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Do corporate tax cuts increase investments?

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Do Corporate Tax Cuts Increase Investments?

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Do Corporate Tax Cuts Increase Investments?*

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ABSTRACT

This paper studies the effect of corporate taxes on investment. Using firm-level data on German corporations, we investigate the 2008 tax reform that cut corporate taxes by 10 percentage points. We expect heterogeneous investment responses across firms, since firms with a foreign parent have more cross-country profit shifting opportunities than domestically owned firms. Using a matching difference-in-differences approach, we show that, following the corporate tax cut, domestically owned firms increased investments to a larger extent than foreign-owned firms. Our results imply that corporate tax changes can increase corporate investment but have heterogeneous investment responses across firms.

Keywords: Corporate taxation, Investment

JEL classification: G31, H24, H25

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1. Introduction

The effect of taxes on corporate investment is a key motivator for governmental reform strategies to boost domestic economy. Recent stimulus packages and large tax reforms in OECD countries include corporate tax cuts, dividend tax reductions, and bonus depreciation allowances.[1] Previous literature on the effectiveness of such provisions shows mixed results, however. While there is empirical evidence that payout taxes affect the allocation of investments across listed firms (e.g., Becker, Jacob, and Jacob 2013), ambiguous findings are obtained for unlisted firms (e.g., Alstadsæter and Jacob 2013; Yagan 2013). In addition, evidence on the impact of bonus depreciation on corporate investment is mixed (e.g., House and Shapiro 2008; Hulse and Livingstone 2010).

Empirical evidence from firm-level data on the direct effect of the statutory corporate tax rate on investment is surprisingly rare. Djankov et al. (2010) analyze macro data from a cross section of 85 countries in 2004. They document a negative effect of statutory corporate tax rates on aggregate investment. Auerbach (1983) uses macro data from the United States. Some studies (e.g., Summers 1981; Feldstein, Dicks-Mireaux, and Poterba 1983; Auerbach and Hassett 1992; Cummins, Hassett, and Hubbard 1996; Devereux, Griffith, and Klemm 2002) apply tax policy measures that combine tax rate and tax base elements using the *q*-approach. Other studies (e.g., Jorgenson 1963; Hall and Jorgenson 1967; Chirinko, Fazzari, and Meyer 1999; Dwenger 2013) implement the user cost of capital approach. This paper aims to test the effect of a statutory corporate tax rate cut on firm investment.

There are three main challenges to studying the effect of corporate taxes on investment. First, one needs firm-level data on listed and unlisted firms, since the majority of firms in an economy are typically unlisted (e.g., Michaely and Roberts 2012; Alstadsæter and Jacob 2013; Yagan 2013). The second requirement relates to identifying tax rate variations. Third and most important, a convincing empirical identification strategy is required since the corporate tax is typically reduced for all corporations (e.g., Hanlon and Heitzman 2010).

We overcome these challenges and contribute to the literature on tax effects on corporate investment. First, we use a large panel of over 19,000 listed and unlisted firms from Germany

[1] Over the past decades, many OECD countries have substantially reduced the corporate tax rate: for example, the United States around the TRA in 1986, Australia in 1987, Austria in 1988 and 2004, Denmark in 1990, Germany in 2001, Italy in 1997, Japan around 1998, New Zealand in 1987, Norway and Sweden in 1991, and the United Kingdom between 1983 and 1986. Large dividend tax cuts (more than 10 percentage points) were, for example, observed in the United States in 2003, in Belgium in 1995, in Japan in 2004, in the Netherlands in 2001, in Spain in 1999, and in Sweden in 2006 for closely held, unlisted corporations. In response to the recent financial crisis, many European Union countries (e.g., Austria, Finland, France, Ireland, and the United Kingdom) implemented bonus depreciation schemes to increase corporate investment.

over the period 2004–2011 with information on the location of the ultimate shareholder. Second, the German 2008 tax reform reduced corporate taxes from 39% to 29%. This is a sufficiently large tax cut to induce investment responses. Third, since this tax cut applies to all German corporations, our identification of the tax effect on investment is based on a difference-in-differences approach. We compare domestically owned German corporations to corporations where the ultimate owner is a foreign corporation.

The intuition behind our empirical identification strategy relates to differences in profit shifting opportunities across firms. Consider two firms with similar economic activity but different ownership structures. In contrast to a firm with a foreign parent corporation, a domestically owned corporation has no (or fewer) opportunities to shift income across borders. Several empirical studies (e.g., Rego 2003; Dyreng and Lindsey 2009; Dyreng, Hanlon, and Maydew 2010) provide evidence that, due to cross-border profit shifting, firms with foreign operations have lower effective tax rates on corporate profits than firms without foreign operations. German corporations with foreign parents engage in international profit shifting (Weichenrieder 2009) and thus have an effective tax rate below the statutory tax rate and below the tax rate of domestically owned firms. We argue that a cut in the statutory tax rate for all firms has heterogeneous effects across firms. The effective cut in corporate tax rates is larger for domestically owned firms than for foreign-owned firms. Using a simple model, we show that the tax sensitivity of foreign-owned firms is reduced by the percentage of profits shifted abroad. We therefore expect the investments of domestically owned firms to respond more to the 2008 corporate tax cut than the investments of corporations with a foreign parent.[2]

To ensure that our empirical results are not driven by potential differences in the economic activity of domestically owned corporations and firms with foreign parents, we use a one-on-one matching procedure without replacement. That is, we compare firms that are similar in size, asset structure, debt policy, and turnover but that differ in ownership structure. Companies' responses to the tax reform, as identified in this study, thus stem from differences in access to profit shifting and not from differences in economic activity across domestically and foreign-owned firms.

We first present graphical evidence on the difference in investments between domestically and foreign-owned firms. We observe a parallel trend in investments before the 2008 tax reform. In each pre-reform year, the difference in investments between domestically

[2] In contrast to Overesch (2009), who examines the effect of cross-country corporate tax rate differences on German inbound investments, we also consider domestic investments by German firms.

owned firms and corporations with a foreign parent is insignificant. Put differently, domestically and foreign-owned firms have similar investments before the tax reform in our matched sample. After the reform, domestically owned firms invest significantly more than firms with a foreign parent. The difference in investment is statistically significantly different from zero each year following the tax rate cut. Our results suggest that corporate investments responded immediately to the tax cut.[3]

We then test our hypothesis in a difference-in-differences setting in which we compare the investment responses of domestically owned and foreign-owned German corporations around the 2008 reform. Our estimation includes firm fixed effects, year fixed effects, and firm-level control variables. After profitability, debt, size, sales, sales growth, and wages are controlled for, the difference-in-differences estimate is significant and positive. That is, the 2008 tax reform increased the investment of firms whose ultimate owner is domestic relative to the investment of foreign-owned firms. A corporate tax cut of 10% has large investment effects on domestically owned firms. We find an increase of 5.8% in investment, which is about 64% of the unconditional mean investment of 9%.

We test the robustness of our results in several ways. We obtain similar effects when using an alternative measure of investment that accounts for potential scaling differences. Further, we control for the macroeconomic situation in the home country of the foreign shareholder. The change in investments between domestic and foreign-owned firms is not driven by an economic downturn in the parent company's home country relative to the German GDP growth. Third, other reform elements of the 2008 tax reform could potentially explain our results. However, we find that the small changes in the dividend taxation of non-corporate shareholders do not explain our results and neither does the temporary introduction of bonus depreciation in 2009 and 2010. Ultimately, a higher number of companies exiting the sample and potential differences in insolvency risk across domestic and foreign firms around the financial crisis do not bias the results.

Our results have several implications. The ongoing "race to the bottom" in corporate tax rates not only affects the location decisions (e.g., Devereux and Griffith 1998, Buettner and Ruf 2009, Overesch 2009) and profit shifting activities of multinational firms (e.g., Clausing 2003; Huizinga, Laeven, and Nicodeme 2008; Markle 2011), but also the investment decisions of both domestic and multinational firms. A corporate tax rate cut affects the allocation of

[3] In contrast, Dwenger (2013) focuses on the long-term effects of user costs on the capital stock. That model includes a long-term specification of a firm's demand for capital. Thus, it only allows an interpretation of long-run effects while misestimating short-run effects.

investments across domestically and foreign-owned firms. In large economies with high tax rates, such as Germany, Japan, the United Kingdom, and the United States, there are many firms without foreign operations, since the domestic market is sufficiently large. Hence, countries can benefit from an increase in domestic investments by cutting corporate tax rates. Conversely, in countries with many internationally active firms and a small domestic market, responses to corporate tax changes may be lower than expected. Our results also point toward differences in tax sensitivity across firms, which refer not only to investment policy but also potentially to capital structure decisions (e.g., MacKie-Mason 1990; Graham 1996a, 1996b).

The remainder of the paper is organized as follows: Section 2 presents the institutional background and a simple investment model. Section 3 presents the data and our empirical estimation strategy. The empirical results and robustness tests are discussed in Section 4. Section 5 sets forth our conclusions.

2. Institutional Background and Hypothesis Development

2.1 2008 Tax Reform

The Business Tax Reform Act of 2008 constitutes the German government's reaction to the demand for a new tax system to improve the country's position in international tax competition. The reform comprised a corporate tax cut and tightening of rules against multinational profit shifting (tax base broadening). The statutory corporate tax rate was lowered from 25% to 15%. In combination with changes to the local business tax on corporations, this resulted in a decrease of the corporate tax burden by 10 percentage points (from about 39% until 2007 to 29% as of 2008).

The interest barrier rule, which limits the deductibility of interest payments from taxable profits, was established as an instrument to constrain financing structures within multinational firms. This thin capitalization rule could have potential investment effects if the rule were binding and if it thereby could reduce access to debt to finance new investment. As Blaufus and Lorenz (2009) show, the German interest barrier, with its exceptions and escape clauses, is relevant only for very few firms. Hence, we believe that the thin capitalization rule does not affect our results since it is not binding for almost all firms in our sample.[4] Therefore, the investment response stems from the corporate tax cut and not from the tax base broadening element of the 2008 reform.

[4] Based on the database DAFNE (the same database as used for this paper), Blaufus and Lorenz (2009) find that fewer than 200 firms are potentially affected by the German thin capitalization rule.

Another change within the 2008 reform was a slight increase in the dividend tax rate for individual, non-incorporated shareholders. According to the partial income method, 60% of dividend income—compared to 50% before the reform—is taxed at the shareholder's personal income tax rate, which ranges from 0% to 45%. This small increase in the dividend tax rate of zero to 4.5 percentage points for non-corporate shareholders could have, apart from any level effects, potential effects on the allocation of investments across firms (Becker, Jacob, and Jacob 2013). Even though the evidence on this effect for unlisted corporations is mixed (Alstadsaeter and Jacob 2013; Yagan 2013), we test the robustness of our results in Section 4.4 below to rule out that our results are driven by the small increase in the dividend tax.

2.2 Effect of Corporate Taxes on Investment

We formulate a simple model that isolates the effect of a corporate tax reduction on investment. We argue that a corporate tax cut has heterogeneous investment effects across firms. Empirical evidence (e.g., Rego 2003; Dyreng and Lindsey 2009; Dyreng, Hanlon, and Maydew 2010) shows that firms with foreign operations have lower effective tax rates on corporate profits. The degree to which firms have access to profit shifting across borders can therefore affect responsiveness to corporate tax changes. To illustrate this effect, we first consider a firm without the opportunity to shift profits. We then relax this assumption and allow profit shifting across borders.

We assume a one-period investment that yields a pre-tax return r. The return is subject to corporate taxation τ^{Corp}. This is the corporate tax rate in the country where the firm is located. The net of corporate tax return is distributed to the shareholder who is subject to dividend taxation τ^{Div}. We follow King (1977), Auerbach (1979), and Bradford (1981) and assume that the investment is financed with internal funds.[5] In sum, the net cash flow at $t + 1$ equals $(1 + r(1 - \tau^{Corp}))(1 - \tau^{Div})$.

Alternatively, the firm could pay out the cash flow immediately. In this case, shareholders pay dividend taxes at a rate of τ^{Div}. The remaining cash flow is invested at an after-tax return of i. Comparing these two investment alternatives, the firm will invest in the project if

[5] The implications of our simple model are similar when this assumption is relaxed. If we assume that the investment is financed with new equity (e.g., Harberger, 1962, 1966; Feldstein, 1970; Poterba and Summers, 1985), the relevant required rates of return increase by $\frac{1}{1-\tau^{Div}}$ in both cases.

$$r^* = i \cdot \frac{1}{(1-\tau^{Corp})} \tag{1}$$

Equation (1) shows that the required rate of return for a corporate investment, r^*, is sensitive to changes in the corporate tax:

$$\frac{\partial r^*}{\partial \tau^{Corp}} = i \cdot \frac{1}{(1-\tau^{Corp})^2} > 0 \tag{2}$$

Equation (2) implies that a corporate tax cut will lower the required rate of return of an investment (r^*). Thus, we expect corporate investment to increase following a corporate tax cut. The underlying assumption of Equation (2) is that the firm has no access to multinational profit shifting and is subject to the domestic marginal tax rate on corporate profits of τ^{Corp}. We denote these firms *domestic* firms.

We next relax the assumption that a firm has no access to profit shifting. We again assume a one-period investment that yields a pre-tax return *r*. The return is subject to an effective corporate taxation, τ_{Eff}^{Corp}. This effective tax rate depends on the percentage of profits, α, shifted to a foreign country where profits are taxed at a rate τ_{For}^{Corp}. The remaining part of the profits, $(1-\alpha)$, is taxed at the domestic corporate tax rate τ_{Dom}^{Corp}. We simplify the determination of the percentage of profits α shifted abroad and assume that α is exogenous. In the Appendix, we endogenize α and allow $\alpha(.)$ to be a function of τ_{For}^{Corp} and τ_{Dom}^{Corp}. Since the implications of our model are similar in this case, we use the simplified version of the model to illustrate the effects. In sum, a firm with access to profit shifting invests in the project if

$$r_{Shifting}^* = i \cdot \frac{1}{\left(1-\tau_{Eff}^{Corp}\right)}$$

with

$$\tau_{Eff}^{Corp} = \alpha \cdot \tau_{For}^{Corp} + (1-\alpha) \cdot \tau_{Dom}^{Corp} \tag{3}$$

From Equation (3), we can derive the effect of a corporate tax change on the required rate of return of a firm with the opportunity to shift income, which we denote *foreign* firm:

$$\frac{\partial r_{Shifting}^*}{\partial \tau_{Dom}^{Corp}} = i \cdot (1-\alpha) \cdot \frac{1}{\left(1-\tau_{Eff}^{Corp}\right)^2} > 0 \tag{4}$$

If the domestic tax rate is reduced, the effect on the required rate of return of a foreign firm, $r_{Shifting}^*$, is mitigated by the fraction of income shifted abroad. Hence, as long as the firm does not shift any profits abroad, α equals zero and both domestic and foreign firms will respond the same way. However, empirical analysis suggests that $\alpha > 0$ (e.g., Weichenrieder

2009, for Germany). In this case, τ_{Eff}^{Corp} is smaller than τ^{Corp} if the foreign tax is below the domestic tax rate. We thus argue that firms with the opportunity to shift income abroad are less responsive to changes in the corporate tax rate than domestic firms. Equation (4) further implies that the effect of a change in the (domestic) corporate tax decreases with a higher degree of profit shifting (α close to one). In the extreme case that all profits are shifted abroad, firm investment will not respond to changes in the corporate tax. Generally, a difference in the investment response to the tax cut depends on α. Given similar economic activity, as long as domestically owned firms shift fewer profits abroad than firms with a foreign parent, investment responses to a tax cut are greater for domestic firms than for foreign firms. We thus formulate our main hypothesis as follows.

Hypothesis: Following a corporate tax cut, the investments of firms without the opportunity of profit shifting (*domestic firms*) will increase more than investments of firms with access to profit shifting (*foreign firms*).

3. Data and Estimation Strategy

3.1 Empirical Identification

We test our hypothesis in a difference-in-differences framework that compares the investments of domestic and foreign-owned German firms around the 2008 tax reform. The resulting estimation equation is

$$Inv_{i,t} = \alpha_0 + \beta_1 Domestic_i \times Reform_t + \beta_2 EBIT_{i,t-1} + \beta_3 Sales_{i,t-1} + \beta_4 Labor_{i,t-1} + \beta_5 Debt_{i,t-1} + \beta_6 Loss_{i,t} + \beta_7 Ln(TA)_{i,t-1} + \alpha_i + \alpha_t + \varepsilon_{it} \quad (5)$$

where the investment of firm i in year t ($Inv_{i,t}$) is the dependent variable. The independent variable of interest is the interaction between $Domestic$ and $Reform$, where $Reform$ is a dummy variable equal to one for all the years after the tax reform (2008 to 2011). We define a German corporation as domestic if the enterprise's overall shareholder resides in Germany. The overall shareholder is defined as having a direct or indirect interest in the German affiliate of more than 50%. The country of the foreign overall shareholder is known; however, this more detailed information is not needed for the analysis.

This difference-in-differences approach identifies the investment effects of the reform on domestic firms vis-à-vis foreign firms. Thus, the interaction of *Domestic* and *Reform* captures differences in the level of investment growth between domestic and foreign companies after

the 2008 tax reform. According to our hypothesis, corporate investment increases after the tax rate cut, but the effect is larger for domestic firms than for foreign firms. Thus, the β_1 coefficient is predicted to be positive.

There could be concerns that, besides ownership structure, potential differences in economic activities between the treatment group (domestic firms) and the control group (foreign firms) bias our results. To account for these differences, we use a one-on-one matching procedure without replacement before estimating Equation (5). Each foreign firm is matched to a domestic firm according to the natural logarithms of sales, wages, liabilities, and total assets of each pre-reform sample year. This approach has two advantages. First, the reform does not affect assignment to the treatment or control group, since sorting and matching are based on pre-reform characteristics. Second, firms cannot enter the treatment or control group after the reform. This ensures that our results are not driven by new firms and their investments after the 2008 tax reform. We thus obtain two groups with the same number of firms prior to the reform that are comparable in firm size, asset structure, and leverage but that differ in ownership structure. We use the matched sample in addition to the full sample when estimating Equation (5).

We further include five firm-level control variables. The regression model controls for the influence of earnings before interest and taxes (EBIT), sales, labor costs, loss firms, and leverage on investment. The variable *Ln(TA)*, the natural logarithm of total assets, accounts for the size of the firm. We lag all firm-level control variables once to avoid an endogeneity bias. The model contains firm fixed effects to capture time-invariant firm-specific influences on levels of investment.[6] Firm-fixed effects also control for differences in investments across industries. We include year fixed effects that account for the business cycle and other macroeconomic effects. We base our statistical inference on robust standard errors clustered at the firm level.

3.2 Data Sample and Summary Statistics

We use firm-level panel data from the Bureau van Dijk's DAFNE database. The database contains the data of German corporations,[7] including financial data, as well as information about the company activity, branch, and ownership structure. Our sample consists of data from

[6] Since the *Domestic* dummy is time invariant, firm fixed effects capture the direct effect of *Domestic*.

[7] These cover limited liability companies with the German legal forms *Aktiengesellschaft*, *Gesellschaft mit beschränkter Haftung*, and *Kommanditgesellschaft auf Aktien* (KGaA, GmbH & Co. KGaA, and AG & Co. KGaA), and other corporations. Small corporations are not included in our sample due to the lack of filing requirements.

19,963 corporations over the period 2004–2011, for a total of 57,149 firm–year observations. Companies offering financial or insurance services are excluded. All the financial data we use are based on German accounting rules.

The data also include information on the location of the ultimate owner. We differentiate between domestic and foreign companies according to the primary place of business of the overall shareholder. We define the dummy variable *Domestic* as equal to one for companies with a German overall shareholder and zero otherwise.[8] The mean of *Domestic* equals 0.781 (see the summary statistics in Table 1). That is, the vast majority of enterprises in the sample are domestic.

Table 1 also presents the summary statistics and variable definitions of independent variables. Our investment variable *Inv* is defined as the difference in fixed assets and intangible assets from t to t - 1 relative to the prior year's fixed and intangible assets. The average growth of fixed and intangible assets compared to the prior year's amounts to 9%. We further use information on EBIT (*EBIT*), turnover (*Sales*), wages to employees (*Labor*), and debt (*Debt*). These four variables are scaled by the prior year's assets. On average, firms have an EBIT-to-assets ratio of 9%, a turnover-to-assets ratio of 222%, a wages-to-assets ratio of 56%, and a debt-to-assets ratio of 54%. We further include the natural logarithm of total assets (average 9.1) as a measure of firm size.

[Insert Table 1 about here]

4. Empirical Results

4.1 Graphical Evidence

The simplest way of testing our hypothesis is to track the investments of domestic and foreign-owned firms over time. Figure 1 uses the matched sample of firms and plots the investment (*Inv*) for each group over 2005–2011. We observe a parallel trend in the investments of domestic and foreign firms prior to the reform. Both set of firms invest about 5% to 10% of their fixed assets each year. Following the 2008 tax reform, the investments of these two groups diverge. The investments of domestically owned firms exceed those of firms with a foreign parent each sample year.

[8] We have basic information about the ultimate owner, but we cannot identify the exact legal status. We assume profit shifting opportunities to be limited in the case of a foreign individual shareholder. This would drive the β_1 coefficient towards zero, since we would then expect similar reactions for both foreign and domestic firms. In an untabulated test, we restrict the sample to industrial firms. Results remain significant and of similar size. We are thus confident that this data limitation cannot drive any positive findings on relative investments of domestically and foreign owned firms.

[Insert Figure 1 about here]

Figure 2 plots the corresponding difference in investment between these two groups. The dotted lines indicate the upper and lower 95% confidence intervals. Prior to the reform, the difference is very small and statistically not different from zero. After the reform, the difference in investment jumps to a higher level. It is positive and significant each post-reform year. That is, domestically owned firms with fewer opportunities for international profit shifting respond much more strongly to the 2008 tax reform than firms with a foreign owner and access to profit shifting. The advantage of the graphical illustration in Figure 2 is that the effect is independent from the business cycle in Germany, since all firms are affected similarly.[9] After the reform, domestically owned firms invest about 5% more than foreign-owned firms. This difference is significant at the 1% level every sample year. The graphical evidence in Figure 2 is a first indication in favor of our hypothesis that investment is responsive to changes in the corporate tax and that investment responses are heterogeneous across firms.

[Insert Figure 2 about here]

4.2 OLS Results

We next test our hypothesis using the difference-in-differences approach. Table 2 presents the coefficient estimates from testing Equation (5). For our baseline tests, we regress investments on the interaction of *Domestic* and *Reform.* Columns (1) and (2) of Table 2 use the full sample. In Columns (3) and (4), we use the matched sample of domestic and foreign firms. We present the results with and without firm-level control variables. We include year fixed effects and firm fixed effects in all four specifications.

[Insert Table 2 about here]

The estimated coefficient of *Domestic*×*Reform* is positive and significant ($p < 0.01$) in all specifications. For the matched sample, which accounts for differences in the economic activities of foreign and domestic firms, the coefficient is 0.0577. The economic magnitudes are large: The increase of 5.8% in investment amounts to about 64% of the unconditional mean investment of 9%. The coefficient estimate is very similar when excluding firm-level control variables. This shows that firm-level characteristics do not affect our results. In sum,

[9] In a robustness test below, we relax this assumption and include a proxy for the economic development in the parent's host country.

the estimates indicate that a corporate tax cut of 10% can have large investment effects on domestically owned firms.

The results for our firm-level control variables show that investments increase for firms that are more profitable (*EBIT*), that have higher turnover (*Sales*) or that are smaller (*Ln(TA)*). More precisely, for the full sample (matched sample), a one standard deviation increase in *EBIT* results in 3.1% (4.2%) more investment, a one standard deviation increase in *Sales* results in 7.0% (7.1%) more investment, and a one standard deviation decrease in *Ln(TA)* results in 49.2% (40.7%) more investment. The latter can be explained by the better growth and investment opportunities of smaller firms.[10] We measure investment relative to existing fixed assets. Therefore, small and high-growth firms have higher investment rates. Investments decrease by about 4.1% if the firm has negative income (*Loss*). We find no significant effect for leverage, and only a weakly significant effect for labor costs.

We test the robustness of our results using an alternative definition of our dependent variable that accounts for potential scaling effects. Instead of using fixed and intangible assets, we scale changes in fixed and intangible assets by total assets. Table 3 presents the coefficient estimates for the difference-in-differences (*Domestic*×*Reform*) for the full and matched samples. In line with our hypothesis, we find a positive and significant coefficient estimate for β_1. For the full sample with controls, the coefficient estimate is 0.0094 (*t*-statistic = 3.13). In the matched sample, β_1 is 0.0108 and significant (*t*-statistic = 3.60).

[Insert Table 3 about here]

4.3 Robustness to Economic Development in the Parent Company's Country

One concern about our estimation strategy is that we cannot identify—and thus cannot control for—the economic situation of the parent firm or group. Put differently, the financial crisis of 2008 and cross-country differences in its effect on GDP growth can potentially affect our results. The difference in investment growth between domestic and foreign companies may be thus influenced by the economic development in the parent country relative to the economic development in Germany. We therefore add the GDP growth rate of the country where the parent is located to our model. Table 4 presents the regression results.

[Insert Table 4 about here]

[10] We test the robustness of our firms to the inclusion of small firms and excluded firms below the median of total assets distribution. The results are robust and similar to the baseline estimates. For the matched sample, the coefficient of *Domestic*×*Reform* is 0.0429 and significant (*t*-statistic = 2.38).

The estimated coefficient of the GDP growth variable is insignificant in all specifications for both the full sample and the matched sample. Thus, the economic situation in the parent country has no impact on the subsidiary's investment behavior. Moreover, the sign of the estimated coefficient is negative. In line with Becker and Riedel (2012), the result suggests that weak economic development leads to higher investments in the affiliate's country. Such investment shifting may be due to the expectation of higher returns when investing in a stronger economic environment than in countries in an economic downturn. However, the effect, as indicated by our results, is not significant.

Most important for our study, the impact of the interaction variable *Domestic×Reform* is comparable to the baseline results. The size of the effect is very similar for the matched sample and is still significant at the 1% level. Thus, our result that the investments of domestic firms increase more after the 2008 reform than those of foreign firms is robust to controlling for cross-country differences in macroeconomic development.

4.4 Effect of the Change in Dividend Tax

We next turn to other reform elements that could potentially affect our results. The 2008 tax reform led to a small increase in the dividend tax rate of zero to 4.5 percentage points through the new partial income method. This change in the dividend tax for non-corporate shareholders could potentially affect the allocation of investments (Alstadsæter and Jacob 2013; Becker, Jacob, and Jacob 2013). Since higher payout taxes increase the costs of external equity, this may shift investments from firms without internal resources to companies that can finance themselves internally. That is, the investments of domestic firms may be driven by such reallocation and a lock-in of capital in firms with high cash. To test whether this mechanism explains our findings, we divide the group of domestic companies into quintiles according to EBIT distribution. EBIT scaled by the prior year's total assets serve as a measure of internal funds available for investments. Splitting this sample into high- and low-EBIT firms allows us to compare the investment levels of German companies with and without internal resources. We are interested in the investment effects on companies in the upper quintile (*HighEBIT*) and bottom quintile (*LowEBIT*) of the EBIT distribution around the 2008 tax reform. The estimation results are reported in Table 5. The regression follows Equation (5) but uses the dummy *High EBIT* instead of the domestic dummy. The sample is restricted to German firms.

[Insert Table 5 about here]

The interaction of *High EBIT* and *Reform* is insignificant in all four specifications. There are two explanations for the insignificant result: First, the dividend tax change may not apply to all firms. In the case of corporate or institutional shareholders, shareholder taxation does not change around the reform. Second, the increase in dividend taxation for private shareholders is not large. In the top tax bracket of 45%, it amounts to 4.5%. The insignificant result in Table 5 indicates that the observed growth in the investments of domestic firms is not limited to high-EBIT firms. Instead, the investment response stems from the cross section of domestically owned firms. The investment response to the 2008 tax cut, as identified in the baseline regression in Table 2, cannot be explained by the increase in dividend taxes.

4.5 Effect of Bonus Depreciations

The third robustness test addresses the influence of a subsequent tax change. Because of the financial crisis, the German government allowed bonus depreciations for investments in fixed assets acquired in 2009 and 2010. This provision may have influenced the corporate investments of German firms in those two years (e.g., House and Shapiro 2008, for the United States). Our coefficient estimate could be biased if the introduction of the bonus depreciation also led to heterogeneous responses across domestic and foreign firms. To test if these two years explain our results, we estimate the reform effect separately for each year. The regression results are presented in Table 6.

[Insert Table 6 about here]

The estimated coefficients of the yearly interaction variables are weakly significant for 2008 in the full sample. When using our preferred sample—the matched sample—we observe a positive and significant difference between domestic and foreign firms each sample year. This result is also supported by Figure 2, which shows an immediate and persistent change in the difference in investment. The coefficient estimates are close to each other and range from 0.0476 to 0.0717. Most importantly, the estimates for 2008 (0.0565) and 2011 (0.0518), that is, the two years without bonus depreciation, are significant and close to our baseline estimate of 0.0577 for the entire post-reform period (see Table 2).

According to this yearly breakdown, the investments of domestic firms are significantly higher than those of foreign firms following the corporate tax cut. The effect is not limited to the years 2009 and 2010. Our effect cannot be attributed to the temporary introduction of bonus depreciation for assets purchased in 2009 and 2010. Thus, we conclude that the

difference in investment growth between domestic and foreign firms is a consequence of the corporate tax cut.

4.6 Robustness to the Financial Crisis

Finally, we test the sensitivity of our results to potential exit effects and bankruptcies. During the financial crisis and the global economic downturn, firms have faced greater insolvency risk. If this risk differs across the treatment and control groups and if foreign firms are more likely to face insolvency, our coefficient estimate for *Domestic*×*Reform* may pick up differences in insolvency risk. Therefore, we restrict the sample to firms that have survived at least seven of eight sample years. These firms were active before, during, and after the financial crisis and do not face insolvency due to the financial crisis. Table 7 presents the regression results for our β_1 coefficient. The results are robust to the restriction. The coefficient of *Domestic*×*Reform* amounts to 0.05, is statistically significant at the 1% level (*t*-statistic = 2.88), and is close to our baseline estimate.[11] From this, we conclude that our result cannot be explained by differences in insolvency risk across domestic and foreign firms that change around the financial crisis. In sum, our results show that the corporate tax cut has a stronger investment effect on domestic firms than on foreign firms.

[Insert Table 7 about here]

5. Conclusion

This paper tests the effect of the 2008 corporate tax cut on firm investment in Germany. Our simple investment model suggests that firms without access to international profit shifting respond more strongly to a corporate tax cut than firms with foreign operations and the opportunity to shift income across borders. We test this expectation in a difference-in-differences setting, which has the advantage that macroeconomic effects cannot affect our results. We find that domestically owned firms respond much more strongly to the tax cut than firms with an ultimate owner in a foreign country. Thus, we conclude that firms' investment strategies are sensitive to corporate tax changes and that the corporate tax rate affects the allocation of investments across domestically and foreign-owned firms.

[11] When the sample is restricted even further to firms that survive all sample years, the coefficient is 0.0514 and still significant at the 5% level (*t*-statistic = 2.45).

Our results have several policy implications. Large economies with high tax rates, such as Germany, Japan, the United Kingdom, and the United States, have both a strong domestic market and large multinational corporations. Countries can increase the investments of domestically active corporations by reducing corporate tax rates. Conversely, the reactions of firms with foreign operations may be lower than expected, since they are less responsive to changes in the local statutory tax rate. These heterogeneous investment responses are also relevant for countries with many internationally active firms and a small domestic market. The effect of a corporate tax cut may be weaker than expected in these countries.

The results also point toward differences in the tax sensitivity of firm policies across corporations, which may affect not only investment strategies, but also financing decisions (e.g., MacKie-Mason 1990; Graham 1996a, 1996b). Differences in tax sensitivity are closely related to a firm's effective tax rate, which decreases, for example, for companies with foreign operations (Rego 2003; Dyreng and Lindsey 2009; Dyreng, Hanlon, and Maydew 2010). Testing the tax responses of domestic versus foreign-owned firms on other business decisions is therefore an interesting avenue for future research.

The ongoing race to the bottom of corporate tax rates affects not only the location decisions (e.g., Devereux and Griffith 1998; Buettner and Ruf 2009; Overesch 2009) and profit shifting activities of multinational firms (e.g., Clausing 2003; Huizinga, Laeven, and Nicodeme 2008), but also the allocation of investments across domestically owned and foreign-owned corporations. Given that European Union governments have recently cut corporate tax rates to reduce profit shifting (e.g., Sweden cut the corporate tax rate from 26.3% to 22% in 2013), the effect of these reforms on corporate investment is a highly relevant empirical question. Our results suggest that firms without access to international income shifting will increase their investment activity following the recent wave of tax rate reductions in the race to the bottom.

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Appendix

We extend our main model and allow $\alpha(.)$ to be a function of τ_{For}^{Corp} and τ_{Dom}^{Corp}. That is, the level of profit shifting of a multinational firm depends on the corporate tax rates in the countries of the subsidiaries. The implications we derived for the simplified model are still valid. Hence, a firm with access to profit shifting invests in a project if

$$r_{Shifting}^{*} = i \cdot \frac{1}{\left(1 - \tau_{Eff}^{Corp}\right)}$$

with

$$\tau_{Eff}^{Corp} = \alpha(.) \cdot \tau_{For}^{Corp} + (1 - \alpha(.)) \cdot \tau_{Dom}^{Corp} \tag{A.1}$$

and

$$\alpha(.) = \alpha\left(\tau_{For}^{Corp}, \tau_{Dom}^{Corp}\right)$$

From Equation (A.1), we can derive the effect of a corporate tax change on the required rate of return of a firm with the opportunity to shift income (*foreign* firm):

$$\frac{\partial r_{Shifting}^{*}}{\partial \tau_{Dom}^{Corp}} = i \cdot \frac{1 - \alpha'(.)(\alpha(.) - \tau_{For}^{Corp})}{\left(1 - (\alpha(.) \cdot \tau_{For}^{Corp} + (1 - \alpha(.)) \cdot \tau_{Dom}^{Corp})\right)^2} > 0 \tag{A.2}$$

Showing that the effect of a corporate tax change on the required rate of return is still larger for domestic firms than for foreign firms is straightforward:

$$\underbrace{i \cdot \frac{1}{(1 - \tau^{Corp})^2}}_{Effect\ on\ Domestic\ Firm} > \underbrace{i \cdot \frac{1 - \alpha'(.)(\alpha(.) - \tau_{For}^{Corp})}{\left(1 - (\alpha(.) \cdot \tau_{For}^{Corp} + (1 - \alpha(.)) \cdot \tau_{Dom}^{Corp})\right)^2}}_{Effect\ on\ Foreign\ Firm} \tag{A.3}$$

The necessary condition is that $\alpha'(.) \geq 0$ and $\alpha'(.) \leq 1$. That is, the proportion of profits shifted abroad is either unaffected by the domestic tax rate ($\alpha'(.) = 0$) or increases with the domestic tax rate ($\alpha'(.) > 0$). If we assume that $\alpha(.)$ is a logistic function that takes on values between zero and one ($0 \leq \alpha(.) \leq 1$ and $0 \leq \alpha'(.) \leq 1$), the effect of a tax cut on domestic firms is larger than on foreign firms.

Figure 1: Average Investment: Domestic versus Foreign-Owned Firms

This figure plots the average investments of domestic firms (black line) and foreign-owned firms (dashed line). Investment is defined as the percentage change in fixed and intangible assets from *t* - 1 to *t*. The dashed vertical line separates the pre-reform from the post-reform years.

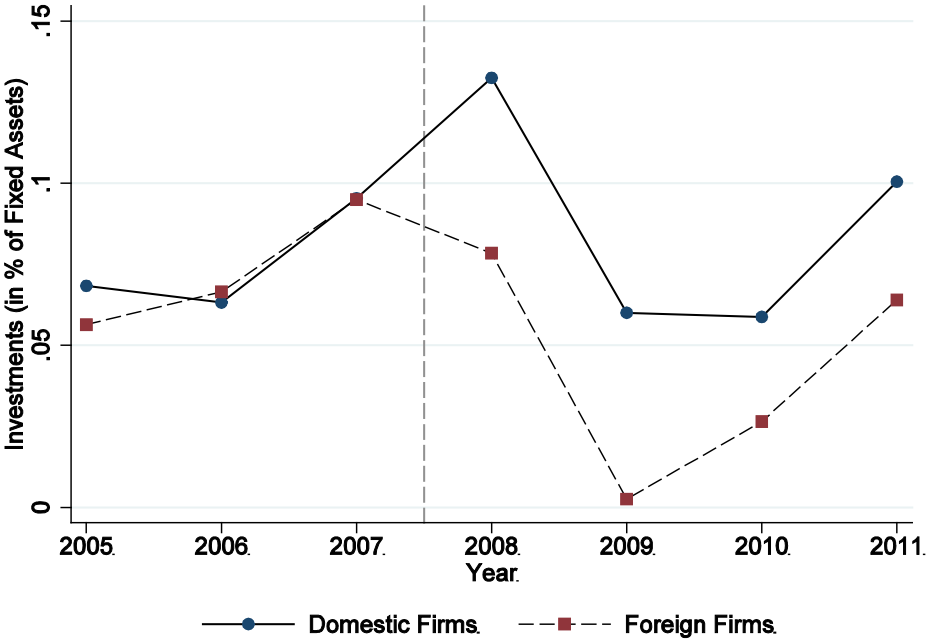

Figure 2: Difference in the Investments of Domestic and Foreign-Owned Firms

This figure plots the difference in investments between domestic firms (black line) and foreign-owned firms (gray line). Investment is defined as the percentage change in fixed and intangible assets from *t* - 1 to *t*. The dashed vertical line separates the pre-reform from the post-reform years. The gray lines are the upper and lower 95% confidence intervals.

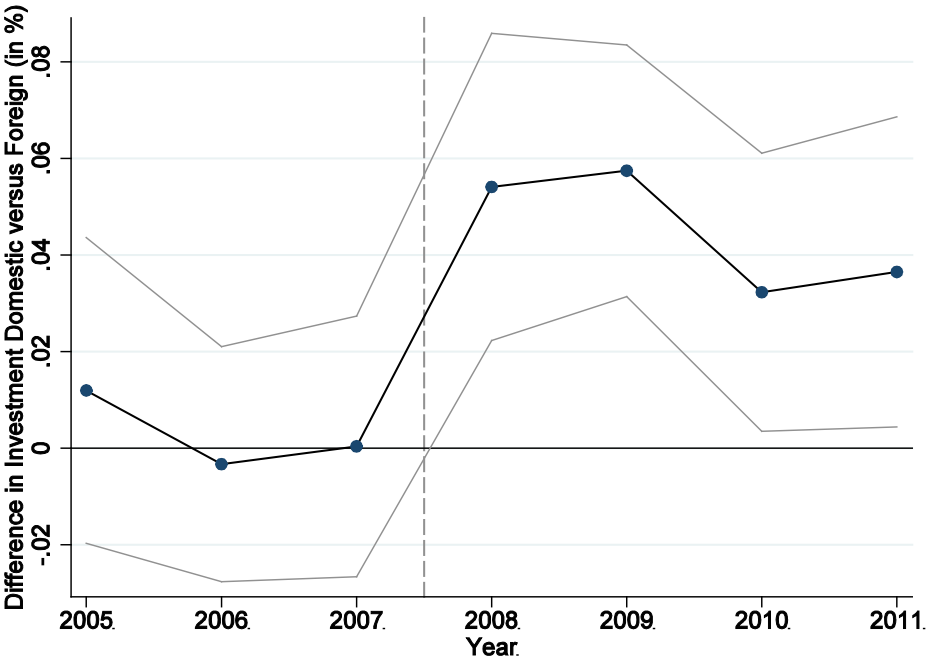

Table 1: Descriptive Statistics

This table presents the summary statistics and variable descriptions of our variables. The full sample comprises 19,963 firms and 57,149 firm–year observations. If not otherwise indicated, the data source is the DAFNE database.

Variable	Description	Mean	Std Dev.
Dependent variable			
Inv	*Inv* is our investment measure. It is defined as the difference in fixed assets and intangible assets from *t* to *t* - 1 relative to the prior year's fixed and intangible assets.	0.090	0.470
Independent variables			
Domestic	Dummy variable equal to 1 if the ultimate owner is located in Germany.	0.781	0.413
EBIT	*EBIT* is the ratio of EBIT relative to the prior year's total assets.	0.090	0.134
Sales	*Sales* is turnover relative to the prior year's total assets.	2.219	1.682
Labor	*Labor* is the ratio of wages to the prior year's total assets.	0.560	0.555
Debt	*Debt* is the ratio of long-term and short-term liabilities to the prior year's total assets.	0.541	0.322
Ln(TA)	*Ln(TA)* is the natural logarithm of total assets.	9.096	1.883
Loss	Dummy variable equal to 1 if income<0	0.141	0.348
GDP Growth	*GDP Growth* is the percentage point growth in GDP from *t* - 1 to *t* in the country where the ultimate owner is located. Source: World Bank.	1.526	3.186

Table 2: Investment and the 2008 Tax Reform

This table presents the regression results on firms' investment policies over 2005–2011. The dependent variable is defined as the difference in fixed assets and intangible assets from *t* to *t* - 1 relative to the prior year's fixed and intangible assets. The independent variables are defined in Table 1. We report the regression results for the full sample and a matched sample. We include firm fixed effects and year fixed effects in all specifications. We report robust standard errors clustered at the firm level in parentheses. ***, **, and * denote a significant difference at the 1%, 5%, and 10% levels, respectively.

	Full Sample		**Matched Sample**	
	(1)	(2)	(3)	(4)
Domestic×Reform	0.0471***	0.0471***	0.0580***	0.0577***
	(0.016)	(0.016)	(0.017)	(0.017)
$EBIT_{t-1}$		0.2301***		0.3106***
		(0.048)		(0.062)
$Sales_{t-1}$		0.0416***		0.0423***
		(0.009)		(0.011)
$Labor_{t-1}$		-0.0629*		-0.0828*
		(0.032)		(0.049)
$Debt_{t-1}$		0.0069		0.0047
		(0.026)		(0.038)
$Ln(TA)_{t-1}$		-0.2612***		-0.2162***
		(0.024)		(0.034)
$Loss_t$		-0.0340***		-0.0414***
		(0.010)		(0.015)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	57,149	57,149	16,705	16,705
R-squared	0.455	0.465	0.292	0.306

Table 3: Investment and the 2008 Tax Reform—Alternative Dependent Variable

This table replicates Table 2 but uses the difference in fixed assets and intangible assets from *t* to *t* - 1 relative to the prior year's total assets (Panel A) and the difference in fixed assets and intangible assets plus depreciation from *t* to *t* - 1 relative to prior year's fixed and intangible assets (Panel B) as dependent variable. The independent variables are defined in Table 1. We report the regression results for the full sample and a matched sample. We include firm fixed effects and year fixed effects in all specifications. We report robust standard errors clustered at the firm level in parentheses. ***, **, and * denote a significant difference at the 1%, 5%, and 10% levels, respectively.

Panel A: Scaling by Total Assets

	Full Sample		**Matched Sample**	
	(1)	(2)	(3)	(4)
Domestic×Reform	0.0094***	0.0094***	0.0107***	0.0108***
	(0.003)	(0.003)	(0.003)	(0.003)
Control Variables	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	56,969	56,969	16,330	16,330
R-squared	0.461	0.480	0.347	0.364

Panel B: Accounting for Depreciation

	Full Sample		**Matched Sample**	
	(1)	(2)	(3)	(4)
Domestic * Reform	0.0432**	0.0428**	0.0515***	0.0531***
	(0.017)	(0.017)	(0.019)	(0.019)
Control Variables	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	40,849	40,849	14,538	14,538
R-squared	0.447	0.461	0.352	0.365

Table 4: Investment and the 2008 Tax Reform, Controlling for GDP Growth

This table presents the regression results on firms' investment policies over 2005–2011. The dependent variable is defined as the difference in fixed assets and intangible assets from *t* to *t* - 1 relative to the prior year's fixed and intangible assets. We add a control for growth in GDP in the ultimate owner's country. The control variables are defined in Table 1. We report the regression results for the full sample and a matched sample. We include firm fixed effects and year fixed effects in all specifications. We report robust standard errors clustered at the firm level in parentheses. ***, **, and * denote a significant difference at the 1%, 5%, and 10% levels, respectively.

	Full Sample		**Matched Sample**	
	(1)	(2)	(3)	(4)
Domestic×Reform	0.0488***	0.0485***	0.0593***	0.0589***
	(0.016)	(0.016)	(0.017)	(0.017)
GDP Growth	-0.0045	-0.0040	-0.0034	-0.0035
	(0.003)	(0.003)	(0.004)	(0.004)
Control Variables	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	56,998	56,998	16,610	16,610
R-squared	0.455	0.465	0.292	0.306

Table 5: Effect on the Allocation of Investments

This table presents the regression results on firm investment policy over 2005–2011. We use domestic firms only. We include firms in the top and bottom quintiles of the EBIT distribution as a measure of internal resources. The dependent variable is defined as the difference in fixed assets and intangible assets from *t* to *t* - 1 relative to the prior year's fixed and intangible assets. The dependent variable of interest is the interaction between high-EBIT firms and the reform dummy (*High EBIT×Reform*). The control variables are defined in Table 1. We report the regression results for the full sample and a matched sample. We include firm fixed effects and year fixed effects in all specifications. We report robust standard errors clustered at the firm level in parentheses. ***, **, and * denote a significant difference at the 1%, 5%, and 10% levels, respectively.

	Full Sample		**Matched Sample**	
	(1)	(2)	(3)	(4)
High EBIT×Reform	0.0441	0.0463	0.0338	0.0244
	(0.036)	(0.036)	(0.045)	(0.049)
Control Variables	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	16,237	16,237	3,012	3,012
R-squared	0.657	0.664	0.538	0.546

Table 6: Investment and the 2008 Tax Reform, by Year

This table replicates Table 2 but presents regressions results, which estimate the reform effect separately for each year. The dependent variable is defined as the difference in fixed assets and intangible assets from *t* to *t* - 1 relative to the prior year's fixed and intangible assets. The independent variables are defined in Table 1. We report the regression results for the full sample and a matched sample. We include firm fixed effects and year fixed effects in all specifications. We report robust standard errors clustered at the firm level in parentheses. ***, **, and * denote a significant difference at the 1%, 5%, and 10% levels, respectively.

	Full Sample		**Matched Sample**	
	(1)	(2)	(3)	(4)
Domestic×2008	0.0377*	0.0366*	0.0562**	0.0565**
	(0.020)	(0.020)	(0.023)	(0.023)
Domestic×2009	0.0644***	0.0617***	0.0717***	0.0704***
	(0.019)	(0.019)	(0.021)	(0.021)
Domestic×2010	0.0454**	0.0445**	0.0550**	0.0507**
	(0.020)	(0.019)	(0.023)	(0.023)
Domestic×2011	0.0430**	0.0490**	0.0476**	0.0518**
	(0.019)	(0.019)	(0.023)	(0.023)
Control Variables	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	57,149	57,149	16,705	16,705
R-squared	0.455	0.465	0.292	0.306

Table 7: Investment and the 2008 Tax Reform for Firms with at Least Seven Sample Years

This table replicates Table 2 but restricts the sample to firms that survived at least seven sample years. The dependent and independent variables are defined in Table 1. We report the regression results for the full sample and a matched sample. We include firm fixed effects and year fixed effects in all specifications. We report robust standard errors clustered at the firm level in parentheses. ***, **, and * denote a significant difference at the 1%, 5%, and 10% levels, respectively.

	Full Sample		**Matched Sample**	
	(1)	(2)	(3)	(4)
Domestic×Reform	0.0435***	0.0431***	0.0492***	0.0489***
	(0.016)	(0.015)	(0.018)	(0.017)
Control Variables	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	30,133	30,133	13,675	13,675
R-squared	0.234	0.253	0.233	0.248

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