Article

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Firm performance following foreign acquisitions in Norway: Evidence of profit shifting?**

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Abstract: The paper examines what happened to the profitability of foreign-acquired firms following acquisition in Norway in the period 1994–2005. Propensity score matching combined with a difference-in-difference estimator is used to show that the profitability of the firms acquired goes down significantly following the acquisition. Cost elements, driving the lower profitability of the foreign-acquired firms, are the elements that could reflect transfer price manipulations. Furthermore, the results indicate that despite deteriorating financial performance, there is no significant change in the operating efficiency, liquidity, or solvency of the acquired firms. This may indicate that the observed changes in profitability can be explained by profit shifting activities of the acquired firms.

Keywords: Profit shifting, transfer pricing, multinational companies, propensity score matching

JEL classification: F23, H25, H26

1 Introduction

Multinational corporations can minimize their tax payments by shifting profits between affiliates in different countries. The incentives and opportunities for profit shifting arise because of corporate tax differences between the countries and mismatches in international tax law. The result is corporate tax revenue losses for high-tax countries and an uneven playing field between multinational and national firms.

The problem of tax-motivated profit shifting—also referred to as base erosion and profit shifting (BEPS)—has received a lot of attention in recent decades. While tax authorities and journalists uncover individual cases of tax planning regularly,[1] providing empirical evidence of profit shifting on a larger scale is challenging. Despite the increasing number of papers in this field, there is still a lot of uncertainty concerning the magnitude of the problem. The OECD (2015) has estimated the size of the corporate tax revenue losses due to profit shifting globally to be between USD 100 and 240 billion or four to ten percent of global corporate tax revenues, while new evidence from Tørsløv et al. (2021) indicates that as much as 40% of the foreign multinational profits (around USD 600 billion) is being shifted to tax havens.

The complexity of the problem and data limitations are the factors that make the analysis of BEPS difficult. Since no data source or method alone can provide a definite answer, using different methods and data sources to analyze companies from different countries

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1 Cases of tax planning by multinational companies in Norway are being uncovered by the Norwegian Tax administration and media regularly. For example, in 2013, the media, in cooperation with the Norwegian tax administration, revealed that Coca Cola, Nestle, Burger King, Peppes Pizza, and TGI Fridays had combined sales of over USD 650 million in Norway yet paid no more than USD 1 million in tax in total, with most of them paying no tax at all (Klassekampen, 2013). In 2017 it has been reported that Facebook in Norway paid just 0,5 million Norwegian kroner in corporate tax for 2016 despite its extensive coverage in the country (Aftenposten, 2017).

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and different periods of time is essential to obtain a better insight into the scope of the BEPS problem.

This paper contributes to existing empirical literature on tax motivated profit shifting by looking for evidence of BEPS among Norwegian multinational companies. It uses firm-level accounting data to analyze changes in the profitability of the Norwegian firms that have been acquired by foreign investors as compared with the profitability of similar national non-acquired firms. As profit-shifting activities impact profitability directly, the idea is to see whether the observed changes in profitability are consistent with the profit shifting activities of the firms in Norway. Since only foreign acquired firms have the incentives and opportunity to engage in tax-motivated profit shifting activities, the underlying assumption is that the observed differences in profitability development between these two types of firms can at least partially be attributed to profit shifting activities.

The results in this paper show lower profitability growth for the foreign-acquired firms following acquisition as compared with similar domestic firms, which is consistent with profit shifting behavior by the acquired firms.

These results rest on two important assumptions. The first one concerns accounting for selection into foreign ownership. Selection into foreign ownership means that firms that are being acquired may differ systematically in terms of both observable and unobservable factors from those that are not. These factors may also affect profitability differences, making it more challenging to attribute the observed differences in profitability to foreign acquisition. Accounting for this selection is the main underlying assumption for the identification strategy used in this paper. I have used propensity score matching to control for selection on observables when comparing the profitability of foreign acquired firms and similar national firms in Norway. To account for the possibility that selection bias can also be due to time invariant unobservable factors, propensity score matching is combined with the difference-in-difference estimator, as proposed by Blundell and Costa-Dias (2002).

Second, it is assumed that the changes in profitability for the acquired firms following foreign acquisition are due to profit shifting. In order to find more support for this evidence, I analyze whether the factors that drive the profitability differences are related to profit shifting and look closer at the changes in the real economic performance of the firms acquired. I find that the main driver of the lower profitability is a significant increase in the share of material costs, which is one of the most interesting items from a transfer pricing perspective. The results indicate further that the observed change in profitability is not associated with similar changes in other economic performance measures (as measured by total assets turnover, the current ratio, and interest coverage), which also supports the hypothesis that profit shifting may be driving the changes in profitability we observe. Providing this type of evidence by linking the profitability differences closer to profit shifting is one of the most important contributions of this paper.

This paper uses data for the period 1994–2005, which means that it describes the situation in Norway prior to many of the important changes in national and international legislation aiming to combat tax-motivated profit shifting being introduced. For example, stricter transfer price regulations were introduced in Norway in 2008, three years after the last year with data in this study. The thin capitalization rules were introduced in 2014 and then extended and tightened in 2019. The country-by-country reporting came into force in 2016. All of these measures were meant to limit the profit shifting activities of the multinational firms that this paper aims to capture. Thus, the results of this paper can serve as a benchmark for further analysis of the effectiveness of the new rules aiming to combat profit shifting behaviors of the multinational firms. If the profitability differentials documented here are due to the profit shifting activities of the multinational firms, and the measures introduced have been effective, one would expect that the replication of the same type of analysis of the data for later years would show that the profitability differential between foreign acquired and national firms has been reduced or evened out. This is confirmed by Hopland et al. (2019), who extend the analysis in this current paper in several respects and look at a longer data panel of Norwegian firms from 1993–2012. They show that the changes in profitability of the firms that became multinational became much less pronounced after the introduction of stricter transfer pricing regulations in 2007/2008, which supports the claim that the profitability differences between national and multinational firms we observe are due to profit shifting activities. This result is also consistent with the results of other empirical studies of profit shifting using different approaches that indicate that the extent of profit shifting seems to decrease over time—e.g., Lohse and Riedel (2013).

The rest of the paper is organized as follows. An overview of the existing literature is presented in Section 2. Section 3 describes the data sources, the sample, and

the variables used in the analysis. Section 4 presents estimation method and the main estimation results. Section 5 concludes by summarizing the main results.

2 Related literature

The question of whether profit shifting is a systematic and extensive problem is interesting and important from a policy perspective, but, as stated above, providing empirical evidence of profit shifting is challenging for tax administrations and researchers alike. The main reason for this is that it is difficult to know whether the financial numbers we observe are a result of real economic operations or tax planning activities on the part of the multinational firms. Without a thorough understanding of the value creation process in each of the corporations and insight into details of the internal transactions of each particular firm, it is thus practically impossible to provide direct evidence of profit shifting.

Despite the fact that we do not have a clear answer to the question of the magnitude of profit shifting, an extensive strand of empirical papers on profit shifting, using different data sources and methods, have contributed greatly to the understanding of the challenges of profit shifting, data limitations, and the approximate size of the problem.

Several of these papers give an excellent summary of the papers in this field, e.g., OECD (2015); Riedel (2018), and Dharmapala (2014, 2019). They provide a good overview of the studies, explain the divergence in the results in different studies, and discuss potential weaknesses and strengths of different approaches and possibilities for new research. They also show that there has been a great development in the literature with researchers testing different techniques, data sources, and identification strategies, thereby providing a better understanding of the profit shifting problem.

The general trend is that all the empirical papers in the field report evidence consistent with profit shifting, while the magnitude estimates vary among studies depending on the method/data sources used (e.g., earlier studies using macro-level data report higher estimates than later studies using firm-level data, which can be explained by the fact that firm-level data allow for controlling for firm and industry fixed effects), and they depend on the period studied (with more recent studies documenting smaller effects indicating the effectiveness of the BEPS counteractive measures).

To place this current paper in the larger framework of the extensive existing literature requires an explanation of the distinction between the empirical studies following the direct and indirect approaches. Studies following the direct approach normally focus on one profit shifting channel at a time, of which transfer pricing and debt shifting are the most common. Direct studies investigating evidence of transfer price manipulations typically use internal trade data. These studies analyze whether the prices set on the goods and services traded between the affiliates of the multinational companies (internal or transfer prices) are being artificially over- or understated as compared with market prices (arm's length prices), or whether internal prices are sensitive to tax rates in a manner consistent with profit shifting. Swenson (2001); Clausing (2003); Bernard et al. (2006) do that type of analysis using international trade data from the U.S.; Vicard (2015) and Davies et al. (2018) use French import and export data; Cristea and Nguyen (2016) use data on Danish exports. All of these papers find evidence consistent with transfer price manipulations in the multinational firms. In the case of debt shifting, interest payments on internal debt and internal leverage are in focus—for example, Desai et al. (2004) provide evidence of debt shifting using data on foreign affiliates of American multinational corporations; Buettner and Wamser (2013) and Møen et al. (2019) use data on German multinational companies.

Other empirical studies on profit shifting, including this one, follow a so-called indirect approach. The general idea of the indirect approach is to look for evidence of profit shifting in some bottom-line measures, for example, taxable profits or taxes, which would reflect all profit shifting activities. Some of the studies in this field use country-level data, while others, such as this paper, analyze firm-level data. Some papers provide evidence of profit shifting by looking at the tax sensitivity of taxable income of multinational firms, such as Hines and Rice (1994), who use macro-level data, and Huizinga and Laevan (2008), who use firm-level data. Others exploit the variation coming from productivity shocks, such as Dharmapala and Riedel (2013), or tax reforms such as the introduction or strengthening of thin capitalization rules, as in Buettner et al. (2012). Still others (such as this one) use a corporate twin approach to compare similar multinational and national firms. Some of the studies use the corporate twin approach to compare tax payments between similar multinational and national firms, such as Egger et al. (2010). The results of our study are most closely related to the corporate twin

approach studies looking at the differences in taxable income between multinational and national firms, such as Grubert et al. (1993) and Grubert (1998) for the US, Langli and Saudagaran (2004) for Norway, Belz et al. (2013) for a sample of European firms, and Oyelere and Emmanuel (1998, 2002) and Bilicka (2019) for the UK. The results of my paper are consistent with the results reported in all these papers showing that foreign-controlled firms are systematically less profitable than comparable national firms, which is consistent with tax-motivated profit shifting behavior of multinational firms. These results are also consistent with Tørsløv et al. (2021), who use macroeconomic data and find among other things that in tax havens foreign firms are much more profitable than local firms, while the opposite is true for high-tax countries.

The main advantage of this indirect approach is that it can uncover profit shifting by all the different profit shifting channels. The main limitation of these studies is that the observed changes and differences in taxable income and taxes can capture more than just profit shifting activities. To address this limitation, most of the studies in this field use different approaches to show that changes in bottom line measures between different types of firms or over time can be attributed to tax-motivated profit shifting.

To investigate to what extent the reduction in profitability in the acquired firms in Norway following the acquisition can be attributed to profit shifting activities, I carried out further analysis to study what is driving the reported changes in profitability. I did that by decomposing the profitability measures and studying some of the items more closely. I found that acquired firms outperformed non-acquired firms in terms of sales and asset growth, and investigated further which particular items on the cost side may be causing the reduction in profitability. I looked more closely at what happens to the share of material costs, labor costs, and other operating costs following the acquisition. The results indicate that the negative profitability differences are mainly driven by the significant increase in the share of the material costs for the acquired firms. Material costs include payments for the raw materials, intermediary goods, and royalty and trademark internal payments, as long as they can be charged on any specific product or service. Thus, it is one of the most interesting items from a transfer pricing perspective. Even though we are not able to distinguish between the costs of materials traded internally and externally, it is known that the share of intra-firm trade in total trade of affiliates tends to be considerable in many countries (we do not have the numbers for Norway, but the share of internal exports in all affiliate exports is estimated to be 64% for neighboring Sweden (Lanz and Miroudot, 2011)). The significant differences in material costs between acquired and non-acquired firms are also consistent with the result in Oyelere and Emmanuel (2002), who also find that the lower profitability of the foreign-controlled firms in the UK is partially due to higher trading expenses, which they argue may be an indicator of transfer price manipulations by the suppliers, who are most likely to be related affiliates in other countries.

Furthermore, I have studied whether the change in profitability for the acquired firms follows their real economic performance, as measured by alternative financial ratios reflecting dimensions of performance other than profitability. In particular, I looked at how the changes in total assets turnover, the current ratio, and interest coverage relate to the development of profitability. A few studies look at the effects of foreign acquisitions on both profitability measures as well as other performance measures together (Fukao et al., 2008; Chen, 2011; Chari et al., 2012). Most of them find positive effects of foreign acquisitions on both efficiency and profitability measures of the acquired firms. To study changes in the productivity and efficiency of the firms, Fukao et al. (2008); Chen (2011); Chari et al. (2012) study indicators such as total factor productivity, employment, fixed assets, and sales. I found, in line with Fukao et al. (2008), that sales, as mentioned above, increase more following the acquisition for the acquired than for the non-acquired firms. Furthermore, the effect of foreign acquisitions on fixed assets (property, plant, and equipment) is found to be positive. While I do not have data to estimate total factor productivity, I used total assets turnover as a partial proxy. The results indicate that the total assets turnover improves following the foreign acquisitions, but the change is not statistically significant. Additionally, I looked at two other performance measures, current ratio (reflecting liquidity of the firms) and interest coverage (reflecting solvency of the firms), but found no statistically significant changes following the foreign acquisitions in these two measures of performance. These results may be a further indication that the observed change in profitability is not associated with similar changes in other performance measures of the firms. Below, I discuss the way in which profit shifting activities may affect these performance measures, and the implications of this for the results.

3 Data

3.1 The sample

The sample for the analysis is constructed by combining three different data sets. The first data set, provided by Dun & Bradstreet (D & B), contains data on the financial statistics of all companies registered in Norway. The second data set, SIFON, provides data on foreign ownership in Norwegian companies (inward FDI). Finally, I used data on direct investments of Norwegian companies abroad (outward FDI), from the Survey of Outward Foreign Direct Investment (Utenlandsoppgaven), collected by the Norwegian tax authorities. These three data sets are merged by unique company IDs, administered by the governmental Brønnøysund Register Center.

The initial sample consists of limited liability firms that either remained domestically owned (purely domestic) or became foreign controlled during the period considered (foreign acquired). A firm is considered foreign acquired if its total foreign ownership share changed in the period studied from below 50% to above. As the focus of the paper is on what happens to profitability of the foreign acquired firms, the sample only includes firms in Norway that do not have affiliates abroad. The sample is further restricted to include firms that belong to one of the following industries: manufacturing, wholesale trade, retail trade, transport, real estate, or R&D/business activities.

To avoid the potential "noise" from a large number of small companies, among which the share of multinational companies is very small, the sample is further limited to companies with average total assets or sales of more than NOK 1,000,000.[2] Furthermore, observations with extreme values for the key variables are excluded.[3]

The final sample consists of 629,919 observations over 12 years for 103,073 Norwegian firms. Table 1 shows the number of observations in the sample over time. Around 99% of the observations in the sample are for purely domestic firms. The rest are for firms that were subject to foreign acquisition during the period studied. In total, there are 8,796 observations of the foreign-acquired firms. The total number of acquisitions during the period studied in the sample is 1,040. Most of the acquired firms belong to the wholesale industry (28%), where they constitute two percent of all firms in the industry. Around 20% of all acquisitions are firms involved in R&D/business activities, followed by the firms in manufacturing and real estate industries, with 17% and 13% of acquisitions, respectively.

3.2 Variables

3.2.1 Outcome variables: Performance measures

Several profitability measures are studied to ensure that the choice of profitability measure does not affect the results. Return on sales is measured as a ratio of taxable income to sales (total operating income) and reflects the profit-generating capacity of all aspects of the firm, including its capital structure. As such, it does not account for differences in leverage or the capital intensity of the firms. From a profit shifting perspective, this means that it can reflect both transfer price manipulations and debt shifting activities. Return on total assets is a ratio of taxable income to total assets and is a measure for how profitable the company is in relation to its total assets. The operating margin, calculated as a ratio of earnings before interest, taxes, depreciation, and amortization (EBITDA) to sales would, among other things, eliminate distortions from various depreciation methods employed following the acquisition, as well as from the differences in capital structure of the firms. However, unlike return on sales, it will not reflect debt shifting activities, if any.

In addition to profitability, I looked at three alternative measures that are meant to reflect other aspects of the firms' economic performance (productive efficiency, solvency, and liquidity). I used Total Assets Turnover as a proxy for productive efficiency. It is calculated as the ratio of sales to the value of assets, and reflects the efficiency with which a firm is using its assets to generate sales revenue. The Current Ratio is the ratio of current assets to current liabilities and measures the ability of the firm to pay off its current or short-term liabilities with current assets. Firms with a large amount of current

2 All restrictions are made after the variables are deflated to 1998 NOK values using the average yearly CPI provided by Statistics Norway.

3 In particular, observations for which the ratio of taxable income to total assets and the ratio of taxable income to sales exceed one in absolute value are dropped. Similarly, observations with a leverage ratio of less than zero and greater than two are excluded. Observations with a tangibility ratio and labor cost share of less than zero and greater than one are dropped from the sample, too. To reduce the influence of outliers, the observations with values lower than the first percentile or larger than the 99th percentile are dropped for most of the remaining variables.

Table 1: Number of observations over time

			Inward FDI		
Year	Total	Purely domestic	pre-acquisition	acquisition	post-acquisition
1994	40,225	39,754	392	79	0
1995	42,876	42,346	428	30	72
1996	45,722	45,163	423	32	104
1997	48,895	48,273	468	27	127
1998	51.741	51,041	513	34	153
1999	53,185	52,435	500	68	182
2000	54,790	53,988	484	88	230
2001	55,982	55,139	414	124	305
2002	56,292	55,423	343	119	407
2003	58,120	57,237	268	110	505
2004	60,168	59,265	134	172	597
2005	61,923	61,059	0	157	707
Total	629,919	621,123	4,367	1,040	3,389

assets (such as cash and cash equivalents) are better positioned to pay off current liabilities at their due dates without having to sell off long-term revenue-generating assets. Interest Coverage is calculated as the ratio of earnings before interest and taxes (EBIT) to interest expense. It measures the firm's solvency, and reflects how easily it can pay interest expenses on outstanding debt.

In addition, I studied the corresponding development in sales, total assets, fixed assets, and leverage. Sales are defined as operating income from the income statement. Total assets are defined as the sum of debt and equity in the balance sheet. Fixed assets cover property, plant, and equipment. The leverage variable is constructed as a share of debt to total assets as reported in the balance sheet.

3.2.2 Other Outcome Variables

To examine what drives the differences in profitability between the acquired and non-acquired firms, I looked at how different cost items from the income statement change following a foreign acquisition. Material costs (of goods sold) cover direct material expenses incurred by firms (raw materials), when they purchase goods for resale or buy parts for assembling the goods sold, as well as royalty fees and license payments for the sold goods. This cost item reflects, among other things, transfer prices paid to the related parties in these transactions. Labor costs cover wages and salaries, as well as payroll tax, pension costs, and other employee benefits. Other operating costs are calculated by subtracting material costs and labor costs from the total operating costs. To see whether any of these costs in particular may be driving the profitability differences, I scaled each cost by operating income. I then looked at the differences in development in each of those for the acquired firms from before to after the acquisition and for the matched non-acquired firms.

3.2.3 Covariates

A number of variables are used as covariates when we estimate the probability of the firms becoming foreign acquired. In addition to the variables described above (operating income, fixed assets, total assets, leverage), age is used and is constructed as the difference between the current year and the year of incorporation of a firm. Market share is also used and is measured as the share of sales of a firm to the total sales in the industry, where industry affiliation is based on three-digit NACE codes.

3.3 Summary statistics

The summary statistics for the outcome variables and the covariates described above are provided in Table 2. As expected, foreign acquisition targets are much larger in size than the rest of the firms, both in terms of sales and assets, and also possess much higher market shares than domestic firms. Age does not seem to be a determining factor for acquisitions, based on the summary statistics.

While foreign acquisition targets do not differ much from the rest of the firms in terms of capital structure, purely domestic firms have comparatively higher shares of fixed assets in their total assets. Tangibility decreases even further in foreign targets following the acquisition. This may reflect disinvestment as a part of the restructuring activities undertaken by the new owners. At the same time, the acquired firms are shown to grow considerably in terms of total assets following the acquisition.

The summary statistics show that firms that were foreign acquired were less profitable than purely domestic firms before the acquisition. Profitability decreases even

Table 2: Summary statistics for the main covariates

			Inward FDI		
Variable	Total	Purely domestic	pre-acq.	acq.	post-acq.
Return on sales	0.0997	0.1002	0.0591	0.0604	0.0587
	(0.2389)	*(0.2393)*	*(0.2078)*	*(0.2252)*	*(0.2004)*
Return on total assets	0.0884	0.0885	0.0818	0.0647	0.0771
	(0.2035)	*(0.2032)*	*(0.2161)*	*(0.2439)*	*(0.2226)*
Operating profit margin	0.2114	0.2126	0.1442	0.1254	0.1109
(EBITDA)	*(0.2975)*	*(0.2979)*	*(0.2675)*	*(0.2639)*	*(0.2327)*
Total assets turnover	2.136	2.136	2.140	2.069	2.207
	(1.924)	*(1.928)*	*(1.636)*	*(1.524)*	*(1.466)*
Current ratio	1.744	1.745	1.669	1.603	1.789
	(2.158)	*(2.162)*	*(1.843)*	*(1.614)*	*(1.952)*
Interest coverage	27.25	27.14	30.99	33.44	42.09
	(91.11)	*(90.79)*	*(98.72)*	*(107.75)*	*(125.14)*
Sales	13,720	13,107	38,040	62,109	79,792
	(98,263)	*(95,391)*	*(128,370)*	*(336,146)*	*(255,406)*
Total assets	11,208	10,795	31,246	48,001	49,806
	(116,197)	*(113,666)*	*(189,080)*	*(324,952)*	*(246,586)*
Fixed assets	4,104	4,048	8,650	11,850	6,207
	(63,876)	*(63,367)*	*(93,019)*	*(186,535)*	*(24,221)*
Labor costs	2,262	2,146	7,603	11,635	13,650
	(12,796)	*(11,934)*	*(27,466)*	*(72,487)*	*(39,394)*
Material costs	7,977	7,642	20,294	30,328	46,557
	(74,241)	*(72,707)*	*(86,936)*	*(138,373)*	*(195,346)*
Labor cost share	0.2059	0.2057	0.2281	0.2222	0.2112
	(0.1859)	*(0.1858)*	*(0.1924)*	*(0.1922)*	*(0.1793)*
Material cost share	0.3546	0.3537	0.3899	0.4126	0.4550
	(0.3121)	*(0.3122)*	*(0.3016)*	*(0.3040)*	*(0.2953)*
Other operating costs share	0.2832	0.2833	0.2815	0.2778	0.2559
	(0.2168)	*(0.2169)*	*(0.2209)*	*(0.2094)*	*(0.2054)*
Tangibility	0.2619	0.2634	0.1940	0.1411	0.1111
	(0.3388)	*(0.3395)*	*(0.2911)*	*(0.2734)*	*(0.2301)*
Leverage	0.7791	0.7794	0.7652	0.7823	0.7381
	(0.2582)	*(0.2580)*	*(0.2563)*	*(0.2798)*	*(0.2852)*
Market share	0.0031	0.0029	0.0105	0.0133	0.0170
	(0.0261)	*(0.0253)*	*(0.0528)*	*(0.0584)*	*(0.0689)*
Loss-making	0.2460	0.2458	0.2512	0.3163	0.2606
	(0.4307)	*(0.4306)*	*(0.4338)*	*(0.4653)*	*(0.4390)*
Age	11.72	11.71	11.57	10.23	13.41
	(13.79)	*(13.77)*	*(15.77)*	*(13.75)*	*(13.71)*
Obs.	629,919	621,123	4,367	1,040	3,389

further following acquisition, and in turn, profitability differences between the acquired and non-acquired firms increase further after acquisition. Similarly, the share of firms with losses is slightly larger among the acquired firms as compared with purely domestic firms.

This may indicate that foreign investors choose the more poorly performing firms for acquisition (lemon picking). The share of loss-making firms (defined as a share of the firms with non-positive taxable income) increases slightly following acquisition, reflecting the fact that foreign investors do not always manage to improve the performance of the acquired "lemon" firms and some of the acquisitions fail. It is therefore important to test whether the decrease in profitability following acquisition may be driven by the failed acquisitions rather than profit shifting.

Turnover, current ratio, and interest coverage all increase for the firms acquired following acquisition, indicating that acquired firms seem to become slightly more effective in the post-acquisition period.

4 Empirical analysis

4.1 Estimation strategy

The main empirical challenge in this paper is to estimate the causal effects of foreign acquisitions on the performance of acquired firms. This is a typical treatment evaluation problem, where foreign acquisition can be considered a treatment, and the different performance measures to be studied constitute the outcomes. This problem can be considered within a counterfactual framework, also known as the potential outcome model (Roy, 1951; Rubin, 1974). In this framework, a treatment (T) defines the existence of two possible states: the treatment exposure state and the no-treatment or control state. We can never observe potential outcomes in both treated and control states for each of the units, or firms, so counterfactuals for each of the states will always be missing. This is a fundamental challenge of counterfactual models. The average treatment effects can, however, still be calculated if we can approximate the missing counterfactual outcomes. The average treatment effect on the treated (ATT), which is focused on in this paper, requires that we only approximate the counterfactual for the treated units. Outcomes of non-acquired domestic firms (non-treated units) are used to construct the counterfactual in this paper.

The average treatment effect can formally be expressed as follows:

$$\begin{aligned} ATT &= E\left(\Pi_i(1) - \Pi_i(0) \mid Tr = 1\right) \\ &= E\left(\Pi_i(1) \mid Tr = 1\right) - E\left(\Pi_i(0) \mid Tr = 1\right) \end{aligned} \tag{1}$$

where $E(\Pi_i(1) \mid Tr = 1)$ is the average outcome observed for those units that have been treated and $E(\Pi_i(0) \mid Tr = 1)$ is the unobserved counterfactual average outcome of the treated units. The latter can be approximated by an observed average outcome of the non-treated units, $E(\Pi_i(0) \mid Tr = 0)$. The observed difference in average outcomes between the two groups will, however, reflect both the average treatment effect on the treated units and systematic differences between the two groups resulting from self-selection into treatment:

$$\begin{aligned} &E\left(\Pi_i(1) \mid Tr = 1\right) - E\left(\Pi_i(0) \mid Tr = 0\right) \\ &= ATT + \left(E(\Pi_i(0) \mid Tr = 1) - E\left(\Pi_i(0) \mid Tr = 0\right)\right) \end{aligned} \tag{2}$$

If the selection expression (last term in the brackets above) is not equal to zero, the estimate of the average treatment effect on the treated units will be subject to selection bias. In this case, we cannot say with certainty whether the effect we estimate is due to the treatment or to systematic differences between the treated and the control units. In the context of this study selection bias may arise from the fact that foreign acquisition targets are not chosen randomly and may differ from the non-acquired firms both in terms of observable and non-observable characteristics. To account for this potential bias, while estimating the effect of foreign acquisitions, I use propensity score matching combined with the difference-in-difference estimator. Propensity score matching allows us to find a match for each of the acquired firms among the non-acquired domestic Norwegian firms, based on similar pre-acquisition characteristics. As matching on many different characteristics is difficult in practice, the matching is done based on propensity scores. This is a common method proposed by Rosenbaum and Rubin (1983) to reduce the dimensionality problem. The propensity score is an estimated predicted probability of becoming treated, conditional on the observed characteristics, X_i: $p(X_i) = Pr(Tr_i = 1 \mid X_i)$.

In the context of this study, it represents the probability of becoming acquired, so that the counterfactual group to the acquired firms will be composed of the non-acquired firms with similar probabilities of becoming acquired.

Identification of the average treatment effect on the treated units using propensity score matching requires

that two assumptions are satisfied (Rosenbaum and Rubin, 1983). The conditional independence assumption states that, based conditionally on all the firm characteristics (X_i), the control group would have the same distribution of outcomes as the treated group if they had not been treated. Hence, after controlling for these firm characteristics, the "hypothetical" outcome distribution of the acquired firms in the absence of acquisition would be the same as the outcome distribution of the non-acquired firms. If the conditional independence assumption holds when based on X_i, it also holds when based on propensity scores (Rosenbaum and Rubin, 1983).

The common support assumption is another important assumption behind the propensity score matching estimator, which ensures that treatment status cannot be perfectly predicted by any of the covariates, so that matches for both treatment and control group observations can be found: $0 < Pr(Tr_i = 1 \mid X_i) < 1$.

The common support restriction implies that if the support of covariates does not overlap for the acquired and non-acquired firms, matching should be performed over the region of common support. Restricting matching to the common support region is advised (Heckman et al., 1997) and implies in practice that some of the units would be dropped to ensure that we do not use units with propensity scores that are too far off, which thus ensures that we compare only comparable units.

If selection depends not only on observable, but also on unobservable factors, the conditional independence assumption described above can be problematic, and the simple propensity score matching estimator may be both biased and inefficient. It may, for example, be argued that foreign takeover targets possess some type of intangible assets, such as unique production processes, that are not easily reflected in accounting figures, but that affect both their attractiveness for foreign investors and their performance. As my data are in panel format, this issue can be addressed by combining the PSM estimator with the difference-in-difference (DiD) estimator, as proposed by Blundell and Costa-Dias (2002). This implies that instead of comparing the post-acquisition performance of the acquired and the matched non-acquired firms, development in performance over time (from the pre- to the post-acquisition periods) for both groups of firms is compared, and the PSM DiD estimator is as follows:

$$\beta_{DiD}^{PSM} = \frac{1}{N_{Tr}} \sum_{i=1}^{N_{Tr}} \left[\left(\Pi_{it}^{PostAcq}(1) - \overline{Pi}_i^{PreAcq(3)}(0) \right) - \sum_{j=1}^{N_{Co}} w_{i,j} \left(\Pi_{jt}^{PostAcq}(0) - \overline{Pi}_j^{PreAcq(3)}(0) \right) \right] \quad (3)$$

where $\Pi_{it}^{PostAcq}$ is performance in the post-acquisition years, with $t \in (0, 1, 2, 3, 4)$, and is the average performance in the pre-acquisition period (average for the three years prior to acquisition):

$$\overline{Pi}_i^{PreAcq(3)} = \frac{1}{N_{T'_{pre}}} \sum_{t'=1}^{T'_{pre}} \Pi_{it'} \quad (4)$$

where T'_{pre}.

In addition to looking at year-by-year changes in performance following the acquisition, I also looked at changes in average performance for the four years following the acquisition as compared with average performance three years prior to acquisition.

4.2 Propensity score matching

The propensity score is estimated using probit regression on the following model:

$$P(T_{it} = 1) = F\left(\overline{X}_i^{PreAcq(3)}, \sigma_t, \alpha_j, \alpha_k \right) \quad (5)$$

where the dependent variable T_{it} is a dummy that is equal to 1 for firms in the year of acquisition and 0 otherwise. X_i represents covariates as described below, which are expected to affect the probability of a firm becoming a foreign takeover target. All characteristics are averaged over the three years prior to acquisition. This means that the propensity score estimation is based on the average pre-acquisition characteristics of the firms rather than pre-acquisition characteristics in one particular year prior to acquisition. This makes the estimation procedure less vulnerable to the year-to-year fluctuations and temporary shocks in the chosen covariates right before the acquisition. σ_t, α_j, and α_k capture time, industry, and region-specific effects.[4]

To select the covariates for the propensity score estimations, I followed the existing literature, using matching methods to estimate the performance effects of foreign acquisitions (Bandick and Karpaty, 2010; Chen, 2011; Chari et al., 2012; Fukao et al., 2008; Arnold and Javorcik, 2009).

4 Industry dummy variables are based on two-digit NACE codes. Region-specific dummies are dummies for each of the five geographic regions in Norway (landsdeler).

Table 3: propensity score estimation — probit results

	Coefficient	Standard Error	*P*-value
Return on sales	−0.4463***	*(0.0973)*	0.000
Tangibility	−0.3929***	*(0.0711)*	0.000
Market share	0.5742**	*(0.2856)*	0.044
Ln(Total Assets)	0.1765***	*(0.0099)*	0.000
Age Q2	−0.1496***	*(0.0377)*	0.000
Age Q3	−0.1676***	*(0.0395)*	0.000
Age Q4	−0.2554***	*(0.0401)*	0.000
Year dummy variables	Yes		
Industry dummy variables	Yes		
Region dummy variables	Yes		
Pseudo R-squared	0.1160		
LR chi-squared	992.08		
Observations	389,749		
Treated	568		
Non-treated	389,181		

The covariates are averaged over three years prior to acquisition (except for age). The coefficients reported are in log-odds form.

To control for size, I included a logarithm of total assets for the firm. Dummy variables for each of the yearly quantile age groups were also included. Furthermore, I controlled for the tangibility of the assets. The share of tangible assets is meant to capture the composition of target firms' assets. Profitability in terms of returns on sales is also included in the estimation to account for the size of the firms in terms of sales and for the possibility that foreign investors systematically choose more or less profitable firms as their targets. A variable for a firm's market share in terms of sales is included to account for the possibility that firms with a larger market share are more attractive foreign acquisition targets.[5]

The results of the probit model are presented in Table 3. The results show that larger firms with a higher market share are more attractive targets for foreign acquirers. In terms of profitability, measured by return on sales, the foreign acquirers seem to have preference for less profitable firms, which is consistent with the descriptive statistics in Table 2. In terms of age, younger firms are shown to be more likely to be acquired than older firms.

To ensure that we find matches for each of the treated firms from a comparison group consisting of firms with similar propensity scores, a common support restriction is imposed by excluding observations from both groups that have a probability of being acquired that are higher than the 99th percentile and lower than the first percentile of the propensity score distribution in the acquired group.[6] This implies that in total, 86,170 observations are dropped from the analysis, of which ten are acquired firms (around 1% of all acquired firms). The number of acquisitions for which the propensity score could be estimated and that survived the common support restriction is 558.

To test the quality of the matching procedure, I looked at the balancing of the covariates by doing a number of tests to establish that the distribution of covariates is comparable between the acquired and the non-acquired firms (see Appendix A for details).

5 Operating efficiency measures (current assets ratio and total assets turnover), interest coverage, and leverage and wage ratios are not included in the main estimation equation since they did not have a significant effect on the acquisition probability when they were included in the estimation equation. In addition, including a large number of covariates in the estimation equation makes it difficult to achieve the balancing of all the covariates.

6 The common support restriction is based on percentile values rather than minimum and maximum values (common) for the propensity scores, due to the presence of outliers (the few observations with extreme values) as mentioned above. The percentile range of the treatment group is used as a benchmark because the focus of the paper is on the treated firms: what I want to estimate is the average treatment effect on the treated group.

The matching was completed using the one-to-one nearest-neighbor method. This method requires that the absolute distance between the propensity scores of treated and control units is minimized, so that the outcome of the control (non-acquired) firm that has the propensity score closest to the treated (foreign-acquired) firm is used as a prediction of the missing potential outcome for that treated firm. The advantage of this method is that it allows bias to be minimized by avoiding use of more, but poorer, matches. Each of the non-acquired firms is allowed to be used as a match for more than one acquired firm, which can also minimize the propensity score distance between the acquired and the matched non-acquired firms, and thus reduce bias. The following matching algorithm is used[7]: first, the observations are sorted based on the estimated propensity score. Next, the closest neighbor is chosen to each of the treated units whether it is above or below the treated unit in the sorted list. If the neighbors from above and below are equally good, the match is drawn randomly from the two. Finally, the DiD estimates of the average treatment effect on the treated units are calculated by comparing the differences between the two groups before and after the foreign acquisition period.

The robustness of the main results is tested using other matching methods (kernel and radius methods) in the sensitivity tests section (see Appendix B).

4.3 Estimation results

4.3.1 What happens to the profitability of the acquired firms following the foreign acquisitions?

The estimates for the three different profitability measures are reported in Table 4. The estimates are DiD estimates showing the differences in the change in profitability for each of the four post-acquisition years (the first five rows in the table) compared with average profitability over the three years prior to acquisition, for the acquired and matched non-acquired firms. The average estimate in the last row is the difference between average profitability in the four years after the acquisition as compared with the average profitability three years prior to the acquisition for the acquired and matched non-acquired firms.

For example, the average operating margin estimate of −0.018 in the last row of column 3 in Table 4 means that on average, the change in average profitability four years after the acquisition as compared to average

7 The nearest neighbor one-to-one matching procedure is implemented using Stata pre-written command attnd.ado to find a match for each of the acquired firms among non-acquired firms within the same year and industry; see Becker and Ichino (2002) for details.

Table 4: ATT matching estimates, profitability measures

	ATT		
	Taxable income/Sales (1)	EBITDA/Sales (2)	Total assets (3)
Differences	Benchmark: 3 years average prior to acquisition		
The year of acquisition	*−0.004*	*−0.012*	*−0.006*
	(−0.474)	(−1.160)	(−0.893)
1 year after acquisition	*−0.015*	**−0.038**	*−0.014*
	(−1.508)	(−3.387)	(−1.613)
2 years after acquisition	**−0.019**	**−0.047**	**−0.018**
	(−1.982)	(−3.889)	(−2.019)
3 years after acquisition	**−0.022**	**−0.033**	*−0.012*
	(−2.003)	(−2.706)	(−1.196)
4 years after acquisition	**−0.042**	**−0.059**	**−0.019**
	(−3.421)	(−4.683)	(−1.771)
Average (4 years after acquisition)	**−0.030**	**−0.052**	**−0.018**
	(−3.996)	(−5.490)	(−2.636)

The matching estimates in this table are based on nearest neighbor 1-to-1 matching with replacement. The coefficients in bold are significant at least at the 10% significance level. The *t*-statistics are reported in parentheses). The standard errors (not reported) are analytical standard errors calculated using the formula in Becker and Ichino (2002).

profitability three years prior to acquisition for acquired firms is 1.8 percentage points lower than the change in the corresponding period for the matched non-acquired firms. This corresponds to a reduction in profitability for the acquired firms of about 14%. All the estimates reported are negative, which means the performance of acquired firms in Norway is reduced after acquisition. The size of the estimates tends to increase in absolute value in the later years following the acquisition.[8] The estimates remain negative—economically and mostly statistically significant—regardless of the profitability measure used but are the largest in absolute value when we look at return on total assets.

The coefficients for the operating margin (EBITDA) in relation to sales (column 3 in Table 4), which account for differences in the firms' leverage, are negative, economically significant, and mostly statistically significant. The fact that the coefficients are smaller in size as compared with return on sales (based on taxable income) may indicate that debt shifting may play a limited role but does not seem to be the main driving force for the result of negative profitability differential.

The estimates based on taxable income (columns 1 and 2 in Table 4) are comparable in size with the estimates in earlier related studies that use Norwegian data but other estimation methods, such as Langli and Saudagaran (2004), who use OLS, and Tropina (2010), who uses panel data methods. The results are also consistent with, and comparable in size to, the estimates in Belz et al. (2013), who also use propensity score matching in combination with the DiD estimation and find significantly negative effects of foreign acquisitions on profitability when the foreign acquirer is tax aggressive.

As a robustness test, I have tested whether the profitability differences may be driven by loss-making firms, which do not have the same type of incentives to involve in profit-shifting. The results indicate that even though loss-making firms are affecting the main results, this is not the group of firms driving the results. I have also tested whether the results are more pronounced for the firms that have a higher foreign ownership share than the default threshold of 50%, since the costs of engaging in profit shifting can be expected to be lower, and the opportunity to do so can be expected to be higher for these firms. The profitability differential was indeed larger in absolute value for those firms as compared with the rest of the acquired firms. The results of both these tests support the hypothesis that profit shifting may be the driving force behind the observed profitability differentials. See Appendix B for the results of these tests.

4.3.2 What is driving the observed profitability differentials?

In this section, I look more closely at the factors that may be driving the profitability differences between the acquired and the non-acquired firms. The results in Table 5 show that both taxable income, sales and total assets are growing faster for the acquired firms than for the matched non-acquired firms. The growth rates for the sales and total assets (that are used as scales in profitability measures above) are generally higher for the total assets and sales as compared with the growth rate for taxable income. This indicates that while the foreign-acquired firms do not seem to have any trouble generating sales income and growing by accumulating more total assets, their taxable income is not growing as fast as that of the corresponding non-acquired firms. The effect on the leverage ratios is on average negative, but there is considerable variation across the years (column 5 of Table 5). This is also an indication that the lower profitability differential is not driven by the potential debt shifting activities by the multinational firms, which is also consistent with the findings by Belz et al. (2013).

Furthermore, I have investigated whether any of the cost items in particular may be driving the negative profitability differential result. With the data available, I can examine more closely what happens to material costs, labor costs, and other operating costs scaled by the firms' operating income. Material costs are interesting in the context of this study, because they include transfer prices paid for the materials and intermediate goods bought from the related parties. These can be artificially manipulated to shift profits in or out of Norway, after firms become foreign acquired. Labor costs are also included in the estimations in order to test whether the lower profitability growth of the foreign-acquired firms is a result of the relatively higher wages following acquisitions.[9]

The results in column 1 of Table 6 indicate that following an acquisition, material costs grow significantly

8 Since the panel data used is unbalanced, the number of treated firms used in the matching varies across the years.

9 These are documented, for example, by Girma and Gorg (2007); Aitken et al. (1996); Feliciano and Lipsey (1999).

Table 5: ATT matching estimates, other performance indicators

	ATT				
	Sales	Taxable Income	Total Assets	Fixed Assets	Leverage Ratio
	(1)	(2)	(3)	(4)	(5)
Differences	Benchmark: 3 years average prior to acquisition				
The year of acquisition	**0.067**	**0.147**	**0.114**	*0.041*	**−0.031** (−2.917)
	(2.527)	(2.464)	(4.822)	(1.007)	
1 year after acquisition	**0.196**	**0.166**	**0.175**	**0.151**	*−0.005*
	(6.273)	(2.559)	(6.093)	(2.585)	(−.418)
2 years after acquisition	**0.236**	**0.289**	**0.198**	0.031	**−0.028**
	(6.311)	(3.631)	(5.872)	(.422)	(−1.815)
3 years after acquisition	**0.268**	**0.252**	**0.242**	**0.260**	**−0.068**
	(5.981)	(2.850)	(6.221)	(3.368)	(−3.987)
4 years after acquisition	**0.296**	**0.218**	**0.300**	**0.410**	*0.092*
	(5.382)	(2.312)	(6.138)	(4.315)	(1.249)
Average (4 years after acquisition)	**0.293**	**0.202**	**0.298**	**0.258**	**−0.040**
	(8.450)	(2.377)	(8.712)	(3.090)	(−3.041)

The matching estimates in this table are based on nearest neighbor 1-to-1 matching with replacement. The coefficients in bold are significant at least at the 10% significance level. All the variables (except leverage) are included in the estimations in log-form. The *t*-statistics are reported in parentheses. The standard errors (not reported) are analytical standard errors calculated using the formula in Becker and Ichino (2002). The mean values are reported in thousand NOK.

Table 6: ATT matching estimates, cost items

	ATT		
	Material costs of Goods sold /Sales	Labor costs /Sales	Other operating costs /Sales
	(1)	(2)	(3)
Differences	Benchmark: 3 years average prior to acquisition		
The year of acquisition	0.006	−0.005	0.003
	(0.963)	(−1.112)	(0.446)
1 year after acquisition	**0.034**	**−0.014**	−0.010
	(4.487)	(−2.685)	(−1.366)
2 years after acquisition	**0.018**	−0.005	0.000
	(2.213)	(−0.877)	(0.014)
3 years after acquisition	**0.027**	**−0.011**	−0.003
	(2.765)	(−1.901)	(−.330)
4 years after acquisition	**0.029**	−0.002	−0.009
	(2.710)	(−0.256)	(−0.966)
Average (4 years after acquisition)	**0.020**	0.000	−0.000
	(2.682)	(0.038)	(−0.020)

The matching estimates in this table are based on nearest neighbor 1-to-1 matching with replacement. The coefficients in bold are significant at least at the 10% significance level. The *t*-statistics are reported in parentheses. The standard errors (not reported) are analytical standard errors calculated using the formula in Becker and Ichino (2002).

more for the acquired firms as compared with the corresponding non-acquired firms. This result is consistent with the results of Oyelere and Emmanuel (2002) in the UK, who also find that trading expenses are partially responsible for the underperformance of the foreign-controlled firms in their sample. The labor costs share and the share of other operating costs, on the other hand, go down following the acquisition, but the decrease is mostly not statistically significant (columns 2 and 3 in Table 6).

As the material costs of goods sold include, but are not limited to, the materials traded internally, this does

not serve as direct evidence of profit shifting but is an additional piece of evidence that may indicate profit shifting by means of transfer pricing.

4.3.3 Changes in other performance measures following foreign acquisitions

In this section, I will test whether the negative changes in profitability reported in Table 4 are accompanied by corresponding changes in other performance measures. Total assets turnover is an indicator of the productive efficiency of firms, and reflects the efficiency with which firms are using their assets. The results in column 1 of Table 7 show that the estimates for the turnover differential between acquired and non-acquired firms vary in sign, from being negative right after the acquisition to becoming positive in the later years, but are not statistically significant. This indicates that foreign-acquired firms do not seem to significantly underperform relative to non-acquired firms in terms of efficiency. It can be argued that this measure may be affected by profit-shifting activities itself through sales, which can potentially include transfer prices on internal sales. If the profits are shifted by artificially lowering export sales prices, this would affect the total asset turnover negatively, meaning that the turnover would go down following the acquisition all else equal. The results in Table 5 show no indication of decreasing sales following the acquisition. There is, however, an indication that the profits may be shifted by the inflated material costs (Table 6). If foreign-acquired firms in Norway indeed shift profits out of Norway by artificially inflating the costs of internal goods traded, this efficiency measure should not be affected.

The DiD estimates for the current ratio are reported in column 2 in Table 7. This is a liquidity measure, which reflects the ability of the firm to pay off current liabilities with current assets. The estimated results show that the estimates for the current ratio are positive for all the years following the acquisition but not statistically significant.

Interest coverage, which can be considered an indicator of the solvency of the firms, reflects how easily a firm can cover its interest expenses. This performance measure can be argued to be affected by profit-shifting activities, both by means of transfer price manipulations (through the EBIT in the nominator) and by debt shifting (through financial expenses in the denominator). If acquired firms used both types of manipulations with the goal of shifting profits out of Norway, the numerator of this ratio would be understated, while the denominator would be overstated. This means that the effect of foreign acquisition on the interest coverage in the presence of profit shifting would be negative. The results in column 3 of Table 7 show that the estimate varies in size and

Table 7: ATT matching estimates, performance measures

	ATT		
Change from year before acquisition to	Total asset turnover	Current ratio	Interest coverage
	(1)	(2)	(3)
Differences	Benchmark: 3 years average prior to acquisition		
The year of acquisition	−**0.107**	−0.078	1.554
	(−2.20)	(−1.047)	(0.360)
1 year after acquisition	−0.034	0.001	2.415
	(−0.719)	(0.016)	(0.438)
2 years after acquisition	0.055	0.038	−2.584
	(1.003)	(0.344)	(−0.477)
3 years after acquisition	0.029	0.165	0.290
	(0.476)	(1.367)	(0.045)
4 years after acquisition	0.042	0.099	−9.364
	(0.619)	(0.723)	(−1.484)
Average (4 years after acquisition)	−0.031	0.074	−4.521
	(−0.632)	(0.794)	(0.949)

The matching estimates in this table are based on nearest neighbor 1-to-1 matching with replacement. The coefficients in bold are significant at least at the 10% significance level. The t-statistics are reported in parentheses. The standard errors (not reported) are analytical standard errors calculated using the formula in Becker and Ichino (2002).

sign for the different years of acquisition, on average being negative, but is never statistically significant.

To sum this topic up, while the effect of foreign acquisition on profitability is negative, we do not observe a corresponding significant negative effect of foreign acquisition on other performance measures. While this discrepancy is not a direct proof of profit shifting activities, it is consistent with the hypothesis that profit shifting drives the profitability differential rather than real performance changes.

5 Summary

This study investigates changes in the profitability of foreign acquired firms following acquisitions in Norway during the period 1994–2005. Using propensity score matching combined with DiD estimation, I have found that the average effect of foreign acquisitions on the profitability of acquired firms in Norway is negative. This result is consistent with earlier evidence from Norway (Langli and Saudagaran, 2004; Tropina, 2010) and may be indicative of profit shifting behavior. The sign of the aggregate net effect indicates that if profit shifting is really the driving factor behind this profitability differential, the net flow of profits is out of Norway, meaning that foreign-acquired firms may not be contributing their fair share of taxes in Norway.

One of the main contributions of this paper is that it studies more closely what is driving these profitability differences. I find that foreign-acquired firms grow more quickly following the acquisition as compared with their domestic counterparts in terms of both total assets and operating revenue. While they do not seem to have problems growing and generating sales, there seem to be certain expenses that limit their profit-generating capacity. My results indicate that while there are no significant differences in the changes of labor cost share and the share of other operating costs between the acquired and the non-acquired firms, the share of material costs of goods sold increases more for the acquired firms than for the non-acquired firms following the acquisitions. This cost item is interesting, because it includes transfer prices paid for the materials and intermediate goods purchased from related parties. I also compare the change in profitability from before acquisition to after acquisition for the acquired and corresponding non-acquired firms to the corresponding change in other performance measures, namely, solvency and liquidity, which reflect productive efficiency. I have found basically no statistically significant differences between foreign acquired and non-acquired firms in terms of these performance measures. Thus, even though the evidence provided in this paper is indirect, the findings are consistent with the fact that profit shifting by means of transfer pricing may be common among the number of foreign acquired firms in Norway.

It is also important to keep in mind that this paper describes the situation in Norway in the period before many of the important changes in national and international legislation aiming to combat tax-motivated profit shifting had been introduced (e.g., stricter transfer price regulations, the thin capitalization rules, and the country-by-country reporting). All these measures were meant to limit the profit shifting activities of the multinational firms that this paper aims to explore. If the profitability differentials documented in this paper are due to the profit shifting activities of the multinational firms and the measures introduced have been effective, the differentials would likely be lower if measured today. This is confirmed by Hopland et al. (2019), who look at a longer data panel of the Norwegian firms from 1993 to 2012, and show that the profitability changes among the firms that become multinational became much less pronounced after the introduction of stricter transfer pricing regulations in 2007/2008. This supports the claim that the profitability differences between national and multinational firms that we observe in this paper are due to profit shifting activities, and these estimates can potentially serve as a benchmark for further analysis of the effects of other BEPS measures.

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Appendix A

Covariate balancing

In this appendix, I will test the quality of the matching procedure described in section 4.2.

Conditional independence or covariate balancing requires that, conditionally depending on the estimated propensity score, the distributions of the observed covariates should be independent of the assignment into treatment (Rosenbaum and Rubin, 1983). As covariate balancing is an important indicator of the quality of the matching procedure, I have performed a number of tests to establish that after the matching is complete, the distribution of covariates is comparable between the acquired and the non-acquired firms.

Two indicators that are often used to assess the quality of matching are the pseudo R-squared statistic and median absolute standardized bias. I have reported both these measures before and after matching in order to assess the success of the matching procedure.

The pseudo-R-squared value in the probit estimations is a goodness-of-fit measure capturing how much of the estimated probability is predicted by the covariates in the model. If the model is successful in predicting the estimated probability of foreign acquisition, the covariates included in the probit model should not have any success in predicting treatment in a matched sample. In other words, pseudo-R-squared values from a probit on a matched sample should be close to zero. After the matching is done in this paper, the pseudo-R-squared statistic decreases to under 3% in all specifications considered (see Table A1). Next, the median absolute standardized bias is compared before and after matching. The median absolute standardized bias is based on the standardized biases calculated for each of the covariates X, which are defined as the ratio of the difference of sample means for the treated and matched non-treated units and the square root of the average sample variance in the two groups. The standardized bias helps to evaluate the "balance" created by the matching procedure in the distribution of variables between the treated and the control groups.

Examining the median of the standardized biases for the covariates used in estimating the propensity scores, before and after the matching procedure (Table A1, columns 5 and 6), indicates that matching considerably reduces the median absolute standard bias.

The results of the balancing test showing mean differences for the key variables between the matched firms in the treated and the control groups are reported in Table A2. The mean differences between the firms in the treatment and the control groups before matching are reported in the table for each of our main covariates, together with the standardized bias and the reduction in bias due to matching. While in most cases, the differences in the variables between the treatment and the control groups are statistically significant in the unmatched sample, they become (or remain) insignificant after the matching. The reduction in the bias of the covariates is in most cases significant and varies from around 45% to 99.7%.

Appendix B

Robustness tests

In this appendix, I will test the robustness of the main results presented above in several different ways. The main idea behind the first two tests is to test whether the profitability differences we observe are more pronounced for the firms that have larger incentives or opportunities to engage in profit shifting activities.

First, I tested whether the result of decreasing profitability may be driven by the loss-making acquired firms. Since firms with only positive profits would have incentives to shift profits abroad, the exclusion of loss-making firms should not affect the results if the negative effect of acquisitions on profitability we observe in the full sample is due to profit shifting activities. I define loss-making acquired firms as acquired firms that have non-positive profitability in each of the post-acquisition years. The results of estimations for the sample of firms excluding those are presented in panel II of Table A3. The estimates for all three profitability measures are still negative and statistically significant but lower in size. This indicates that even though loss-making firms are affecting the main estimates, this is not the group of firms driving the results.

Second, I tested whether the results are more pronounced for the firms that are acquired with higher foreign ownership share. The original definition of the acquisition is based on the majority ownership, i.e., acquisition of more than 50% of the shares by foreign investors. The costs of engaging in profit shifting can be expected to be lower, and the possibility of doing so is expected to be greater for the firms where the foreign ownership share is more than 90% or for those that are fully acquired. To test for that, I have rerun the

Table A1: Covariate balancing tests (Taxable income/Sales)

	Number of *t* treated	Number of controls	Probit pseudo R-squared before	Probit pseudo R-squared after	Median bias, before	Median bias, after
	(1)	(2)	(3)	(4)	(5)	(6)
0 (year of acquisition)	568	389,181	0.116	0.011	16.8	2.6
1st year post acquisition	413	320,833	0.121	0.009	18.6	2.7
2nd year post acquisition	311	268,098	0.130	0.010	20.4	2.7
3rd year post acquisition	241	221,337	0.150	0.015	22.2	4.3
4th year post acquisition	169	179,851	0.162	0.029	16.6	5.6
4 years post acquisition (average)	157	167,658	0.167	0.028	18.1	3.9

Table A2: Balancing test: Taxable income/ Total assets

Variable	Matching status	Mean (Treated)	Mean (Controls)	% bias	% reduction in bias	*t*-test	*p*-value
Taxable income/Sales	Unmatched	0.0761	0.0857	−6.7		−0.79	0.428
	Matched	0.0761	0.0780	−1.3	80.0	−0.13	0.897
Tangibility	Unmatched	0.1493	0.2862	−53.4		−5.80	0.000
	Matched	0.1493	0.1489	0.1	99.7	0.01	0.988
Market share	Unmatched	0.0225	0.0031	30.1		10.80	0.000
	Matched	0.0225	0.0129	15.0	50.4	1.22	0.223
Ln (Total Assets)	Unmatched	9.255	7.916	99.0		13..60	0.000
	Matched	9.255	9.199	4.1	95.8	0.33	0.744
Age q1	Unmatched	0.1975	0.2601	5.9		0.76	0.449
	Matched	0.1975	0.2484	8.6	−44.2	0.76	0.446
Age q2	Unmatched	0.2612	0.3058	−9.9		−1.21	0.224
	Matched	0.2612	0.2739	−2.8	71.5	−0.25	0.800
Age q3	Unmatched	0.2025	0.21145	0.3		0.04	0.968
	Matched	0.2229	0.18	−4.7	−1395	−0.41	0.681
Age q4	Unmatched	0.2484	0.2315	4.0		0.50	0.616
	Matched	0.2484	0.2548	−1.5	62.3	−0.13	0.897
Industry group 1	Unmatched	0.1975	0.1713	6.7		0.87	0.384
	Matched	0.1975	0.1656	8.2	−21.6	0.73	0.466
Industry group 2	Unmatched	0.4013	0.1529	57.6		8.64	0.000
	Matched	0.4013	0.4268	−5.9	89.7	−0.46	0.648
Industry group 3	Unmatched	0.0701	0.3259	−67.7		−6.84	0.000
	Matched	0.0701	0.0510	5.1	92.5	0.71	0.479
Industry group 4	Unmatched	0.0892	0.0660	8.7		1.17	0.242
	Matched	0.0892	0.1147	−9.5	−9.8	−0.74	0.457
Industry group 5	Unmatched	0.0892	0.1544	−20.0		−2.26	0.024
	Matched	0.0892	0.0764	3.9	80.5	0.41	0.683
Industry group 6	Unmatched	0.1529	0.1295	6.7		0.87	0.384
	Matched	0.1529	0.1656	−3.7	45.4	−0.31	0.759

Table A3: ATT matching estimates: robustness tests

		ATT		
	Acq.	Taxable income/ Sales (1)	Taxable income/ Total assets (2)	EBITDA/ Sales (3)
Differences		(4 years after acquisition (average) – 3 years prior to acquisition (average))		
I. Original sample	155	**−0.030**	**−0.052**	**−0.018**
		(−3.996)	(−5.490)	(−2.636)
II. Excluding loss-making firms	124	**−0.027**	**−0.038**	**−0.016**
		(−3.459)	(−4.000)	(−2.168)
III. Foreign ownership share over 90%	129	**−0.038**	**−0.061**	**−0.024**
		(−4.976)	(−5.554)	(−3.456)

Table A4: ATT matching estimates: different matching methods

	ATT		
	Taxable income/ Sales (1)	Taxable income/ Total assets (2)	EBITDA/ Sales (3)
Differences	(4 years after acquisition (average) – 3 years prior to acquisition (average))		
Nearest neighbor matching	**−0.030**	**−0.052**	**−0.018**
	(−3.996)	(−5.490)	(−2.636)
Kernel matching	**−0.031**	**−0.050**	**−0.025**
	(−3.65)	(−2.80)	(−2.60)
Radius matching	**−0.031**	**−0.050**	**−0.023**
	(−2.03)	(−3.28)	(−2.55)

main estimates for the sample of these firms. The results are presented in panel III of Table A3. The results are consistent with the hypothesis above: the firms acquired with higher ownership share (lower shareholdings by the minority Norwegian owners) have larger profitability differentials (in absolute value) than the rest of the acquired firms.

The results of both of these tests support the hypothesis that profit shifting may be the driving force behind the observed negative profitability differential between the acquired and matched non-acquired firms.

Lastly, I tested the robustness of the matching estimates using different matching techniques. The results of these estimations are presented in Table A4. The original results, using nearest neighbor method with replacement, are presented in panel I.

The estimates using caliper (radius) matching are presented in panel II. This method is a variation of the nearest neighbor method which uses all of the control units within a certain propensity score distance or caliper.

In kernel matching, shown in panel III, the counterfactual outcomes are weighted by the propensity score distance between acquired and non-acquired firms, so that the closest non-acquired firms have the biggest weight. The outcomes of the non-acquired firms are then averaged using these weights.

The choice of propensity score distance or caliper in the methods above is a question of trade-off between efficiency and bias: increasing the propensity score distance increases efficiency but also increases the bias resulting from using more (but sometimes poorer) matches. In the estimations presented in panels II and III of Table A4, the caliper is set to 0.005, which is two standard deviations from the propensity score in the sample. Extending the caliper to one or three standard deviations, for example, does not affect the results qualitatively.

Independently of the matching method chosen, all of the profitability differential estimates are negative and statistically and economically significant.

The matching estimates in this table are based on nearest neighbor 1-to-1 matching with replacement. The coefficients in bold are significant at least at the 10% significance level. The *t*-statistics are reported in parentheses). The standard errors (not reported) are analytical standard errors calculated using the formula in Becker and Ichino (2002).

The coefficients in bold are significant at least at the 10% significance level. The *t*-statistics are reported in parentheses. The standard errors for nearest neighbor matching (not reported) are analytical standard errors calculated using the formula in Becker and Ichino (2002). The standard errors for kernel and radius matching are bootstrapped standard errors. The caliper in both kernel and radius matching is set to 0.005.