mean*	*Std. dev.*
PROFITS	7,660	15,605	152,821	435,020
ASSETS	31,913	127,157	332,558	1,108,193
EMP	305	661	1,273	4,737
SALES	138,832	500,023	1,673,586	6,537,835
Observations	50,716		7,086	
Pct of sample	87.7		12.3	
Pct of total profits	26.4		73.6	
Pct of total assets	40.7		59.3	

Note: The classification of MNCs into Group 1 and Group 2 uses the estimates from the FMNB model in Table 6. For details, see equation (6) in the text and the associated discussion.

Group 1 firms have fewer assets, fewer employees, and fewer sales. Finally, almost 88 percent of the sample is categorized in Group 1. All of these characteristics are inconsistent with our expectations concerning profit-shifting firms.

Table 8 tests the last of the four hypotheses. The tax law change of 2008 gradually increased tax rates for MNCs in China. Firms with the capability of shifting profits overseas had opportunity to prepare for this law change and take advantage of it when it took effect. Accordingly, if Group 1 firms were profit-shifters, we should see a greater elasticity for them in the 2008–2009 period compared to Group 2 firms. The interaction variable *ETRxTreatment* captures this effect, where *Treatment* is a dummy variable that takes the value 1 for the years 2008 and 2009. There is little difference between the two groups. We fail to reject the null of no difference in interaction effects between the two groups.

If profit-shifting characterizes a significant proportion of firms, EM&W's FMM approach should allow one to identify this behavior based on different sensitivities to tax rates. EM&W successfully used this approach to identify profit-shifting behavior among German MNCs. However, when we apply this approach to Chinese MNCs, we fail to find evidence of profit-shifting behavior. While there appear to be two distinct groups of firms in our sample, with one group having a somewhat larger profit-tax elasticity than the other (–0.0146 versus –0.0106), this group of firms is characterized by relatively small profits, are relatively small in size, and comprise the great majority of firms in the sample. All of these characteristics are inconsistent to what we expect to see in profit-shifting firms. Further, we observe little difference in the two groups in their tax elasticities after China's tax law changed in 2008.

Table 8: Estimating the effect of the law change on the profit-tax elasticity

Variables	*NB Model*	*FMNB Model*	
	(1)	*Group 1* (2)	*Group 2* (3)
ETR	–0.0092***	–0.0139***	–0.0094***
	(–12.75)	(–22.46)	(–5.91)
ETRxTreatment	–0.0027***	–0.0017*	–0.0026
	(–2.78)	(–1.74)	(–1.21)
Observations	57,802	57,802	
AIC	1,170,642	1,137,232	
BIC	1,170,812	1,137,581	
Hypothesis test (NB vs. FMNB): $\chi^2(20) = 33450.2$, p-value = 0.000			
Hypothesis test (Interaction effects the same): $\chi^2(1) = 0.12$, p-value = 0.732			

Note: "NB" and "FMNB" represent the negative binomial and (2-component) finite mixture negative binomial models, respectively. The dependent variable is *PROFITS*. In addition to the variables listed in the table, all regressions include year dummy variables. *t*-statistics are reported in parentheses and are based on clustered robust (by firm) standard errors. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

6 Robustness check

6.1 Fixed effects

The previous section ignored the panel structure of the data other than to adjust the standard errors for clustering. In this section, we attempt to exploit the fact that we have multiple observations per firm.

Table 9 reports the number of observations per firm ID for the main sample of 57,802 observations. We note that 13,002 observations, or 22.49 percent of the sample, are only observed once during the five-year sample period 2005–2009. The subsequent analysis excludes these because our fixed effects approach requires multiple observations per firm. We also note that some firm IDs are associated with more than 5 observations over the five-year sample period. This could be due to mergers and acquisitions. It could also be due to coding errors, where multiple firms have been assigned the same ID. Eliminating these, together with the removal of firms having only one observation, reduces the sample size to 44,743 from the original 57,802.

Complicating our efforts to estimate a fixed effects version of FMM model is the well-known incidental parameters problem associated with maximum likelihood estimation of nonlinear models (Neyman and Scott, 1948; Lancaster, 2000; Greene, 2004; Fernandez-Val and Weidner, 2016). EM&W address this problem by introducing a time-invariant, MNC-specific, fixed term, $c_i = \exp(\gamma^l + \overline{\boldsymbol{x}}_i\boldsymbol{\xi}^l)$, where $\overline{\boldsymbol{x}}_i$ is the time-averaged mean of the vector of $\boldsymbol{x}_{it}$ for a given MNC i.[9] This firm-specific, fixed term is easily incorporated into the FMM methodology, so that the panel data version of Equations (4)–(6) becomes

$$f(y_{it}|\boldsymbol{x}_{it},\overline{\boldsymbol{x}}_i,\boldsymbol{\beta}^1,\boldsymbol{\beta}^2,\pi^1) = \pi^1 f^1(y_{it}|\boldsymbol{x}_{it},\overline{\boldsymbol{x}}_i,\boldsymbol{\beta}^1) + (1-\pi^1)f^2(y_{it}|\boldsymbol{x}_{it},\overline{\boldsymbol{x}}_i,\boldsymbol{\beta}^2) \quad (4')$$

$$\pi^1 = \frac{exp(\boldsymbol{\delta})}{[1+exp(\boldsymbol{\delta})]} \quad (5')$$

and

$$\Pr(y_{it} \in 1) = \frac{\pi^1 f^1(y_{it}|\boldsymbol{x}_{it},\overline{\boldsymbol{x}}_i,\boldsymbol{\beta}^1)}{\pi^1 f^1(y_i|\boldsymbol{x}_i,\boldsymbol{\beta}^1)+(1-\pi^1)f^2(y_{it}|\boldsymbol{x}_{it},\overline{\boldsymbol{x}}_i,\boldsymbol{\beta}^2)} \quad (6')$$

Table 10 summarizes the results of re-estimating the model and testing Hypotheses 1.1 through 1.4 using the fixed effects FMM approach described above. Panel A reports the results of estimating the model without a treatment interaction effect (corresponding to Table 6). Panel B repeats the analysis when a treatment interaction term is included (corresponding to Table 8). We start with Panel A.

[9] For a similar approach to fixed effects in a linear model setting, see Wooldridge's "correlated random effects" model (Wooldridge, 2016).

Table 9: Number of observations per firm ID

Observations per firm ID	*Observations*	*Percent*
1	13,002	22.49
2	12,416	21.48
3	13,230	22.89
4	11,932	20.64
5	7,165	12.4
6	24	0.04
7	14	0.02
9	9	0.02
10	10	0.02
Total	57,802	100

Note: Observations are for the main sample, which consists of annual observations of MNCs for the years 2005–2009 (the panel is unbalanced). The shaded rows indicate that there are more annual observations per firm ID than are possible in our five-year sample, most likely because the same firm ID was used for more than one firm.

Table 10: Robustness check: fixed effects estimates

VARIABLES	*NB Model* (1)	*FMNB Model* *Group 1* (2)	*Group 2* (3)
A. Profit-tax elasticity (without treatment interaction effect)			
ETR	–0.0108***	–0.0120***	–0.0119***
	(–8.54)	(–14.73)	(–4.93)
Observations	44,743	44,743	
AIC	916,622	890,248	
BIC	916,919	890,849	
Hypothesis test (NB vs. FMNB): $\chi^2(35) = 26444.4$, p-value = 0.000			
Hypothesis test (Tax elasticities the same): $\chi^2(1) = 0.00$, p-value = 0.969			
B. Profit-tax elasticity (with treatment interaction effect)			
ETR	–0.0090***	–0.0113***	–0.0105***
	(–6.85)	(–12.44)	(–4.21)
ETRxTreatment	–0.0043**	–0.0019	–0.0033
	(–1.97)	(–1.14)	(–0.76)
Observations	44,743	44,743	
AIC	916,591	890,241	
BIC	916,904	890,877	
Hypothesis test (NB vs. FMNB): $\chi^2(37) = 26423.8$, p-value = 0.000			
Hypothesis test (Interaction effects the same): $\chi^2(1) = 0.07$, p-value = 0.793			

Note: "NB" and "FMNB" represent the negative binomial and (2-component) finite mixture negative binomial models, respectively. The dependent variable is *PROFITS*. Estimation is based on equations (4')–(6'). In addition to the variables listed in the table, all regressions include year dummy variables and MNC-specific averages of the time-varying variables. *t*-statistics are reported in parentheses and are based on clustered robust (by firm) standard errors. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

Column (1) in Table 10 reports the one-component NB model, while Columns (2) and (3) report the two-component, FMNB estimates. The first hypothesis says that a necessary condition for profit-shifting to exist is that we should be able to identify two distinct groups of MNCs within our sample. As before, when we estimate the NB and FMNB models, we reject the nested, single-component model in favor of the two-component alternative, consistent with the first of our four hypotheses.

However, while our analysis identifies two distinct groups of MNCs, the two groups do not appear to differ with respect to their profit-tax elasticities. We estimate a profit-tax elasticity of –0.0120 for Group 1, and –0.0119 for Group 2. A test of equality of the two elasticities results in the conclusion that there is no significant difference between the elasticities of the two groups. As a result, we fail to find support for Hypothesis 1.2. As there is no discernible difference between the two groups, and hence no way to identify one group as profit-shifters and the other as non-profit-shifters, there is no value in testing Hypothesis 1.3, with its focus on group characteristics.

Panel B addresses Hypothesis 1.4 by including a treatment interaction effect. We again fail to reject the null hypothesis of no difference in the treatment interaction effects across the two groups. Thus, we find no support for Hypothesis 1.4.

In conclusion, fixed effects FMM estimation, while it finds evidence of two distinct groups of MNCs, does not find that one group is more tax elastic in its profits than the other group. As a result, we come to the same conclusion as in the previous section: there is no evidence to indicate the existence of profit-shifting behavior in our sample of Chinese MNCs.

6.2 The tax responsiveness of investment

In their analysis of profit-shifting, EM&W did not study profit-shifting directly. Rather, they investigated the existence of profit-shifting indirectly, through the tax responsiveness of investment. In their own words: "This paper investigates the tax responsiveness of multinational firms' investment decisions in foreign countries, distinguishing firms that are able to avoid taxes (avoiders) from those that are not (non-avoiders)." For their main measure of investment, they use MNC total fixed assets. We replace *PROFITS* with total fixed assets (*ASSETS*) and repeat the fixed effects FMM estimation of the preceding section. The switch from *PROFITS* to *ASSETS* causes a slight change in the four hypotheses that we will test:

Hypothesis 2.1: FMM should identify two groups of firms.

Hypothesis 2.2: Profit-shifters should be less tax elastic than non-profit-shifters.

Hypothesis 2.3: Profit-shifters are expected to be larger firms, as measured by PROFITS, ASSETS, EMPLOYEES, and SALES. Further, we expect the number of profit-shifters to be smaller than the number of non-profit-shifters.

Hypothesis 2.4: Profit-shifters should evidence a smaller tax elasticity effect from the 2008/2009 tax increase than non-profit-shifters.

Table 11 reports the results from testing these four hypotheses. To allay suspense, the results are virtually identical to those of Table 10. Starting with Panel A, we again find strong evidence that there are two groups of MNCs. However, we find no statistical difference in the estimates of the investment-tax elasticities of the two groups. Likewise, when we redo the analysis with an interaction term for the years after the change in tax law, we again find no evidence of significant differences between the two interaction effects.

Table 11: Robustness check: fixed effects estimates of investment-tax elasticity

VARIABLES	*NB Model* (1)	*FMNB Model* *Group 1* (2)	*Group 2* (3)
A. Investment-tax elasticity (without treatment interaction effect)			
ETR	0.0000	0.0003	0.0005
	(0.15)	(0.98)	(0.67)
Observations	44,741	44,741	
AIC	1,004,380	965577	
BIC	1,004,676	966178	
Hypothesis test (NB vs. FMNB): $\chi^2(35) = 38872.4$, p-value = 0.000			
Hypothesis test (Tax elasticities the same): $\chi^2(1) = 0.02$, p-value = 0.878			
B. Investment-tax elasticity (with treatment interaction effect)			
ETR	0.0006**	0.0003	0.0011
	2.28	(0.91)	(1.39)
ETRxTreatment	–0.0012**	0.0001	–0.0010
	(–2.04)	(0.09)	(–0.85)
Observations	44,741	44,741	
AIC	1,004,329	965,576	
BIC	1,004,642	966,212	
Hypothesis test (NB vs. FMNB): $\chi^2(37) = 38826.6$, p-value = 0.000			
Hypothesis test (Interaction effects the same): $\chi^2(1) = 0.47$, p-value = 0.494			

Note: "NB" and "FMNB" represent the negative binomial and (2-component) finite mixture negative binomial models, respectively. The dependent variable is *ASSETS*. Estimation is based on equations (4')–(6'). In addition to the variables listed in the table, all regressions include year dummy variables and MNC-specific averages of the time-varying variables. *t*-statistics are reported in parentheses and are based on clustered robust (by firm) standard errors. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

7 Conclusion

Despite much attention to the topic of tax avoidance in developing countries, and despite the importance of China to the world's economy, relatively little is known about the existence of profit-shifting in China. This study uses a large sample of MNCs in China to investigate the existence of profit-shifting. The 100% flat rate structure of China's corporate income tax system, along with heterogeneity in statutory rates due to industry, location, and other legislated preferences, allows us to equate effective tax rates with statutory tax rates, and, in turn, relate these to firm behavior.

Our analysis employs two main approaches to the problem. First, we directly estimate the relationship between profits and tax rates. Using this approach, we estimate a negative and significant relationship between tax rates and MNC profits, consistent with profit-shifting behavior. However, we recognize that this result could be spurious, as this estimating approach is vulnerable to omitted variable bias. Indeed, given that tax preferences are based on factors that could reasonably be connected to firm profits (type of industry MNC is engaged in, geographical location, business environment), omitted variable bias is expected, though the sign of the bias is a priori indeterminate.

Because of this concern, we turn to an innovative approach employed by EM&W, and use a two-component FMM to search for the existence of profit-shifting. Previous research has noted

that many, perhaps most MNCs cannot profit-shift because they do not have affiliates located in low-tax, tax havens. This division between firms that can, at least potentially, profit-shift, and those that can't, allow EM&W to apply their FMM approach to identify two groups of firms based on their tax elasticity behavior.

Pooling almost 60,000 observations from 2005–2009, we find evidence of two distinct groups of MNCs. However, subsequent analysis is unable to match these groups to profit-shifters and non-profit-shifters. In some cases, we find that the tax elasticities of the two groups are significantly different, but the characteristics of the two groups do not match those we expect of profit-shifters. In these cases, we find that firms categorized as profit-shifters have lower profits, are smaller in size, and more numerous than firms that are classified as non-profit-shifters. This is exactly the opposite of what we would expect, and what previous research has shown. In other cases, we find no significant difference in the tax elasticity of the two groups. As a result, we conclude that there is no evidence of profit-shifting among MNCs in China, at least over the period 2005–2009.

Why do our results differ from EM&W who, using a similar approach, find evidence of profit-shifting in their analysis of German MNCs? One reason is that the tax rates facing the firms in our sample are much lower than those faced by the German MNCs. EM&W report a mean effective average tax rate of approximately 27% for their sample. In contrast, our mean effective tax rate was approximately 18%. This would have made it more difficult for MNCs in China to find tax-attractive locations to which to shift profits. As corporate tax rates for foreign-owned MNCs in China have risen in subsequent years, it may be that more recent data may provide evidence of what we were unable to find in our sample. This is a topic for future research.

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See for the discussion paper: http://www.economics-ejournal.org/economics/discussionpapers/2017-26).

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