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# The impact of an accelerated depreciation tax policy on employment: Evidence from China

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## ABSTRACT

We examine the impact of an accelerated depreciation tax policy (ADP) on employment. As a tax incentive policy, we expect an ADP to impact firm behavior significantly, but its effect on employment remains uninvestigated. Leveraging the two-stage implementation of an ADP in selected industries in China in 2014 and 2015 and using a difference-in-differences research design, we find that: 1) the ADP significantly increases employment, which is consistent with the output effect hypothesis; and 2) the ADP increases firms' labor demand, mainly by stimulating investment in fixed assets and easing their financial constraints. Additional analysis suggests that the impact of ADP on employment is more salient for small firms, non-state-owned firms, and high growth firms, and skilled labor employment, indicating that the ADP is more effective for firms with high financial constraints and hiring skilled labor to accompany the increase in capital investment.

## 1. Introduction

Across the globe, governments use accelerated depreciation tax policies (ADP) to stimulate corporate investments. An ADP increases the deductible corporate tax amount at the beginning of the investment period, consequently reducing firms' tax burden and stimulating firm- and economy-wide investment (Desai & Goolsbee, 2004; Edgerton, 2010; House & Shapiro, 2008; Hulse & Livingstone, 2010; Ohn, 2018; Ohn, 2019; Zwick & Mahon, 2017; Steinmuller et al., 2019). Although a few studies document that lower payroll taxes (Ku et al., 2020) and general tax cuts (Zidar, 2019) can boost employment (Garrett et al., 2020), how an ADP, as a tax policy, affects firm-level employment is still an open research question. Given that employment is a critical economic performance indicator (Grenčfková & Berkovic, 2020), it is always interesting to examine the contributing factors of employment and explore the ways to promote employment. Politically, it is a good public policy to create jobs and maintain economic stability in terms of reducing unemployment. Therefore, it is of practical importance to study whether a major tax policy has effect on employment.

We propose two hypotheses to test the impact of an ADP on employment. First, the output effect hypothesis suggests that the tax incentive policy stimulates firms to expand corporate investments, which leads to increased firm demand for labor to accompany the increased investments. Second, the substitution effect hypothesis states that a tax incentive policy makes fixed assets de facto cheaper.

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Hence, in the presence of an ADP, a firm substitutes more affordable fixed assets for relatively more expensive labor. In sum, on the one hand, the ADP may promote employment by enhancing fixed asset investments and alleviating the financing constraints of a firm. On the other hand, the ADP may also reduce the demand for labor by firms due to marginally using more fixed assets to substitute for labor. Hence, the impact of ADP on employment needs to be further tested. Our findings will shed light on the effect of a tax policy on employment and offer lessons to other developing countries.

The purpose of our study is to examine the impact of an ADP on employment using China's two-stage implementation of a new ADP tax policy. Our study is also motivated by the fact that previous literature primarily focuses on the economic consequences of an ADP in developed countries; few studies examine the impact of an ADP in developing countries. We argue that, when facing severe financial constraints, firms respond more strongly to an ADP because it can reduce a firm's tax burden at the beginning of the depreciation period, resulting in tax savings. The time value of money and the easing of financial constraints soon after purchase of fixed assets improve a firm's internal cash flow. The tax savings from an ADP are like an interest-free loan to a firm (Zwick & Mahon, 2017) leading to more corporate investments. Operating in an emerging market, Chinese firms, especially small, non-state-owned firms, and high growth firms, face binding financial constraints due to China's capital impediments (Allen et al., 2005). Given these financial constraints, how does an ADP affect employment? As the ADP was introduced in China in six industries in 2014 and was expanded to four more industries in 2015, we leverage the two-stage ADP implementation to conduct our analysis using a multi-temporal difference-in-differences (DID) research design to mitigate endogeneity.

Using data from 2011 to 2018, we offer three findings. First, the ADP significantly increases a firm's labor force, supporting the output effect hypothesis. The core findings are robust to an alternative metric of employment, a dynamic trend analysis, placebo tests, and after accounting for industry influence. Second, the transmission channel analysis suggests that the ADP significantly increases firms' labor demand by stimulating firms to increase investment in fixed assets and easing firms' financial constraints. In addition, we document that the increase in employment steers towards more skilled labor. Hence, the findings corroborate the output effect hypothesis. Third, the positive effect of ADP on employment is more salient for small firms, non-state-owned firms, and high growth firms, suggesting that the tax policy is more effective for financially constrained and fast-growing firms.

We make a significant economic policy contribution. Our findings advance the literature on the impact of an ADP, which mostly addresses the effect of ADP on corporate investments, by documenting that an ADP has a positive effect on employment, especially that of skilled labor. Thus, as a tax policy, an ADP encourages a positive effect on an economy by promoting corporate investments and employment. Therefore, our study sharpens our understanding regarding the impact of an ADP and provides important lessons for other emerging markets that might consider using a similar policy of accelerated depreciation.

This paper proceeds as follows. Section 2 introduces background and literature review. Section 3 contains theoretical analysis and hypothesis. Section 4 explains the research design, including sample selection and data sources, the model setting and variable definitions. Section 5 contains the empirical analysis, including base regression analysis, robustness tests, mechanism tests, and additional analysis. Section 6 concludes.

## 2. Background and literature review

### 2.1. Background

In accounting, firms depreciate fixed assets according to the matching principle and the principle of prudence to reflect the daily depreciation of fixed assets with the local generally accepted accounting principles. The depreciation methods of fixed assets mainly include straight-line, workload, or accelerated depreciation methods.

The straight-line method refers to the average amortization of depreciation expenses during the expected useful life of fixed assets. Thus, the depletion of fixed assets has nothing to do with the degree of use. The workload method refers to the average apportionment of fixed assets based on the estimated total workload. Because the workload of each period is not equal, the depreciation accrued for each period is also not equal. Accelerated depreciation methods mainly include the sum of the years' digits method and the double-declining balance method.

Under the accelerated depreciation method, the depreciation accrued in the early period of the use of fixed assets is disproportionately more, and the depreciation accrued in the future decreases rapidly. Fixed assets perform better at the initial stage of use and have higher output, which can create more economic benefits for a firm. Therefore, using the accelerated depreciation method to accrue more depreciation at the beginning of the period is more in line with the principles of accounting. At the same time, depreciation is an expense that can be used for tax deductions. A higher allowance for depreciation translates into greater tax deductions and consequently, more tax savings for firms to enjoy. Although accelerated depreciation does not change a firm's overall tax payment, the accelerated depreciation at the beginning of the depreciation period can delay the firm's need to pay tax and speed up the recovery of cash for investment in fixed assets. Taking the time value of money into the account, we consider accelerated depreciation is akin to an interest-free loan. Then, the interest-free loan helps reduce corporate income taxes, improve corporate cash flow conditions, stimulate corporate investment in fixed assets, and promote corporate equipment upgrades and technological progress. Collectively, when a tax policy allows accelerated depreciation, it encourages corporate investments.

The Law of the People's Republic of China on Firm Income Tax stipulates that, except for special regulations, only depreciation

accrued by firms using the straight-line method can be deducted. To stimulate firms to make corporate investments, the Chinese government has allowed specific industries to use accelerated depreciation methods (including the sum of the years' digits method, the double-declining balance method, and the shortened depreciation period method<sup>2</sup>) since 2014 (as shown in Table 1). These industries include the following: biopharmaceutical manufacturing; special equipment manufacturing; railway, ship, aerospace and other transportation equipment manufacturing; computer, communications and other electronic equipment manufacturing; instrumentation manufacturing; information transmission; software; and the information technology service industry. In 2015, the government expanded the availability of accelerated depreciation to four more industries, including light industry, the textiles industry, the machinery industry, and the automobile industry.<sup>3</sup>

The ADP in China is interesting because it allows some firms to accelerate the depreciation and enjoy tax savings while firms in other industries cannot. Therefore, we can leverage the exogenous shock of China's ADP to compare the employment effects on firms that were permitted to use accelerated depreciation and those that were not.

To illustrate the tax incentive effect of an ADP on corporate investments, we present a case study in Table 2 to compare the present value of tax savings stemming from various depreciation methods (straight-line, double balance depreciation, sum of the years' digits method, and a shortened period of six years). We assume that a firm purchased a machine worth 10 million yuan at the beginning of the period, with an estimated service life of ten years, an estimated net salvage value of 0, a corporate income tax rate of 25%, and the discount rate of 7% to calculate the present value of tax savings.

In Table 2, for the accelerated depreciation methods (such as double balance depreciation, the sum of the years' digits method, and a shortened period of six years), we see that in the first four years of the use of fixed assets, the depreciation accrued each year is greater than the depreciation accrued by the straight-line method. The tax savings are also more significant in the ADP methods than the straight-line method. Therefore, an ADP reduces the cash outflow at the beginning of the period, reduces the burden on firms, and encourages firms to invest in fixed assets. However, note that no matter which depreciation method is used, the total amount of depreciation (all 10 million yuan) and the total amount of tax benefits (all 2.5 million yuan) are the same. Therefore, an ADP only delays firms' tax payments—it does not reduce the overall tax burden. However, money has a time value. An ADP changes the timing of depreciation and, thus, changes the present value of the tax savings on the total depreciation. Specifically, we set up a discount model below and assume that the estimated useful life of the equipment is  $n$ , the annual depreciation amount is  $D_n$ , the corporate income tax rate is  $T$ , and the discount rate is  $r$ . Then, the calculation is based on the depreciation amount, the amount of deductible tax savings is  $D_n \times T$ , and the total present value of tax savings is  $P$ .

$$P = \sum_{n=1}^N \frac{D_n \times T}{(1+r)^n} \quad (1)$$

## 2.2. Literature review

The literature on the economic effect of the ADP of fixed assets primarily examines developed countries, and the findings are mixed. Some studies suggest that the ADP helps to stimulate firms to invest in fixed assets. [Zwick and Mahon \(2017\)](#) find that the ADP in the U.S. significantly increases corporate fixed asset investments, especially for small firms. [Maffini et al. \(2019\)](#) document that the ADP in the U.K. increases the corporate investment rate by at least 2.1–2.5%. [Ohrn \(2019\)](#) reports that the ADP in the U.S. reduces the cost of buying fixed assets for firms and significantly stimulates corporate fixed asset investments. In contrast, other studies find that the ADP has little impact on corporate investments. [Desai and Goolsbee \(2004\)](#) report that the ADP of the U.S. has little effect on corporate fixed asset investment. [Knittel \(2007\)](#) documents that operating loss firms adopt less ADP in the U.S., while industries with more long-term assets adopt more ADP. [House and Shapiro \(2008\)](#) find that the ADP in the U.S. has little impact on the growth of overall investments. Similarly, [Hulse and Livingstone \(2010\)](#) document that the ADP in the U.S. has no significant effect on a firm's capital expenditure. [Edgerton \(2010\)](#) suggests that tax asymmetry significantly weakens the effect of the ADP on corporate investments in the U.S.

In addition, some scholars have also studied the impact of ADP on firm financing. [Panteghini and Vergalli \(2016\)](#) document that the ADP in the U.S. reduces firms' default risk and lowers the leverage ratio of firms. [Hines and Park \(2019\)](#) suggest that the ADP in the U.S. increases the problem of asset replacement, resulting in creditors adding more restrictive terms to the loan contracts and thus fewer high-risk corporate loans.

A few studies investigate the impact of ADP on employment. [Zwick and Mahon \(2017\)](#) report that the ADP induces a wage increase. [Garrett et al. \(2020\)](#) find the ADP in the U.S. enhances firm employment and wage. The limited evidence for the impact of an ADP on firm employment suggests room for further research.

Our study is related but differs from [Garrett et al. \(2020\)](#) in two aspects. First, we use Chinese data to study the impact of China's ADP on employment. As China is a developing country, the institutional environment is imperfect, and Chinese firms face severe financial constraints. Hence, we expect the ADP may have a more significant impact on Chinese firms. Second, a firm's adoption of an ADP and employing labor may be endogenously determined. The government's gradual promotion of China's ADP enables us to use the multi-temporal difference-in-differences model to produce minimal endogeneity issues.

<sup>2</sup> This method should not be less than 60% of the prescribed depreciation period.

<sup>3</sup> The industry segments involved in the reform are shown in Table 1.

**Table 1**  
Accelerated depreciation tax policy (ADP) Content.

Date	Content	Industries
January 1, 2014	Firms are allowed to use newly purchased fixed assets to shorten the depreciation life or adopt accelerated depreciation methods	Special equipment manufacturing, railway, ship, aerospace, and other transportation equipment manufacturing, computer, communication, and other electronic equipment manufacturing, instrument manufacturing, information transmission, software, and information technology services.
January 1, 2015		Key industries in the four major fields of light industry, textile, machinery, and automobile include pharmaceutical manufacturing, agricultural and sideline food processing industry, food manufacturing industry, textile industry, textile and garment industry, clothing industry, leather, fur, feather, and its products and shoemaking industry, wood processing and wood, bamboo, rattan, palm and grass products industry, furniture manufacturing, papermaking, and paper products industry, printing and recording media reproduction industry Cultural and educational, industrial and aesthetic, sports and entertainment products manufacturing, chemical fiber manufacturing, metal products industry, general equipment manufacturing, automobile manufacturing, electrical machinery and equipment manufacturing, daily chemical products manufacturing under chemical raw materials and chemical products manufacturing, and plastic products manufacturing under rubber and plastic products.

Table 1 lists the date, content and specific industries involved in the implementation of ADP policy. It is sorted according to the notice of the Ministry of Finance and the State Administration of Taxation on improving the firm income tax policy for accelerated depreciation of fixed assets (C.S. [2014] No. 75) and the notice of the Ministry of Finance and the State Administration of Taxation on further improving the firm income tax policy for accelerated depreciation of fixed assets (C.S. [2015] No. 106)

**Table 2**  
Depreciation amount, tax savings amount, and present value of tax savings under different depreciation policies (Unit: ten thousand yuan).

Year	1	2	3	4	5	6	7	8	9	10	Total
Straight-line method											
Amount of depreciation	100	100	100	100	100	100	100	100	100	100	1000
Amount of tax savings	25	25	25	25	25	25	25	25	25	25	250
Present value tax savings	23	22	20	19	18	17	16	15	14	13	179
Double declining balance method											
Amount of depreciation	200	160	128	102	82	66	52	42	84	84	1000
Amount of tax savings	50	40	32	25.5	20.5	16.5	13	10.5	21	21	250
Present value tax savings	47	35	26	19	15	11	8	6	11	11	189
Sum of the years' digits method											
Amount of depreciation	182	164	145	127	109	91	73	55	36	18	1000
Amount of tax savings	45.5	41	36.25	31.75	27.25	22.75	18.25	13.75	9	4.5	250
Present value tax savings	43	36	30	24	19	15	11	8	5	2	193
Method of reduced life depreciation period (60% of depreciation period)											
Amount of depreciation	167	167	167	167	167	167	-	-	-	-	1000
Amount of tax savings	41.75	41.75	41.75	41.75	41.75	41.75	-	-	-	-	250
Present value tax savings	39	36	34	32	30	28	-	-	-	-	199

Table 2 shows the present values of depreciation, and tax benefits under the straight-line method, the double-declining balance method, the sum of years' digits method, and the reduced-life depreciation method. We assume that a firm buys a piece of equipment worth 10 million yuan at the beginning of the period, with an expected life of ten years, a predicted net salvage value of 0, and a corporate income tax rate of 25%.

### 3. Testable hypothesis

According to Eq. (1), an ADP helps firms expand investment in fixed assets.  $D_n$  increases if a firm increases its corporate investments. However, we must analyze whether an increase in corporate investments means hiring more labor. The impact of an ADP on employment depends on two effects: the output effect and the substitution effect.

With the output effect, an increase in fixed asset investments means an expansion of firms' production scale. There are two rationales. First, when the time value of money is considered, the ADP will increase depreciation at the beginning of the period, which will result in the deductible tax savings generated by depreciation. The value is greater than the present value of the tax savings under the straight-line method, which reduces the cost of firms' buying fixed assets and increases the rate of return of firms' investment in fixed assets. Hence, the ADP helps stimulate firms to increase the investments of their fixed assets. It is equivalent to an interest-free loan effect of the ADP (Zwick & Mahon, 2017). A larger production scale requires more labor, which leads to an increase in labor demand. Second, the ADP will accrue more depreciation at the beginning of the period, resulting in more tax savings, which will help reduce the initial capital burden on the firm, improve the firm's cash flow, and ease the firm's internal financing constraints. At the same time, the ADP stimulates firms to increase investment in fixed assets, which will help firms send positive signals to external stakeholders, leading to an easing of firms' external financial constraints. The easing of financial constraints under the ADP allows firms to hire more employees, which leads to increased overall employment.

With the substitution effect, the intuition is that when the cost of capital is lower than the cost of labor, capital will replace labor, leading to a decrease in labor demand. An ADP, therefore, helps firms reduce their tax burdens, cash expenditures, and corporate capital costs through increased depreciation. The interest-free loan effect enables firms to invest more in upgrading their machinery and equipment, thereby improving their firm-wide production efficiency. Firms' technological progress and increased investment in innovation will lead to a decline in firms' demand for labor, especially unskilled labor, resulting in a decrease in employment. In addition, when firms use the savings from ADP to purchase machinery and equipment, those expenditures squeeze labor expenditures, which will lead to a reduction in labor demand and employment. Based on the analysis, we have two competing hypotheses.

**H1.** : An ADP will lead to an increase in employment.

**H2.** : An ADP will lead to a decrease in employment.

## 4. Research design

### 4.1. Data

We use all A-share firms from the Shanghai and Shenzhen Stock Exchanges during 2011–2018. Then, we delete: 1) firms are financially distressed; 2) firms belong to financial industries, and 3) firms without complete financial information. The final sample has 20,156 firm-years from 3273 firms. The data are retrieved from the China Stock Market and Accounting Research and WIND databases. We winsorize continuous variables at the 1% and 99% levels.

### 4.2. Methods

The implementation of the ADP by batches in 2014 and 2015 is conducive to a multi-temporal DID model for estimation. Therefore, we follow [Bertrand and Mullainathan \(2003\)](#) to construct a multi-temporal DID fixed-effect model (2) to analyze the impact of ADP on employment.

$$LNNUM_{i,t} = \alpha_0 + \alpha_1 * DEPRECIATE_{i,t} + CONTROL + FIRM + YEAR + \mu_{i,t} \quad (2)$$

where  $LNNUM_{i,t}$  is the natural logarithm of the number of employees of firm  $i$  in year  $t$  and  $DEPRECIATE_{i,t}$  is a (1, 0) indicator variable with a value of 1 when firm  $i$  is included in the ADP program in year  $t$ , and 0 otherwise.<sup>4</sup>

We include a set of control variables, including *SIZE* (firm size), *OCF* (cash flow from operating activities), *SOE* (state-owned firm status), *MARGIN* (corporate gross profit margin), *LGC* (high management compensation), and the macroeconomic control variables *MARKET* (marketization index) and *PRVWAGE* (regional per capita wage). We also include firm and year fixed effect<sup>5</sup> in Eq. (2) and clustered the standard errors of estimates of Eq. (2) at the industry level.  $\alpha_1$  captures the impact of the ADP reform on employment in a firm. If H1 (H2) is valid,  $\alpha_1$  is positive (negative). Because we plan to conduct propensity score matching (PSM) to match treatment firms (those enjoy ADP) with control firms (those did not enjoy ADP). We compare the profiles of treatment and control firms with respect the set of control variables in Eq. (2). The results in Table 2 show that before PSM, some of the variable means exhibit significant differences between treatment and control firms. After PSM, the differences become minimal.

## 5. Results and discussion

### 5.1. Descriptive statistics

Table 4 presents the descriptive statistics of the sample. The mean and median of  $LNNUM$  are 7.6121 and 7.5412. The mean value of  $DEPRECIATE$  is 0.3098, which means that an approximately 30.98% of the firms in the sample were affected by the implementation of the ADP. For the control variables, taking *OCF* as an example, the minimum value is  $-0.1667$ , and the maximum value is 0.2392, indicating a significant difference in cash flow among firms. The difference between the mean and median of control variables such as *SIZE*, *MARGIN*, *LGC*, *MARKET*, and *PRVWAGE* are small, indicating that the sample distribution is relatively balanced.

### 5.2. Baseline results

We present the baseline results of Eq. (2) in Panel A of Table 5. Column (1) uses only firm control variables, while column (2) adds the macroeconomic control variables. Consistently across both columns, the coefficients of  $DEPRECIATE$  are positive and significant at the 1% level, indicating that the ADP of fixed assets implemented in 2014 and 2015 significantly increased firm-level employment. The results support H1. Control variables, if significant, carry the expected signs. For instance, the coefficients of *SIZE* and *OCF* are positive and significant at the 1% level, which is consistent with intuition. When a firm is larger or has more cash, it hires more labor. Besides,

<sup>4</sup> Whether a firm is affected by the ADP depends on the content in Table 1.

<sup>5</sup> We follow [Faccio and Hsu \(2017\)](#), [Garrett et al. \(2020\)](#), and [Liu et al. \(2022\)](#) to control for firm fixed effect to account for firm invariant characteristics.

**Table 3**  
Propensity score matching (PSM) Balance Test.

Variable	Unmatched Matched	Mean			%reduction  bias	t-test	
		Treated	Control	%bias		t	p >  t
SIZE	Unmatched	21.91	22.12	-16.40		-10.46	0.000
	Matched	21.91	21.90	0.600	96.10	0.380	0.707
SOE	Unmatched	0.191	0.395	-47.20		-29.51	0.000
	Matched	0.191	0.183	1.700	96.30	1.110	0.267
LEV	Unmatched	0.371	0.436	-32		-20.39	0.000
	Matched	0.371	0.373	-1.100	96.60	-0.640	0.522
CASH	Unmatched	0.218	0.241	-17.10		-10.34	0.000
	Matched	0.218	0.219	-1	94.40	-0.620	0.532
AGE	Unmatched	8.036	9.678	-23.30		-15.17	0.000
	Matched	8.036	8.076	-0.600	97.60	-0.320	0.750
GROWTH	Unmatched	0.216	0.230	-2.900		-1.830	0.0670
	Matched	0.216	0.211	0.900	70.70	0.520	0.602

**Table 4**  
Summary statistics.

Variable	N	Mean	P50	Std	Min	Max
LNNUM	20156	7.6121	7.5412	1.2652	4.4308	11.1347
DEPRECIATE	20156	0.3098	0	0.4624	0	1
SIZE	20156	22.0520	21.8794	1.2891	19.6127	25.9957
OCF	20156	0.0431	0.0427	0.0700	-0.1667	0.2392
SOE	20156	0.3316	0	0.4635	0	1
MARGIN	20156	0.2920	0.2602	0.1746	-0.0031	0.8279
LGCOM	20156	15.2749	15.2410	0.6853	13.5911	17.1671
MARKET	20156	8.0602	8.6400	1.7159	2.9200	10.0000
PRVWAGE	20156	6.8148	6.3690	2.3970	3.4004	14.5766

This table shows the summary statistics of explained variables, explanatory variables, firm-level variables, and macro-level variables from 2011 to 2018. All variables are winsorized at the 1st and 99th percentiles. The definitions of variables are listed in the Appendix.

the coefficients of *LGCOM* and *PRVWAGE* are positive and significant at the 1% level, suggesting that when a firm has high management compensation or the regional wage level is high, it hires more labor.

### 5.3. Robustness tests

#### 5.3.1. Alternative metrics for employment

For robustness check, we use a change model of Eq. (2). The model is.

$$\Delta \text{JOB}_{i,t} = \beta_0 + \beta_1 \text{DEPRECIATE}_{i,t} + \Delta \text{CONTROL} + \text{FIRM} + \text{YEAR} + \mu_{i,t} \tag{3}$$

Where  $\Delta \text{JOB}$  is the natural logarithm of the number of employees in service in the current year minus the natural logarithm of the number of employees in service in the previous year. The findings are presented in Panel B of Table 5. The coefficient of *DEPRECIATE* continues to be positively significant at the 1% level. The results are qualitatively similar to those of column (2) in Panel A of Table 5. Thus, the support of H1 is robust to alternative metrics for firm-level employment.

#### 5.3.2. Dynamic trend analysis

The main regression results in Panels A and B of Table 5 show that the ADP has a significant role in promoting employment. However, this may result from factors that existed before the policy was implemented. Therefore, to alleviate this endogeneity problem, we use Eq. (4) to test the dynamic impact of the ADP on employment (Bertrand & Mullainathan, 2003).

$$\begin{aligned} LNNUM_{i,t} = & \beta_0 + \beta_1 * \text{BEFORE}_{i,t}^{-3} + \beta_2 * \text{BEFORE}_{i,t}^{-2} + \beta_3 * \text{BEFORE}_{i,t}^{-1} \\ & + \beta_4 * \text{CURRENT}_{i,t}^0 + \beta_5 * \text{AFTER}_{i,t}^1 + \beta_6 * \text{AFTER}_{i,t}^2 + \beta_7 * \text{AFTER}_{i,t}^3 \\ & + \text{CONTROL} + \text{FIRM} + \text{YEAR} + \mu_{i,t} \end{aligned} \tag{4}$$

where  $\text{BEFORE}^{-3}$  is three years before the year of the ADP implementation,  $\text{BEFORE}^{-2}$  is two years before the year of the ADP implementation,  $\text{BEFORE}^{-1}$  is one year before the year of the ADP implementation, *CURRENT* is the year of the ADP implementation,  $\text{AFTER}^1$  is one year after the ADP implementation,  $\text{AFTER}^2$  is two years after the year of the ADP implementation and  $\text{AFTER}^3$  is three years and more after the year of the ADP implementation. If the increase in employment is caused mainly by the ADP, there will be no significant change in the employment level before the ADP reform, that is,  $\beta_1, \beta_2$  and  $\beta_3$  are expected to be insignificant. Specifically, if the policy impact is immediate and constant, then we expect  $\beta_4 > 0$ , and  $\beta_5 = \beta_6 = \beta_7 = 0$ . If the policy impact increases over time, then

**Table 5**  
The impact of the accelerated depreciation policy (ADP) on employment.

Panel A: Baseline model		
Dep. Var: <i>LNNUM</i>	Adding firm control variables (1)	Adding macro-control variables (2)
<i>DEPRECIATE</i>	0.0478 * ** (3.1945)	0.0502 * ** (3.0067)
<i>SIZE</i>	0.6375 * ** (24.1565)	0.6356 * ** (23.9378)
<i>OCF</i>	0.3459 * ** (3.6569)	0.3494 * ** (3.7490)
<i>SOE</i>	0.0192 (0.9166)	0.0192 (0.9456)
<i>MARGIN</i>	-0.5494 * ** (-7.7010)	-0.5452 * ** (-7.8212)
<i>LGCOM</i>	0.0776 * ** (3.2429)	0.0791 * ** (3.3716)
<i>MARKET</i>		-0.0053 (-0.3857)
<i>PRVWAGE</i>		0.0379 * ** (3.8781)
Constant	-7.5065 * ** (-15.2624)	-7.7057 * ** (-14.3093)
N	20,156	20,156
Firm_FE	Yes	Yes
Year_FE	Yes	Yes
Adj. $R^2$	0.9301	0.9302

Panel B: Change model	
Dep. Var: $\Delta$ <i>JOB</i>	With firm and macroeconomic control variables (1)
<i>DEPRECIATE</i>	0.0151 * ** (3.0128)
$\Delta$ <i>SIZE</i>	0.4221 * ** (16.2079)
$\Delta$ <i>OCF</i>	0.0807 * (1.7676)
$\Delta$ <i>SOE</i>	-0.0056 (-0.5210)
$\Delta$ <i>MARGIN</i>	0.0061 (0.1312)
$\Delta$ <i>LGCOM</i>	0.0439 * ** (6.6467)
$\Delta$ <i>MARKET</i>	0.0097 (1.1661)
$\Delta$ <i>PRVWAGE</i>	0.0056 (0.3184)
Constant	-0.0018 (-0.1472)
N	16,878
Firm_FE	Yes
Year_FE	Yes
Adj. $R^2$	0.2183

Table 5 shows the basic regression results of the employment effects of the ADP. Panel A is for the baseline model with column (1) including only firm-level control variables, and column (2) adding the macroeconomic-level control variables. Panel B shows the results using a change model. All regression results are clustered at the industry level. The definitions of these variables are listed in the Appendix. \* \*\*, \* \*, and \* indicate significance at the 1%, 5%, or 10% levels, respectively. The *t*-statistics are shown in parentheses.

we expect  $\beta_4, \beta_5, \beta_6, \beta_7 > 0$ . We present the findings in column (1) of Table 6. As expected, the employment level does not change significantly before the implementation of the ADP, but the employment level increases after the change. In addition,  $\beta_1, \beta_2, \beta_3$  is insignificant and  $\beta_4, \beta_5, \beta_6$  and  $\beta_7$  are positively significant. Thus, the ADP policy impact increases over time. Therefore, the design of the multi-temporal DID model in this paper confirms the parallel trends assumption.

Further, we plot a dynamic trend figure (Fig. 1) according to the regression results of column (1) of Table 6. In Fig. 1, the circle represents the point estimation, and the dotted line represents the 95% confidence interval. From Fig. 1, in the years before the implementation of the ADP, the estimated coefficient  $\beta_1, \beta_2$  and  $\beta_3$  are not significantly different from 0, indicating that there is no significant *ex-ante* trend difference in a firm's employment level between the treatment group and the control group before the ADP

**Table 6**  
Robustness tests.

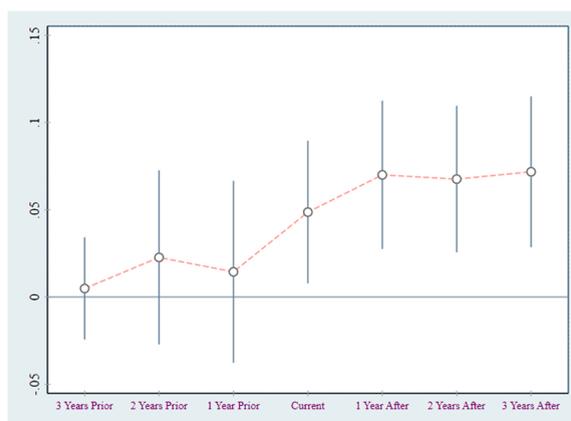
Dep. Var	Dynamic trend analysis	Placebo test	PSM+DID	Single time point DID (2014)	Single time point DID (2015)	Industry* Year fixed effects	The impact of government subsidies	Delete samples from three provinces in northeastern China
	LNNUM (1)	LNNUM (2)	LNNUM (3)	LNNUM (4)	LNNUM (5)	LNNUM (6)	LNNUM (7)	LNNUM (8)
BEFORE <sup>-3</sup>	0.0049 (0.3513)							
BEFORE <sup>-2</sup>	0.0227 (0.9594)							
BEFORE <sup>-1</sup>	0.0144 (0.5840)							
CURRENT	0.0487 ** (2.5116)							
AFTER <sup>1</sup>	0.0700 *** (3.4741)							
AFTER <sup>2</sup>	0.0676 *** (3.3963)							
AFTER <sup>3</sup>	0.0718 *** (3.5059)							
TREATxPOST				0.0262 (1.0609)	0.0680 ** (2.6292)			
TREAT				0.2068 *** (6.0721)	0.1752 *** (7.0985)			
DEPRECIATE		0.0211 (0.9788)	0.0603 ** (2.2958)			0.0197 *** (5.1295)	0.0569 *** (2.9340)	0.0546 *** (2.9303)
SUBSIDIES							-0.0734 ** (-2.8760)	
SIZE	0.6358 *** (23.9870)	0.6817 *** (20.4860)	0.6422 *** (30.2810)	0.7175 *** (20.2202)	0.7061 *** (23.3739)	0.6416 *** (25.5507)	0.6146 *** (16.8733)	0.6255 *** (22.8040)
OCF	0.3503 *** (3.7074)	0.3861 ** (2.6692)	0.3764 *** (4.1608)	2.0275 *** (5.0992)	2.1293 *** (6.4337)	0.3702 *** (3.7330)	0.3154 *** (3.4310)	0.3636 *** (3.7116)
SOE	0.0174 (0.8573)	0.1467 (1.5196)	0.0217 * (1.8425)	0.1268 (1.7216)	0.1158 (1.6788)	0.0208 (1.0331)	0.0102 (0.5780)	0.0172 (0.7492)
MARGIN	-0.5461 *** (-7.8827)	-0.4692 *** (-3.2982)	-0.4809 *** (-3.8434)	-0.7427 *** (-3.0433)	-0.5261 * (-1.8860)	-0.5652 *** (-6.6906)	-0.4889 *** (-6.5657)	-0.5747 *** (-6.8853)
LGCOM	0.0791 *** (3.3865)	0.0902 *** (3.2165)	0.0871 *** (3.9254)	0.2104 *** (4.4376)	0.2210 *** (5.6694)	0.0765 *** (3.3993)	0.0663 *** (4.1079)	0.0859 *** (3.0908)
MARKET	-0.0053 (-0.3821)	0.0188 (1.2599)	-0.0083 (-0.5053)	-0.0042 (-0.2956)	-0.0047 (-0.3830)	-0.0047 (-0.3265)	-0.0093 (-0.5643)	-0.0029 (-0.2343)
PRVWAGE	0.0382 *** (3.9066)	0.0655 *** (4.1386)	0.0403 *** (6.0213)	-0.0393 ** (-2.7044)	-0.0387 ** (-2.7886)	0.0446 *** (5.0063)	0.0421 *** (5.4716)	0.0388 *** (4.8037)
Constant	-7.7184 *** (-14.2845)	-9.2364 *** (-11.5881)	-7.9670 *** (-18.8340)	-11.1874 *** (-28.4405)	-11.1407 *** (-30.0763)	-7.8350 *** (-15.6617)	-7.0227 *** (-8.6561)	-7.6039 *** (-15.8557)
N	20,156	16,068	13,220	14,496	16,001	20,156	19,370	19,379
Firm_FE	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Year_FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind_FE	No	No	No	Yes	Yes	No	No	No
IndxYear_FE	No	No	No	No	No	Yes	No	No
Adj. R <sup>2</sup>	0.9302	0.9054	0.9372	0.6517	0.6363	0.931	0.930	0.930

The results of the robustness test are shown in Table 6. Column (1) shows the dynamic trend analysis. Column (2) shows the placebo test. Column (3) uses a propensity score matching (PSM) for the DID model. Column (4) uses single time point difference-in-differences model and deletes industries affected by the 2015 ADP policy. Column (5) uses single time point difference-in-differences model and deletes industries affected by the 2014 ADP policy. Column (6) considers industry-year fixed effects. Column (7) considers the effects of government subsidies, and column (8) considers the impact of two policies in the three northeastern provinces. All regression results are clustered at the industry level. The definitions of these variables are listed in the Appendix. \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, or 10% levels, respectively. The t-statistics are shown in parentheses.

implementation. Thus, the common trend assumption of the treatment and the control groups is valid. At the same time,  $\beta_4$ ,  $\beta_5$ ,  $\beta_6$  and  $\beta_7$  are significantly different from 0, indicating that the impact of ADP on firm employment has certain sustainability.

### 5.3.3. Placebo test

To avoid the random generation of DID regression results, we refer to Aghamolla and Li (2018) and choose 2009–2016 as the sample period, keeping the industries affected by the ADP unchanged and assuming that the changes took place in 2012 and 2013. Column (2) of Table 6 shows that the coefficient of DEPRECIATE is not significant after changing the sample period and the time point of the event, indicating that the regression results are not randomly generated. The ADP can significantly increase the level of employment.



**Fig. 1.** Dynamic trend analysis. Notes: In Fig. 1, the circle represents the point estimation, and the dotted line represents the 95% confidence interval.

In addition, we also conduct a placebo test by randomly generating the treatment firms (Gao et al., 2020) and make 1000 regressions using Eq. (2). The regression results are shown in Fig. 2. We find that most of the coefficients and the associated t-statistics kernel density estimates in the random sampling process are distributed near 0. The coefficient of *DEPRECIATE* (0.0502) and t-statistics (3.0067) in column (3) of Table 5 are located at the right tail of the coefficient kernel density as shown in Fig. 2A and t-statistics kernel density as shown in Fig. 2B. Hence, the regression results are not due to other unobservable factors.

#### 5.3.4. Propensity score matching (PSM) and difference-in-differences (DID)

Considering that the pilot firms may not necessarily adopt the ADP, we use the propensity score matching and difference-in-differences method (PSM and DID) to alleviate the endogenous problem by following Ye et al., (2019). We use *SIZE*, *SOE*, *LEV*, *CASH*, *AGE*, and *GROWTH* as the matching variable for the PSM. According to the propensity score, we use 1:2 nearest neighbors matching method with replacement, and to obtain 6244 treatment firms and 6976 control firms. On this basis, we conduct difference-in-differences regression on the samples of the treatment group and the control group to explore the impact of ADP on firm financing constraints.

Fig. 3 reports the results of propensity scores. Fig. 3A shows the distribution of propensity score before matching, and Fig. 3B shows the distribution of propensity score after matching. As shown in Fig. 3A, there is a significant difference in propensity scores between the pre-matching treatment group and the control group. After matching, the propensity scores of the control group move to the right and mostly coincide with the treatment group. Their distribution patterns are close, indicating that PSM has corrected the distribution deviation between the treatment group and the control group.

Column (3) of Table 6 shows the regression results of PSM and DID. The results show that the ADP has a significant positive correlation with employment at the 5% level, indicating that after controlling endogenous problems, the conclusion that the ADP leads to a significant increase in firm employment is still valid.

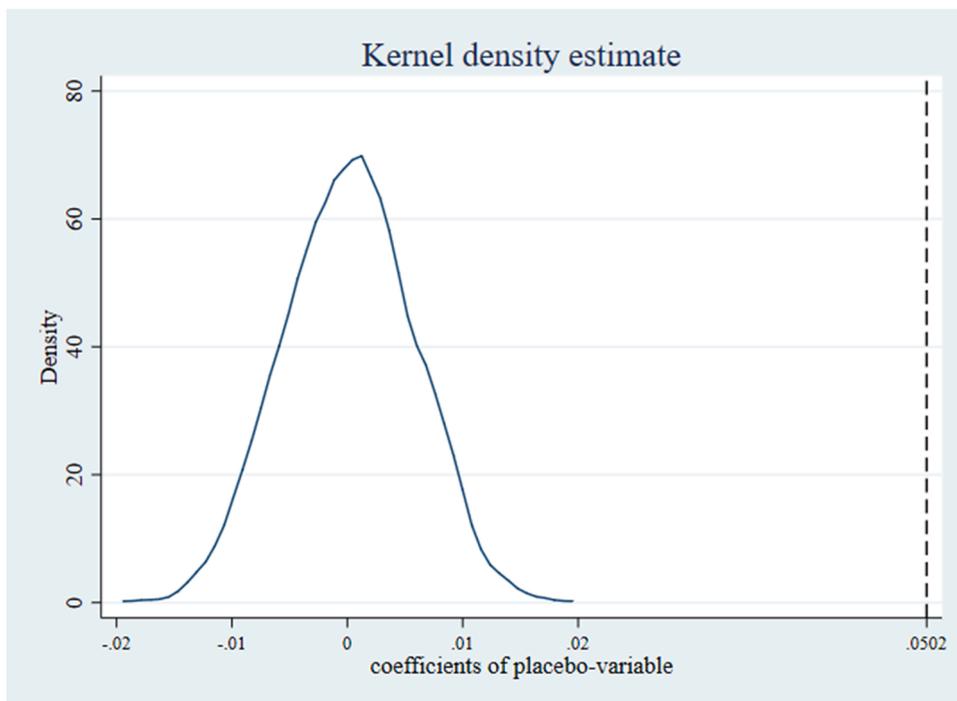
#### 5.3.5. Single time point DID

Goodman-Bacon (2021) suggests that using the two-way fixed effect model may lead to the problem that the early processed firm sample becomes the control sample of the late processed firm (and vice versa). Therefore, when the multi-temporal DID model is used, the estimation coefficients may deviate over time. Therefore, to mitigate this impact, we exclude firms affected by the ADP in 2015 to establish a single time point PSM and DID model (5). In Eq. (5),

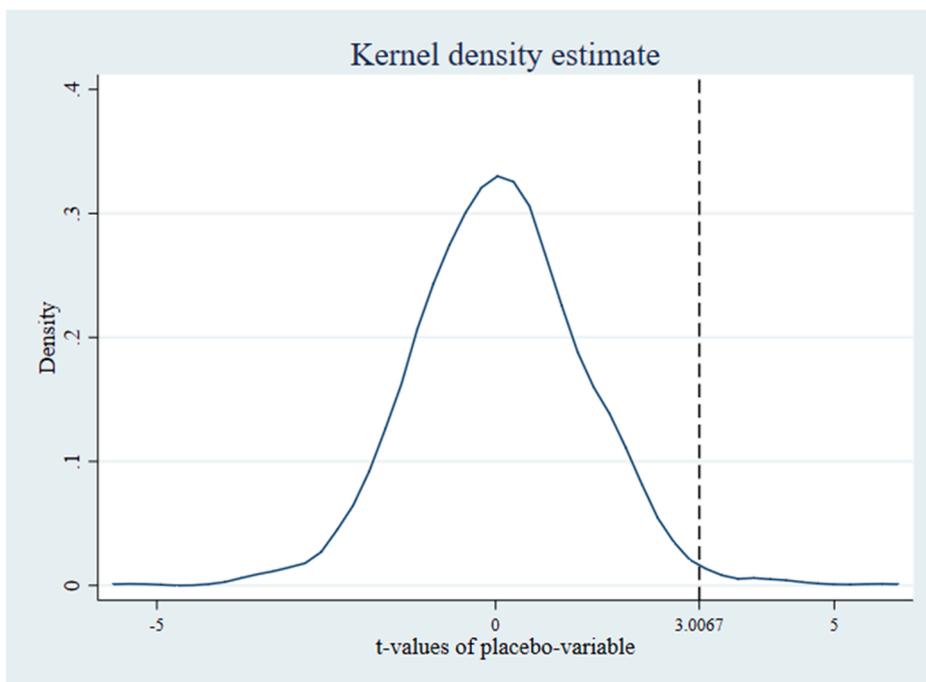
$$LNUM_{i,t} = \gamma_0 + \gamma_1 * TREAT_i * POST_t + \gamma_2 * TREAT_i + \gamma_3 * POST_t + CONTROL + IND + YEAR + \mu_{i,t} \quad (5)$$

where  $TREAT_i$  is a dummy variable of whether the six industries are affected by the ADP in 2014, that is, when the firm belongs to a pilot industry,  $TREAT_i$  is 1, otherwise it is 0.  $POST_t$  is a dummy variable of the policy implementation year, that is, in 2014 and beyond, the value is 1, otherwise it is 0. In Eq. (5), we control for the industry and year fixed effects and cluster the error of estimates at the industry level. The regression results in column (4) of Table 6 show that the coefficient of  $TREAT_i * POST_t$  is insignificant. If we exclude firms affected by the ADP in 2014, the regression results in column (5) of Table 6 show that the coefficient of  $TREAT_i * POST_t$  is significantly positive at the level of 5%. We attribute the insignificant results in column (4) be perhaps due to the new ADP policy and firms take time make their labor employment adjustment.<sup>6</sup>

<sup>6</sup> We also use only samples in 2014 and 2015 and define  $POST=1$  if the year is 2014 and 0 otherwise. The unreported results show that the coefficient of  $TREAT * POST$  is insignificant. Hence, there are no significant difference for the impact of ADP on employment between 2014 and 2015. Those two years are all under the impact of ADP.

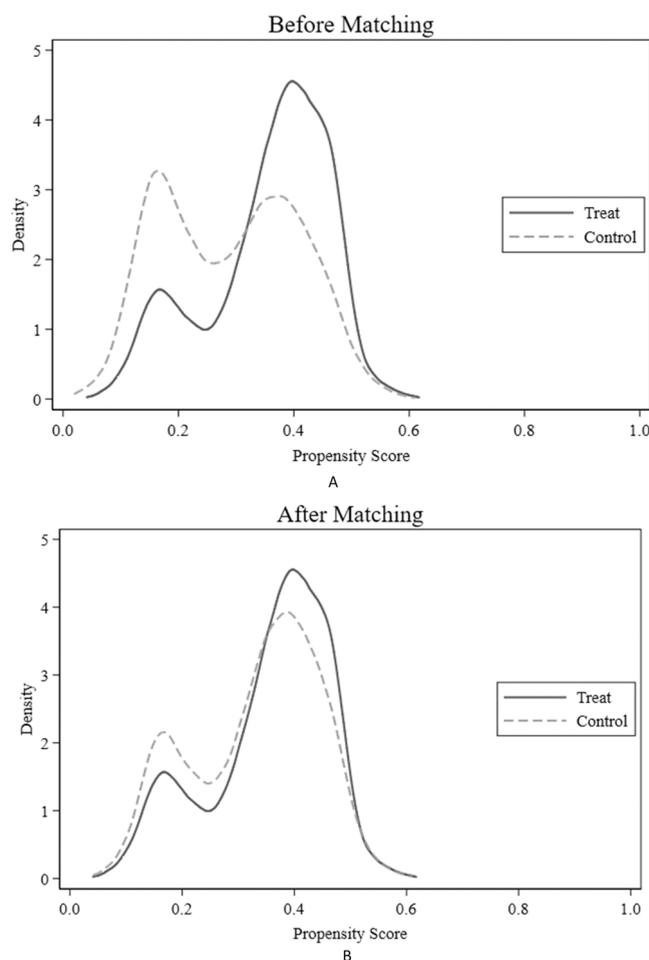


A



B

Fig. 2. A. Placebo Test of Coefficients, 2B. Placebo Test of T-values, Notes: These figures show the coefficients and T values kernel density estimates in the random sampling process.



**Fig. 3.** A. The Density of PSM (Before Matching), 3B. The Density of PSM (After Matching) Notes: These figures show the kernel density estimates of PSM.

#### 5.3.6. Control industry-year fixed effect

Considering the influence of unobservable factors among different industries on the regression results, we further control industry\*year fixed effect in Eq. (2). Column (6) of Table 6 shows that the coefficient of *DEPRECIATE* is significantly positive at the 1% level, indicating that the baseline results of remain intact.

#### 5.3.7. The impact of government subsidies

The ADP reflects the government's support for firms. Some firms enjoy additional government subsidies, which leads to their expansion of fixed asset investment and positively increases employment. To account for the effect of government subsidies, we augment Eq. (2) with a firm's government subsidies to operating income ratio (*SUBSIDIES*). The results in column (7) of Table 6 show that, after controlling for the impact of government subsidies, the coefficient of *DEPRECIATE* remains positive and significant at the 1% level.

#### 5.3.8. The impact of two policies implemented in three provinces in northeastern China

In 2004, three northeastern provinces of China (Heilongjiang, Jilin, and Liaoning) implemented the ADP and the VAT reform at the same time. These two tax policies allowed firms in these three provinces to increase the depreciation rate of fixed assets substantially. For robustness, we delete the sample of firms in the three northeastern provinces in Eq. (2). The results in column (8) of Table 6 give the same qualitative effects as those in Table 5.

### 5.4. Transmission mechanism

The logic of H1 is that China's ADP mainly enhances a firm's tax savings through tax cuts and stimulates firms to expand corporate investments, thereby increasing the demand for labor. If the logic is valid, we should observe that investment in fixed assets and the easing of financial constraints are important channels through which the ADP impacts firm employment. We examine these two

channels below.

5.4.1. Fixed asset investment

We use the new fixed assets in a year divided by the fixed assets in the previous year to gauge a firm's increase in fixed assets. For robustness, we use two metrics: *INVEST1* is newly added fixed assets at *t* divided by newly added fixed assets at *t-1*. *INVEST2* is the standardized ratio of (fixed assets + the net value of construction in progress + the added value of construction materials) at *t* to the fixed asset at *t-1*. We partition the full sample into subsamples of low and high investment subsamples using the mean.

We present the findings in Table 7. As shown in columns (1) to (4), the coefficients of *DEPRECIATE* are positive and significant at the 1% level for the large-scale fixed assets subsample. In contrast, those of the small-scale fixed asset subsample is insignificant. The findings suggest that the impact of the ADP is more salient for firms with large-scale fixed assets, which is natural because this results in more tax savings from the ADP and consequently higher employment.

5.4.2. Financial constraints

To further validate the logic behind H1, we examine the mediating effects of financial constraints. We use two metrics: *WW* and *CASH*. *WW* is  $(-0.091 * CASHFLOW/ASSET + 0.021 * LEV - 0.044 * SIZE - 0.035 * GROWTH + 0.102 * INDGROWTH)$ , where *CASHFLOW* is the operating net cash flow, *ASSET* is the total assets, *LEV* is the ratio of total liabilities to total assets, *SIZE* is the natural logarithm of total assets, *GROWTH* is the growth rate of the main business income; *INDGROWTH* is the growth rate of the industry, which is measured by the average growth rate of the main business income of the enterprise in the same industry. A large value of *WW* means a severe financial constraint. We partition the full sample into subsamples of low and high financial constraints using median *WW*. *CASH* is (monetary fund + trading financial assets) / total assets at the beginning of the year. A large value of *CASH* suggests a firm has low financial constraints. We partition the full sample into subsamples of low and high financial constraints using median cash level.

We present the findings in Table 7. As shown in columns (5) to (8), the coefficients of *DEPRECIATE* are positive and significant at the 1% level for the high *WW* (*CASH*) subsamples. In contrast, those of the low *WW* (*CASH*) subsamples are insignificant. The findings suggest that ADP helps ease financing constraints and increase employment.

Table 7  
Transmission mechanism.

Dep. Var. <i>LNNUM</i>	<i>Fixed asset investment</i>				<i>Financial constraints</i>			
	<i>INVEST1</i>		<i>INVEST2</i>		<i>WW</i>		<i>CASH</i>	
	Low	High	Low	High	Low	High	Low	High
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>DEPRECIATE</i>	0.0276 (1.5738)	0.0937 *** (3.8944)	0.0137 (1.4417)	0.1011 *** (3.3754)	0.0046 (0.3785)	0.0528 ** (2.7416)	0.0155 (1.0239)	0.0574 *** (4.2781)
<i>SIZE</i>	0.6405 *** (22.7952)	0.5839 *** (12.9965)	0.6442 *** (30.3921)	0.5906 *** (11.7550)	0.6240 *** (28.7829)	0.5766 *** (10.5261)	0.6225 *** (23.1471)	0.6256 *** (28.4691)
<i>OCF</i>	0.3889 *** (3.0661)	0.2798 ** (2.8093)	0.3206 *** (3.0099)	0.2624 ** (2.1762)	0.2158 ** (2.3137)	0.1829 (1.4703)	0.3464 *** (4.0589)	0.3095 *** (3.4601)
<i>SOE</i>	0.0428 (1.6276)	0.0464 (1.4095)	0.0759 (0.9269)	-0.0031 (-0.1253)	0.0182 (0.9467)	0.0936 *** (4.4410)	0.0215 (0.9541)	0.0288 (0.6764)
<i>MARGIN</i>	-0.5781 *** (-5.9040)	-0.4661 *** (-4.3535)	-0.4800 *** (-10.3250)	-0.5179 ** (-2.8412)	-0.3697 *** (-4.3368)	-0.4924 *** (-3.5644)	-0.4938 *** (-4.8770)	-0.5703 *** (-6.1781)
<i>LGCOM</i>	0.1119 ** (2.8771)	0.0413 *** (3.6054)	0.0949 *** (3.0201)	0.0516 * (1.7522)	0.0585 *** (4.2329)	0.0731 ** (2.1688)	0.0642 *** (3.1042)	0.1055 ** (2.4451)
<i>MARKET</i>	-0.0152 (-1.0238)	0.0021 (0.1076)	0.0019 (0.1552)	0.0134 (0.3968)	0.0031 (0.1763)	-0.0004 (-0.0302)	-0.0029 (-0.2228)	-0.0239 (-1.1744)
<i>PRVWAGE</i>	0.0256 * (2.4100)	0.0896 *** (4.6525)	0.0440 *** (3.2606)	0.0366 *** (3.4801)	0.0405 *** (3.3182)	0.0404 *** (3.1253)	0.0398 *** (3.3471)	0.0166 (1.0291)
Constant	-8.1728 *** (-12.8904)	-6.3690 *** (-5.6587)	-8.2192 *** (-13.4205)	-6.5136 *** (-5.3693)	-7.1692 *** (-11.0234)	-6.5090 *** (-6.0404)	-7.2286 *** (-11.0558)	-7.5798 *** (-16.3729)
N	13,135	7021	12,386	7770	10,078	10,077	10,189	9958
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R <sup>2</sup>	0.9286	0.9340	0.9353	0.9279	0.9429	0.8983	0.9359	0.9296

Table 7 shows the underlying mechanism for the effect of the ADP on a firm's employment. Columns (1)-(4) present the findings using the scale of investments. *Invest1* is newly added fixed assets at *t* divided by newly added fixed assets at *t-1*. *Invest2* is the standardized ratio of (fixed assets + the net value of construction in progress + the added value of construction materials) at *t* to the fixed asset at *t-1*; Columns (1) and (2) report the results for firms with below-mean fixed asset investment and above-mean fixed asset investment, respectively. So do columns (3) and (4). Columns (5)-(8) present the findings using financial constraints. *WW* equals to  $(-0.091 * CASHFLOW/ASSET + 0.021 * LEV - 0.044 * SIZE - 0.035 * GROWTH + 0.102 * INDGROWTH)$ . Columns (5) and (6) report the results for firms with the medians, respectively. *CASH* is (monetary fund + trading financial assets) / total assets at the beginning of the year. Columns (7) and (8) report the results for firms with the medians, respectively. All regression results are clustered at the industry level. The definitions of these variables are listed in the Appendix. \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, or 10% levels, respectively. The t-statistics are shown in parentheses.

## 5.5. Additional analysis

### 5.5.1. The underlying logic of testable hypothesis

We logic behind the output effect hypothesis (H1a) is that the ADP has an interest-free loan effect. Due to the time value of money, the ADP increases the amount of tax incentives at the beginning of the firm's investment period and delays the tax payment time of the firm. The interest-free loan effect of ADP is mainly achieved by improving the lack of internal cash flow of firms. Therefore, firms with insufficient internal cash flow will be more sensitive to the ADP. In firms with a higher degree of financing constraints, the ADP will have a more significant role in promoting employment. Therefore, we use the firm's size, the state ownership of the firm, and the firm's growth to examine the response of firms to the ADP.

**5.5.1.1. Firm size.** Compared with large firms, small-scale firms have weaker corporate governance, higher information opacity, more significant financial risks, and higher financing constraints. Therefore, we expect the ADP to be more salient on employment in small firms. Following Parise (2018), we consider a firm's *SIZE* is below (above) the sample mean size, it is a small (big) firm. Columns (1) and (2) of Table 8 are the results of regression grouped by size. The regression results show that the effect of the ADP in promoting the number of employees is more salient in the small business group, indicating that the ADP will significantly facilitate the increase in the number of employees in small firms.

**5.5.1.2. State ownership status of a firm.** State-owned firms have natural links to the government and state-owned banks, making external financing easier to access. On the contrary, non-state-owned firms are more likely to face "credit discrimination" because of limited collateral, high information opacity, and high credit risk. Therefore, compared with state-owned firms, non-state-owned firms face a higher degree of financing constraints. The columns (3) and (4) in Table 8 present the results of a group regression by the nature of property rights. The findings show that the ADP has a more significant effect on the number of employees in the non-state-owned firm group, indicating that the ADP would significantly increase the number of non-state employees.

**5.5.1.3. Growth of firms.** The life cycle theory divides the firm's development into four stages: start-up, growth, maturity, and decline. When the firm is in the start-up period and growth period, the firm has vigorous growth and a great demand for funds. On the contrary, when the firm is in the mature stage, the firm has rich cash flow and less need for funds. The ADP can significantly increase the internal cash flow of firms in the short term. Therefore, firms with strong growth are more motivated to use the ADP, resulting in the

**Table 8**  
Additional analysis.

Dep. Var.: <i>LNNUM</i>	Firm size		Ownership status		Growth	
	Small	Big	Non-state owned	State owned	Low	High
	(1)	(2)	(3)	(4)	(5)	(6)
<i>DEPRECIATE</i>	0.0246 *** (3.7224)	0.0307 (1.7194)	0.0743 ** (2.1391)	0.0334 (1.7114)	0.0244 (1.2225)	0.0686 *** (3.4259)
<i>SIZE</i>	0.6247 *** (10.5222)	0.5976 *** (17.8751)	0.6231 *** (17.3080)	0.5803 *** (8.2638)	0.6341 *** (23.0694)	0.6108 *** (17.6650)
<i>OCF</i>	0.2125 *** (3.1861)	0.1083 (1.6923)	0.2998 ** (2.2838)	0.3409 *** (4.4030)	0.3214 ** (2.8312)	0.2287 *** (2.9824)
<i>SOE</i>	-0.0411 (-1.0605)	0.0107 (0.8136)	-	-	0.0302 (0.9407)	0.0239 (1.1227)
<i>MARGIN</i>	-0.3689 *** (-4.8412)	-0.1970 * (-1.7475)	-0.4793 *** (-4.3507)	-0.5077 *** (-3.1045)	-0.5365 *** (-5.3295)	-0.6444 *** (-5.0591)
<i>LGCOM</i>	0.0668 *** (3.6638)	0.0597 *** (3.3118)	0.0996 *** (4.3608)	0.0354 (1.2093)	0.1020 ** (2.5904)	0.0438 ** (2.4337)
<i>MARKET</i>	-0.0132 (-0.5311)	0.0126 (0.6557)	-0.0196 (-0.9472)	0.0043 (0.2503)	-0.0051 (-0.2194)	0.0057 (0.5161)
<i>PRVWAGE</i>	0.0873 ** (7.1955)	0.0390 ** (2.7714)	0.0232 (1.0898)	0.0570 ** (2.7503)	0.0424 ** (3.4279)	0.0383 *** (4.9051)
Constant	-7.4549 *** (-5.3032)	-6.8741 *** (-8.7622)	-7.5752 *** (-11.3012)	-5.9130 *** (-3.8094)	-8.0638 *** (-13.2856)	-6.6650 *** (-8.4470)
N	10,118	10,038	11,542	6535	11,699	8457
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R <sup>2</sup>	0.9532	0.9552	0.9161	0.9405	0.9282	0.9367

Table 8 shows the results of the regressions for additional analysis. Columns (1) and (2) show the results of subsamples by firm size which is the natural logarithm of total assets. We define that when the sample is below-mean size, it is a small firm, otherwise, it is a big firm. Columns (3) and (4) show the results of subsamples by state-ownership. Columns (5) and (6) show the results of subsamples by firm growth which is (operating income in  $t$ -operating income in  $t-1$ ) / operating income in  $t-1$ . We define that when the sample is below-mean growth, it is a firm with low growth, otherwise, it is a firm with high growth. All regression results are clustered at the industry level. The definitions of variables are listed in the Appendix. \*\*\*, \*\*, \* and \* indicate significance at the 1%, 5%, or 10% levels, respectively. The  $t$ -statistics are shown in parentheses.

**Table 9**  
The impact of the ADP on labor employment of different departments.

<i>Dep. Var</i>	<i>TECH</i> (1)	<i>PRODUC</i> (2)	<i>SALE</i> (3)	<i>SERVICE</i> (4)	<i>GENADM</i> (5)	<i>PURCHA</i> (6)	<i>FINAN</i> (7)	<i>ADMIN</i> (8)	<i>OTHER</i> (9)
<i>DEPRECIATE</i>	0.0719 *** (4.0266)	0.1030 (1.7059)	-0.0145 (-0.6336)	0.1967 (1.7125)	-0.0355 (-1.5030)	0.1209 (1.0793)	0.0254 *** (2.9782)	0.0359 (1.2696)	0.1198 ** (2.4066)
<i>SIZE</i>	0.6528 *** (18.7818)	0.6046 *** (12.5095)	0.6257 *** (17.8229)	0.6082 *** (4.6075)	0.5208 *** (6.3167)	0.4284 *** (6.2764)	0.6291 *** (29.0564)	0.6159 *** (12.2752)	0.5664 *** (9.7261)
<i>OCF</i>	0.1853 ** (2.1798)	0.3422 *** (5.2690)	0.1935 (0.8487)	0.3230 (1.0974)	0.2117 (1.1657)	0.5474 (1.4098)	0.2510 ** (2.4280)	0.1548 (1.1880)	0.1057 (0.6718)
<i>SOE</i>	0.0150 (0.8600)	0.0166 (0.5782)	-0.0297 (-1.4532)	-0.1100 (-1.3162)	-0.0155 (-0.2364)	0.1942 (1.0035)	0.0511 ** (2.3800)	0.0871 *** (5.0010)	0.1029 (1.2445)
<i>MARGIN</i>	-0.1544 ** (-2.1198)	-0.7278 *** (-5.3689)	-0.1574 (-0.4932)	0.0150 (0.0357)	-0.3411 * (-1.8305)	-0.8539 *** (-3.5562)	-0.3595 *** (-5.3823)	-0.3163 ** (-2.4586)	-0.1104 (-0.3601)
<i>LGCOM</i>	0.0905 *** (4.8100)	0.0595 ** (2.5273)	0.0783 ** (2.3402)	0.1319 (1.7649)	0.0620 (1.0343)	0.0050 (0.0740)	0.0494 * (2.0342)	0.0540 (1.5211)	0.1987 *** (5.9210)
<i>MARKET</i>	0.0019 (0.1277)	-0.0146 (-0.4607)	0.0214 (1.1259)	-0.1274 (-1.0514)	0.0174 (0.5422)	-0.0119 (-0.2324)	-0.0306 * (-1.8920)	-0.0415 *** (-2.9141)	0.0155 (0.1567)
<i>PRVWAGE</i>	0.0175 (1.4990)	0.0286 ** (2.1415)	0.0080 (0.4281)	0.0800 (0.6331)	0.0181 (1.1824)	0.0271 (0.4083)	0.0282 ** (2.6751)	0.0081 (0.6181)	0.0815 (1.3541)
Constant	-10.1475 *** (-13.5958)	-7.2765 *** (-6.0187)	-10.1369 *** (-9.8569)	-9.2980 *** (-3.6296)	-7.3765 *** (-3.7371)	-5.0255 ** (-2.2483)	-10.6126 *** (-18.9022)	-8.8103 *** (-10.8652)	-10.8864 *** (-5.9156)
N	18,920	16,765	18,213	440	4784	500	17,564	16,024	5299
Firm_FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year_FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R <sup>2</sup>	0.8944	0.9206	0.9104	0.9504	0.9091	0.9311	0.9286	0.8787	0.8287

Table 9 shows the basic regression results for the effect of ADP on different types of labor employment. All regression results are clustered at the industry level. The definitions of these variables are listed in the Appendix. \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, or 10% levels, respectively. The *t*-statistics are shown in parentheses.

improvement of employment level. We use  $(\text{operating income in } t - \text{operating income in } t-1) / \text{operating income in } t-1$  to represent the growth of firms, and group the samples according to the mean. When the sample is less than the mean, it is considered that the growth of firms is low, otherwise, it is considered that the growth of firms is high. Columns (7) and (8) of Table 8 are regression results grouped by growth. The regression results show that the effect of the ADP in promoting the number of employees is more significant in the high growth group, indicating that the ADP will significantly promote the increase in the number of employees in high growth firms. Based on the analysis, the ADP promotes employment mainly in firms with a higher degree of financing restriction.

### 5.5.2. The impact of the ADP on different types of labor employment

Labor is not homogenous. To supplement our analysis, we examine Eq. (1) with respect to different types of labor employment. Specifically, we use the employee composition data of firms provided by the WIND database. The database divides employees into production personnel (*PRODUC*), sales personnel (*SALE*), customer service personnel (*SERVICE*), technicians (*TECH*), financial personnel (*FINAN*), human resources personnel (*HR*), administrative personnel (*ADMIN*), general management personnel (*GENADM*), risk control auditors (*RISK*), purchase and warehousing personnel (*PURCHA*) and other personnel (*OTHER*) according to their positions. However, there are insufficient observations for the *RISK* ( $N = 33$ ) and *HR* ( $N = 67$ ) categories. Hence, we report the remaining nine categories of labor employment. We use the natural logarithm labor employment in each department and use Eq. (2) for regression respectively.

The results are presented in Table 9. The regression results in column (1) of Table 9 show that the coefficient of *DEPRECIATE* is positively significant at the 1% level, suggesting that the ADP enhances technical labor employment. In column (7) and (9) for the finance and other department employees, the coefficients of *DEPRECIATE* are significant. We interpret the findings as that when a firm employs more technical personnel, it needs to support them with corresponding financial personnel and personnel from other departments. Collectively, the results in Table 9 corroborate with the baseline findings in Table 5 and support the notion that the ADP promotes firm employment to accompany the increase of using more capital. An increase in capital investment requires more technical labor to engage in operation.

### 5.5.3. Other economic consequences

Our analyses focus on the impact of ADP on employment. Given the ADP targets at firms' capital, we examine the other economic consequences of the ADP. Specifically, we consider the natural logarithm of sales revenue to measure a firm's output level (*LNOUTPUT*), the natural logarithm of net profit (*LNNETPROFIT*), liabilities divided by assets to represent a firm's financial leverage (*LEV*), and the natural logarithm of the salary that a firm pays its employees (*LNSALARY*) and use these variables to replace *LNNUM* in Eq. (2). The results are presented in Table 10.

As shown in Table 10, the coefficients of *DEPRECIATE* are insignificant for the regression equations of output and employee wage in

**Table 10**  
Other economic consequence of ADP.

Dep. Var	<i>LNOUTPUT</i>	<i>LNNETPROFIT</i>	<i>LEV</i>	<i>LNSALARY</i>
	(1)	(2)	(3)	(4)
<i>DEPRECIATE</i>	0.0154 (1.4250)	-0.0724 * * (-2.1289)	0.0381 * * * (4.0704)	-0.0126 (-0.4253)
<i>SIZE</i>	0.9092 * * * (32.7010)	0.8759 * * * (25.2186)	0.0207 (0.9038)	0.7497 * * * (19.8969)
<i>OCF</i>	1.0618 * * * (10.8157)	1.5151 * * * (8.6787)	-0.1393 (-1.2336)	0.7636 * * * (4.1115)
<i>SOE</i>	0.0041 (0.1782)	-0.2277 * * * (-4.4196)	0.0567 * * (2.4947)	0.1069 * * * (5.8967)
<i>MARGIN</i>	-0.8496 * * * (-4.7407)	3.5621 * * * (6.0606)	-0.4010 * * * (-5.7904)	-0.1537 * (-1.8221)
<i>LGCOM</i>	0.1867 * * * (11.6226)	0.3074 * * * (14.6394)	-0.0332 * * (-2.1404)	0.2489 * * * (4.4649)
<i>MARKET</i>	0.0310 * * (2.1537)	0.0352 (1.2388)	-0.0086 (-0.9997)	0.0315 * * (2.6329)
<i>PRVWAGE</i>	0.0056 (0.3642)	-0.0127 (-0.5720)	0.0079 (1.0977)	0.0588 * * * (4.5070)
Constant	-1.6276 * * (-2.3308)	-6.5388 * * * (-8.3869)	0.5811 (0.8716)	-4.1085 * * * (-6.1718)
N	20,147	18,516	20,156	20,013
Firm_FE	Yes	Yes	Yes	Yes
Year_FE	Yes	Yes	Yes	Yes
Adj. R <sup>2</sup>	0.9513	0.8071	0.5003	0.8792

Table 10 shows the basic regression results of the natural logarithm of sales revenue to measure a firm's output level (*LNOUTPUT*), the natural logarithm of net profit (*LNNETPROFIT*), liabilities divided by assets to represent a firm's financial leverage (*LEV*), and the natural logarithm of the salary that a firm pays its employees (*LNSALARY*) of the ADP. All regression results are clustered at the industry level. The definitions of these variables are listed in the Appendix. \* \* \*, \* \*, and \* indicate significance at the 1%, 5%, or 10% levels, respectively. The t-statistics are shown in parentheses.

columns (1) and (4). Thus, the initial stage of implementing an ADP has no effect on a firm's output and employee wage. In contrast, the coefficient of *DEPRECIATE* in column (2) of Table 10 is negatively significant at the 5% level while the same coefficient in column (3) is positively significant at the 1% level. Hence, the early implementation of the ADP lowers a firm's profit and increases its financial leverage. We interpret the findings to be consistent with the notion that the ADP raises a firm's corporate investments in the early implementation of the ADP resulting in the increase of the cost, leading to lowering its profit and higher financial leverage due to external financing of the corporate investments.

## 6. Conclusion

We examine the impact of China's 2014 and 2015 implementation of an ADP on fixed assets on firm employment. We use a quasi-natural experiment to conduct our analysis.

Our robust findings suggest that China's ADP has significantly increased the labor demand of firms by stimulating firms to increase their investment in fixed assets and easing their financial constraints. When firms increase fixed asset investment, they use more labor. Additional analysis suggests the positive effect of the ADP is more salient for small firms, non-state-owned firms, high growth firms, and on hiring more skilled labor, which corroborate the underlying logic of the output effect hypothesis.

Our paper sharpens the understanding of the relationship between tax incentive policies and employment. Most importantly, while we expect an ADP to promote firms' corporate investments, we show that it also enhances employment, especially that of skilled labor. Hence, it is desirable for a government, especially those in emerging economies, to promote an ADP to encourage both corporate investments and employment.

## Declaration of Competing Interest

We do not have conflicts of interest.

## Appendix A. Variables definitions

See Appendix A section here.

The Appendix provides variable definitions.

Variable	Definition
<b>Dependent variables</b>	
<i>LNNUM</i>	The natural logarithm of the number of employees in service
$\Delta$ <i>JOB</i>	The natural logarithm of the number of employees in service in the current year minus the natural logarithm of the number of employees in service in the previous year
<b>Independent variable</b>	
<i>DEPRECIATE</i>	This variable is an indicator variable. It equals 1 when the firm <i>i</i> belongs to the industry affected by the accelerated depreciation policy in year <i>t</i> ; otherwise, it equals 0.
<b>Firm control variables</b>	
<i>SIZE</i>	The natural logarithm of total assets
<i>OCF</i>	The ratio of net cash flow from operating activities to total assets of a firm
<i>SOE</i>	Nature of corporate equity
<i>MARGIN</i>	(Operating income-operating costs)/operating income
<i>LGCOM</i>	The natural logarithm of the total compensation of the firm's top managers
<b>Macro economy control variables</b>	
<i>MARKET</i>	Report on Marketization Index of Chinese provinces (2018) by Fan Gang
<i>PRVWAGE</i>	Per capita salary (Unit: ten thousand yuan)

## References

- Aghamolla, C., & Li, N. (2018). Debt contract enforcement and conservatism: Evidence from a natural experiment. *Journal of Accounting Research*, 56(5), 1383–1416.
- Allen, F., Qian, J., & Qian, M. (2005). Law, finance, and economic growth in China. *Journal of Financial Economics*, 77(1), 57–116.
- Bertrand, M., & Mullainathan, S. (2003). Enjoying the quiet life? Corporate governance and managerial preferences. *Journal of Political Economy*, 111(5), 1043–1075.
- Desai, M. A., & Goolsbee, A. D. (2004). Investment, overhang, and tax policy. *Brookings Papers On Economic Activity*, 2004(2), 285–338.
- Edgerton, J. (2010). Investment incentives and corporate tax asymmetries. *Journal of Public Economics*, 94(11), 936–952.
- Faccio, M., & Hsu, H. (2017). Politically connected private equity and employment. *Journal of Finance*, 72(2), 539–574.
- Gao, H., Hsu, P., Li, K., & Zhang, J. (2020). The real effect of smoking bans: Evidence from corporate innovation. *Journal of Financial and Quantitative Analysis*, 55(2), 387–427.
- Garrett, D. G., Ohrn, E., & Suárez Serrato, J. C. (2020). Tax policy and local labor market behavior. *American Economic Review: Insights*, 2(1), 83–100.
- Goodman-Bacon, A. (2021). Difference-in-differences with variation in treatment timing. *Journal of Econometrics*, forthcoming.
- Grncíková, A., & Berkovic, V. (2020). Impact of Industry 4.0 on labor productivity in the Slovak Republic. *Problems and Perspectives in Management*, 18(2), 396–408.

- Hines, J. R., & Park, J. (2019). Investment ramifications of distortionary tax subsidies. *Journal of Public Economics*, 172, 36–51.
- House, C., & Shapiro, M. D. (2008). Temporary investment tax incentives: Theory with evidence from bonus depreciation. *American Economic Review*, 98(3), 737–768.
- Hulse, D. S., & Livingstone, J. R. (2010). Incentive effects of bonus depreciation. *Journal of Accounting and Public Policy*, 29(6), 578–603.
- Knittel, M. (2007). Corporate response to accelerated tax depreciation: Bonus depreciation for tax years 2002-2004. *OTA Working Paper 98*.
- Ku, H., Schönberg, U., & Schreiner, R. C. (2020). Do place-based tax incentives create jobs? *Journal of Public Economics*, 191, Article 104105.
- Liu, G., Liu, Y., & Zhang, C. (2022). Tax enforcement and corporate employment: Evidence from a quasi-natural experiment in China. *China Economic Review*, 73, Article 101771.
- Maffini, G., Xing, J., & Devereux, M. P. (2019). The impact of investment incentives: Evidence from U.K. corporation tax returns. *American Economic Journal: Economic Policy*, 11(3), 361–389.
- Ohrn, E. (2018). The effect of corporate taxation on investment and financial policy: Evidence from the DPAD. *American Economic Journal: Economic Policy*, 10(2), 272–301.
- Ohrn, E. (2019). The effect of tax incentives on U.S. manufacturing: Evidence from state accelerated depreciation policies. *Journal of Public Economics*, 180, Article 104084.
- Panteghini, P. M., & Vergalli, S. (2016). Accelerated depreciation, default risk and investment decisions. *Journal of Economics*, 119(2), 113–130.
- Parise, G. (2018). Threat of entry and debt maturity: Evidence from airlines. *Journal of Financial Economics*, 127(2), 226–247.
- Steinmuller, E., Thuncke, G. U., & Wamser, G. (2019). Corporate income taxes around the world: A survey on forward-looking tax measures and two applications. *International Tax and Public Finance*, 26(2), 418–456.
- Ye, D., Deng, J., Liu, Y., Szewczyk, S. H., & Chen, X. (2019). Does board gender diversity increase dividend payouts? Analysis of global evidence. *Journal of Corporate Finance*, 58, 1–26.
- Zidar, O. (2019). Tax cuts for whom? Heterogeneous effects of income tax changes on growth and employment. *Journal of Political Economy*, 127(3), 1437–1472.
- Zwick, E., & Mahon, J. (2017). Tax policy and heterogeneous investment behavior. *American Economic Review*, 107(1), 217–248.