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Cash on the Table? Imperfect Take-up of Tax Incentives and Firm Investment Behavior

Wei Cui
Allard School of Law at the University of British Columbia, cui@allard.ubc.ca

Jeffrey Hicks

Jing Xing

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Wei Cui*
Peter A Allard School of Law
University of British Columbia

Jeffrey Hicks
Vancouver School of Economics
University of British Columbia

Jing Xing†
Antai College of Economics and Management
Shanghai Jiao Tong University

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†Corresponding author. Email:jing.xing@sjtu.edu.cn. Address: 1954 Huashan Road, Antai College of Economics and Management, Shanghai Jiao Tong University, Shanghai, China.

Abstract

We investigate whether tax incentives are effective in stimulating private investment in less developed countries, by exploiting the introduction of accelerated depreciation for fixed assets investment in China as a natural experiment. In contrast to the large positive impact of similar tax incentives in the U.S. and U.K. found in recent studies, accelerated depreciation appeared ineffective in stimulating Chinese firms' investment. Using confidential corporate tax returns from a large province, we find that firms fail to claim the tax benefits on over 80 percent of eligible investments. Firms' take-up of the tax incentive is significantly influenced by their taxable positions and tax sophistication. Information transmission and resources of local tax authorities also play a significant role. Our study contributes to the understanding of conditions under which tax-based investment incentives can be effective.

Keywords: tax incentives, investment, take-up, tax administration
JEL Classification: H2, H3

Tax incentives for investment are widely used around the world today to provide fiscal stimulus. They have in particular enjoyed a long history of implementation in developed countries. The United States, for example, introduced accelerated depreciation in 1954 and an investment tax credit in 1962 (Auerbach, 1982). Relative to this long history, it is only recently that empirical studies convincingly documented positive investment responses to such policies (House and Shapiro, 2008; Maffini et al., 2019; Ohrn, 2018; Zwick and Mahon, 2017).[1] At the same time, evidence persists that substantial frictions may arise in the implementation of such policies. In the U.S., for instance, between 40 and 60 percent of firms did not claim bonus depreciation on eligible investments (Kitchen and Knittel, 2016). Sources of friction recently examined in research include tax losses (Edgerton, 2010), accounting rules that counteract the effect of tax rules (Edgerton, 2012; Graham et al., 2017), and compliance costs (Kitchen and Knittel, 2016). Some of these frictions continue to fuel critiques of accelerated depreciation and similar policy (Bazel and Mintz, 2019).

In this paper, we analyze the recent introduction of accelerated depreciation (AD) in China. The Chinese setting is important: China has seen more capital investment than anywhere else in the world in the last decade (Chen et al., 2019a). Until recently, Chinese tax policy had almost uniformly relied on preferential corporate tax rates to encourage investment. Facing both a declining trend of investment and budgetary concerns, the government introduced AD in 2014 as a better-targeted policy tool. The AD rules were considerably more generous for a subset of industries. This allows us to use a difference-in-differences approach to identify the causal effect of the introduction of AD on investment. We find that although the tax benefit of AD in China is sizeable and comparable to that of U.S. bonus depreciation or U.K. first-year capital allowances, Chinese firms showed surprisingly limited investment responsiveness, in contrast to the findings of large investment responses in the

[1] Hassett and Hubbard (2002) noted that even in the early 1990s, “almost no economist believed that the investment demand elasticity was much different from zero”.

U.S. and the U.K..

Using confidential corporate tax returns for a large province in China, we then investigate why the tax incentive failed to stimulate private investment. We document that firms failed to claim AD on over 80 percent of eligible investment. We evaluate two complementary explanations for why firms forgo the tax benefits. One explanation is that the prevalence of widespread tax losses, and the tax law's treatment of losses, render the present value of AD small or even negative relative to the regular depreciation schedule. Consistent with this narrative, we find strong disincentive effects of tax losses on claiming AD. However, even after accounting for this, the take-up rate of AD remains dismal. The second narrative is that, due to poorly established channels of tax policy publicity and a lack of prior exposure, many firms are unaware of the policy or face learning and compliance costs in claiming its benefits. Unlike preferential tax rates previously used to stimulate investment, the benefits of AD require firms to conduct more involved calculations, which may be demanding on taxpayers who lack prior knowledge and official guidance. Consistent with this narrative, we find that larger firms and those with more tax-related expertise are more likely to claim AD.

This raises the question of whether dedicating tax administration resources to publicity and taxpayer education can help firms to better utilize tax incentives. The role of tax administration is particularly vital in developing countries. In China, taxpayers rely heavily on tax administrators for knowledge about tax law (Cui, 2015a).[2] Firms are assigned to a local tax bureau that is responsible for securing taxpayer compliance and educating taxpayers on new policies. Consistent with the hypothesis that resource-constrained tax bureaus will devote less time to information delivery and taxpayer education, we find that tax administrators' workload, measured by the number of firms in a tax bureau's jurisdiction relative to the bureau's staff size, negatively predicts take-up. We also document that firms further away

[2] The adoption of tax policy in China also largely bypasses legislatures and the legal system, and consequently lacks the venues of publicity and outreach that tax policies possess in democratic countries.

from their tax bureau are less likely to claim AD, which we attribute to tax administrators being better able to convey tax policies to firms within a closer geographic distance. A series of robustness checks, placebo tests, and heterogeneity results reinforce the core findings and support our interpretation of the effects as the consequence of information transmission from tax administrators to firms. In contrast to the emphasis in prior literature on the importance of tax administration in reducing tax evasion (Keen and Slemrod, 2017), our findings indicate that investments in tax administration resources can also have a significant impact on effective policy implementation.

Our study echoes themes found in much earlier discussions of investment incentives in developed countries. Imperfect take-up of accelerated depreciation benefits received frequent comment in the U.S. from the 1950s until the 1980s (Wales, 1966; Auerbach, 1982). Analyses of the phenomenon tended to emphasize conflicting incentives arising from an increasingly complex U.S. corporate tax system, rather than taxpayer awareness and learning, as constraints on the effectiveness of AD (Gordon et al., 1987). However, imperfect take-up of accelerated depreciation was observed also in other corporate tax systems (Kanniainen and Sodersten (1994) speaks of the "well-documented failure of Nordic corporations" to claim AD benefits), and its causes were not well-understood (Aarbu and Mackie-Mason, 2003; Forsling, 1998). In the implementation of investment incentives in emerging economies, it is not surprising that these puzzles from industrialized countries in an earlier era should resurface, or that information transmission might turn out to be an important factor. Pham (2019), for example, suggests that Vietnamese firms failed to claim a reduction in the corporate tax rate simply because the tax agency declined to reissue tax returns to reflect the new tax reduction.

Our study contributes to several strands of literature. First, we provide new evidence for the phenomenon of imperfect take-up of tax benefits (Gronberg, 2015; Kitchen and Knittel, 2016; Pham, 2019; Zwick, 2018), in a non-U.S. and, specifically, emerging economy context. The context allows us to examine certain determinants of imperfect take-up that may have been in play elsewhere as well. Second, we contribute to the literature on the interaction between tax administration and tax policy implementation (Dabla-Norris et al., 2019; Goodspeed et al., 2013). We emphasize the role of tax administrators in communicating information to taxpayers and thereby increasing firms' engagement with new policies. In this way, our study also adds to the discussion on the importance of information transmission and tax expertise in the effective implementation of tax policy (Abeler and Jäger, 2015; Chetty and Saez, 2013; Chetty et al., 2013; Graham et al., 2017; Hoopes et al., 2015; Zwick, 2018). Finally, we contribute to studies of investment incentives in developing countries (Chen et al., 2019a; Fan and Liu, 2020), by extending analysis of responses to AD beyond the existing evidence from developed countries (Maffini et al., 2019; Ohrn, 2018; Zwick and Mahon, 2017).

The rest of the paper proceeds as follows. Section 1 provides background on the Chinese government's adoption of AD and compares the policy to investment incentives studied in recent scholarship. Section 2 describes the data we employ. Section 3 analyzes firms' investment responses. Section 4 analyzes firms' take-up of AD. Section 5 investigates what factors influence the decision to claim AD conditional on having eligible investment. Section 6 discusses the implications of our findings for tax policy and concludes.

1 Accelerated depreciation: Policy background

Accelerated depreciation (AD) is a familiar tax policy tool in developed countries for stimulating private investment. The U.S. first introduced AD in 1954 by allowing taxpayers to use the double declining balance (DDB) and the sum-of-the-year's-digits (SYD) methods, and Section 179 expensing (the most accelerated form of depreciation) became available to small businesses in 1958 (Guenther, 2018). As the Treasury and Congress began to introduce uniform depreciation schedules for asset classes in the 1960s and 1970s, options for choosing shorter useful lives were also offered (Auerbach, 1982). This culminated in the Accelerated Cost Recovery System (ACRS) in 1981. The more generous Section 179 expensing and bonus depreciation studied in the recent U.S. literature (Kitchen and Knittel, 2016; Zwick and Mahon, 2017) thus represent only the latest episodes in a long history of similar tax incentives. Many other industrialized countries have likewise long used AD as a policy tool (Forsling, 1998).

In contrast, AD is a relatively new policy instrument in Chinese business income taxation. The basic depreciation rules under the 2008 Enterprise Income Tax Law (EITL) regime are extremely simple and provide only for straight-line depreciation and five fixed asset classes, with useful lives ranging from 3 to 20 years.[3] AD existed before the 2014 policy change, but in a very limited fashion—it was in principle permitted only in cases where fixed assets have become technologically obsolete or are unusually vulnerable to disintegration and erosion. In other words, pre-2014 AD was not contemplated by the statute as a possible tax preference, but only as relevant when serious errors in the classification of assets for economic depreciation require correction. In 2012, firms in software development and integrated circuits industries were permitted to access AD as a new form of tax incentive, but these firms were relatively few. Moreover, claims were subject to scrutiny by tax administrators and supposed to be verified by field audits. Consistent with both the narrowness and stringency of the original AD regime, before 2014 there was no entry for claiming AD separately from regular depreciation on schedule A105080 of the corporate income tax return, where firms report depreciation and amortization deductions taken.

The Ministry of Finance announced the new AD policy on September 24, 2014, and the SAT issued more detailed rules in October and November 2014. Effective from January

[3]The useful life of assets is the minimum number of years for straight-line depreciation. Unlike the tax depreciation rules, Chinese accounting rules allow DDB and SYD depreciation.

1, 2014, all firms regardless of industry could immediately expense newly purchased fixed assets with unit value under 5,000 CNY, and newly purchased instruments and machinery with unit value under 1 million CNY that are used exclusively for R&D.[4] Moreover, all firms in all industries could claim additional depreciation–either a 40% reduction in useful asset life, or use of the DDB or SYD methods–on newly purchased instruments and machinery with unit value exceeding CNY 1 million that were used exclusively for R&D.

A selected subset of industries was provided with even more generous AD. First and most significantly, starting from January 1, 2014, firms in six industries could elect AD for any newly purchased fixed assets at 40% of the original useful asset life (or, alternatively, use the DDB or SYD method), regardless of the size and purpose of the investment.[5] Second, Small and Micro Profit Enterprises (SMPEs)[6] in the six industries could immediately expense investment on instruments and machinery that are partially used for R&D and have a unit value not exceeding 1 million CNY. In September 2015, these tax incentives were extended to firms in four additional industries for eligible asset purchases made on or after January 1st, 2015. Table 1 illustrates the matrix of policies.

As shown in Table 2, the preferential AD policies target primarily, though not exclusively, certain manufacturing industries. As these AD incentives for the ten targeted industries are not limited to investment in instruments and machinery used for R&D purposes, they are much more generous than those available to other industries. All AD policies announced in 2014 and 2015 were introduced as permanent measures, and they remain in force as of 2020.[7]

Figure 1 plots the search intensity index (the blue line) for the key words "accelerated

[4] 1 CNY = 0.16 USD during this period.

[5] Under China's AD rules, taxpayers may choose one method from shortened useful life, DDB, and SYD. In the remainder of the paper we will discuss the 40% reduction in useful life as the main tax benefit, although the SYD method may yield faster depreciation for long-lived assets.

[6] SMPEs were defined under the EITL as firms with (1) total assets under certain thresholds (30 million or 10 million CNY depending on industry), (2) total employees under certain thresholds (100 or 80 depending on industry), and (3) taxable income of less than 300,000 CNY.

[7] In 2019, the Chinese government extended the preferential treatment given to the 2014 and 2015 industries to all manufacturing industries, also on a permanent basis.

depreciation for fixed assets investment" (in Chinese) from the popular Chinese search engine Baidu, during the period 2014/01-2016/12. There is a clear jump in the search index in the week of the 2014 policy announcement, and very little search activity before, indicating that the 2014 AD policy was likely unexpected. Search intensity did not display the same increase around the September 2015 announcement relative to the preceding months. We plot the search intensity index for the keywords "tax reporting" (in Chinese) during the same period as a comparison. The two indices co-move indicating that search for AD information coincides with general tax filing.

China's AD policy announced in 2014 and 2015 is reminiscent of earlier U.S. policies, such as the DDB and SYD depreciation methods introduced in the Revenue Act of 1954 and the shortening of statutory asset lives under ACRS in 1981. The simple average (across asset classes) of the extent by which ACRS shortened useful lives was 43.67%, which is very close to the 40% reduction under China's AD policy.[8] Another point of comparison is the Modified Accelerated Cost Recovery System (MACRS) in place in the U.S. since 1986. Because MACRS permits DDB depreciation, if we compare assets with the same statutory useful life, the benefit of AD policy in China is roughly equivalent to the accelerated depreciation available under MACRS.[9] Table 3 presents calculations of the present value of depreciation deductions under the regular schedule, under AD using 60% useful life, and under DDB (the rough equivalent of MACRS), separately. Denoting $Z_{t,k}$ as the depreciation deduction in year t, the present value of deductions is defined as:

$$Z_k = Z_{1,k} + \sum_{j=2}^{L_k} \frac{Z_{t,k}}{(1+r)^j} \tag{1}$$

[8]Changes in asset life brought about by ACRS relative to the pre-1981 Asset Depreciation Range system are summarized in Table 1 of Gravelle (1982).

[9]There are two notable differences: (i) China does not have a half-year rule and depreciation begins in the month when asset is placed in service; (ii) MACRS allows switch-over from DDB to straight-line depreciation when that is faster, but China does not.

where r is the risk-adjusted discount rate. We use a 7% rate which is used by both Zwick and Mahon (2017) and Maffini et al. (2019) and likely to be a lower bound faced by Chinese firms. The middle three columns of Table 3 show that for an asset with a useful life (L_k) of 5 years under the regular schedule, the difference in value between the regular and accelerated regimes is \$5.9 on a \$100 investment, which generates \$1.46 in tax savings at the standard 25% tax rate.

The second-to-last column of Table 3 shows the present value of depreciation if the DDB method–the rough equivalent of U.S. MACRS–was applied. For assets of 5 years or longer, the present value of deductions under AD is greater than DDB. This allows the calculation in the last column of Table 3 of an implied bonus depreciation factor: U.S. bonus depreciation allows firms to deduct a percentage of the asset immediately and the remaining asset according to MACRS. The Chinese AD rules are equivalent to allowing first-year bonus depreciation at 21% or 22% (for 5- and 10-year assets), somewhat smaller than the 30% bonus factor in U.S. legislation in 2002.

More generally, to quantify the effect on tax savings for our sample of firms, we assume that each firm allocates a dollar of new investment in proportion to their current asset holdings. Denoting $V_{i,k}$ as firm i's holdings of type k assets, we define the average tax value of depreciation deductions as

$$\tau Z = \frac{1}{N}\sum_i \tau_i \sum_k \frac{V_{i,k}}{\sum_k V_{i,k}} Z_k \tag{2}$$

where τ_i is firm i's tax rate. While the standard tax rate in China is 25%, Small and Micro-Profit Enterprises faced 20% and 10% rates during this period, and High and New Technology Enterprises (HNTEs) faced a 15% rate. Using each firm's observed tax rate in 2013 from the tax returns for the province we study, Table 4 reports that AD increased Z by \$9.5 on a \$100 investment, which is greater than the effect of bonus depreciation studied in

Zwick and Mahon (2017) and that of the U.K. first-year capital allowances studied in Maffini et al. (2019). However, the effect on tax savings is attenuated by lower statutory rates firms faced in China: it is \$1.7 on a \$100 investment. The user cost of capital, $(1-\tau Z)/(1-\tau)$, declined by .022, or 2.1 percent following AD, which is on the lower bound of the effect of bonus depreciation but higher than the U.K. first-year capital allowances. Note that this change in the user cost of capital is also the relative change between the targeted and non-targeted industries due to AD provisions that the targeted industries were eligible for, but for which the non-targeted industries were not.

There are two main tax policy changes during the period we study that may also affect firms' investment decisions. The first is the lowering of the effective corporate tax rate for certain SMPEs. However, this policy is available to firms in all sectors, and therefore would not drive differences between industries that define our treatment and control groups. The second is the expansion of the value added tax to the service sector, which may increase the investment incentives of firms in service industries. In our research design, firms in both the treated and control groups are from the manufacturing sector already subject to the VAT. They are thus not directly affected by the expansion of the VAT, and any indirect effect of such reform may reasonably be assumed to be common across treated and control groups.

2 Data and sample descriptions

2.1 Corporate tax returns

For our empirical analyses, we use a novel and newly available administrative data set from a large and prosperous province in China. The data set is extracted from the comprehensive database that the provincial tax agency uses for all of its activities, including taxpayer risk assessment and inspections, and internal evaluations of administrative outcomes. Our data set covers the period 2010-2016 and includes de-identified information for firms of all sizes and sectors. It contains a large number of variables from the annual corporate income tax return, income statements and balance sheets, as well as a taxpayer registry. The data we use is both relied on by tax administrators and backed by genuine legal obligations borne by taxpayers.

Specifically, our data set includes most entries on Schedule A105080 of the corporate income tax return where taxpayers report asset-specific accelerated depreciation. For each of the five different asset classes of fixed assets, there are four fields that report, respectively, the sum and the individual values of three forms of accelerated deduction for assets: (1) immediate expensing; (2) AD introduced in 2014/5; and (3) the minor amounts of AD in place prior to 2014/5.[10] These fields were not available on corporate tax returns before 2014. In addition to the amount of AD claimed, Schedule A105080 breaks down a firm's stock of fixed assets by type, which allows us to calculate firms' asset compositions. Moreover, we have information from the main Schedule A100000 where we observe firms' current tax loss positions, whether they have loss carry forwards, and their statutory corporate income tax rates. The data also includes basic financial statement variables that firms submit to the tax authority.

Another novel feature of our data set is that it provides a 9-digit area code for each corporate taxpayer, which allows us to identify the neighborhood where the firm is located. Furthermore, tax registration data identify the tax bureau that is directly in charge of each firm.[11] We manually collect the physical address of each tax bureau. Using the 9-digit area code to proxy for each firm's location and combining it with the location of the tax

[10]The entry on AD introduced in 2014/5 is supposed to be backed up by a separate worksheet (A105081). However, instructions for schedule A105080 and the separate worksheet were unclear about how this field is to be completed.

[11]In 2018, a systematic change in the organization of Chinese tax administration resulted in the merger of many bureaus and thus potential address changes. By contrast, during the 2010-2016 period covered by our data, the general configuration of tax bureaus remained relatively stable.

bureau, we can calculate the geographic distance between each firm and its tax bureau. We also manually search the websites of each tax bureau to obtain information on staff size.[12] Pooling all this information together, we can analyze how features of tax administration influence the effectiveness of AD.

2.2 Sample descriptions

We obtain from the tax returns 4,547 firms in the 2014 targeted industries, 17,721 firms in the 2015 targeted industries, and 8,419 firms in non-targeted manufacturing industries, for which we observe non-missing necessary financial information. Firms in 2014 targeted industries are not in the control group for the 2015 AD reform, nor vice versa. Table 5 provides summary statistics of key variables in our analyses for each group as of 2013.

Generally speaking, firms in the 2015 targeted industries are similar to those in the non-targeted industries in most dimensions. Firms in the 2014 targeted industries appear to be more different. Consistent with the fact that the 2014 targeted industries are more "high tech" than traditional manufacturing industries (Table 2), firms in this group are younger, smaller (by revenue, asset and employee), faster growing, and more likely to report HNTE status. These firms also hold more cash and are less likely to borrow. For all three groups, a large proportion of firms are in loss-making positions and carry a substantial amount of unclaimed losses. Between 4% and 8% of firms in the targeted industries are state- or collectively-owned, as opposed to privately-owned. The proportion of SOEs is much higher for firms in the non-targeted industries.

Non-targeted firms and those in the 2015 targeted industries tend to be located further away from local tax bureaus. Since the majority of these firms are in the more traditional manufacturing industries, this may reflect the fact that these firms are typically located away

[12] The websites do not disclose historical information on staff size year by year. Under the assumption that the staff size is highly persistent over time, the 2018 information will accurately proxy bureau resources from 2014-2016.

from commercial and administrative areas. On average, one local tax collector corresponds to around 200 firms in the local area for the non-targeted group, which increases to between 250-270 firms per tax official for the targeted firms.

3 Did AD stimulate investment?

3.1 Baseline estimations

We start by examining whether the introduction of AD stimulated investment by exploiting the differential generosity of AD across targeted and non-targeted industries in a difference-in-differences framework. Denote $y_{i,t}$ as firm i's investment rate in fixed assets in year t, D_i as an indicator for being in a targeted industry, and $Post_t$ as an indicator for years after the policy implementation.[13] The baseline difference-in-differences specification is:

$$y_{i,t} = \alpha_t + \alpha_g + \alpha_a + \beta \times Post_t \times D_i + \epsilon_{i,t,g} \quad (3)$$

The coefficient of interest, β, captures the difference in investment rate between targeted and non-targeted firms under the AD regime, relative to the difference before AD's implementation. For identification, we rely on the differential AD provisions for the targeted and non-targeted industries. Specifically, policy variation arises as long as investment in both groups is not mainly driven by small-scale purchases, or by purchases of equipment used exclusively for R&D.[14] In this case, AD reduced the user cost of capital for the targeted firms. Following Hall and Jorgenson (1967)'s prediction that a decrease in the cost of capital will increase the investment rate in the short-run, we expect the coefficient β to be positive.

[13] For the 2014 targeted industries, the post period is 2014 to 2016. For the 2015 targeted industries, the post period is 2015 to 2016.

[14] Few firms claimed R&D super deductions in the tax returns, which indicates infrequent R&D investment by firms.

We control for three-digit industry (α_g), time (α_t), and firm age fixed effects (α_a).[15]

Table 5 reveals considerable differences in observed firm-level characteristics between targeted and the non-targeted firms. This reflects the fact that the AD provisions differ across industries. Therefore, we construct a control group of firms that are more comparable with targeted firms using a two-step matching procedure. In the first step, we restrict the control group to be non-targeted firms in the manufacturing sector. In the second step, we match targeted and non-targeted firms using Coarsened Exact Matching (CEM) (Iacus et al., 2011).[16] We match on firms' i) age, ii) profit margin ($\frac{TotalProfit}{Sales}$), iii) total asset stock (tangible and intangible) reported on the balance sheet, and iv) revenue growth, all as of 2013.[17] Unlike matching applied to cross-sectional data, which aims to maximize balance among all relevant covariates, our goal is to create a control group with parallel trends of investment before the policy and similar contemporaneous shocks during the policy. Lingering imbalance among covariates does not imply a violation of the identifying assumptions required for difference-in-differences.

Table A.1 reports summary statistics for the matched sets of firms both before and after matching. Panel A compares the 2014 targeted industries to their matched control firms. Panel B does the same for the 2015 targeted industries. We also report the p-values from testing the difference of means between the targeted and control groups. Before matching, the targeted and non-targeted groups are statistically different in terms of all the matching

[15] Firm age is calculated as the number of years since they registered with the tax authority. The industry fixed effects perfectly capture treatment status.

[16] CEM first coarsens the matching variables by sorting values of each variable into mutually exclusive bins. It then exactly matches treated and control firms based on their coarsened values. As an example, with two matching variables, each grouped into two bins, CEM would create four cells from the Cartesian product of each binned variable. Targeted and control firms are then exactly matched based on which of the four cells they belong in. Before CEM matching, we restrict the treatment and control samples to have a common support for each of the matching variables and drop firm-year observations with zero business revenue.

[17] Matching on age provides control firms at similar points their life-cycle; profit margin provides firms with similar productivity; total asset stock obtains firms of similar size; revenue growth obtains firms with similar growth trajectories.

variables in 2013. After matching, targeted firms are statistically indistinguishable from control firms on each of the matched variables before the policy reform aside from total assets. They also become more similar in terms of fixed asset investment rates, taxable incomes, and the cash effective tax rates before the implementation of AD.

Our main outcome variable is the fixed asset investment rate. Firms do not report new asset purchases in the tax return. Therefore, we proxy firms' investment rate as the year-over-year change in the logarithm of total fixed assets measured at original cost in benchmark analyses, and explore other measures of investment as robustness checks in the next section. Figure 2 reports the time trends in the investment rate for the matched targeted and control firms. We control for firm age and three-digit industry fixed effects while plotting the trends. Panel A and B correspond to the 2014 and 2015 targeted industries, respectively. These figures reveal that pre-treatment reform trends are parallel between the targeted and non-targeted groups, which helps validate our difference-in-differences approach. Both panels display downward investment trends common to the targeted and non-targeted firms, which is likely driven by the macro-economic environment in China during this period. Likewise, for both treatment groups the investment trends did not change noticeably relative to the control group after AD's implementation, suggesting that stimulus effect of AD was minor or non-existent.

Table 6 presents the baseline pooled difference-in-differences estimates corresponding to Equation (3) with all coefficients scaled by 100. All regressions employ DFL re-weighting (DiNardo et al., 1996) based on total sales, a common approach for controlling for changes in the distribution of firms over time (Yagan, 2015; Zwick and Mahon, 2017).[18] Standard errors are clustered at the three-digit industry level to account for within-industry correlations and serial correlation over time within a firm. Consistent with Figure 2, the investment rate

[18]The results are highly similar without DFL re-weighting. Appendix B details the construction of the weights.

dropped by 0.7 percentage point among the 2014 targeted group after the implementation of AD, relative to the control group (column 1). Column (2) estimates a 0.34 percentage point drop in the investment rate for the 2015 targeted firms. Both estimates in the first two columns are statistically indistinguishable from zero. The upper bounds for the estimated treatment effects are 1 and 0.62 percentage points for the 2014 and 2015 cohorts, respectively.

The AD provisions that the targeted industries were eligible for, but for which the control industries were not, reduced the user cost of capital by 2.1 percent. We derive an upper bound on the investment elasticity with respect to the cost of capital as $\eta = \frac{\frac{\hat{\beta}_u}{\bar{I_{pre}}}}{.021}$, where $\hat{\beta}_u$ is the upper bound on the confidence interval of β and $\bar{I_{pre}}$ is the average investment rate before the policy reforms in the targeted industries (reported in Table 6). We calculate η as 3.6 ($\frac{\frac{1}{13.1}}{.021}$) and 3.1 ($\frac{\frac{.62}{9.61}}{.021}$) for the 2014 and 2015 policy reforms, respectively. These are much smaller than estimates from Maffini et al. (2019) (8.3-9.9) and from Ohrn (2018) (6.5).

In Columns (3) and (4), we weight the regressions by the logarithm of lagged revenue to estimate a size-weighted effect. The results are similar to the baseline results reported in the first two columns, indicating limited heterogeneity in the response across firm size. To investigate whether sample composition matters, we restrict to a balanced panel of firms present in the data from 2010 to 2016 in Columns 5 and 6. The results are qualitatively similar to those in Columns 1 and 2.

These results indicate that on average, AD did not lead to more investment among firms in the targeted industries. However, this null response could mask some degree of heterogeneity. For example, firms in taxable losses cannot benefit from AD immediately and therefore may respond less. Second, firms who use shorter duration assets benefit less from AD. Third, smaller firms may either respond more to AD due to financial constraints as suggested by Zwick and Mahon (2017), or respond less due to lower salience of AD's benefits. To test each dimension of treatment effect heterogeneity, we construct binary variables indicating (i) tax loss status; (ii) above-median weighted asset lives; (iii) above-median level of revenue as a measure of firm size[19]; (iv) the presence of interest expenses on the tax form which indicates some ability to borrow; and (v) above-median cash holdings which potentially indicates less financial constraints.[20] To condstruct these indicators, we first calculate the average value for each firm using pre-reform observations (2011 to 2013). Next, we calculate the median of the pre-reform averages across the regression sample, and then sort firms into the above and below median categories accordingly. Denoting X_h the combined matrix of these indicators and α_h the set of fixed effects for each, we extend our difference-in-differences regressions by interacting D_i, $Post$, and $D_i \times Post$ with X_h:

$$\begin{aligned} Y_{it} =& \alpha_t + \alpha_g + \alpha_a + \alpha_h + \beta \times Post \times D_i + \gamma_d \times D_i \times X_h + \gamma_p \times Post \times X_h \\ &+ \beta_h \times Post \times D_i \times X_h + \epsilon_{it} \end{aligned} \tag{4}$$

Columns 7 and 8 of Table 6 show the heterogeneous treatment effects β_h. For both reforms, none of the estimated coefficients on these interaction terms is statistically different from 0. The lack of heterogeneity strengthens our conclusion that AD did not stimulate investment.

We illustrate the dynamic effects of the two policy reforms in Figure A.1, where we do not see investment response in any of the years post reform. In the baseline specification, as the targeted industries are mostly in manufacturing, we restrict the control group to be manufacturing firms so that they are *a priori* more comparable. To illustrate the role of excluding non-manufacturing industries, Figure A.1 also plots dynamic difference-in-differences estimates using all non-targeted firms as the control group including services industries. Using this larger control group violates the parallel trend assumption for the 2015 AD reform, which would challenge any interpretation of the estimated post-treatment differences between the treated and control groups as the treatment effect. To highlight the

[19] Using total assets does not change the result.

[20] While the last two indicators proxy for financial constraints, accurate measurement of financial constraints is nonetheless difficult (Farre-Mensa and Ljungqvist, 2016).

role of matching and DFL re-weighting, Figure A.1 also plots results using the manufacturing control group without matching and without DFL re-weighting. Neither qualitatively affect pre-treatment trends but do marginally affect post-treatment trends in the 2014 experiment. The 2014 targeted industries were much more narrowly-selected, making them less comparable to non-targeted industries which could explain the minor difference in post-treatment outcomes without matching. Matching on pre-treatment covariates makes the treatment and control groups more comparable and, therefore, potentially less susceptible to differing aggregate shocks post-treatment. Figure A.1 also shows dynamic difference-in-differences estimates based on specifications with firm fixed effects, and a balanced sample, and results from these alternative specifications are qualitatively similar to our baseline findings.

3.2 Alternative measures of investment

We use alternative measures of investment as our outcome variable in Table A.2. Columns (1) and (2) use the change in the capital stock, $K_t - K_{t-1}$, normalized by sales in the base period. Columns (3) and (4) use the growth rate measured by $\frac{K_t - K_{t-1}}{K_{t-1}}$ instead of the first difference of the logarithm. Similar to the baseline results, we continue to find little impact of the AD on firm investment.

To this point, we measured the stock of fixed assets at historical costs. In the absence of asset dispositions, the year-over-year change reflects the dollar amount of new purchases. However, if asset dispositions correlate with acquisitions – a firm purchases a new machine to replace an old one which they subsequently dispose of – this measure of investment and the estimated treatment effect will be biased downwards.[21] We consider a third measure of investment: the change in fixed assets net of accounting depreciation. This measure is less

[21] For instance, if a taxpayer acquires a CNY 1 million new asset and disposes a used asset with historical cost of CNY 1 million, there would be no change in the aggregate historical cost of assets and thus the firm's new asset purchase would not be reflected in this measure of investment.It also follows that simple measures of capital expenditures may overstate net acquisitions.

affected by asset disposal because older assets, which have already depreciated substantially on the balance sheet, are more likely to be disposed of.[22] Columns (5) and (6) of Table A.2 display the estimated treatment effect, which is similar to the baseline results. This suggests that the null treatment effect among the 2015 industries, and the negative point estimate among the 2014 industries, are unlikely due to asset disposition bias in our baseline measurement for investment.

3.3 Results from Orbis

To ensure that the province we study is not an outlier, we present investment trends using a nationally representative sample of firms from the database Orbis. Orbis collects balance sheet information from Chinese firms, including the value of fixed assets net of accounting depreciation. We select firms with necessary financial data, around 15% of which are firms from the province we study.

Panels A and B of Figure 3 plot the investment rate time trends for the targeted industries and non-targeted manufacturing firms using Orbis data. Two patterns are apparent. First, the nationwide data show a downward trend in the investment rate leading up to the reform, mimicking the provincial trends in Figure 2. Second, neither figure exhibits a detectable increase in investment among firms in the targeted industries. In unreported output, we estimate treatment effects of -2.3 and -.9 percentage points for the 2014 and 2015 targeted industries respectively, and only the former is statistically significant.

Our results appear to contradict the study by Fan and Liu (2020), which concludes that the 2014 AD policy increased firms' investment. Fan and Liu (2020) use a data set (the National Taxpayer Survey Data or NTSD) that contains a national sample of firms similar to Orbis, and use different empirical specifications from ours. We do not have access to

[22]In the example from the preceding footnote, the net value of the used asset disposed of (i.e. historical cost minus cumulative accounting depreciation) is likely to be much lower than CNY 1 million. The change in net asset value will be positive and reflect the new asset purchase.

NTSD and cannot compare our investment measure directly with theirs. Nevertheless, in unreported exercise, we obtain null investment response among targeted firms using their empirical specifications. Importantly, the null investment response we find is consistent with the low take-up rate of AD discussed in Section 4 below, and the claiming of AD benefits is observable in tax returns but not in the NTSD. Furthermore, the province we study is relatively prosperous with a competent tax administration. This, along with the results based on Orbis data that corroborate our core empirical finding from the provincial tax data, suggests that our findings are not due to factors unique to the province we analyze.

4 Take-up of Accelerated Depreciation

4.1 Patterns and trends of AD take-up

Results from the previous section suggest that AD did not considerably stimulate investment among targeted firms. Using the tax returns, we extend the investigation to the take-up of AD among Chinese firms.

We begin by examining trends in the utilization of AD. Panel A of Figure 4 plots the percentage of firms that claimed AD, in at least one asset class, on their tax return between 2014 and 2016. Targeted firms have higher claiming rates than control firms in all three years, consistent with the broader scope of eligible fixed asset purchases. The claim rates are higher among the 2014 targeted firms relative to the 2015 targeted group. Table A.3 further shows take-up rates in each targeted industry. The take-up rate was highest in i) instrumentation manufacturing, (ii) computer, communications and other electronic equipment manufacturing, and (iii) special equipment manufacturing, all of which belong to the 2014 targeted group.

Across all industries, claiming rates spiked in 2015. This spike may be partially driven by the accumulation of AD related to assets purchased in 2014.[23] However, Figure A.2 shows that over 80% of AD claimants in 2015 were first-time claimers, implying that the increase was largely caused by an influx of new claimants. As the policy was announced late in the 2014 fiscal year, the spike in 2015 is also likely due to a delay in take-up.

Panel B of Figure 4 calculates the take-up rate conditional on having eligible investment. We infer that a firm purchased a new asset, in a given asset class, if their asset stock increased year-over-year. We then plot the average claim rate across the five asset classes.[24] Firms in the targeted industries with positive investment could, in theory, have 100% take-up. However, Panel B reveals that the claiming rate ranges from 2.5% to 17.5% – firms fail to claim AD on over 80% of eligible investment and appear to leave cash on the table. Panel C shows that the low claiming rate is observed for all asset classes, although buildings and structures and transportation have substantially lower claim rates than electronics and production equipment. This is surprising as the value of AD is higher for longer-lived assets.

In Panel D, we plot the amount of AD conditional on claiming. The main tax advantage offered to non-targeted firms was immediate expensing on fixed asset purchases with unit value of 5,000 CNY or less. Consistent with this, the median amount claimed by these firms is below 10,000 CNY in all years.[25] Among the 2014 targeted firms, the median amount of AD is 30,000, 20,000, and 70,000 CNY respectively in 2014, 2015, and 2016. The median amount of AD claimed by 2015 targeted firms was 20,000, 9,000, and 30,000 CNY, respectively.

Imperfect take-up is present for both large-scale and small-scale investment. Figure A.3 in the Appendix A plots the distribution of investment depending on whether AD was claimed or not. The distributions are very similar, with only a modest rightward shift for claimed

[23] We only observe total AD within each asset class, and therefore AD in a given year may correspond to assets purchased in prior years that have not fully depreciated for tax purposes.

[24] This definition of claiming is lower than the one presented in Panel A because it calculates the claiming probability within an asset class rather than the probability of claiming AD for at least one asset class.

[25] For such acquisitions, reported AD is equal to the sum of the purchase prices across all qualified purchases and therefore, the median of 10,000 CNY should correspond to multiple small acquisitions. We cannot distinguish between one large purchase and two small purchases in the tax returns.

investment. In Table A.4, we calculate tax savings foregone on unclaimed investment. To do so, we take $K_{i,k,t} - K_{i,k,t-1}$ as our measure of dollar investment in asset class k. If positive, we then proxy for whether they claimed AD for that investment by whether $AD_{i,k,t} > AD_{i,k,t-1}$.[26] We then calculate the average, median, and total forgone tax savings, reported in Table A.4. Total tax saving foregone by the 2014 and 2015 treatment groups, respectively, is 176 million CNY (30 million USD) and 543 million CNY (90 million USD). The average forgone savings per firm, for the 2014 and 2015 groups respectively, is 25,000 CNY and 22,000 CNY (4,000 and 3,520 USD). Table A.4 also indicates that the total tax revenue loss to the government due to actual AD claims is 41 million and 111 million CNY respectively.

4.2 Comparing take-up of tax incentives in different contexts

Imperfect take-up of AD is well-documented in developed countries, though explanations offered for it tend to be casual. Wales (1966) observed imperfect utilization of AD benefits introduced in the US in 1954, and argued that taxpayer learning, the presence of losses or insufficient net income may all affect AD adoption. Many small businesses also failed to choose AD under the 1971 US Asset Depreciation Range system: both added accounting complexity and prior taxpayer "self-help" to accelerated deductions (through non-compliance) were suggested as possible causes (Auerbach, 1982). Subsequent U.S. literature tended to emphasize incentives, rather than knowledge, as constraints on the effectiveness of AD. For example, Gordon et al. (1987) document that U.S. individual investors adopt straight-line depreciation for 60% of their investments in structures and forgo the benefits of AD. They suggest that incentives for churning real property may explain the under-utilization of AD. However, the puzzle of imperfect take-up extends well beyond the U.S. system. Scandinavian countries

[26] If a firm did not claim AD on positive investment in year t, we assume it would not claim in later years. We exclude firms in tax loss positions at the time of investment and, for simplicity, assume that currently profitable firms remain profitable for the duration of the asset life. This exercise is merely illustrative. A more precise calculation would involve forecasting the firm's future profit.

witnessed enduring under-utilization of AD allowances for decades, leading a special government commission to be convened to study the phenomenon in 1989 (for reviews of this topic see Forsling (1998) and Aarbu and Mackie-Mason (2003)). The problem seems to have persisted into this century (Gronberg, 2015).

Chinese AD rules are limited in complexity in comparison to rules in developed countries. Chinese tax law still contains neither rules for recapture of excessive deductions when depreciable assets are sold nor "anti-churning" rules–all rules that had been put in place in the U.S. by the time ACRS was adopted. Nor is there any book-tax conformity requirement that would hinder adopting tax AD. It is thus unlikely that other unique aspects of Chinese law explain low AD take-up, and past studies of imperfect take-up that relate to compliance costs and information transmission are more likely to be germane to understanding Chinese firms' response to AD. Kitchen and Knittel (2016) show that firms in U.S. states where income tax returns are less harmonized with the Internal Revenue Code display lower take-up of bonus depreciation, suggesting that compliance costs may hinder take-up. Zwick (2018), though examining the claiming of a different type of tax benefits (carryback of losses), shows that take-up is directly affected by the professional advice firms receive. In one recent study from a developing country, Pham (2019) reports that the majority of Vietnamese firms failed to claim the benefits of a simple 30% corporate tax rate reduction. Pham (2019) argues that firms' lack of awareness of the tax preference, resulting from the government's decision not to flag the rate reduction on the main tax return, partly explains the low take-up. Similarly, we show in the next section that poor awareness of AD among Chinese firms may be a key factor leading to its imperfect take up. In separate work, using the same administrative data, we find substantial bunching in response to a series of rate cuts for small and micro-profit firms in China since 2010, which implies that many taxpayers were aware of the tax cut. Compared with AD, a rate cut is likely more salient, both intrinsically and because rate cuts have been a more common form of preferential tax policy in China. Thus, the form and salience of the tax incentives seem to matter in developing countries where tax policy transmission is inefficient.

5 What affects the take-up?

We examine two complementary narratives that could explain the highly imperfect take-up of AD as documented in Section 4. One explanation is that the prevalence of widespread tax losses, and the tax law's asymmetric treatment of losses, render the benefit of AD small, or even negative relative to the regular depreciation schedule. The second narrative is that, due to poorly established channels of tax policy publicity and a lack of prior exposure, many firms are unaware or do not understand the benefits of AD. We disentangle these narratives by examining how tax loss positions, firm tax sophistication, and tax administration influence take-up.

We start by defining "claiming" and "investing". In the tax returns, we observe for each firm the total stock of assets, and the AD amount claimed, for each asset class. Claiming is defined as a firm reporting a positive year-over-year increase in the AD amount for asset class k: $C_{i,k,t} = 1$ if $AD_{i,k,t} > AD_{i,k,t-1}$. We choose this approach, rather than $AD_{i,k,t} > 0$, because AD reported in year t may be attributable to asset purchases from previous periods.[27] Similarly, $I_{i,k,t}$ is an indicator that equals 1 if the year-over-year change in the stock of asset type k, measured at original cost, is positive ($K_t > K_{t-1}$). As discussed in Section 3.2, this is a conservative measure for the purchase of new fixed assets since a firm that simultaneously purchases a new asset and disposes of an old one may report a year-over-year decrease in the asset stock.[28] In the discussion below, we define *take-up* as the probability of claiming

[27] Both methods are imperfect. In practice, all AD claims in 2014 and the majority in 2015 are first-time claims, and therefore the definitions are equivalent in those years. Even 2016, around 50% of AD claimers did not claim AD in the previous year. In line with this, we obtain rather similar results when claiming is defined based on $AD_{i,k,t} > 0$.

[28] Our benchmark estimations exclude firms that had negative "investment" but claimed AD.

AD conditional on having positive investment, $Pr(C_{i,k,t} = 1 \mid I_{i,k,t} = 1)$.

5.1 Firm-level characteristics

5.1.1 Hypotheses and graphical evidence

Taxable losses

Firms with negative or zero taxable income cannot benefit immediately from claiming AD. Therefore, the low take-up of AD may be related to the fact that a substantial proportion of firms in our sample are in taxable loss. We first examine how take-up correlates with firms' current-year taxable positions. For each firm, we construct their uncensored taxable income before any AD deduction is applied. Uncensored taxable income is total profit reported on the tax return plus the net value of book-tax adjustments (excluding AD adjustments) minus any exempt income and claimed loss carry-forwards.[29] In Panel A of Figure 5, we plot the take-up rate of AD against the uncensored taxable income measure normalized by total revenue. Take-up rates are less than 1 percent for firms in taxable loss, then begin to rise steeply with income after the zero-income benchmark. The take-up rate rises from 4 to almost 14 percentage points as normalized taxable income rises from 0 to 0.2. This suggests a strong disincentive effect of tax losses on claiming. Note that we normalize taxable income by total revenue to reduce the effects of firms size on take-up. The upward slope when taxable income is positive can be explained if normalizing by total revenue is insufficient to reduce the size effect. Alternatively, a firm with more taxable income for a given level of revenue is more likely to claim AD, since it is less likely to be pushed into taxable losses after claiming.

The present value of AD is also likely to be smaller for firms with larger stocks of unclaimed tax losses, since these firms may take a longer time to become taxable. To investigate

[29] If this value is negative, the firm would report zero taxable income in the tax returns, and as a result, the taxable income in tax returns are truncated.

the relationship between the stock of tax losses and take-up, we construct the stock of unused tax losses for each firm. We begin with observed tax losses in 2010, the first period of our data, and sum the accumulation of additional losses thereafter.[30] In Panel B of Figure 5, we plot the lagged stock of taxable losses against the take-up rate of AD, controlling for fixed asset size. In this and all scatter plots below, we also include year, asset class, and two-digit industry fixed effects. There, we observe a negative correlation between the stock of unused taxable losses and claim propensity.

It is worth noting that the effect of taxable loss stocks on claiming can be magnified by a binding time limit on loss carry forwards (Dreßler and Overesch, 2013). In China, during our sample period, taxable losses could be carried forward for only five years and not backward, which is much less generous than the tax treatment on losses in other countries. This should further suppress the incentives of firms with large unused taxable losses to claim AD.

Tax Sophistication

The low take-up rate may also reflect non-trivial compliance costs of claiming. Compliance costs can arise when firms have to navigate and learn about tax law, especially when new forms of tax incentives are implemented, and when publicity and general guidance from tax authorities is limited. Firms with greater tax sophistication may have an advantage in coping with this cost. One crude measure of tax sophistication is the size of a firm–larger firms are more likely to employ dedicated accountants and tax experts. For this reason, firm size is often included in analyses about firms' tax aggressiveness. Consistent with this, Panel A of Figure 6 shows a strong positive correlation between business revenue and the probability of claiming AD. In unreported graphical analysis, we find that the number of employees, an alternative measure of firm size, is also strongly and positively correlated with the likelihood of claiming.

[30] Since we do not observe the stock of tax losses accumulated before 2010 in the tax returns, our measure is a lower bound.

Prior experience with complex tax incentives may also enhance firms' tax sophistication. In China, various tax incentives given to firms with High and New Technology Enterprise (HNTE) status have existed for a long time (Chen et al., 2019b). To obtain HNTE status, firms not only need to satisfy requirements based on R&D intensity, but also need to comply with extensive procedures of claiming tax benefits. As a result, these firms are likely to have invested in the capacity to manage the complexity of claiming corporate tax preferences, thereby better positioning themselves to take advantage of new incentives. Consistent with this conjecture, Panel B of Figure 6 shows that HNTEs are twice as likely to claim AD than non-HNTE firms.[31]

Size of Investment and Ownership Type

The absolute value of claiming AD grows with the size of investment. In the presence of fixed costs of claiming AD, the probability of claiming should rise with investment size. Consistent with this hypothesis, Panel C of Figure 6 shows a positive relationship between investment size and take-up rates.

One unique feature of Chinese firms is that many are state-owned or state-controlled (SOEs). It is unclear how SOEs would respond to AD. On one hand, SOEs may be less focused on profit maximization, and therefore, less effective in tax planning. Moreover, as tax revenue is often the goal in yardstick competition among promotion-incentivized local officials (Lü and Landry, 2014), some SOEs may be expected to pay more taxes to the local government. On the other hand, Cui (2015b)'s review of the empirical literature on the taxation of Chinese SOEs suggests that listed SOEs participate in tax lobbying and engage in tax planning much like private enterprises. SOEs may also be more aware of tax incentives if they frequently interact with government agencies that oversee tax policy. Greater awareness may lead to higher take-up.

[31] While HNTE firms face a lower statutory rate, they are also frequent users of a 50% super-deduction for R&D related expenses. Such super-deduction would raise the value of one additional dollar of AD to a level similar to other taxpayers.

Panel D of Figure 6 plots the average take-up rate separately for privately-owned and state- or collectively-owned firms. State-owned firms were roughly 35% less likely to claim AD relative to privately-owned firms, without controlling for other covariates. This supports the conjecture that firms' ownership matters for the take-up, and that private firms are more tax sophisticated than SOEs or are more incentivized to reduce tax liabilities.

5.1.2 Multivariate Regression Analysis

We are interested in how covariates $X_{i,t}$ predict the likelihood of claiming AD conditional on having eligible investment: $\frac{\partial P(C_{i,k,t}=1|I_{i,k,t}=1)}{\partial X_{i,t}}$. To start, we simply restrict to firms with investment ($I_{i,k,t} = 1$), estimate a probit model on the decision to claim AD, and present estimates of the average marginal effects: $\frac{\partial \hat{P}(C_{i,k,t}=1|I_{i,k,t}=1)}{\partial X_{i,t}}$. Firms' choices over investment and claiming are inherently more complex than the descriptive approach we employ here. Our goal is to examine the predictors of the decision to claim AD in a reduced-form manner without fully-specifying and estimating the dynamic nature of investment and claiming decisions. As a robustness extension, we extend the simple probit model to a selection model that accounts for some forms of selection bias that could arise due to correlated propensities to both invest and claim AD.

Table 7 presents the estimation results using targeted firms only. All columns report average marginal effects scaled by 100. Standard errors are computed using the delta-method and are clustered at the three-digit industry level. Columns (1) and (2) report the estimated effects of each firm characteristic on the conditional probability of claiming. Column (1) includes two-digit industry fixed effects and year fixed effects, and column (2) adds prefecture fixed effects to control for geographic variation. Confirming the graphical evidence, current taxable losses negatively predict take-up. Based on column (2), firms in tax-loss positions in the current year (before AD deductions) are 2.67 percentage points, or 41 percent (2.67/6.36), less likely to claim AD on eligible investments on average, all else equal. The stock of unused tax losses at the end of the previous year also negatively correlates with take-up probability. Interpreting the coefficient in column (2), a 100 percent increase in the loss stock measure corresponds to a 0.08 percentage point, or 1.3 percent, decline in the probability of claiming.

Results regarding proxies for tax sophistication – firm size and HNTE status – also confirm the graphical evidence. The coefficients in column (2) indicate that a 100 percent increase in the number of employees and business revenue is associated with a 0.84 and 0.23 percentage point increase in the probability of claiming, respectively, on a base claiming rate of 6.36%. HNTE firms are 1.63 percentage points (21 percent) more likely to claim AD relative to non-HNTE firms. This estimated marginal effect is large and statistically significant, consistent with the hypothesis that HNTEs have higher tax expertise. Related, a doubling of the size of eligible investment is associated with a .06 percentage point increase in take-up probability, although the association is not statistically significant in column (2). Since our measure of investment is conservative, based on changes in asset stock, the estimated effect of investment size on take-up is likely attenuated downwards. Finally, we find that state- and collectively-owned firms are 1.16 percentage points (20 percent) less likely to claim AD than privately-owned firms.

Because we simply restrict to firms with investment ($I_{i,k,t} = 1$) and correlate take-up decisions with $X_{i,t}$, selection bias could arise if the idiosyncratic propensities of both decisions are correlated (Heckman, 1979). As an example, assume that firm size increases the latent payoff of investing, and that the idiosyncratic propensities are positively correlated. In this case, only small firms with high idiosyncratic investment payoffs will invest. Due to the positive correlation, these firms will also be more likely to claim, making small firms appear more likely to claim as well. In column (3), we examine whether accounting for this form of selection matters by implementing the standard two-stage choice model developed by Heckman (1979) and discuss in greater detail in Appendix C. If there is substantial selection bias, the average marginal effects presented in column (3) should differ from those from the probit model in column (2). However, the point estimates are mostly unchanged, implying that accounting for selection may not be essential. Note that this selection correction should still be considered a purely descriptive exercise – it does not attempt accurately model the more complicated joint and dynamic decision making process of investment and claiming.

5.2 The role of tax administration

As discussed in Section 1, AD is a new form of tax incentives for private investment in China. It is also less straightforward than a simple tax rate cut. Consequently, AD policy may lack salience for the majority of Chinese firms. In this context, while firms' own experience and tax sophistication affect the take-up of AD, tax administrators could also play a crucial role. In China, in addition to conducting audits and otherwise ensuring taxpayer compliance, front line tax administrators are generally responsible for informing taxpayers of the content of tax law (Cui, 2015a). Indeed, most taxpayers may rely on officials in nearby tax offices instead of third-party tax professionals to learn about rules applicable to their businesses. Major changes in tax law and policy are commonly accomplished by bureaucratic campaigns to spread knowledge of the changes among taxpayers. Disseminating information about tax policy items that are politically important may even become a part of the performance metrics applicable to civil servants. In contrast, general media coverage of tax policy changes is weak. Additionally, because only the national government can enact tax policies, sub-national politicians lack opportunities and incentives to take credit for or promote such policies. For all these reasons, the information transmission role of tax administrators takes on singular importance.

The role of tax administrators in disseminating policy knowledge and thereby enhancing policy effectiveness has rarely been investigated in the past. However, in their study of the relationship between firm performance and tax administration quality, Dabla-Norris et al. (2019) include communication and information transmission as one aspect of quality.

In this section, we consider two dimensions in tax administration that potentially bear on transmission of policy information: geographical distance between the firms and the tax administrators, and the staffing levels of each local tax bureau.

First, information transmission may be lost if firms and tax administrators are distant from each other. Geographic proximity is likely to be particularly important as we find that local tax bureaus in the province spend little on official advertising efforts. Available data from disclosed budgetary reports of some local tax bureaus indicate that only 1-3 percent of total spending is related to dissemination of tax-related policies. Proximity to regional tax offices has also been used in other research as a proxy for the degree of information transmission from firm to tax administrator (McKenzie and Seynabou Sakho, 2010).This leads to our first hypothesis that being located closer to the local tax bureau increases the awareness and therefore use of tax incentives. In our data, tax registration information assigns each firm to the jurisdiction of a tax bureau. Utilizing the area code of the firm and its local tax bureau, we calculate the geographic distance between each firm-bureau pair.[32] Figure A.4 illustrates the histogram of measured distances in our sample, which demonstrates rich variations across firms.

Second, delivery of new tax incentives is likely to be constrained by the resources of local tax bureaus. To measure resource levels, we obtained data on the number of staff for a subset of local tax bureaus, available from their official websites. We divide this number into the number of firms assigned to the bureau in 2013. A higher ratio of firms to bureau staff in a given jurisdiction suggests a greater workload for administrators and weaker capacity to provide guidance and other necessary assistance to firms. This, in turn, may predict lower take-up of AD. Panels A and B of Figure 7 plot the raw correlation between take-up and the two tax bureau characteristics, respectively. Consistent with both hypotheses, firms further

[32] We observe the firm's bureau assignment as of 2017. Firms are unable to change their bureau assignment. However, if some bureaus closed or changed location between 2014 and 2016, then the 2017 information we collect will contain measurement error.

away from their bureaus have lower claim rates, as do firms assigned to lower-resourced tax bureaus.

Table 8 presents estimates of the average marginal effects of these two variables on the probability of claiming conditional on investing. All columns control for the firm characteristics in Table 7 and two-digit industry fixed effects. One may be worried that the bureau staffing measure, which varies only at the bureau level, is correlated with unobservable geographic factors that influence take-up. To account for this, we further control for prefecture fixed effects. The estimated coefficients on the number of firms per tax administrator are negative and statistically significant in columns (1) and (2). We include both measures in column (3). Using column (3) as our baseline specification, we find that a 100 percent increase in staffing predicts a 1.74 percentage point, or a 25 percent (1.74/6.84), increase in take-up. A 100 percent increase in distance predicts a 0.73 percentage point, or 10 percent, decrease in take-up. These results are strongly suggestive of higher awareness and understanding of AD among firms with greater access to their tax administrators.

One may be concerned that a firm's distance to its local tax bureau is correlated with the proximity to other important government institutions. As a placebo test, we examine whether take-up correlates with the firm's distance to the nearest district or county People's Government office (that is, the office of the district or county's chief executive). Column (4) shows that the estimated effect of this placebo is indistinguishable from zero. This result corroborates the view of local tax bureaus as the relevant source of tax-related information. Additionally, in Column (5), we include tax bureau fixed effects such that the effect of distance is identified solely on within-bureau variation, as opposed to differences in geographic size across bureau jurisdictions, and show that the estimated effect is largely unchanged. This rules concerns that the estimated effect of distance is driven by spurious differences across geographic areas or bureaus.

One concern is that firms located further from tax bureaus are generally less tax compliant and therefore less likely to claim AD. In Column (6), we include three indicators of firms' non-compliance tendency: the gap between the firm's statutory tax rate (STR) and their measured effective tax rate, the ratio of fixed assets in total assets, and the ratio of profits to business revenue. Firms whose ETRs are much lower than the statutory rates may be less compliant; firms with more tangible fixed assets may be more compliant since it is easier for the tax bureau to verify their assets (Gordon and Li, 2009); and firms with a higher ratio of profits to revenue may be more compliant (Cai and Liu, 2009). While these are only rough proxies for tax compliance, column (6) shows that none of these variables predicts take-up of AD nor does including them in the regression materially change the estimated coefficients on the tax administration variables. In unreported exercises, we do not find systematic evidence that firms located further away from tax offices, or those facing a higher ratio of firms to tax bureau staffs, are more likely to avoid tax.

Another possible confounding factor is that firms located in industrial parks, or in urban areas, may have more opportunities to learn about AD from other firms. On the other hand, tax offices may locate closer to firms in such locations, or allocate more personnel, to deal with greater demand. In Column (6), we include two dummies to indicate whether a firm is located in an industrial park and in the urban area. Neither of these dummies is significantly associated with take-up of AD, and the estimated coefficients on the two tax administration variables are qualitatively unchanged.

Finally, firms with lower tax sophistication should benefit more from increased access to tax administrators, while firms more experienced in complying with new and complex tax provisions should be less affected by improved information transmission. To test this hypothesis, Column (7) interacts both tax administration characteristics with an indicator for HNTE status. We expect HNTE firms to be less reliant upon tax administrators for understanding AD. Consistent with this, the marginal effects of both tax bureau staff resources and the distance between firms and their local tax bureaus are attenuated towards zero for

HNTE firms.

5.3 Regional accounting resources

Finally, we consider the role of accounting capacity. Previous studies show that professional tax preparers help firms optimize their tax strategies (Zwick, 2018). If a firm has adequate accounting resources, the compliance costs of claiming should be lower. We do not have firm-level measures of internal accounting capacity, and thus use two measures of regional accounting resources to proxy firms' access to third-party accounting expertise. The first proxy is based on the 2010 Population Census conducted by the National Statistics Bureau, which samples 4 million individuals nationwide. Using the census data on the province we study, we calculate the percentage of accountants among all sampled individuals in each district, and the total number of accountants scaled by the number of firms in each district. The ratios proxy for the external, and possibly internal, accounting resources of firms. Our second measure is the number of accounting firms, scaled by the total number of firms in each district, which proxies for external resources available to firms. We obtain information on accounting firms and their physical address from a certified online platform that provides information about companies' registration information and credit record.

Table 9 shows the average marginal effects of each measure of accounting resources. We do not find that being in districts with more abundant external accounting resources leads to a higher claiming rate for AD. The estimated coefficient on accountants per worker and that on the number of accounting firms scaled by total number of firms in the same area are both insignificantly different from 0. Somewhat puzzlingly, there is a negative and significant association between the number of accountants scaled by the number of firms and the take-up rate. Overall, these results suggest that external accounting resources in developing countries, such as China, are less likely to be as important as professional third-party tax preparers in the US.

5.4 The relationship between take-up decision and investment

Our analyses suggest that Chinese firms had a rather low take-up rate of AD, which is consistent with our finding that AD did not stimulate investment. However, we do not think of firms' claiming decision as having a causal impact on their investment response. Claiming AD benefits (among firms with positive investments) is an imperfect indicator of awareness and understanding of the policy, which are necessary conditions for an investment response. At the same time, many taxpayers may claim AD benefits on infra-marginal investments. Moreover, firms' investment and claiming decisions may be determined by the same underlying factors. For example, firms with a large amount of taxable losses should have less incentive to claim AD and at the same time, may be less likely to purchase new assets.

It is nevertheless relevant from the policy point of view to investigate whether AD claims are mostly on marginal or infra-marginal investment. Some might be curious, for example, whether among AD claimers an investment response can be detected. Figure A.5 plots the investment rate for three different groups: (1) treated firms that claimed AD at least once during 2014-2016; (2) treated firms that never claimed AD; and (3) firms in the control group. We do not observe any significant divergence in the investment rate of the three groups following either the 2014 or the 2015 AD policy. This is consistent with the idea that claiming happened largely on infra-marginal investment, and suggests a rather pessimistic view regarding the initial effect of implementing AD in China–it was a pure transfer from the government to some large and sophisticated firms.

In unreported exercises, we also confirm that treated firms with relatively more tax expertise, or with greater access to tax administration resources, did not display different investment patterns from the control group after the implementation of AD, even though they were more likely to claim the AD benefit. Why these firms that are aware of the AD policy, as demonstrated through the act of claiming AD benefits, failed to respond to the investment incentive is unclear. Certainly, becoming aware of a tax incentive is only a necessary but not a sufficient condition for responding to it. Our study highlights the challenge of satisfying even this basic necessary condition in an emerging economy context. As awareness of the AD incentive grows over time, it is likely–though by no means a certainty–that responsiveness to the incentive will also grow.

6 Conclusions

We use the introduction of accelerated depreciation for fixed asset investment in China as a natural experiment to examine whether new forms of tax incentives can stimulate private investment. Based on confidential corporate tax returns from a large Chinese province, we document that firms did not claim AD on over 80% of cases. We show that tax loss positions, tax sophistication, and access to tax administration are all strong predictors of firms' engagement with the policy. We conclude that AD failed to stimulate private investment, which contrasts with recent studies that find sizable responses to similar policies in the US and UK, where tax expertise and tax policy publicity are notably different.

There are important reasons to believe that our findings—in terms of both the low take-up rate for a significant tax benefit, and the impact of tax administrator accessibility on such take-up—are not attributable to factors unique to the Chinese context. Imperfect take-up of investment tax incentives in the form of AD has been documented in other countries (see Section 4.2 above). Even in the U.S., Zwick (2018) shows that eligible corporate taxpayers' take-up rate between 1998 and 2011 for a relatively simple tax benefit, the operating loss carryback, was only 37%. Zwick (2018) also finds that the quality of tax return preparers significantly affects eligible taxpayers' likelihood of using the loss carryback. In general, it is well-recognized that the accounting, tax and legal professions play an important role in transmitting information about the content of tax law and policy (OECD, 2017). The success of such professions, however, is likely to depend on the existence of sizeable populations of firms that are sufficiently large and profitable to pay for legal and accounting advice and outsource compliance tasks. In less developed countries, these professions tend not to flourish. This sharply reduces possible channels for policy information transmission. Tax administrators may become the main "tax professionals" capable of disseminating tax knowledge, with the news media playing at best a secondary role. One interpretation of our findings is that, in China, tax administrators mattered more for take-up than the availability of accounting resources. Where professional resources are even less abundant than in China, one can imagine that tax administrators may play a still more crucial role in educating taxpayers.

What are the implications for policy designs? One response to constraints on the transmission of information about tax policy is to make tax law less complex. The limit on how "simplified" tax law can become, however, should not be under-estimated. Restricting tax policy instruments only to tax rate variations clearly has disadvantages. The Chinese AD policy and the tax return schedule on which AD benefits are claimed are already simple when compared to tax returns in some developed countries. Thus, if taxpayers fail to apply even relatively simple rules, it may be important to examine instead how tax law information can be more effectively transmitted. The use of newly available digital technology is certainly one direction for exploration (OECD, 2019). Designing incentives for tax administrators so that they are adequately motivated to educate taxpayers even while trying to raise revenue is another possible direction. Both take on special significance when traditional types of tax professionals may not easily materialize.

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Table 1: **Illustration of the Accelerated Depreciation and Expensing Provisions**

	Unit Value < 5000	**5000 < Unit Value < 1 Million**	**Unit Value > 1 Million**
Targeted Industries	Immediate expensing for all fixed asset purchases	(1) Accelerated depreciation for all fixed asset purchases (2) Immediate expensing for equipment that is used exclusively for R&D *(3) Small Firms Only:* Immediate expensing for equipment that is shared for R&D	Accelerated depreciation for all fixed asset purchases
All Firms	Immediate expensing for all fixed asset purchases	Immediate expensing for equipment that is used exclusively for R&D	Accelerated depreciation for equipment that is used exclusively for R&D

Note: This table illustrates the provisions for accelerated depreciation and immediate expensing implemented in 2014 and 2015. All firms were eligible for immediately expensing fixed asset purchases below unit value 5000CNY. The targeted industries were further eligible for AD on all fixed asset purchases greater than unit value 5000CNY, whereas the non-targeted industries were not. All firms were eligible for immediate expensing or AD on equipment (a subset of fixed assets) that were used for R&D purposes.

Table 2: **Targeted Industries**

2014 Targeted Industries
Biopharmaceutical manufacturing
Manufacturing of professional equipment
Manufacturing of railway, vessel, aerospace and other transportation equipment
Manufacturing of computer, communication, and other electronic equipment
Manufacturing of instruments and apparatus
Information transmission, software, and information technology services
2015 Targeted Industries
Light industry
Textile
Machinery
Automobile
Non-Targeted Manufacturing Industries
Wine, beverage, tea, and tobacco processing and manufacturing
Petroleum processing, coking and nuclear fuel processing
Chemical raw materials and chemical manufacturing
Rubber and plastic products industry
Non-metallic mineral products industry
Ferrous and non-ferrous metal smelting and rolling processing industry
Other Manufacturing
Waste resource comprehensive utilization industry
Metal products, machinery and equipment repair industry

Note: This table lists the set of targeted industries in 2014 and 2015, and the list of non-targeted manufacturing industries, respectively. Section 1 describes the accelerated depreciation provisions for the targeted industries.

Table 3: **Regular and accelerated asset depreciation schedules**

	Asset Life		PV Deductions ($r = 7\%$)				Implied BD Factor
Assets	Regular	AD	Regular	AD	Diff.	DDB	
Buildings and Structures	20	12	0.566	0.708	0.142	0.643	N.A.
Production Equipment	10	6	0.752	0.850	0.098	0.808	0.220
Furniture, Tools, Appliances	5	3	0.877	0.936	0.059	0.919	0.210
Transportation	4	3	0.906	0.936	0.030	0.945	N.A.
Electronic Equipment	3	2	0.936	0.967	0.031	0.971	N.A.

Note: The first two columns show the asset lives for each asset class under the regular depreciation schedule and the AD schedule introduced in 2014 and 2015 as described in Section 1. We also calculate the present value of deductions for a dollar of investment in each asset class under the regular depreciation schedules, the AD schedule, and the difference between the two. We use a discount rate of 7% (the risk-adjusted rate used in Zwick and Mahon (2017) and likely a lower bound on the effective interest rate facing most firms in China). We also calculate the present value of depreciation using the double declining balance (DDB) method and assuming there is no savage value. This is an approximation of U.S. MACRS but ignores the half-year rule and the switch to straight-line depreciation allowed under U.S. law. In the last column, we calculate the implied bonus depreciation (BD) factor. This is obtained by equating the present value of depreciation under BD and DDB (roughly similar to MARCS) to that under AD. We only calculate this for the 5-year and 10-year assets, since bonus depreciation is not available for the 20-year asset, and DDB is faster than AD for 3- and 4-year assets.

Table 4: **Cost of Capital Changes**

	China			Recent Studies	
	Regular Depreciation	Accelerated Depreciation	Change	Change in Zwick (2017)	Change in Maffini (2019)
Z	.741	.836	.095	.048 to .078	.033
τZ	.132	.150	.017	.017 to .027	.011
$\frac{1-\tau Z}{1-\tau}$	1.060	1.038	-.022	-.026 to -.042	-.016

Note: The first row reports the average net present value of depreciation deductions with and without accelerated depreciation (Z). The second row reports the average net present value of the tax savings due to these deductions (τZ). The third row presents estimates of the user cost of capital under each depreciation scheme ($\frac{1-\tau Z}{1-\tau}$) . We assume that each firm allocates a dollar of new investment in proportion to their pre-AD asset holdings. Denoting $V_{i,k}$ as firm i's holdings of type k assets, define $Z_i = \sum_k \frac{V_{i,k}}{\sum_k V_{i,k}} Z_k$ and $Z = \frac{1}{N} \sum_i Z_i$, where Z_k is the present value of deductions for a dollar of investment in asset class k. We define τZ as $\frac{1}{N} \sum_i \tau_i Z_i$ where τ_i is firm i's tax rate. Similarly, $\frac{1-\tau Z}{1-\tau}$ is the average across firms of $\frac{1-\tau_i Z_i}{1-\tau_i}$. The last two columns report the analogous figures for accelerated depreciation policies studied in Zwick and Mahon (2017) and Maffini et al. (2019). Our calculations of Z under AD are based on the 40% reduction in useful life provisions for purchases greater than 5,000 CNY in the targeted industries. The calculations ignore immediate expensing on purchases of less than 5,000 CNY, for which all industries were eligible, and the immediate expensing provisions for R&D-related purchases.

Table 5: **Full Sample Descriptive Statistics 2013**

	Non-Targeted Industries		2014 Targeted Industries		2015 Targeted Industries	
	Mean	N	Mean	N	Mean	N
Total Assets	5516	8419	3649	4547	4497	17721
Fixed Assets	1529	8419	902	4547	1350	17721
Average Useful Life	11.41	7114	8.88	3311	11.56	15620
Business Revenue	4699	8384	2188	4510	3403	17670
Revenue Growth	-.06	7940	.12	4092	-.04	16895
Taxable Income	114	8418	128	4547	80	17721
Percent In Tax Losses	.28	8419	.4	4547	.27	17721
Tax Loss Stock	227	2510	81	1867	166	5109
Cash Holdings / Total Assets	.11	8417	.26	4544	.11	17716
Claimed Interest	.29	8419	.2	4547	.33	17721
Age	16.04	8083	10.72	4294	15.76	17169
Employees	65.4	8419	50.09	4547	74.04	17721
State or Collectively Owned	.12	8419	.04	4547	.08	17721
High and New Tech Enterprise	.08	8083	.15	4294	.06	17169
Distance to Tax Bureau (km)	13	6584	9.25	3028	12.65	13965
Firms per Tax Administrator	206	6740	270	3119	250	14719

Note: This table displays means for select firm characteristics among targeted industries and manufacturing firms in non-targeted industries for the full sample of firms observed in 2013. Total Assets, Fixed Assets, Business Revenue, Taxable Income, and Tax Loss Stock are all in CNY10,000s. The mean of Tax Loss Stock is calculated conditional on having a positive amount. The average asset life duration is calculated among the subset of firms with positive reported values for at least one asset type. All continuous variables are winsorized at the 1st and 99th percentiles within each group of firms.

Table 6: **Did AD Stimulate Investment?**

	Baseline		Size-Weighted		Balanced Sample		Heterogeneity	
	(1) 2014	(2) 2015	(3) 2014	(4) 2015	(5) 2014	(6) 2015	(7) 2014	(8) 2015
Treat × Post	-0.70	-0.34	-0.66	-0.30	-1.00	-0.00	-2.00	-0.29
	(0.86)	(0.49)	(0.87)	(0.51)	(0.92)	(0.48)	(1.85)	(0.55)
	[-2.41,1.00]	[-1.30,0.62]						
Treated × Post								
× In Tax Loss							-0.21	-0.87
							(2.24)	(0.90)
× Long Asset Life							0.59	-0.62
							(1.65)	(0.73)
× High Revenue							1.14	1.05
							(1.38)	(0.73)
× Interest Expense							1.19	-0.12
							(2.07)	(0.71)
× High Cash Ratio							-0.30	-0.10
							(1.88)	(0.56)
N	27945	95742	27914	95657	22703	78493	27945	95742
Treated Firms	1865	11910	1865	11910	1388	9197	1865	11910
Untreated Firms	3341	5880	3341	5880	2554	4445	3341	5880
Treated Clusters	38	94	38	94	38	94	38	94
Untreated Clusters	43	46	43	46	43	46	43	46
Dep. Var. Mean	13.10	9.61	12.99	9.68	12.48	9.81	13.10	9.61

Note: This table reports the estimated treatment effect based on Equation (3). In the baseline estimations (Columns (1) and (2)), the control group are firms in non-targeted manufacturing industries that were matched to targeted firms as described in Section 3. Columns (3) and (4) weight the regressions (based on Equation 3) by the logarithm of revenue earned in the previous year to estimate a size-weighted investment response. Columns (5) and (6) restrict to a balanced panel of firms present in the data from 2010 to 2016. Columns (7) and (8) show estimates of treatment effect heterogeneity as described in Section 3. Throughout the table, we control for three-digit industry, year, and firm age fixed effects. The outcome variable is winsorized at the 1st and 99th percentiles within each year separately for the treated and control groups. The average of the outcome variable in the pre-treatment period (2011 to 2013) among the treated industries is shown in the "Dep. Var. Mean" row and scaled by 100 (a growth rate of 13.10 percent in column 1). Coefficients are scaled by 100. The 95% percent confidence interval is shown in square brackets for the baseline results in columns (1) and (2). Standard errors are clustered at the three-digit industry level and shown in parenthesis. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 7: **Predictors of Claiming: Firm-Level Characteristics**

	Pr(Claim | Invest)		
	(1)	(2)	(3)
	Probit Model		Selection Model
In Tax Loss Before AD	-2.63***	-2.67***	-2.66***
	(0.44)	(0.42)	(0.43)
Lagged Log(Tax Loss Stock)	-0.08**	-0.08**	-0.08**
	(0.03)	(0.03)	(0.03)
Log(Employees)	0.75***	0.84***	0.82***
	(0.20)	(0.19)	(0.18)
Lagged Log(Revenue)	0.23*	0.23*	0.11
	(0.13)	(0.12)	(0.15)
High and New Technology Enterprise	2.02***	1.63***	1.55***
	(0.57)	(0.55)	(0.57)
Log(Investment Size)	0.09**	0.06	0.06
	(0.05)	(0.04)	(0.04)
State or Collectively Owned	-1.28*	-1.16	-1.12
	(0.76)	(0.71)	(0.71)
Two-Digit Industry FE	Yes	Yes	Yes
Prefecture FE	No	Yes	Yes
N	48688	48688	171496
Mean of Outcome Var.	6.36	6.36	6.36

Note: This table reports the estimated average marginal effects of firm-level characteristics on the probability of claiming AD conditional on having purchased eligible investment ($P(C_{i,t,k} = 1 | I_{i,t,k} = 1)$). Columns (1) and (2) present estimates from the probit model and column (3) reports estimates from the selection model, both described in Section 4. Claiming and investment are defined as outlined in Section 4. Coefficients are scaled by 100. All time-varying explanatory variables are measured in year $t - 1$. To account for zeros, each variable inside the logarithm is shifted to the right by one unit; results are unchanged when instead using the inverse hyperbolic sine to approximate the logarithm while allowing for zeros. All continuous covariates are winsorized at the 1st and 99th percentiles within each year. Standard errors are computed using the delta-method and are clustered at the three-digit industry level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 8: **Predictors of Claiming: Tax Administration**

	Pr(Claim $\mid$ Invest)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log(# Firms / # Tax Administrators)	-0.86***		-1.74***			-1.81***	-1.81***
	(0.23)		(0.36)			(0.44)	(0.37)
Log(Distance to Tax Bureau)		-0.40**	-0.73***		-0.47**	-0.72**	-0.96***
		(0.20)	(0.25)		(0.21)	(0.28)	(0.33)
Log(Distance to Government Office)				0.23			
				(0.17)			
STR minus Cash ETR						0.86	
						(0.60)	
Fixed Assets / Total Assets						0.44	
						(0.79)	
Total Profit / Business Revenue						0.33	
						(0.42)	
Industrial Park						0.41	
						(0.63)	
Urban Area						-0.15	
						(0.63)	
Log(# Firms / # Tax Admin.) × HNTE							0.34
							(0.56)
Log(Distance to Tax Bureau) × HNTE							0.94
							(0.69)
Firm Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Two-Digit Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Prefecture FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Tax Bureau FE	No	No	No	No	Yes	No	No
N	42909	40859	34376	46718	40379	34376	34376
Claim Rate	6.59	6.64	6.84	6.30	6.72	6.89	6.84

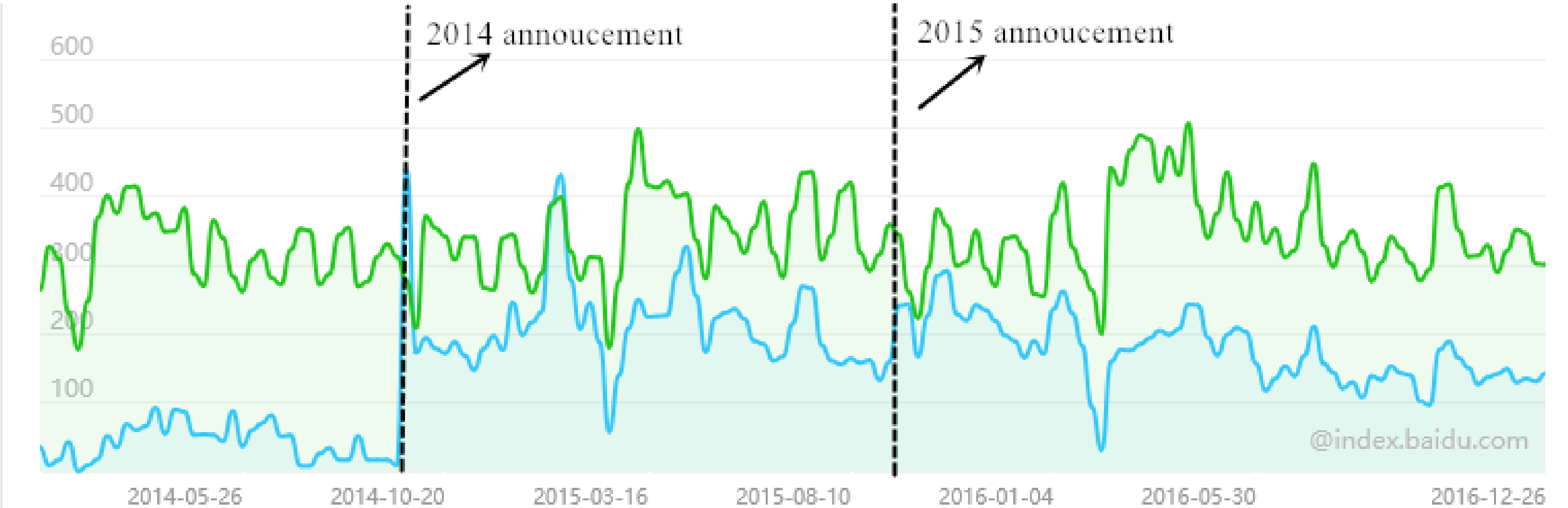
Note: This table reports the estimated average marginal effects of tax bureau characteristics on the probability of claiming AD conditional on having purchased eligible investment ($P(C_{i,t} = 1 | I_{i,t} = 1)$) using the probit model described in Section 4. Claiming and investment are defined as in Table 7. Coefficients are scaled by 100. The selection model in column (6) is described in Section 4 and C. All continuous covariates are winsorized at the 1st and 99th percentiles within each year for each of the two treatment groups. Standard errors are computed using the delta-method and are clustered at the three-digit industry level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 9: **Predictors of Claiming: Accounting Resources**

	Pr(Claim | Invest)			
	(1)	(2)	(3)	(4)
Log(# Accountants / # Workers)	-0.34			0.07
	(0.42)			(0.46)
Log(# Accountants / # Firms)		-0.54**		-0.52**
		(0.23)		(0.25)
Log(# Accounting Firms / # Firms)			-0.04	-0.17
			(0.37)	(0.39)
Log(# Firms / # Tax Administrators)	-1.48***	-1.75***	-1.74***	-1.76***
	(0.36)	(0.35)	(0.36)	(0.39)
Log(Distance to Tax Bureau)	-0.59**	-0.75**	-0.73***	-0.75**
	(0.30)	(0.31)	(0.25)	(0.32)
Firm Characteristics	Yes	Yes	Yes	Yes
Two-Digit Industry FE	Yes	Yes	Yes	Yes
Prefecture FE	Yes	Yes	Yes	Yes
N	24557	24557	34376	24557
Claim Rate	6.30	6.30	6.84	6.30

Note: This table reports the estimated average marginal effects of regional accounting resources on the probability of claiming AD conditional on having purchased eligible investment using the probit model described in Section 4. Claiming and investment are defined as in Table 7. The measures of accounting resources are described in Section 5.3. Coefficients are scaled by 100. All continuous covariates are winsorized at the 1st and 99th percentiles within each year for each of the two treatment groups. Standard errors are computed using the delta-method and are clustered at the three-digit industry level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

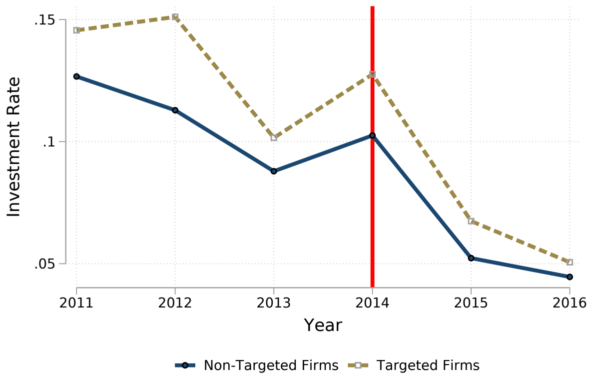
Figure 1: **Search Engine Queries for Accelerated Depreciation**



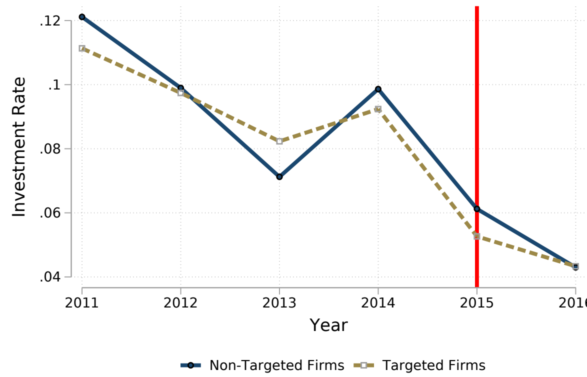
Note: This figure plots the intensity indices of search engine queries from the Chinese website Baidu during the period January, 2014-December, 2016. The shaded blue series is the index for the key words "fixed assets accelerated depreciation" and the green series is the index for the key words "tax reporting". Both key words are in Chinese. The dashed black lines indicate the weeks for the 2014 and 2015 AD policy announcements.

Figure 2: **Growth Rate of Fixed Assets (Historical Cost)**

Panel A: **Targeted vs. Non-Targeted, 2014**



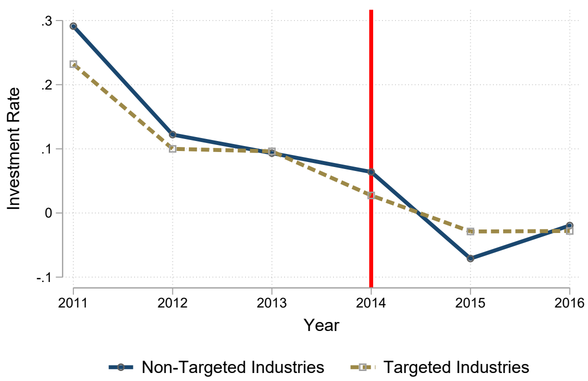
Panel B: **Targeted vs. Non-Targeted, 2015**



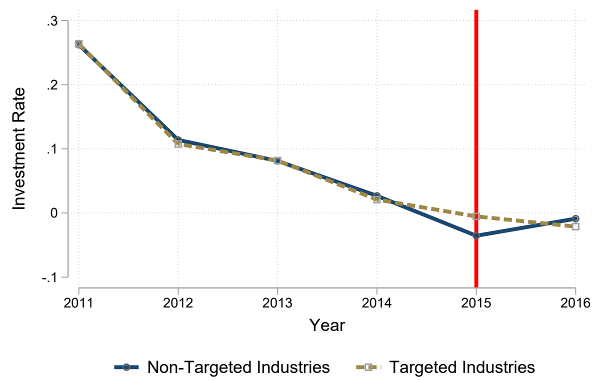
Note: Panels A and B plot trends in year-over-year changes in the logarithm of fixed assets measured at historical cost for the matched treated and control firms. The control firms are those in non-targeted manufacturing industries and matched as described in Section 3. For the plotted trends, we control for firm age, lagged profit margin, and lagged revenue growth, consistent with Equation 3. The vertical red lines indicate the timing of the AD policy announcement and implementation.

Figure 3: **Growth Rate of Fixed Assets (Net of Accounting Depreciation)**

Panel A: **Orbis Data: 2014 Targeted Industries**

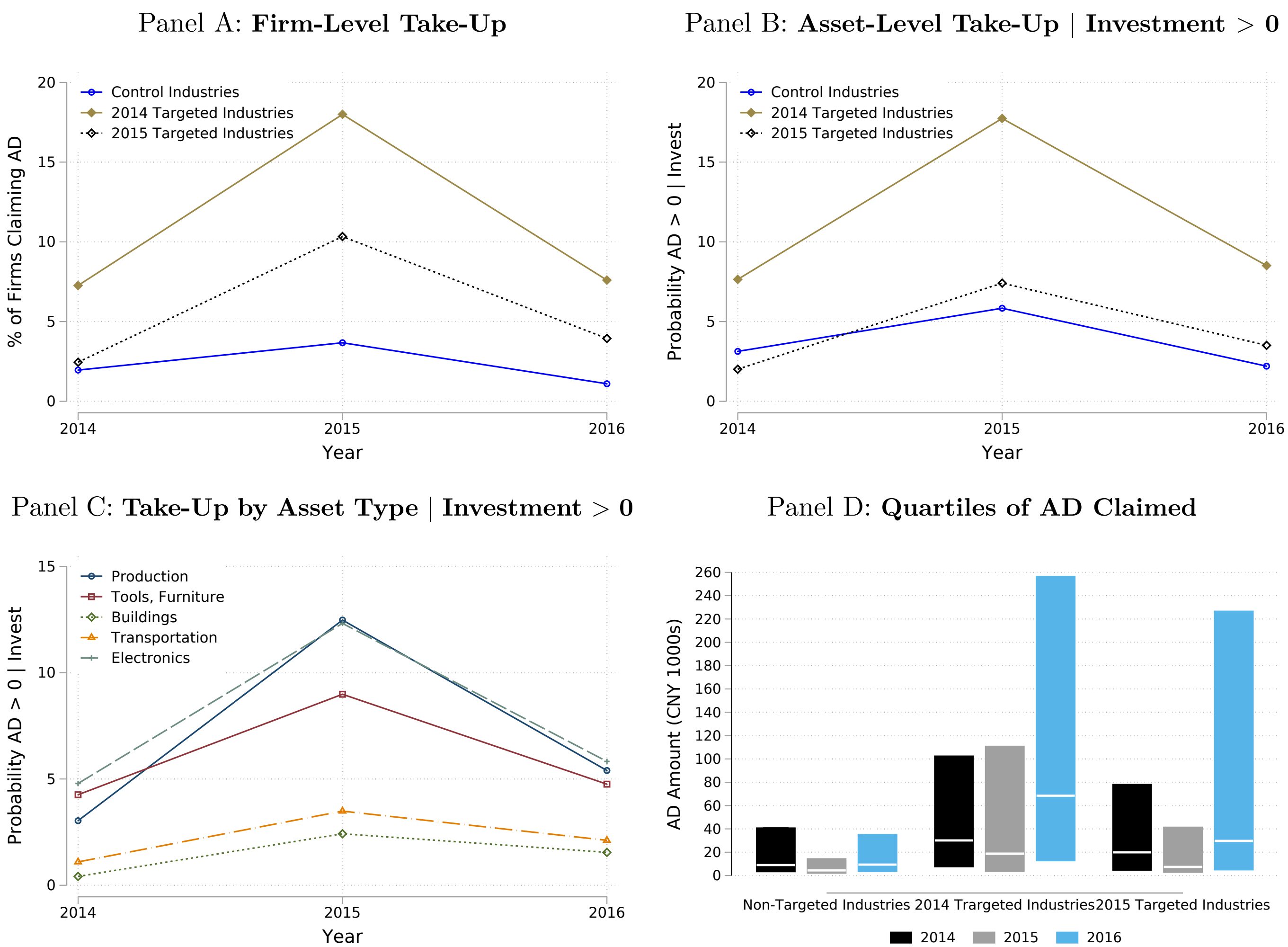


Panel B: **Orbis Data: 2015 Targeted Industries**



Note: This figure plots trends in year-over-year changes in the logarithm of fixed assets net of accounting depreciation for the treated and manufacturing control industries using Orbis, which is nationally representative. We present the raw trends before matching or controlling for firm age, lagged profit margin, and lagged revenue growth.

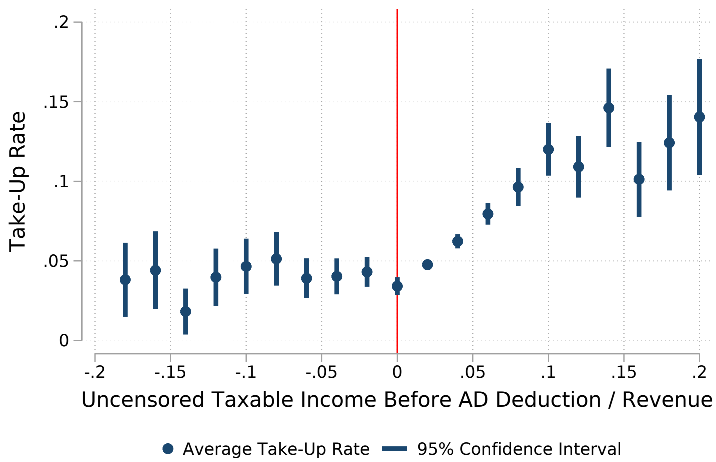
Figure 4: **Take-Up of Accelerated Depreciation**



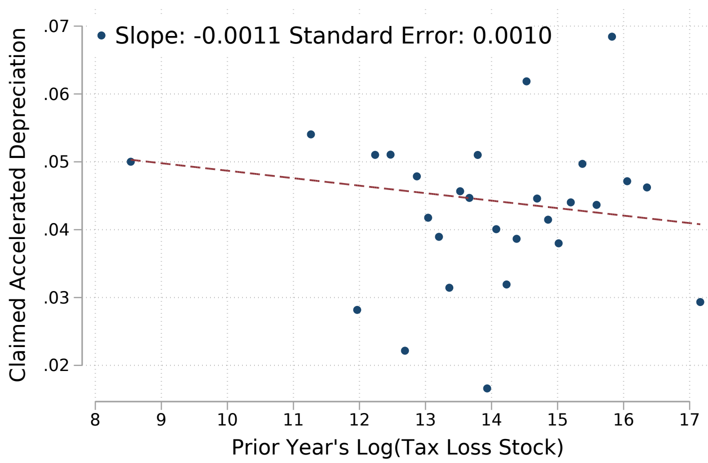
Note: This figure plots AD claiming trends during the period 2014-2016. Firms are divided into the 2014 targeted group, the 2015 targeted group, and the non-targeted group. Panel A plots the percent of firms within each group that claimed AD in at least one asset class. Panel B calculates the take-up rate conditional on having eligible investment. For each asset class, we restrict to firms with a year-over-year increase in the asset stock (at historical cost). Among the remaining firms, we calculate the percent with positive AD. We then average this take-up rate across the five asset classes. Panel C plots the conditional claiming rate within each asset category. Panel D plots the median and interquatile range of AD amounts claimed. The top and bottom of the bars indicate the 25th and 75th percentiles, respectively, and the white divider on each bar denotes the median.

Figure 5: **Tax Loss Positions and AD Take-Up**

Panel A: **Taxable Losses and Take-Up**



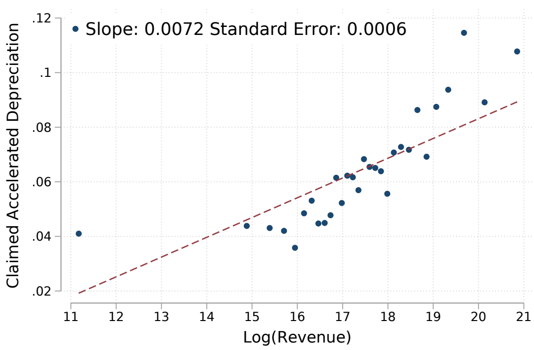
Panel B: **Tax Loss Stocks and Take-Up**



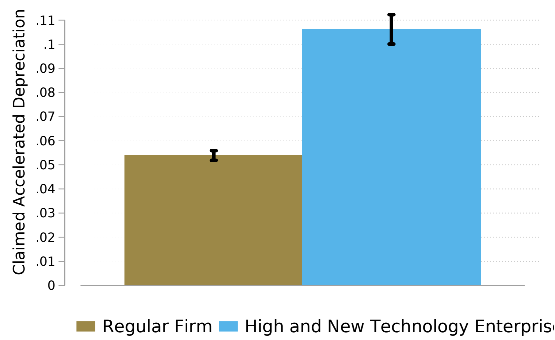
Note: This figure restricts the sample to firms that belong to the 2014 or 2015 targeted industries. Uncensored taxable income is total profit (reported on the tax return and roughly equivalent to book pre-tax profit) plus the net value of book-tax adjustments (excluding AD adjustments) minus any exempt income. Each observation is a firm-year-asset type triplet. Within each triplet, we retain firms with an increase in the asset stock relative to the previous period. Panel A plots the probability of claiming any AD against normalized uncensored taxable income. Panel B plots the probability of claiming AD against the estimated stock of tax losses in the previous year, after controlling for firm size (lagged log revenue), and year, asset-class, and two-digit industry fixed effects.

Figure 6: **Other Firm-Level Characteristics and AD Take-Up**

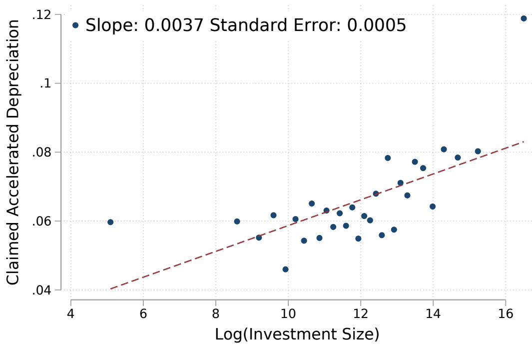
Panel A: **Revenue Size**



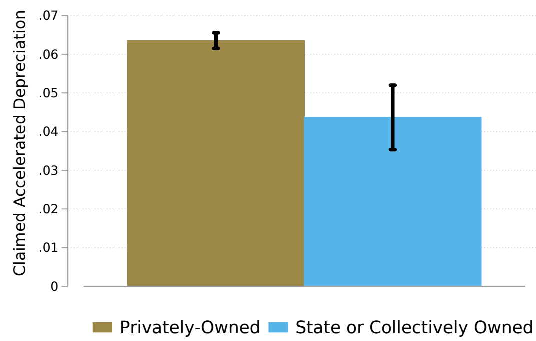
Panel B: **HNTE Status**



Panel C: **Size of Investment**



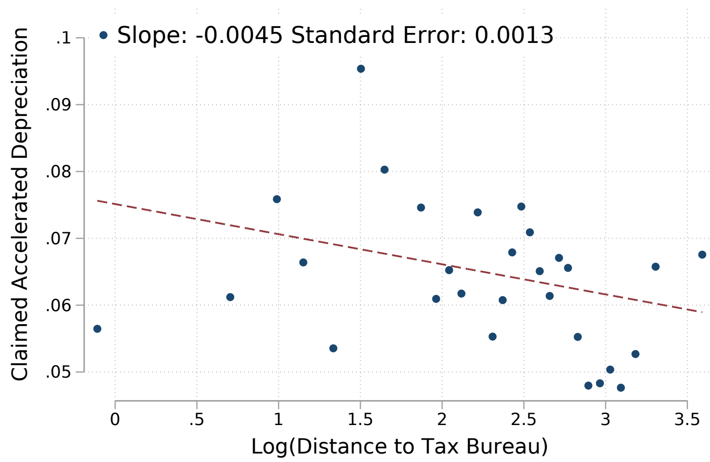
Panel D: **Ownership Type**



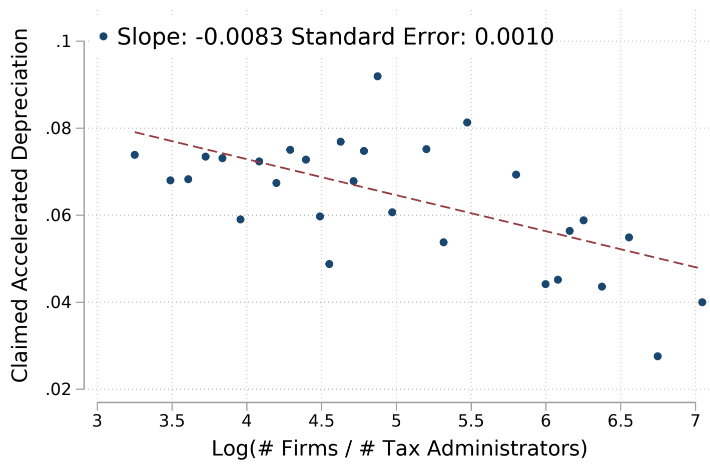
Note: This figure shows the uni-variate correlations between firm-level characteristics and AD claiming. The sample restricts to firms that belong to the 2014 or 2015 targeted industries. Each observation is a firm-year-asset type triplet. Within each triplet, we retain firms with an increase in the asset stock relative to the previous period. Panels A and C generate thirty equal-frequency bins based on the predictor variable and plot the average claim rate within each bin. Panel A plots the correlation between lagged firm revenue (in logs) and AD claiming. Panel B shows the average claiming rate for HNTE and non-HNTE firms. Panel C plots the correlation between investment size (in logs) and AD claiming. Panel D plots the average claiming rate for privately-owned and state- or collectively-owned firms. Panels A and C control for year, asset-class, and two-digit industry fixed effects.

Figure 7: **Tax Bureau Characteristics and AD Take-Up**

Panel A: **Distance to Tax Bureaus**



Panel B: **Tax Administrators Per Firm**



Note: This figure shows the uni-variate correlations between tax bureau characteristics and AD claiming. The sample restricts to firms that belong to the 2014 or 2015 targeted industries. Each observation is a firm-year-asset type triplet. Within each triplet, we retain firms with an increase in the asset stock relative to the previous period. Panel A plots correlation between AD claiming and the straight-line distance between the firm and its assigned tax bureau (in logs). Panel B plots the correlation between AD claiming and the number of firms per tax administrator in the local area (in logs).

A Supplemental Tables and Figures

Table A.1: **Matched Difference-in-Difference Sample**

Panel A: 2014 policy reform	Not Matched					Matched				
	Targeted		Control			Targeted		Control		
	Mean	N	Mean	N	p	Mean	N	Mean	N	p
Total Assets (10000s)	5304	3334	6179	7114	0	7191	1865	8056	3341	0
Profit Margin	-.27	3146	-.08	6965	0	-.06	1865	-.06	3341	.93
Revenue Growth	.3	2730	.05	6424	0	.06	1865	.06	3341	.78
Age	12.13	3334	16.12	7114	0	15.48	1865	15.32	3341	.25
Investment Rate	.17	2878	.08	6514	0	.1	1865	.09	3341	.34
Fixed Assets (10000s)	829	3334	993	7114	0	1145	1865	1319	3341	0
Business Revenue (10000s)	3346	3319	5228	7106	0	4631	1865	6399	3341	0
Taxable Income (10000s)	178.62	3334	137.46	7113	0	267.65	1865	289.35	3341	.35
Tax Loss Stock (10000s)	39	3334	51	7114	0	29	1865	43	3341	0
Percent In Tax Losses	.34	3334	.26	7114	0	.21	1865	.21	3341	.9
Average Useful Life	8.89	3334	11.41	7114	0	10.77	1865	11.55	3341	0
State or Collectively Owned	.04	3334	.1	7114	0	.04	1865	.07	3341	0
Cash ETR	.15	3322	.17	7081	0	.19	1858	.19	3332	.43
Distance to Bureau (km)	9.81	2364	13.13	5760	0	10.76	1410	12.86	2695	0
Firms/Bureau Employees	274	2408	216	5762	0	264	1497	220	2724	0
Panel B: 2015 policy reform	**Not Matched**					**Matched**				
	Targeted		Control			Targeted		Control		
	Mean	N	Mean	N	p	Mean	N	Mean	N	p
Total Assets (10000s)	5096	15620	6013	7114	0	5373	11910	5801	5880	0
Profit Margin	-.04	15334	-.05	6965	0	-.03	11910	-.03	5880	.46
Revenue Growth	.05	14288	.03	6424	0	.04	11910	.04	5880	.51
Age	15.8	15620	16.14	7114	0	15.76	11910	15.75	5880	.87
Investment Rate	.08	14480	.08	6514	.32	.08	11910	.07	5880	.23
Fixed Assets (10000s)	853	15620	922	7114	0	904	11910	916	5880	1
Business Revenue (10000s)	3893	15601	4928	7106	0	4172	11910	4922	5880	0
Taxable Income (10000s)	96.31	15620	124.54	7113	0	110.87	11910	125.38	5879	.03
Tax Loss Stock (10000s)	40	15620	49	7114	0	39	11910	44	5880	0
Percent In Tax Losses	.25	15620	.26	7114	.9	.24	11910	.22	5880	.06
Average Useful Life	11.56	15620	11.41	7114	0	11.54	11910	11.42	5880	.03
State or Collectively Owned	.07	15620	.1	7114	0	.06	11910	.09	5880	0
Cash ETR	.18	15577	.17	7081	.01	.19	11883	.19	5858	.62
Distance to Bureau (km)	12.71	12669	13.13	5760	0	12.64	9684	13.15	4758	0
Firms/Bureau Employees	257	13116	216	5762	0	255	10053	214	4779	0

Note: This table reports descriptive statistics of key variables in 2013 for the unmatched and matched samples using non-targeted manufacturing firms as the control group. Firm-year observations with zero fixed assets are excluded. The matching process is described in Section 3. The first five columns report the mean, sample size, and p-value for the difference of means for the targeted and control firms without matching. The last five columns report the same using the set of matched firms. Profit margin is the ratio of total pre-tax profit over business revenue. Investment rate is the annual change in the logarithm of the fixed asset stock, measured at original cost. The stock of tax losses are the unclaimed tax losses accumulated since 2010. Average useful life is the dollar-weighted average tax-life of firms' asset holdings. Cash ETR is total income tax paid over total accounting profit. All continuous variables are winsorized at the 1st and 99th percentiles.

Table A.2: **Impact of AD on Investment–Alternative measures of investment**

	$\frac{K_t - K_{t-1}}{Sales_{t-1}}$		$\frac{K_t - K_{t-1}}{K_{base}}$		$\Delta Ln(NetValue)$	
	(1)	(2)	(3)	(4)	(5)	(6)
	2014	2015	2014	2015	2014	2015
Treat × Post	1.18	-0.16	-3.47**	-0.01	-2.01	-1.27
	(1.01)	(0.32)	(1.74)	(0.72)	(1.97)	(1.60)
N	29161	99952	28415	97442	11710	37059
Treated Firms	1865	11910	1865	11910	1275	6966
Untreated Firms	3341	5880	3341	5880	1968	3351
Treated Clusters	38	94	38	94	38	94
Untreated Clusters	43	46	43	46	43	46
Dep. Var. Mean	6.27	4.81	25.25	16.01	5.44	5.11

Note: This table reports the difference-in-differences estimation results using alternative outcome variables: (i) the year-over-year change in the fixed asset stock measured at historical cost normalized by sales in the pre-policy year, (ii) the investment rate as measured by $\frac{K_t - K_{t-1}}{K_{t-1}}$, and (iii) the first-difference of the logarithm of the net asset stock. Standard errors are robust clustered at the three digit industry level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.3: **Take-Up of AD by Industry**

	Claim Rate
Agricultural and sideline food processing industry	0.101
Food manufacturing	0.110
Textile industry	0.113
Textile and apparel, apparel industry	0.132
Leather, fur, feathers and their products and footwear	0.134
Wood processing and wood, bamboo, rattan, palm, grass products industry	0.063
Furniture manufacturing	0.159
Paper and paper products industry	0.118
Printing and recording media reproduction industry	0.094
Culture, education, beauty, sports and entertainment products manufacturing	0.116
Chemical raw materials and chemical manufacturing	0.160
Pharmaceutical manufacturing	0.212
Chemical fiber manufacturing	0.120
Rubber and plastic products industry	0.135
Metal products industry	0.120
General equipment manufacturing	0.120
Special equipment manufacturing	0.279
Automotive Manufacturing	0.136
Railway, marine, aerospace and other transportation equipment manufacturing	0.201
Electrical machinery and equipment manufacturing	0.152
Computer, communications and other electronic equipment manufacturing	0.275
Instrumentation manufacturing	0.302
Telecommunications, radio and television and satellite transmission services	0.164
Internet and related services	0.103
Software and information technology services	0.106

Note: This table plots the percent of firms within each industry that claimed accelerated depreciation at least once between 2014 and 2016.

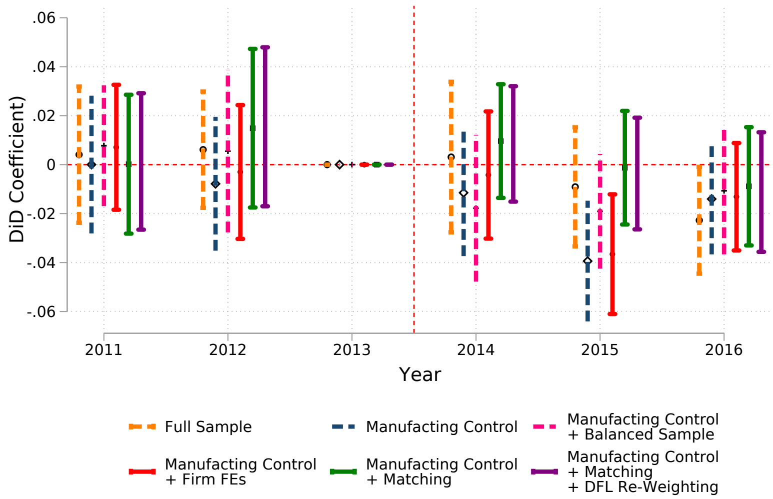
Table A.4: **Present Value of Claimed and Unclaimed Tax Savings**

Treatment Group	Not Claimed			Claimed		
	Mean	Median	Total	Mean	Median	Total
2014 Treatment Group	24.88	1.67	176371	27.21	2.12	26937
2015 Treatment Group	21.97	1.64	543734	31.18	2.05	48117

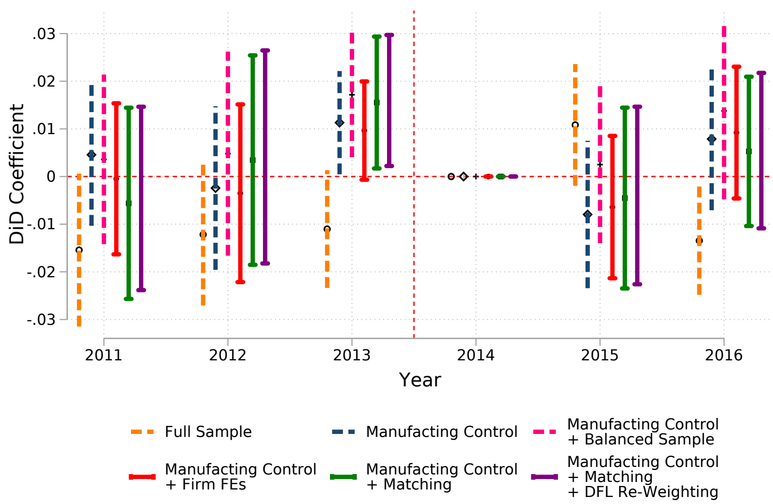
Note: This table shows estimated tax savings from accelerated depreciation (AD) for investment, separately according to whether AD was actually claimed for the investment. All values are expressed in 1,000 CNY. Investment is defined as the year-over-year change in the value of assets in asset class k ($K_{k,t} - K_{k,t-1}$). A firm is deemed to have claimed AD on the investment if the year-over-year change in AD is positive: $AD_{k,t} > AD_{k,t-1}$. Tax savings are calculated as $\tau_{i,t} \times (NPV_{k,AD} - NPV_{k,Regular})$, where $\tau_{i,t}$ is the tax rate the firm faces in year t, and the last two terms are the net present value of depreciation deductions under AD and regular depreciation, respectively, for asset class k. This calculation assumes (1) that firms keep the asset for the entire length of its useful tax life, (2) that firms are in taxable positions during that time, and (3) that the firm's tax rate does not change. We restrict to firms in a taxable position in the year of investment. The base tax rate $\tau_{i,t}$ is calculated as firm i's income tax liability over its observed taxable income in the year of investment (t). This is 25% unless the firm is eligible for statutory reductions for SMPE firms ($\tau_{i,t}$ = 10% or 20%) and HNTE firms ($\tau_{i,t}$ = 15%). Immediate expensing is assumed for imputed investment of value less than 5,000 CNY such that $NPV_{k,AD} = K_{k,t} - K_{k,t-1}$. The mean and median are calculated across all firm-asset class-year observations. The total sums the tax savings across all firm-asset class-year observations. Only observations in the treated years are included.

Figure A.1: **Dynamic Difference-in-Difference**

Panel A: Δ **Log Fixed Assets, 2014, Historical Cost**

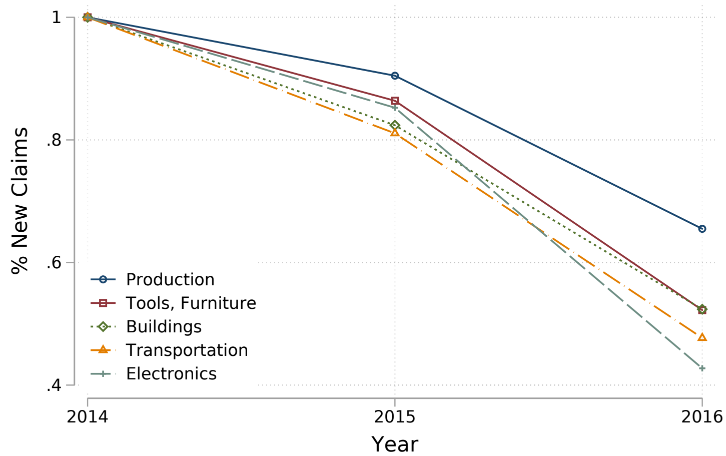


Panel B: Δ **Log Fixed Assets, 2015, Historical Cost**



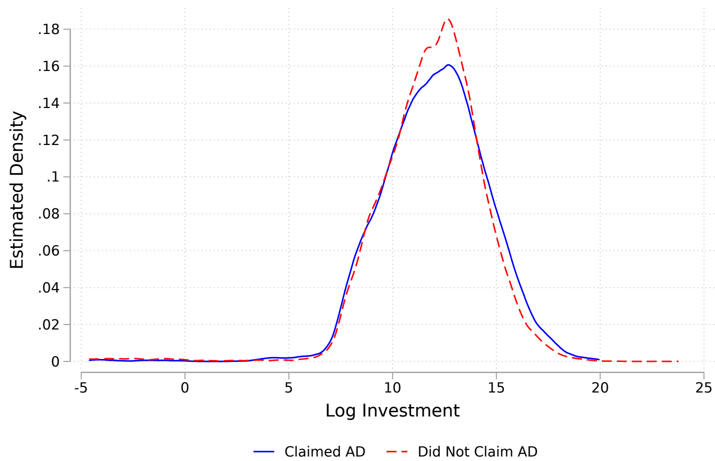
Note: This figure plots the estimated dynamic difference-in-difference coefficients β_s and 95 percent confidence intervals from the following specification: $\Delta ln(K_t) = \alpha_t+\alpha_i+\alpha_a+\sum_{s\neq 0}\beta_s\times 1\{t=s\}\times D_i+\gamma X_{i,t}+\epsilon_{i,t,k}$ where time (t) is normalized to zero in the year prior to the policy implementation. α_t, α_i, and α_a are fixed effects for year, three-digit industry, and firm age respectively. K_t is the stock of fixed assets measured at original cost as reported on firms' depreciation tax return. The Full Sample series uses all non-targeted firms as in the control group including service industries. The Manufacturing Control series restricts the control group to manufacturing industries. The final four series (a) restrict to firms present for all seven years, (b) control for firm fixed effects, (c) restrict the matched sample as described in Section 3, and (d) restrict to matched sample and DFL re-weight. Our baseline results presented in the main text correspond to specification (d). Standard errors are clustered at the three digit industry level. Panels A and B presents results for the 2014 and 2015 targeted industries respectively. Investment is winsorized at the 1 and 99% level in each year and treated/control group.

Figure A.2: **New AD Claims as % of Total Claims**



Note: This figure plots the percentage of first-time AD claims in total claims by asset type during the period 2014-2016.

Figure A.3: **Distribution of Investment by Claimed Status**

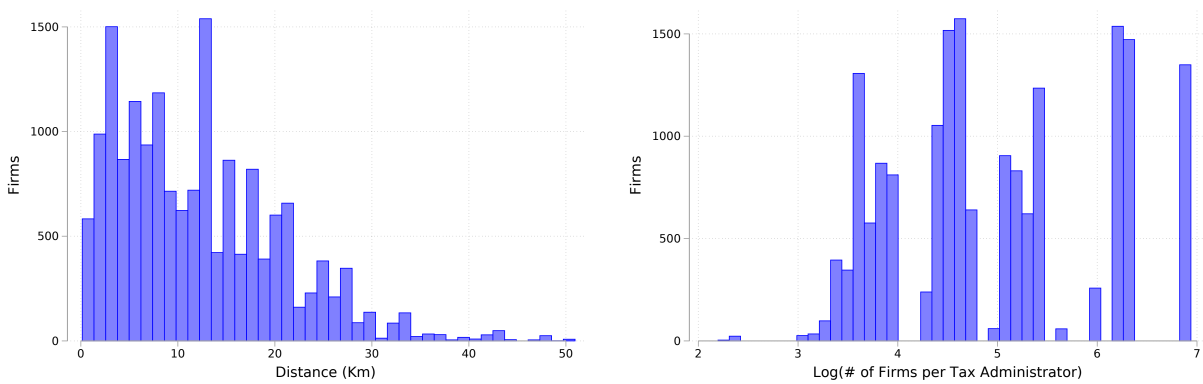


Note: This figure plots the distribution of investment (in logs) separately by whether AD was claimed on that investment. Investment is defined as the year-over-year change in the value of assets in asset class k $(K_{k,t} - K_{k,t-1})$. Observations with with $K_{k,t} - K_{k,t-1} \leq 0$ are excluded. A firm is deemed to have claimed AD on the investment if $AD_{k,t} > AD_{k,t-1}$. The density is estimated using the Epanechnikov kernel and a bandwidth of .23 and .43 for the unclaimed and claimed distributions respectively.

Figure A.4: **Distributions of Tax Bureau Characteristics**

Panel A: **Distance to Tax Bureaus**

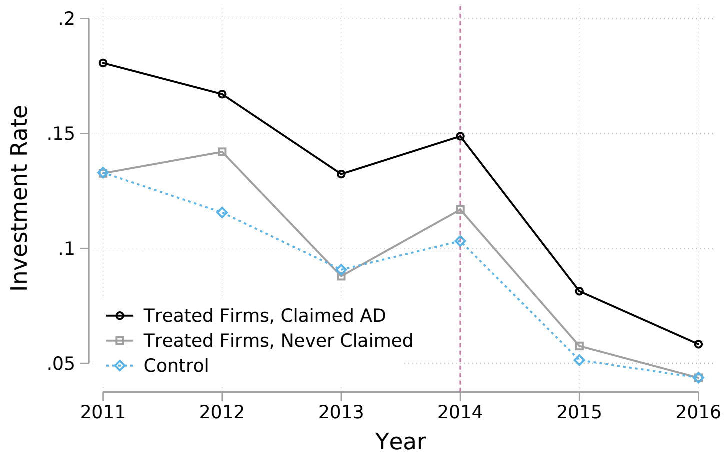
Panel B: **Tax Administrators Per Firm**



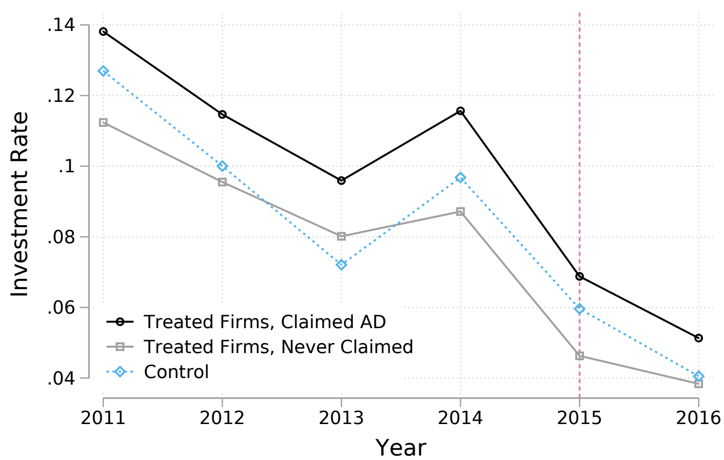
Note: These figures plot the distributions in 2013 of firms' distance to their local tax bureau and the number of firms the bureau oversees divided by the bureau's number of employees. Only firms in the targeted industries are kept.

Figure A.5: **Investment Trends by Treatment and Claiming**

Panel A: **2014 Treated Firms and Control Group**



Panel B: **2015 Treated Firms and Control Group**



Note: This figure plots average investment rate time trends for three groups of firms: (1) treated firms that claimed AD at least once, (2) treated firms that never claimed AD, and (3) control firms. We restrict to the matched regression sample described in Section 3. Panel A plots the 2014 treated industries and their control firms. Panel B plots the 2015 treated industries and their control firms. Investment rates are winsorized at the 1st and 99th percentiles within each treated-control group in each year.

B Regression Weights

Regression weights for the difference-in-differences analysis are constructed in two steps. First, we match on base year observables using Coarsened Exact Matching (Iacus et al., 2011) as described in the main text and calculate weights following their recommended procedure. Denote N_c and N_d the total number of matched control and treated firms. For each strata s, we calculate the number of control firms N_c^s and the number of treated firms N_d^s. Treated firms are given a regression weight h_i of one. Control firms are assigned regression weights proportional to the number of control firms, relative to the number of treated firms, in the strata: $h_i = \frac{N_c}{N_d}\frac{N_d^s}{N_c^s}$. In the extension where we weight by lagged log revenue, $h_{i,t} = ln(rev_{i,t-1}) \times \frac{N_c}{N_d}\frac{N_d^s}{N_c^s}$.

Second, we use the re-weighting method of DiNardo et al. (1996) to flexibly control for changes in the firm distribution between control and treated industries. This method is very frequently used in the investment literature, including in Yagan (2015) and Zwick and Mahon (2017). The re-weighting procedure proceeds as follows. First, we create ten bins (b) corresponding to the deciles of the revenue distribution for the control firms in the year before the policy implementation (base year). The DFL weights ($w_{i,t,g,b}$) for firm i, with revenue in bin b, in group g (where a group is a treatment status-year pair) are:

$$w_{i,t,g,b} = h_i \times \frac{\sum_{i' \in b \,\cap\, i' \in \underline{g}} h_{i'}}{\sum_{i' \in b \,\cap\, i' \in g} h_{i'}} \times \frac{\sum_{i' \in g} h_{i'}}{\sum_{i' \in \underline{g}} h_{i'}} \tag{B.1}$$

Where $\underline{g}$ is the control group in the base year. These weights capture changes in the distribution of firm size (revenue) over time. However, one may be concerned that this attenuates the treatment effect towards zero if investment growth caused by the AD policy is correlated with revenue growth. In our setting, results are highly similar without DFL re-weighting – using h_i rather than $w_{i,t,g,b}$.

C Selection Model

This section provides further details for the selection model specification used in Section 4. In this model, a firm in time t chooses to invest in assets of type k if their latent payoff function ($U_{i,k,t}$) is positive. The firm claims AD on that investment if the net benefit of doing so ($NB_{i,t,k}$) is positive. Both $U_{i,k,t}$ and $NB_{i,t,k}$ are functions of observables $X_{i,t}$:

$$I_{i,k,t} = 1 \text{ if } U_{i,k,t} = \beta X_{i,t} + \eta_{i,k,t} > 0 \tag{C.1}$$

$$C_{i,k,t} = 1 \text{ if } I_{i,k,t} = 1 \text{ and } NB_{i,t,k} = \gamma X_{i,t} + \epsilon_{i,k,t} > 0 \tag{C.2}$$

We are interested in how covariates $X_{i,t}$ predict the likelihood of claiming AD conditional on having eligible investment: $\frac{\partial P(C_{i,k,t}=1|I_{i,k,t}=1)}{\partial X_{i,t}}$. If we simply restrict to firms with investment ($I_{i,k,t} = 1$) and correlate take-up decisions with $X_{i,t}$, selection bias could arise if the idiosyncratic errors $\epsilon_{i,k,t}$ and $\eta_{i,k,t}$ are correlated (Heckman, 1979). As an example, assume that firm size increases the latent payoff of investing, and that the error terms are positively correlated. In this case, only small firms with idiosyncratically higher investment payoffs will invest. Due to the positive error correlation, these firms will also be more likely to claim, making small firms appear more likely to claim as well.

To account for this, we model the distribution of the error terms and their correlation. Error terms $\epsilon_{i,k,t}$ and $\eta_{i,k,t}$ are assumed to be jointly normally distributed allowing for non-zero co-variance. We then estimate β and γ by maximum likelihood. The resulting log likelihood contribution for firm i, in year t, in asset-class k can be written as

$$
\begin{aligned}
ln(L_{i,k,t}) &= (1 - I_{i,k,t})ln[P(I_{i,k,t} = 1)] + I_{i,k,t}(1 - C_{i,k,t})ln[P(I_{i,k,t} = 1, C_{i,k,t} = 0)] \\
&+ I_{i,k,t} \times C_{i,k,t} \times ln[P(I_{i,k,t} = 1, C_{i,k,t} = 1)] \\
&= (1 - I_{i,k,t})ln[\Phi(-X_{i,t}\beta)] + I_{i,k,t}(1 - C_{i,k,t})ln[\Phi(X_{i,t}\beta) \\
&- \Phi(X_{i,t}\beta, X_{i,t}\gamma, \Omega)] + I_{i,k,t} \times C_{i,k,t}ln[\Phi(X_{i,t}\beta, X_{i,t}\gamma, \Omega)]
\end{aligned}
$$

where $I_{i,k,t}$ and $C_{i,k,t}$ are indicators for investing and claiming as defined in Section 5.1.2, Ω is the covariance matrix of $\epsilon_{i,k,t}$ and $\eta_{i,k,t}$ as in Equations (4) and (5), and Φ the cumulative distribution function for the normal distribution.

Omitting subscripts for simplicity, $Pr(C = 1 \mid I = 1)$ can be written as follows:

$$
\begin{aligned}
Pr(C = 1 \mid I = 1) &= P(X\delta + \eta_2 > 0 \mid X\beta + \eta_1 > 0) \\
&= \int_{-X\beta}^{\infty} \Phi((X\delta + \eta_1\Omega_{1,2}/\Omega_{2,2})/\sigma_{2|1})\phi(\eta_1; \sigma_1)d\eta_1 \Big[\frac{1}{\Phi(X\beta/\sigma_1)}\Big]
\end{aligned}
$$

And differentiating with respect to X, we have:

$$
\begin{aligned}
\frac{dPr(C \mid I)}{dX} = \Big[&\Phi((X\delta - X\beta\Omega_{1,2}/\Omega_{2,2})/\sigma_{2|1})\phi(-X\beta; \sigma_1)(\frac{dX\beta}{dX}) + \\
&\int_{-X\beta}^{\infty} \frac{d\Phi((X\delta - X\beta\Omega_{1,2}/\Omega_{2,2})/\sigma_{2|1})}{dX}\phi(\eta_1)d\eta_1\Big]\Big[\frac{1}{\Phi(X\beta/\sigma_1)}\Big] - \\
&\Big[\int_{-X\beta}^{\infty} \Phi((X\delta + \eta_1\Omega_{1,2}/\Omega_{2,2})/\sigma_{2|1})\phi(\eta_1; \sigma_1)d\eta_1\Big]\Big[\frac{\phi(X\beta/\sigma_1)(\beta/\sigma_1)}{\Phi(X\beta/\sigma_1)^2}\Big]
\end{aligned}
$$

To aid in the identification, we include three variables in the investment ($U_{i,k,t}$) equation which are excluded from the claiming equation: the firm's lagged cash holdings, an indicator for whether a firm claimed interest expenses on their prior year's tax form, and the lagged growth rate of their fixed asset stock. Lagged cash holdings and interest expenses proxy for the ability to finance investments in year t, but should not affect the payoff of claiming AD. We include the firm's prior year investment rate as investment has been shown to have some degree of serial correlation (Cooper and Knittel, 2006).[33] In column (1) of Table C.1, we report the estimated marginal effects on the probability of investment in the current year. The dummy variable indicating interest expense deductions, firms' lagged cash holdings, and the firm's prior year's investment rate all positively predict current investment and are jointly significant at the 1 percent level, partially validating them as effective excluded variables. The last two columns of Table C.1 show the average marginal effects of each predictor on the probability of claiming conditional on investing. As described in the main text, results are nearly identical to a simple probit model.

[33]The lagged investment rate would violate the exclusion restriction if we defined claiming as $AD(t) > 0$, as prior year's investments can entail AD claiming into the present. Defining claiming as $AD(t) > AD(t+1)$ controls for the concern.

Table C.1: **Predictors of Claiming: Firm-Level Characteristics**

	Selection Model		
	(1)	(2)	(3)
	Pr(Invest)	Pr(Claim | Invest)	
In Tax Loss Before AD		-1.81***	-1.85***
		(0.40)	(0.39)
Lagged Log(Tax Loss Stock)	-0.27***	-0.12***	-0.12***
	(0.03)	(0.03)	(0.03)
Log(Employees)	1.95***	0.74***	0.82***
	(0.16)	(0.20)	(0.19)
Lagged Log(Revenue)	2.63***	0.14	0.13
	(0.27)	(0.16)	(0.15)
High and New Technology Enterprise	7.19***	2.07***	1.66***
	(0.55)	(0.58)	(0.57)
Log(Investment Size)		0.09**	0.06
		(0.04)	(0.04)
State or Collectively Owned	-5.66***	-1.32*	-1.19*
	(0.49)	(0.76)	(0.70)
Lagged Claimed Interest Deduction	1.96***		
	(0.34)		
Lagged Investment Rate	5.00***		
	(0.44)		
Lagged Log(Cash Holdings)	1.35***		
	(0.13)		
Two-Digit Industry FE	Yes	Yes	Yes
Prefecture FE	Yes	No	Yes
N	171490	171490	171490
Mean of Outcome Var.	28.39	6.39	6.39
Excluded Variables Joint P-value	0.000	0.000	0.000

Note: Column (1) reports the estimated average marginal effects of firm-level characteristics on $Pr(I_{i,t,k} = 1)$. Columns (2) and (3) report the estimated average marginal effects of firm-level characteristics on the probability of claiming AD conditional on having purchased eligible investment ($P(C_{i,t,k} = 1|I_{i,t,k} = 1)$). Claiming and investment are defined as outlined in Section 4. Coefficients are scaled by 100. All time-varying explanatory variables are measured in year $t-1$. To account for zeros, each variable inside the logarithm is shifted to the right by one unit; results are unchanged when instead using the inverse hyperbolic sine to approximate the logarithm while allowing for zeros. All continuous covariates are winsorized at the 1st and 99th percentiles within each year. Standard errors are computed using the delta-method and are clustered at the three-digit industry level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.