Tax Reduction and Corporate Investment - Applying Big Data to Tax Policy Formulation

Ming-Che Lu  
Chaoyang University of Technology  
168, Jifeng E. Rd., Wufeng District, Taichung, 41349 Taiwan, R.O.C.  
886-4-23323000 ext. 4426  
mclu@cyut.edu.tw

Yi-Xuan Chen  
Chaoyang University of Technology  
168, Jifeng E. Rd., Wufeng District, Taichung, 41349 Taiwan, R.O.C.  
886-4-23323000 ext. 4426  
hot5589631@gmail.com

Yu-Ying Yang  
Chaoyang University of Technology  
168, Jifeng E. Rd., Wufeng District, Taichung, 41349 Taiwan, R.O.C.  
886-4-23323000 ext. 4426  
tops929638@gmail.com

Min-Xuan Sha  
Chaoyang University of Technology  
168, Jifeng E. Rd., Wufeng District, Taichung, 41349 Taiwan, R.O.C.  
886-4-23323000 ext. 4426  
alice1234565434@gmail.com

Yan-Wei Chen  
Chaoyang University of Technology  
168, Jifeng E. Rd., Wufeng District, Taichung, 41349 Taiwan, R.O.C.  
886-4-23323000 ext. 4426  
yanwei8684@gmail.com

Sih-Ling Lin  
Chaoyang University of Technology  
168, Jifeng E. Rd., Wufeng District, Taichung, 41349 Taiwan, R.O.C.  
886-4-23323000 ext. 4426  
sihlingling@gmail.com

ABSTRACT

In this paper, we apply big data to the tax reform evaluation for the Ministry of Finance of the Republic of China. From empirical data, we find strong evidences that the reduction of profit-seeking enterprise income tax rate indeed improves corporate investment. Some sensitivity tests are performed to ensure our results robust.

CCS Concepts

• Social and professional topics → Computing/technology policy → Commerce policy → Taxation
• Social and professional topics → Computing/technology policy → Commerce policy → Governmental regulations.

Keywords

Profit-seeking enterprise income tax; Corporate investment; Government policy.

1. INTRODUCTION

A few days ago, the Ministry of Finance of the Republic of China (hereafter, ROC) planned to implement an income tax reform plan. That is, profit-seeking enterprise income tax rate increases from 17% to 20% and the additional profit-seeking enterprise income tax rate for undistributed surplus earnings remained at 10%, the total corporate tax burden fell from 32.5% to 25.3%. The tax reform in 2010 provided us with an insight into the relationship between tax reduction and corporate investment.

The tax reform in 2010 has been showed that the decrease in the profit-seeking enterprise income tax rate significantly affects the company’s dividend policy [1]. Since the imputation tax credit on individual income tax for shareholders has become less, big shareholders’ cash dividends are subject to more tax. Therefore, companies will have incentives to reduce cash dividends, and the surplus will remain more within the companies.

According to the pecking order theory, due to capital cost consideration, companies usually use internal funds as their best financing option [2][3]. With the support of major shareholders, companies can expand the scale of investment through internal financing. Lower capital costs trigger more investment.

According to the free cash flow hypothesis, managers of firms with free cash flows tend to waste cash on investment projects with negative net present value [4][5]. The retention of surplus may result in free cash flows. Higher free cash flows lead to overinvestment.

This study will find empirical evidences that the reduction of profit-seeking enterprise income tax rate improves corporate investment.

2. METHODOLOGY

Our pre- versus post-2010 tax reform analysis is designed to test whether the reduction of profit-seeking enterprise income tax rate has had the desired impact on investment.
2.1 Measurement of Variables
Capital expenditure (CAPE)

Following with the framework of McNichols and Stubben [6], capital expenditure is used to proxy corporate investment. CAPE is calculated as capital expenditure scaled by beginning-of-year net property, plant, and equipment.

Tax reduction (TAXR)

TAXR is equal to 1 if the observation belongs to the post-2010 tax reform period, and 0 otherwise.

Tobin’s Q (TOBQ)

Tobin’s Q is used to proxy investment opportunity. TOBQ is the beginning-of-year market value of assets divided by book value of assets. \( TOBQ = \frac{MVE + TA - BVE}{TA} \), where \( MVE \) is the market value of equity, \( BVE \) is the book value of equity, and \( TA \) is the total assets, all measured at the beginning of the year.

Cash flows (CF)

Cash flows are included to control for difference in internal financing capability. CF is calculated as cash flow from operations scaled by the beginning-of-year property, plant, and equipment.

Earnings (EARN)

Earnings are included to control for difference in profitability. EARN is calculated as net income divided by the number of end-of-year common shares outstanding.

Time trend (TIME)

TIME is a trend variable equal to the difference between the current year and 2005.

2.2 Model Specification

The regression model to test whether there are differences in capital expenditure between the periods of pre- and post-2010 tax reform is as follows:

\[
CAPE_{it} = \beta_0 + \beta_1 TAXR_{it} + \beta_2 TOBQ_{it} + \beta_3 CF_{it} + \beta_4 EARN_{it} + \beta_5 TIME_{it} + \epsilon_{it}
\]

where CAPE is capital expenditure scaled by beginning-of-year net property, plant, and equipment; TAXR is a dummy variable equal to 1 if the observation belongs to the post-2010 tax reform period, and 0 otherwise; TOBQ is the beginning-of-year market value of assets divided by book value of assets; CF is the cash flow from operations scaled by beginning-of-year property, plant, and equipment; EARN is net income divided by the number of end-of-year common shares outstanding; TIME is a trend variable equal to the difference between the current year and 2005.

The positive coefficient on TAXR, \( \beta_1 \), reflects that 2010 tax reform improves corporate capital expenditures.

2.3 Data

We extract the financial data and stock price data from the Taiwan Economic Journal (TEJ) database. The sample firms used in this study are publicly traded companies that are listed on TSE or OTC. To examine the effect of the 2010 tax reform, this study uses five years before 2010 tax reform, that is, 2005, 2006, 2007, 2008, and 2009, and seven years after 2010 tax reform, that is 2010, 2011, 2012, 2013, 2014, 2015, and 2016.

The sampling criteria are as follows: 1. This study excludes financial institutions due to their special regulatory requirements; 2. This study deletes firm-year observations with missing required financial data. Finally, these sampling screens yield a sample of 15,320 firm-year observations to test whether there are differences in capital expenditure between the periods of pre- and post-2010 tax reform.

3. EMPIRICAL RESULTS

3.1 Descriptive Statistics

Table 1 summarizes the descriptive statistics of the sample. The statistics in this table shows that the mean ratio of capital expenditure to net property, plant, and equipment for the sample firms is 20.4%. There are 64% of firm-years in post-2010 tax reform period. The mean (median) Tobin’s Q is 1.404 (1.131), consistent with unrecognized assets making the market value of assets to exceed the book value of assets. The median ratio of cash flow from operations to beginning-of-year property, plant, and equipment for the sample firms is 0.234, suggesting that more than one half of the sample firms generate positive cash flow from operations. The mean and standard deviation of earnings per share is 1.698 and 2.842, respectively, indicating the variability of profitability for the sample firms.

Table 1. Descriptive statistics of the variables in our empirical model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPE</td>
<td>0.204</td>
<td>0.280</td>
<td>0</td>
<td>1.600</td>
<td>0.112</td>
</tr>
<tr>
<td>TAXR</td>
<td>0.640</td>
<td>0.479</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>TOBQ</td>
<td>1.404</td>
<td>1.026</td>
<td>0.169</td>
<td>38.058</td>
<td>1.131</td>
</tr>
<tr>
<td>CF</td>
<td>0.459</td>
<td>1.857</td>
<td>-5.190</td>
<td>9.030</td>
<td>0.234</td>
</tr>
<tr>
<td>EARN</td>
<td>1.698</td>
<td>2.842</td>
<td>-3.820</td>
<td>10.550</td>
<td>1.190</td>
</tr>
</tbody>
</table>

Notes:
1. This sample consists of 15,320 firm-years from 2005 to 2016.
2. The variables are defined as: CAPE is capital expenditure scaled by beginning-of-year net property, plant, and equipment; TAXR is a dummy variable equal to 1 if the observation belongs to the post-2010 tax reform period, and 0 otherwise; TOBQ is the beginning-of-year market value of assets divided by book value of assets; CF is the cash flow from operations scaled by beginning-of-year property, plant, and equipment; EARN is net income divided by the number of end-of-year common shares outstanding.

Table 2 reports the results of t-test which compares the group of firm-years in pre-2010 tax reform period versus the group of firm-years in post-2010 tax reform period. The results indicate significant differences in capital expenditure ratio, Tobin’s Q, cash flow from operations, and earnings per share. The fact that mean capital expenditure ratio in post-2010 tax reform period is less than that in pre-2010 tax reform period may stem from the declining trend of domestic investment in those years. The results show that mean Tobin’s Q in post-2010 tax reform period is larger than that in pre-2010 tax reform period, indicating higher investment opportunities after 2010 tax reform. The results show that mean cash flow from operations in post-2010 tax reform period is less than that in pre-2010 tax reform period, indicating lower internal financing capabilities after 2010 tax reform. The
results show that mean earnings per share in post-2010 tax reform period is larger than that in pre-2010 tax reform period, indicating higher profitability after 2010 tax reform.

Table 2. Tests of mean differences between pre- and post-2010 tax reform periods

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (Pre-2010)</th>
<th>Mean (Post-2010)</th>
<th>t-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPE</td>
<td>0.213</td>
<td>0.200</td>
<td>-2.692***</td>
</tr>
<tr>
<td>TOBQ</td>
<td>1.377</td>
<td>1.420</td>
<td>-2.465**</td>
</tr>
<tr>
<td>CF</td>
<td>0.546</td>
<td>0.411</td>
<td>4.322***</td>
</tr>
<tr>
<td>EARN</td>
<td>1.539</td>
<td>1.786</td>
<td>-5.230***</td>
</tr>
</tbody>
</table>

Notes:
1. There are 5,479 firm-years in pre-2010 tax reform period and 9,841 firm-years in post-2010 tax reform period.
2. The variables are defined as: CAPE is capital expenditure scaled by beginning-of-year net property, plant, and equipment; TOBQ is the beginning-of-year market value of assets divided by book value of assets; CF is the cash flow from operations scaled by beginning-of-year property, plant, and equipment; EARN is net income divided by the number of end-of-year common shares outstanding; TIME is a trend variable equal to the difference between the current year and 2005.
3. Numbers in the upper-right triangle are the Spearman rank-correlation coefficients, and numbers in the lower-left triangle are the Pearson correlation coefficients.
4. "***", "**", and "*" denote correlations are significantly different from 0 at 1%, 5% and 10% level, respectively.

3.2 Regression Analysis

Table 4 presents estimation results of the regression model presented in model specification section. The results mainly exhibit that the coefficient on TAXR (t-statistic = 4.924) is significantly positive at 1% level, suggesting that after controlling investment opportunity, internal financing capability, profitability, and time trend, the tax reform in 2010 significantly improve corporate capital expenditures. The results also exhibit that the coefficients on TOBQ, CF, and EARN (t-statistic = 20.151, 11.441, and 12.280, respectively) are all significantly positive at 1% level, documenting that investment opportunity, internal financing capability, and profitability are significantly positively related to corporate capital expenditures. Finally, the results exhibit that the coefficient on TIME is significantly negative at 1% level, indicating again the declining trend of domestic investment during our sample period.

Table 4. Estimation and test results in capital expenditure model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Predicted Sign</th>
<th>Estimate</th>
<th>Standard Error</th>
<th>t-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPE</td>
<td>β₀</td>
<td>+</td>
<td>0.146</td>
<td>0.005</td>
<td>27.592***</td>
</tr>
<tr>
<td>TOBQ</td>
<td>β₁</td>
<td>+</td>
<td>0.043</td>
<td>0.009</td>
<td>4.924***</td>
</tr>
<tr>
<td>CF</td>
<td>β₂</td>
<td>+</td>
<td>0.014</td>
<td>0.001</td>
<td>11.441***</td>
</tr>
<tr>
<td>EARN</td>
<td>β₃</td>
<td>+</td>
<td>0.010</td>
<td>0.001</td>
<td>12.280***</td>
</tr>
<tr>
<td>TIME</td>
<td>β₅</td>
<td></td>
<td>-0.010</td>
<td>0.001</td>
<td>-7.871***</td>
</tr>
</tbody>
</table>

Adj. R²: 7.3%

F-Statistic: 241.65***

Notes:
1. This sample consists of 15,320 firm-years from 2005 to 2016.
2. The variables are defined as: CAPE is capital expenditure scaled by beginning-of-year net property, plant, and equipment; TAXR is a dummy variable equal to 1 if the observation belongs to the post-2010 tax reform period, and 0 otherwise; TOBQ is the beginning-of-year market value of assets divided by book value of assets; CF is the cash flow from operations scaled by beginning-of-year property, plant, and equipment; EARN is net income divided by the number of end-of-year common shares outstanding; TIME is a trend variable equal to the difference between the current year and 2005.
3. "***", "**", and "*" denote significance at 1%, 5%, and 10% level, respectively.

Table 3 presents the simple correlation matrix for our analysis variables. Numbers in the upper-right triangle are the Spearman rank-correlation coefficients, and numbers in the lower-left triangle are the Pearson correlation coefficients.

Table 3. Spearman/Pearson correlation matrix

<table>
<thead>
<tr>
<th>Variable</th>
<th>CAPE</th>
<th>TAXR</th>
<th>TOBQ</th>
<th>CF</th>
<th>EARN</th>
<th>TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPE</td>
<td>1</td>
<td>-0.032***</td>
<td>0.241***</td>
<td>0.201***</td>
<td>0.276***</td>
<td>-0.071***</td>
</tr>
<tr>
<td>TAXR</td>
<td>-0.022***</td>
<td>1</td>
<td>-0.043***</td>
<td>0.027***</td>
<td>0.833***</td>
<td></td>
</tr>
<tr>
<td>TOBQ</td>
<td>0.215***</td>
<td>0.020**</td>
<td>1</td>
<td>0.285***</td>
<td>0.480***</td>
<td>0.010</td>
</tr>
<tr>
<td>CF</td>
<td>0.140***</td>
<td>-0.035***</td>
<td>0.118**</td>
<td>1</td>
<td>0.499***</td>
<td>-0.002</td>
</tr>
<tr>
<td>EARN</td>
<td>0.190***</td>
<td>0.042***</td>
<td>0.358***</td>
<td>0.267***</td>
<td>1</td>
<td>0.013</td>
</tr>
<tr>
<td>TIME</td>
<td>-0.048***</td>
<td>0.851***</td>
<td>0.027***</td>
<td>-0.017***</td>
<td>0.033***</td>
<td>1</td>
</tr>
</tbody>
</table>

Notes:
1. This sample consists of 15,320 firm-years from 2005 to 2016.
2. The variables are defined as: CAPE is capital expenditure scaled by beginning-of-year net property, plant, and equipment; TAXR is a dummy variable equal to 1 if the observation belongs to the post-2010 tax reform period, and 0 otherwise; TOBQ is the beginning-of-year market value of assets divided by book value of assets; CF is the cash flow from operations scaled by beginning-of-year property, plant, and equipment; EARN is net income divided by the number of end-of-year common shares outstanding; TIME is a trend variable equal to the difference between the current year and 2005.
3. "***", "**", and "*" denote significance at 1%, 5%, and 10% level, respectively.
4. SENSITIVITY ANALYSIS
We perform the following sensitivity tests. The results reported in Table 4 may exist estimation biases due to potential omitted variables. Thus, we repeat our analysis including industry/firm effects, presented in Table 5. As can be seen from Table 5, the coefficients of determination (Adjusted $R^2$) have increased to 8.9% and 23.6%, respectively, documenting that the potential omitted variable problem is effectively solved by including industry/firm effects. In addition, the results of Table 5 are qualitatively similar to those reported in Table 4, suggesting that our main findings are unlikely to be driven by potential omitted variable biases.

Table 5. Estimation and test results in capital expenditure model – including industry/firm effect

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient Estimate</th>
<th>t-Statistic Estimate</th>
<th>t-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>$CAPE_{it}$</td>
<td>$\beta_0 + \beta_1 TAXR_{it} + \beta_2 TOBQ_{it} + \beta_3 CF_{it}$</td>
<td>$\beta_4 EARN_{it} + \beta_5 TIME_{it} + \epsilon_{it}$</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0.209</td>
<td>7.169***</td>
<td>0.120</td>
</tr>
<tr>
<td>$TAXR$</td>
<td>$\beta_1$</td>
<td>0.041</td>
<td>4.816***</td>
</tr>
<tr>
<td>$TOBQ$</td>
<td>$\beta_2$</td>
<td>0.039</td>
<td>16.530***</td>
</tr>
<tr>
<td>$CF$</td>
<td>$\beta_3$</td>
<td>0.012</td>
<td>9.985***</td>
</tr>
<tr>
<td>$EARN$</td>
<td>$\beta_4$</td>
<td>0.011</td>
<td>12.799***</td>
</tr>
<tr>
<td>$TIME$</td>
<td>$\beta_5$</td>
<td>-0.010</td>
<td>-8.346***</td>
</tr>
</tbody>
</table>

Fixed industry effect: Yes
Fixed firm effect: Yes

Adj. $R^2$: 8.9% 23.6%
F-Statistic: 43.989*** 3.975***

Notes:
1. This sample consists of 15,320 firm-years from 2005 to 2016.
2. The variables are defined as: $CAPE$ is capital expenditure scaled by beginning-of-year net property, plant, and equipment; $TAXR$ is a dummy variable equal to 1 if the observation belongs to the post-2010 tax reform period, and 0 otherwise; $TOBQ$ is the beginning-of-year market value of assets divided by book value of assets; $CF$ is the cash flow from operations scaled by beginning-of-year property, plant, and equipment; $EARN$ is net income divided by the number of end-of-year common shares outstanding; $TIME$ is a trend variable equal to the difference between the current year and 2005.
3. *** denotes significance at 1% level; ** denotes significance at 5% level; * denotes significance at 10% level.

5. CONCLUSIONS
This research is motivated by government’s tax reform plan about profit-seeking enterprise income tax rate. Government claimed that this tax reform plan can improve corporate investment and promote overall economic growth. However, he could not provide relevant evidence to support his statement. The tax reform in 2010, similar to current income tax reform plan, produced a lot of researchable data for evaluating subsequent effect of current income tax reform plan. Our research object is to explore the relationship between tax reduction and corporate investment by applying empirical data.

We compare corporate capital expenditures for the pre-2010 tax reform period versus the post-2010 tax reform period, and find that after controlling investment opportunity, internal financing capability, profitability, and time trend, the tax reform in 2010 significantly improve corporate capital expenditures. Our results support government’s claims that reduction in profit-seeking enterprise income tax rate can increase corporate investment. Moreover, sensitivity tests are performed to ensure our results robust.

This study illustrates government policy reliant on big data by the results of 2010 tax reform. Obviously, the content and scale of tax reduction are relevant to the corporate decision-making. We ignore the difference between 2010 tax reform and current tax reform. The usefulness of our results is limited when applying to current tax reform. On the other hand, corporate investment may not necessarily be capital expenditure. Further researches may focus on the relationships between tax reduction and other investment activities.

6. REFERENCES