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Depreciation Rate

by Perpetual Inventory Method and Depreciation Expense as Accounting Item

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by Perpetual Inventory Method and Depreciation Expense as Accounting Item[1]

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Abstract

We find that, in China, the Total Value of Fixed Assets is roughly equivalent to the imputed value of fixed assets of Industrial Enterprises above the Designated Size from 1993 to 2016. Then, we estimate the depreciation rates of 37 industrial sectors using the Perpetual Inventory Method (PIM) and Depreciation Expense as Accounting Item (DEAI), and find that the average values from 2001 to 2016 are 0.0677 and 0.0799, respectively. After comparing the two methods, we find that the PIM includes more information, such as revaluation of fixed assets, and they are equivalent under certain conditions. We also find that the depreciation rate by PIM from 1993 to 2000 is close to the value of 5.4% estimated by Chow and Li (2002). Finally, we find that the depreciation rate is significantly affected by the enterprise's profit after tax, based on panel estimation.

JEL classification: D24, E22, L6

Keywords: China, depreciation rate, depreciation expense, industrial sector, PIM, DEAI

1 Introduction

(Depreciation rate at the national and industrial level in China)

The depreciation rate is an indispensable and important indicator for measuring capital stock and investment efficiency. Estimation of China's depreciation rate is in progress, but a consensus has not been reached. For example, the depreciation rate is estimated to be from 5% to 12%, and is reported as 5.4% in Chow and Li (2002), 5.7% in Chen (2014), 5-7% in Tian (2016), 9.6% in Zhang et al. (2004), and 10-12% in Bai et al. (2006). Not only are there considerable differences in the values of estimated depreciation rates, as above, there are also significant differences in the estimation methods used in the above studies. These estimates also predict different trends. For example, Chen (2014) finds an increasing trend, while Bai et al. (2006) and Tian (2016) report a decreasing one.

Consequently, a natural question would be which estimate is most plausible, and which should be used. In other words, it is difficult to find an accurate estimation of the depreciation rate at the national level. In this situation, we have to think carefully about how best to proceed. We may consider its upper bound instead of the accurate rate. We know that the 2nd sectoral Gross Domestic Product (GDP, the share in 1993, 2000, 2016 was 46.6%, 45.9%, 39.9%, respectively) has been a big component in China over the past few decades,[3] so the depreciation rates of each industrial sector should be a big part of the depreciation rate at the national level. If we can estimate the depreciation rate by industrial sector, we may indirectly and roughly determine the

[3] In China, the 2nd sectoral GDP is divided into two parts. One is industry and the other one is construction, and their shares of GDP in 2016 are 33.3% and 6.7%, respectively.

upper bound of the depreciation rate at the national level, because the 3rd or service sector will have a lower depreciation rate than the 2nd sector, as reported by Wykoff and Hulten (1979) and Hulten and Wykoff (1981). Furthermore, there are no detailed estimates of the depreciation rate by industrial sector in existing studies.

(This study and related studies)

Two methods have been used to estimate the depreciation rate in previous research. The first is to use information regarding asset life. Life by asset class is used to estimate the depreciation rate in a detailed manner in Hulten and Wykoff (1981). In line with this approach, the depreciation rate by industrial sector is estimated based on the asset life and asset structure of state-owned enterprises in China during the period 1980-1987in Zheng et al. (1993). However, the life of constructions, machinery, and other investment goods in China are assumed to be 45, 20, and 25 years, respectively in Zhang et al. (2004, lines 3-10, p.39) by referring to Huang et al. (2002), and this assumption is controversial. We cannot use the approach used by Hulten and Wykoff (1981) because current, detailed data on life by asset class in private (or non-state-owned) enterprises for China, as in the U.S., are not available.

The second method is to use the Perpetual Inventory Method (PIM, hereafter) after estimating the initial capital stock, as in Chow (1993) and Chow and Li (2002) (also in Chou 1991; Wu 2000; Chen 2014; Tian 2016). They simultaneously estimate the initial value of capital stock and the depreciation rate. Theoretically, these two

values cannot be estimated simultaneously, so the methodology is problematic. Hence, we have to consider a new approach to solve the issue of initial capital stock.

In the case of China, we have difficulty in using foreign depreciation rates directly, as in Hayashi and Inoue (1991) and Ogawa et al. (1994), which use the U.S. depreciation rate reported by Hulten and Wykoff (1981) to estimate the Marginal *q* for Japan. This would be plausible for a developed country like Japan because capital goods are freely traded, but as China is a developing country, it is unlikely that the depreciation rate is similar to that of the U.S. This is because capital goods cannot be freely traded between the U.S. and China due to the different fixed asset structures. Even within developing countries, depreciation rates in Indonesia, for example, significantly differ between new and old firms because they have different capital goods structures (Schündeln 2013).

(Contribution and structure of this research)

We find that the Total Value of Fixed Assets (TVFA, hereafter) is roughly equivalent to the imputed value of fixed assets of Industrial Enterprises above the Designated Size from 1993 to 2016 in China. Then, we estimate the depreciation rates of China's 37 industrial sectors from 2001 to 2016 by PIM and Depreciation Expense as Accounting Item (DEAI), and compare these two methods. It is proved that the two methods are equivalent under certain conditions. We also perform panel estimations to test whether the profit after tax has a significant impact on the depreciation rate, as predicted by the economic depreciation hypothesis by Hotelling (1925) and Preinreich

(1940). As far as we know, there is no accurate estimate for the depreciation rates of private and state-owned enterprises by industrial sector for China, so these estimated values are helpful for measuring the deprecation rate at the national level and the investment efficiency by industrial sector.

The remainder of the paper is organized as follows. Research questions are presented in Section 2. Section 3 shows the data source and empirical specification. Section 4 presents the estimation results, and Section 5 concludes and discusses the implications of this study.

2 Research questions

2.1 Depreciation rate

As described above, there is no consensus on the estimation method for either the depreciation rate or the series of capital stock, even though these parameters are important for calculating the values of factors such as the total factor productivity for China. The estimation of depreciation by industrial sector in China would indirectly answer how large the upper bound of the depreciation rate would be at the national level. The depreciation rate is also an indispensable parameter for calculating the efficiency of physical capital investment by industrial sector in Qiu and Wan (2018).

2.2 Unknown initial capital stock and its solution

When we estimate capital stock by PIM, as in Chow and Li (2002) and Chow (1993), the initial capital stock and depreciation rate are unknown. Hence, the authors introduce some new measures, such as GDP, and assume that the ratio of the initial

GDP to the initial capital stock is equal to some particular value, and then estimate the capital stock series by circulating both depreciation rate and series of capital stock. It is obvious that this approach is essentially an estimation or a simulation, the reliability of which depends heavily on the validity of the additional assumptions. If the initial capital stock is accurate enough, according to the estimation, the capital stock can be estimated in the same way for every year, so the PIM would be redundant. Thus, the initial capital stock will affect all the results, regarding both the depreciation rate and the capital stock.

To address this issue, we use data that are roughly equivalent to the imputed value of the series of capital stock, then estimate the depreciation rate using both PIM and DEAI.

2.3 Depreciation and enterprise profits after tax

Economic depreciation has been studied for a long time, see Hotelling (1925) and Preinreich (1940). One of the main theoretical results is that the profit of new investment will accelerate depreciation for corporate profit maximization. This is because the profit would be the expected return of new investment, as well as part of the fund resources for new investment. To test this hypothesis empirically, we use panel data from 37 industrial sectors to perform regression analysis.

3 Data and empirical specification

3.1 Data

We collected data from the National Data by the National Bureau of Statistics of China (NBSC, hereafter).[4] The main economic indicators of Industrial Enterprises above the Designated Size by industrial sector, totaling 37 sectors, were downloaded. The statistical methods are different before and after 2000, so we obtained data for the period 2000 - 2016. Data on previous years are necessary for estimation, so only the deprecation rate for 2001-2016 can be estimated. We also use the following formula Eq. (1), from the balance sheet of enterprises, following the Chinese Accounting Standards for Business Enterprises.[5]

$$TVFA_{mt} = OVFA_{mt} - AD_{mt} - IFA_{mt} + DFA_{mt} + Errors_{mt}, \quad (1)$$

where,

$Original\ Value\ of\ Fixed\ Assets_{mt}\ (OVFA_{mt})$: is the cost of fixed assets, or the total expenditure of an enterprise on fixed assets through purchase, construction, installation, transformation, expansion or technical upgrading for industry *m* at time *t*.[6]

$Accumulated\ Depreciation_{mt}\ (AD_{mt})$: is the accumulated figure of fixed asset depreciation over the past few years, extracted by the enterprise at the end of the period for industry *m* at time *t* (also see footnote 6).

$Impairment\ for\ Fixed\ Assets_{mt}\ (IFA_{mt})$: is the recoverable value of the

[4] See details from the official website (http://data.stats.gov.cn/).
[5] See details from the official website (http://kjs.mof.gov.cn/zhuantilanmu/kuaijizhuanzeshishi/index_1.html).
[6] See details from the official website (http://data.stats.gov.cn/english/easyquery.htm?cn=C01).

fixed assets that are lower than the book value for industry *m* at time *t*.[7]

$Disposal\ on\ Fixed\ Assets_{mt}$ (DFA_{mt}): is the value of the fixed assets transferred by the enterprise for reasons such as sale, scrapping, damage, foreign investment, non-monetary asset exchange, debt restructuring, etc., and expenses incurred during the disposal process for industry *m* at time *t*.[8]

$Errors_{mt}$: includes items such as construction in progress for industry *m* at time *t*, which are omitted.

The data from 1992 to 1999 can no longer be downloaded from the official website of the NBSC, but we obtained the China Statistical Yearbook (CSY, hereafter) for these years. TVFA and OVFA for 1992 (CSY 1993, p.425), 1993 (CSY 1994, p. 379), 1994 (CSY 1995, p.389), 1995 (CSY 1996, p.421), 1996 (CSY 1997, p.425), 1997 (CSY 1998, p.445), 1998 (CSY 1999, p.433), 1999 (CSY 2000, p.435). Unfortunately, there is no information on the TVFA for both 1992 and 1999. Our existing database does not contain data on the accumulated depreciation for the period 1992 - 1999, so the depreciation rate during this period cannot be estimated by DEAI.

[7] See details from the official website (http://kjs.mof.gov.cn/zhuantilanmu/kuaijizhuanzeshishi/index_1.html). See Article 2 of the Accounting Standards for Business Enterprises No. 8. Supplement: The original regulation covers not only fixed assets but also all assets; Original regulation: Recoverable value of fixed assets is lower than the book value. This standard is from the Accounting Department of the Ministry of Finance of the People's Republic of China.

[8] See details from the official website (http://upload.news.esnai.com/news/200611238582211884.pdf). See Appendix to the "Accounting Standards for Business – Application Guide." Also see p.61 of Item 1 of the Accounting and Main Accounting Processing. Supplement: When a fixed asset is disposed, the enterprise accountant first extracts the original value of the fixed asset, then extracts the accumulated depreciation and asset impairment, then calculates the residual value of the fixed asset, adds the cost of the disposal of the fixed assets, and finally accounts for the pure losses or the pure profits from the disposal of the fixed assets.

3.2 Data issues and their solution

Before estimating the depreciation rate using the PIM, we need to estimate the size of investment, because the investment size appears in the formula of the depreciation rate and reliable direct data on investment size are not available. The NBSC has published data on the annual fixed asset investment of the whole economy and the fixed assets investment of the sub-industry, while the data cannot be used directly because the statistical standards change frequently.

Before 1998, Industrial Enterprises counted all Independent Accounting of Industrial Enterprises (CSY 1994, p.415). According to the report by the NBSC,[9] from 1998 to 2006, the Above-scale Industries refer to non-state-owned industrial enterprises with annual main business incomes of 5 million yuan or over, as well as all state-owned enterprises nationwide. These standards changed during the period 2007-2010, and the Above-scale Industries refer to industrial enterprises with an annual main business income of at least 5 million yuan (including non-state-owned and the state-owned enterprises). Furthermore, the standards have changed again since 2011, and the Above-scale Industries refer to industrial enterprises with an annual main business income of 20 million yuan or over (including non-state-owned and state-owned enterprises).

Due to the change in statistical standards described above, the depreciation rates in 2007 and 2011 cannot be estimated because data on the previous year (2006 and

[9] See details of Question 17 from the official website (http://www.stats.gov.cn/tjzs/cjwtjd/201311/t20131105_455942.html).

2010) were from different standards, so we use the average value of the estimated results during the period with the same statistical standards to replace the estimated results in 2007 and 2011. That is, the values for 2007 and 2011 are interpolated based on the average values during the period 2008 - 2010 and the period 2012 - 2016, respectively. Due to the lack of statistical data on some items in 1992, 1999 and 2000, we also applied the same method to interpolate the depreciation rate.

3.3 TVFA as the imputed value

Based on the above accounting guidelines, the TVFA should theoretically be close to the imputed value of fixed assets. The devaluation of fixed assets is included in the TVFA. Nevertheless, the profits of disposal of fixed assets are also included in the TVFA, and this includes upvaluation of disposed fixed assets. The undisposed fixed assets may be undervalued if the capital goods are inflated. This did not occur in the case of real prices (adjusted by the Consumer Price Index, CPI) during the sample period because capital goods were deflated compared to inflation in consumer goods. For the period 1993-2016, the average inflation rate of capital goods (Price Index for Investment in Fixed Assets, PIIFA, hereafter, preceding year = 1, data by sector are not available) and consumer goods (CPI, preceding year = 1) was 3.3% and 4.5%, respectively. Therefore, the TVFA should be roughly equivalent to the imputed value of fixed assets.

3.4 Depreciation rate by both PIM and DEAI

PIM is always used to estimate the depreciation rate in the literature. In terms of accounting base, depreciation is counted as an expense item, also called DEAI. For example, depreciation expense is used in Feletham and Ohlson (1996, p.215), and it is called accounting depreciation in Hayashi and Inoue (1991). In the following subsection, we find that PIM includes more data than DEAI in the analysis. Hence, we will perform PIM and DEAI to estimate the depreciation rate, and then analyze the differences between these methods.

The estimation of depreciation rate by PIM was developed by Goldsmith (1951). The basic formula is

$$K_t = (1 - \delta_{pim-t})K_{t-1} + I_t, \quad (2)$$

where capital stock, depreciation rate and investment at time *t* are represented by K_t, $\delta_{\mathrm{pim}-t}$, I_t, respectively. We can obtain the depreciation rate implicitly by transforming Eq. (2) into Eq. (3) as proposed by Hulten and Wykoff (1981)

$$\delta_{pim-t} = \frac{K_{t-1}+I_t-K_t}{K_{t-1}}. \quad (3)$$

The key to estimating the depreciation rate using the PIM is determining how to choose the capital stock ($\mathbb{K}$) and gross investment ($\mathbb{I}_t$). We will use the TVFA (= K) as the capital stock.

Due to the different statistical standards used to calculate the investment data by

the NBSC, we use the OVFA to estimate the gross investment.

$Gross\ Investment_{mt}\ (or\ I_{mt}) = OVFA_{mt} - OVFA_{mt-1}$, and note that, when DFA occurs, the estimated depreciation rate by PIM can be negative. After selecting data on capital stock and gross investment, we need to control for inflation in the estimation of the depreciation rate by PIM. We substitute $\mathbf{PIIFA}$ into Eq. (3) which is then transformed into Eq. (4), as follows,[10]

$$\delta_{pim-mt} = \frac{[TVFA_{mt-1}+(OVFA_{mt}-OVFA_{mt-1})+TVFA_{mt}]\ /\ PIIFA_t}{TVFA_{mt-1}}. \quad (4)$$

Some studies, such as Chow and Li (2002), use the depreciation of fixed assets to estimate the depreciation rate by assuming a value for the initial capital stock. The depreciation of fixed assets is an accounting indicator, and fully follows the accounting depreciation method called DEAI in this paper. We use PIIFA to control for inflation, and then the depreciation rate can be estimated by DEAI, as shown in the following formula:

$$\delta_{deai\_mt} = \frac{[AD_{mt}-AD_{mt-1}]\ /\ PIIFA_t}{TVFA_{mt-1}}, \quad (5)$$

where, δ_{deai_mt} : depreciation rate by DEAI of m industrial at time t, and the depreciation of fixed assets is $AD_{mt} - AD_{mt-1}$. When fixed assets are disposed,

[10] Other terms are omitted because the data are not available.

the AD will decrease, so this difference can be negative.

3.5 Comparing PIM and DEAI

We compare the two methods for estimating the depreciation rate. As the denominators of the two methods (Eq. (4), (5)) are the same, we only need to compare their numerators. By substituting TVFA (=K) into Eq. (3), we obtain the equation for the PIM,

$$\delta_{pim-mt} K_{mt-1} = (AD_{mt} - AD_{mt-1}) + (IFA_{mt} - IFA_{mt-1}) + (DFA_{mt-1} - DFA_{mt}) + (Errors_{mt-1} - Errors_{mt}). \quad (6)$$

It is obvious that the numerator of DEAI in Eq. (5) $(= AD_{mt} - AD_{mt-1})$, is just a part (or item) of the depreciation rate estimated by the PIM in Eq. (6). Estimation of depreciation by PIM includes not only information regarding the depreciation of fixed assets but also the devaluation and upvaluation of fixed assets, etc. We obtain the following relationship between depreciation rate by PIM and the one by DEAI.

Theorem:

Depreciation rate by PIM contains more information than that by DEAI, and they are equivalent under certain condition.

Proof:

By considering inflation, we obtain Eq. (7), as follows, by dividing Eq. (6) by

K_{mt-1},

δ_{pim-mt}

$$= \frac{[(AD_{mt} - AD_{mt-1}) + (IFA_{mt} - IFA_{mt-1}) + (DFA_{mt-1} - DFA_{mt}) + (Errors_{mt-1} - Errors_{mt})]/PIIFA_t}{K_{mt-1}}$$

$$= \delta_{deai\_mt} + \frac{[(IFA_{mt} - IFA_{mt-1}) + (DFA_{mt-1} - DFA_{mt}) + (Errors_{mt-1} - Errors_{mt})]/PIIFA_t}{K_{mt-1}}$$

$$= \delta_{deai\_mt}$$

for $\frac{[(IFA_{mt} - IFA_{mt-1}) + (DFA_{mt-1} - DFA_{mt}) + (Errors_{mt-1} - Errors_{mt})]/PIIFA_t}{K_{mt-1}} = 0.$

(7)

Q.E.D.

The depreciation rate by DEAI (δ_{deai_mt}) is just one component of that by PIM (δ_{pim-mt}). Therefore, estimates of the depreciation rate based on the PIM will include more economic information.

3.6 Regression analysis

To analyze the determinants of the depreciation rate under the predictions of the economic depreciation hypothesis, we consider the following empirical specification:

$$y_{mt} = \alpha_0 + \alpha_1 RTPAT_{mt} + \alpha_2 RTVFA_{mt} + \alpha_3 RSC_{mt} + \tau_m + \rho_t + \varepsilon_{it}, \quad (8)$$

where, y_{mt} is δ_{pim_mt} or δ_{deai_mt}.

δ_{mt}: Depreciation rate by PIM for industrial sector *m*, at time *t*;

δ_{deai_mt}: Depreciation rate by DEAI, defined by $DEAI_{mt}$ / $TVFA_{mt-1}$ of industry *m* at time *t*;

$RTPAT_{mt}$: Total Profits after tax $_{mt}$ / TVFA $_{mt-1}$ for industrial sector *m* at time *t*;[11] to test the economic depreciation hypothesis. We predict that this variable should have a significantly positive impact on the depreciation rate.

$RTVFA_{mt}$: Total Assets $_{mt}$ / TVFA $_{mt-1}$ of industry *m* at time *t*, to capture the industry size effect because the type and structure of capital goods of a big firm may be significantly different to those of a small one.

RSC_{mt}: State Capital $_{mt}$ / Actual Receipt Capital $_{mt-1}$ of industry *m* at time *t*, to capture the potential impact of state-own enterprises, because they may behave differently to private firms.

α_1, α_2, α_3, are coefficients, and α_0 is constant term, while τ_m, ρ_t, and ε_{it}, are error terms for capturing industrial fixed effects, time effects (time trend or dummy by year) and random errors, respectively. We will use a panel estimation method with fixed effects and robust standard errors to obtain the parameters.

4 Empirical results

4.1 Depreciation rate by both PIM and DEAI

[11] As profits are generally earned by selling products, profits here are adjusted by the Producer Price Index (PPI, preceding year = 1).

The depreciation rate of the national total according to the PIM during the period 1993-2016, and by DEAI during 2001-2016, are shown in Figure 1. There are similar time transitions, with almost the same trend. In contrast, the average values of the estimated depreciation rates by both PIM and DEAI during 2001-2016 are shown in Figure 2. These also show almost the same fluctuations and trend.

The results presented here show an upward trend, so do not validate the downward trend in Bai et al. (2006) and Tian (2016).

The depreciation rates of 37 industrial industries estimated by PIM and DEAI during the period 2001-2016 are shown in Table 1a -1d.[12] The average values of the depreciation rate of the national total according to the PIM and DEAI are 0.0677 and 0.0799, respectively. Similar results are obtained by the PIM and DEAI, and the average values of estimated depreciation by sector are 0.0711 and 0.0858, respectively.

From the results presented above, the estimated depreciation rate by DEAI is approximately 1 percent higher than that by PIM. The estimated values are summarized in Table 2. The standard deviation of the depreciation rate by DEAI (0.0896) is 0.7 percent larger than that by PIM (0.0825). As shown in the previous subsection, the calculation of depreciation using the PIM includes more information on investment intermediaries or asset revaluation than that using DEAI. Hence, the depreciation rate by PIM would be more appropriate for use in future studies in economics.

[12] In Table 1a, 1b, and 1d, we use italic and bold characters to indicate the 14 modified estimates obtained by replacing unusually high depreciation rates or outliers.

4.2 Depreciation rate by PIM from 1993 to 2000

Due to data constraints, we cannot use the DEAI to estimate the depreciation rate from 1993 to 2000. However, we can use the PIM to estimate the depreciation rate from 1993 to 2000. The average value of the estimated depreciation rates from 1993 to 1998 is 0.0449, which is close to the average value (0.0539) of the depreciation rate from 1993 to 1998 in Chow and Li (2002). Hence, the depreciation rate estimated by PIM is validated by previous studies.

4.3 Depreciation rate and enterprise profits after tax

The descriptive statistics of the main variables are summarized in Table 2, and the empirical results are summarized in Table 3. We find that the depreciation rate is significantly affected by the enterprise profits after tax. This conclusion is consistent with the predictions of the economic depreciation hypothesis.

5 Conclusion

We find that the TVFA is roughly equivalent to the imputed value of fixed assets of Industrial Enterprises above the Designated Size by industrial sector (totaling 37 sectors) for the period 1993-2016. This TVFA is used to investigate the issue of the initial value of capital stock and estimate the depreciation rate using the PIM and DEAI.

From 2001 to 2016, the average depreciation rates according to these two methods are 0.0677 and 0.0799, respectively, and they exhibit the same trends over time. According to our comparison of these two methods, the PIM contains more information on investment intermediaries, asset revaluation, and other factors, although it is proved that the depreciation rate by PIM is equivalent to the one by DEAI under certain conditions. Hence, the depreciation rate according to the PIM would be more appropriate for applications to studies in economics. Furthermore, because the DEAI is not reported for the period 1993-1999, we only estimate the depreciation rate using the PIM during this period, and the value is close to that of 5.4% reported by Chow and Li (2002).

We also regress the depreciation rates by PIM and DEAI using an industrial panel data set, and find that depreciation rates are significantly affected by enterprise profits after tax. This result is consistent with the predictions of the economic depreciation hypothesis, which insists that depreciation would mainly come from the corporate motive of profit maximization and technological innovation in the life cycle of capital goods.

The estimated value of the depreciation rate in this paper can be used to study return to capital or growth accounting at the national level, and the efficiency of capital stock by industrial sector. In future research, we could use the approach presented here to estimate the depreciation rate and its determinants using data on the 3rd, or service, sector.

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Table 1a: Depreciation rates of the 37 industrial sectors by Perpetual Inventory Method(PIM) and Depreciation Expense as Accounting Item(DEAI), 2001-2016

Year	National Total		Mining and Washing of Coal		Extraction of Petroleum and Natural Gas		Mining and Processing of Ferrous Metal Ores		Mining and Processing of Non-Ferrous Metal Ores		Mining and Processing of Non-metal Ores		***Mining of Other Ores***		Processing of Food from Agricultural Products		Manufacture of Foods		Manufacture of Liquor Beverages and Refined Tea	
	PIM	DEAI	PIM	DEAI	PIM	DEAI	PIM	DEAI	PIM	DEAI	PIM	DEAI	PIM	DEAI	PIM	DEAI	PIM	DEAI	PIM	DEAI
2001	0.0611	0.064	0.0555	0.0668	0.1902	0.1542	0.0214	0.041	0.0796	0.034	0.0238	0.0275	0.1601	0.2045	0.0227	0.0277	0.0245	0.064	0.0408	0.0408
2002	0.0499	0.0535	0.0558	0.0626	0.0633	0.0899	0.0968	0.095	-0.014	0.001	0.0046	0.0208	-0.421	-0.296	0.0164	0.0251	0.0534	0.0441	0.0494	0.0533
2003	0.0575	0.0613	0.0245	0.0502	0.1825	0.1095	0.0942	0.115	0.0075	0.029	0.0099	-0.007	***0.0942***	***0.3811***	0.0167	0.0329	0.0142	0.0344	0.0457	0.0441
2004	0.0442	0.079	-0.005	0.0636	0.1407	0.1866	0.1509	0.186	0.0356	0.02	-0.006	0.0108	-0.017	-0.339	0.0373	0.0495	0.0754	0.0765	0.0469	0.0225
2005	0.0391	0.0717	0.006	0.078	0.0353	0.0734	-0.052	0.028	-0.011	0.042	-0.074	-0.032	0.1028	0.1265	0.0314	0.0567	0.0336	0.0717	0.0367	0.063
2006	0.0601	0.0796	0.0262	0.1025	0.0916	0.1399	-0.002	0.059	0.0084	0.065	0.1469	0.1137	-0.471	-0.477	0.0504	0.0689	0.0654	0.0619	0.0451	0.0628
2007	0.0520	0.0682	0.0272	0.0706	0.1173	0.1256	0.0515	0.0872	0.0176	0.0316	0.0176	0.0224	-0.0919	-0.0667	0.0291	0.0435	0.0444	0.0588	0.0441	0.0477
2008	0.0884	0.1092	0.0704	0.0545	0.029	-0.003	0.0355	0.167	0.0619	0.121	0.1405	0.1589	-0.067	-0.081	0.1214	0.1387	0.0692	0.0972	0.03	0.1325
2009	0.0287	0.0677	0.0611	0.1246	-0.224	0.0481	-0.093	0.012	-0.024	0.023	-0.072	0.0053	***0.3694***	***0.9575***	0.1769	0.2003	0.047	0.0707	0.0838	0.0122
2010	0.119	0.1148	0.0394	0.1344	0.1569	0.0621	0.0669	0.129	0.0498	0.069	0.1498	0.1421	***0.3892***	***0.4193***	0.2237	0.2381	0.134	0.1237	0.0796	0.1176
2011	0.0787	0.0972	0.0570	0.1045	-0.0127	0.0359	0.0030	0.1023	0.0292	0.0711	0.0727	0.1021	0.2305	0.4318	0.1740	0.1924	0.0834	0.0972	0.0645	0.0874
2012	0.0689	0.0804	0.0475	0.0790	-0.0205	-0.0310	0.1002	0.1197	0.0499	0.0873	-0.0218	-0.0029	0.6119	0.6515	0.1683	0.1677	0.0477	0.0482	0.0544	0.0838
2013	0.1146	0.1081	0.0846	0.0912	0.1243	0.1306	0.0871	0.1273	0.0954	0.0972	0.0749	0.1032	-0.7753	-0.7857	0.2840	0.3025	0.1305	0.1433	0.0674	0.0673
2014	0.0783	0.0869	0.0284	0.0655	0.2373	0.2564	0.1561	0.1398	0.0515	0.0530	0.2189	0.2305	-0.1092	-0.0963	0.0256	0.0452	0.0849	0.0871	0.0742	0.0887
2015	0.0505	0.0605	0.0036	0.0217	-0.0602	0.0051	0.0470	0.0600	0.0228	0.0472	-0.1044	-0.0822	0.0177	0.0838	0.0182	0.0296	0.1401	0.1499	0.0642	0.0847
2016	0.0922	0.0767	0.0926	0.0057	0.2117	0.1912	0.0019	-0.0451	0.0632	0.0512	-0.0049	0.0068	0.5591	0.5010	0.0535	0.0373	0.0961	0.0905	0.0645	0.0640
Avg.	0.0677	0.0799	0.0422	0.0735	0.0789	0.0984	0.0478	0.0889	0.0327	0.0526	0.0360	0.0513	0.0364	0.1009	0.0906	0.1035	0.0715	0.0824	0.0557	0.0670

Source: Authors' estimations based on data from the National Data by National Bureau of Statistics of China. http://data.stats.gov.cn/

Table 1b: Depreciation rates of the 37 industrial sectors by Perpetual Inventory Method(PIM) and Depreciation Expense as Accounting Item(DEAI)，2001-2016 (cont.)

Year	Manufacture of Tobacco		Manufacture of Textile		Manufacture of Textile Fabrics Wearing Apparel and Accessories		Manufacture of Leather Fur Feather and Related Products and Footwear		Processing of Timber Manufacture of Wood Bamboo Rattan Palm and Straw Products		Manufacture of Furniture		Manufacture of Paper and Paper Products		Printing Reproduction of Recording Media		***Manufacture of Articles for Culture Education Art and Carfts, Sport and Entertainment Activities***	
	PIM	DEAI	PIM	DEAI	PIM	DEAI	PIM	DEAI	PIM	DEAI	PIM	DEAI	PIM	DEAI	PIM	DEAI	PIM	DEAI
2001	0.0628	0.0848	0.0354	0.0384	0.0470	0.0481	0.0679	0.0604	0.0378	0.0402	0.0636	0.0643	0.0401	0.0441	0.0615	0.1329	0.0655	0.0605
2002	0.0880	0.0667	0.0234	0.0385	0.0244	0.0528	0.0140	0.0299	0.0522	0.0477	0.0598	0.0670	0.0336	0.0504	0.0612	0.0008	0.0848	0.0984
2003	0.0909	0.0846	0.0138	0.0315	0.0205	0.0405	0.0260	0.0581	0.0330	0.0409	0.0383	0.0950	0.0482	0.0469	0.0834	0.1115	0.0815	0.0924
2004	0.0824	0.0873	0.0400	0.0540	0.0488	0.0565	0.0831	0.0744	0.0198	0.0660	0.0418	0.0840	0.0356	0.0714	0.0821	0.0755	0.0905	0.1150
2005	0.0776	0.1009	0.0404	0.0469	0.0447	0.0626	0.0408	0.0687	0.0441	0.0605	0.0828	0.0724	0.0496	0.0530	0.0589	0.0795	0.0353	0.0526
2006	0.0795	0.0804	0.0541	0.0601	0.0767	0.0814	0.0498	0.0731	0.0585	0.0659	0.0570	0.0800	0.0373	0.0617	0.0911	0.0856	0.0534	0.0704
2007	0.0802	0.0841	0.0345	0.0449	0.0437	0.0570	0.0469	0.0608	0.0409	0.0535	0.0572	0.0771	0.0407	0.0546	0.0730	0.0810	0.0685	0.0815
2008	0.2362	0.0690	0.0837	0.0929	0.1333	0.1552	0.0895	0.1136	0.1350	0.1475	0.1121	0.1369	0.0843	0.1032	0.1142	0.1357	0.1259	0.1418
2009	0.0436	0.0973	0.0324	0.0313	0.0299	0.0509	0.0451	0.0498	0.0411	0.0674	0.0529	0.0785	0.0069	0.0424	0.0567	0.0410	0.0347	0.0402
2010	-0.1191	0.0622	0.0897	0.1032	0.0738	0.0718	0.1073	0.1130	0.1417	0.1473	0.1291	0.1145	0.0857	0.0884	0.0897	0.0927	0.0151	0.0504
2011	0.0536	0.0762	0.0686	0.0758	0.0790	0.0926	0.0806	0.0921	0.1059	0.1207	0.0980	0.1099	0.0589	0.0780	0.0869	0.0898	0.0586	0.0775
2012	0.2882	0.0641	0.0381	0.0437	0.2299	0.2764	0.2299	0.2617	0.0971	0.0731	0.1284	0.1174	0.0655	0.0565	0.0941	0.1175	***0.2626***	***0.3015***
2013	0.1042	0.1978	0.1001	0.1073	0.1584	0.1594	0.0754	0.1279	0.1967	0.2054	0.2690	0.2773	-0.0143	-0.0087	0.1982	0.2017	0.1496	0.1521
2014	0.1254	-0.0158	0.0746	0.0753	0.1013	0.0995	0.1518	0.1085	0.1694	0.1766	0.0483	0.0504	0.0517	0.0570	0.1151	0.1135	0.1501	0.1561
2015	-0.0304	0.0800	0.0862	0.0734	0.1026	0.1107	0.0943	0.0818	0.0225	0.0330	0.0466	0.0566	0.0331	0.0306	0.0742	0.0830	0.0974	0.1073
2016	0.0737	0.0563	0.0528	0.0571	0.1230	0.1021	0.1088	0.1006	0.0985	0.0860	0.0260	0.0338	0.0464	0.0367	0.0848	0.0784	0.0928	0.1083
Avg.	0.0835	0.0797	0.0542	0.0609	0.0836	0.0948	0.0820	0.0922	0.0809	0.0895	0.0819	0.0947	0.0440	0.0541	0.0891	0.0950	0.0916	0.1066

Source: Authors' estimations based on data from the National Data by National Bureau of Statistics of China. http://data.stats.gov.cn/

Table 1c: Depreciation rates of the 37 industrial sectors by Perpetual Inventory Method(PIM) and Depreciation Expense as Accounting Item(DEAI)，2001-2016 (cont.)

	Processing of Petroleum and Coking of Nuclear Fuel		Manufacture of Raw Chemical Materials and Chemical Products		Manufacture of Medicines		Manufacture of Chemical Fibers		Manufacture of Rubber and Plastics Products		Manufacture of Non-metallic Mineral Products		Smelting and Pressing of Ferrous Metals		Smelting and Pressing of Non-ferrous Metals		Manufacture of Metal Products		Manufacture of General Purpose Machinery	
	PIM	DEAI	PIM	DEAI	PIM	DEAI	PIM	DEAI	PIM	DEAI	PIM	DEAI	PIM	DEAI	PIM	DEAI	PIM	DEAI	PIM	DEAI
2001	0.072	0.1003	0.0711	0.0461	0.0259	0.051	-0.054	-0.0804	0.0715	0.0584	0.0253	0.0317	0.0656	0.0706	0.0323	0.0493	0.0467	0.0483	0.0479	0.0298
2002	0.0828	0.0506	0.061	0.0555	0.0311	0.0521	0.0744	0.056	0.0474	0.0527	0.0459	0.0453	0.0136	0.0303	0.0306	0.0397	0.0433	0.0617	0.0494	0.0558
2003	0.0366	0.0259	0.0621	0.0703	0.0109	0.0641	-0.029	-0.0242	0.0607	0.0734	0.0354	0.0318	0.0336	0.069	0.0131	0.0528	-0.021	-0.007	0.0533	0.0569
2004	0.0574	0.0801	0.0471	0.0565	0.0713	0.045	0.0213	0.0707	0.0551	0.0801	0.0489	0.0636	0.0216	0.0711	0.0452	0.0672	0.066	0.0556	0.0541	0.08
2005	0.0837	0.1414	0.0145	0.0565	0.0466	0.0857	0.0865	0.0793	0.05	0.0523	0.0262	0.0474	0.0336	0.085	0.0411	0.0797	0.0466	0.0852	0.052	0.069
2006	0.0341	0.0848	0.064	0.0787	0.0713	0.0725	0.0669	0.061	0.068	0.079	0.0594	0.0596	0.0438	0.0694	0.043	0.0552	0.0813	0.0964	0.048	0.0714
2007	0.0611	0.0805	0.0533	0.0606	0.0429	0.0617	0.0277	0.0271	0.0588	0.066	0.0402	0.0466	0.0353	0.0659	0.0342	0.0573	0.0437	0.0567	0.0508	0.0605
2008	0.1134	0.1672	0.102	0.1325	0.0653	0.0996	0.0302	0.016	0.1089	0.1259	0.0894	0.1042	0.0751	0.0941	0.0903	0.106	0.1568	0.1924	0.1758	0.1798
2009	0.0729	0.1005	0.014	0.0569	0.0293	0.0496	-0.001	-0.0113	0.09	0.0811	0.0175	0.0541	0.0541	0.0991	0.0353	0.1142	0.0508	0.0753	0.0079	0.0609
2010	0.1298	0.1067	0.1328	0.1239	0.1059	0.1187	0.0712	0.1043	0.1148	0.125	0.0805	0.0906	0.1657	0.1515	0.1331	0.1032	0.1029	0.122	0.1616	0.1501
2011	0.1054	0.1248	0.0829	0.1044	0.0668	0.0893	0.0334	0.0364	0.1045	0.1107	0.0624	0.083	0.0983	0.1149	0.0863	0.1078	0.1035	0.1299	0.1151	0.1303
2012	-0.001	0.0128	0.093	0.1177	0.0461	0.0929	-0.004	0.021	0.0414	0.0615	0.1229	0.1357	0.0878	0.1209	0.0379	0.0552	0.1909	0.213	0.0126	0.0024
2013	0.1823	0.1258	0.14	0.1201	0.182	0.185	0.0669	0.0882	0.1473	0.1574	0.0786	0.0776	0.1088	0.0889	0.0745	0.0902	0.1008	0.1067	0.1347	0.139
2014	0.072	0.0707	0.0637	0.0775	0.1039	0.1011	0.0702	0.0452	0.0864	0.0719	0.089	0.0874	0.0398	0.0233	0.0733	0.08	0.0691	0.1068	0.1043	0.1033
2015	0.0754	0.0722	0.0439	0.0566	0.068	0.0824	0.1058	0.1253	0.0776	0.0839	0.0407	0.0594	-0.013	0.0159	0.0472	0.048	0.0837	0.056	0.0525	0.0476
2016	-0.0225	0.0642	0.0773	0.0606	0.0511	0.0733	0.1653	0.1270	0.0440	0.0308	0.0882	0.0724	0.0634	0.0276	0.0841	0.0525	0.1229	0.1071	0.0275	0.0359
Avg.	0.0722	0.0880	0.0702	0.0797	0.0637	0.0828	0.0457	0.0464	0.0766	0.0819	0.0594	0.0681	0.0579	0.0749	0.0563	0.0724	0.0805	0.0942	0.0717	0.0795

Source: Authors' estimations based on data from the National Data by National Bureau of Statistics of China. http://data.stats.gov.cn/

Table 1d: Depreciation rates of the 37 industrial sectors by Perpetual Inventory Method(PIM) and Depreciation Expense as Accounting Item(DEAI)，2001-2016 (cont.)

Year	Manufacture of Special Purpose Machinery		Manufacture of Automobiles，Railway Vessel Aerospaceand Other Transport Equipments		Manufacture of Electrical Machinery and Equipment		Manufacture of Communication Equipment Computers and Other Electronic Equipment		Manufacture of Measuring Instruments and Machinery		***Utiliztion of Waste Resources***		Production and Supply of Electric Power and Heat Power		Production and Supply of Gas		Production and Supply of Water		Transition of average depreciation of 37 industrial sectors	
	PIM	DEAI	PIM	DEAI	PIM	DEAI	PIM	DEAI	PIM	DEAI	PIM	DEAI	PIM	DEAI	PIM	DEAI	PIM	DEAI	PIM	DEAI
2001	0.0433	0.0258	0.0511	0.0713	0.0682	0.0717	0.1047	0.0944	0.0596	0.0682			0.0672	0.0815	0.004	0.0113	0.0586	0.0539	0.0562	0.0606
2002	0.0224	0.0186	0.0557	0.0417	0.0494	0.0525	0.0721	0.1106	0.0537	0.0483			0.0629	0.0599	0.0591	0.0566	0.0392	0.0615	0.0358	0.0431
2003	0.0642	0.1418	0.0468	0.0758	0.0383	0.0614	0.1229	0.1071	0.0611	0.1064			0.095	0.0791	0.0009	0.065	0.0324	0.0599	0.0472	0.0711
2004	0.0446	0.0247	0.016	0.0634	0.0522	0.0679	0.0771	0.1237	0.0948	0.0643	***0.1386***	***0.1864***	0.0279	0.0908	0.0775	0.0778	0.0109	0.0778	0.0556	0.0672
2005	0.0009	0.0364	0.0819	0.092	0.033	0.0742	0.1072	0.1214	0.0291	0.0731	0.1693	0.1847	0.0301	0.0684	0.0002	0.0452	0.0257	0.0422	0.0427	0.0728
2006	0.0565	0.0709	0.0314	0.0748	0.0763	0.0761	0.1146	0.1132	0.0886	0.1125	***0.0504***	***0.0704***	0.0648	0.0794	0.0165	0.0464	0.0701	0.0727	0.0467	0.0643
2007	0.0386	0.0531	0.0472	0.0698	0.0529	0.0673	0.0998	0.1117	0.0645	0.0788	0.1194	0.1472	0.0580	0.0765	0.0264	0.0504	0.0395	0.0613	0.0483	0.0644
2008	0.1454	0.1987	0.0557	0.1054	0.1521	0.2017	0.1404	0.1653	0.0881	0.1046	***0.1715***	***0.1579***	0.0706	0.0949	0.0396	0.0612	0.079	0.1015	0.0985	0.1189
2009	0.0263	0.0432	0.0308	0.0729	0.0492	0.0925	0.1173	0.0988	0.0869	0.0974	0.0142	0.0738	0.0256	0.0448	0.0341	0.0658	-0.003	0.0124	0.0392	0.0892
2010	0.1276	0.1402	0.1346	0.1604	0.1141	0.125	0.158	0.1753	0.1057	0.1391	0.1928	0.205	0.1074	0.0809	0.0827	0.0903	0.0815	0.0594	0.1169	0.1288
2011	0.0998	0.1274	0.0737	0.1129	0.1052	0.1398	0.1386	0.1465	0.0936	0.1137	0.1262	0.1456	0.0679	0.0735	0.0521	0.0724	0.0526	0.0578	0.0848	0.1123
2012	0.1519	0.1300	0.0602	0.0357	-0.0297	-0.0434	0.1392	0.1319	-0.0624	-0.0792	0.2715	0.2706	0.0483	0.0702	0.0411	0.0820	0.0577	0.0596	0.1039	0.1104
2013	0.1063	0.1199	0.1214	0.0995	0.1277	0.1323	0.1693	0.1623	0.1277	0.1204	0.3397	0.4028	0.0862	0.0646	0.0642	0.0245	0.0539	0.0653	0.1064	0.1129
2014	0.0968	0.1010	0.0631	0.0760	0.0629	0.0588	0.1302	0.1354	0.1205	0.1564	0.2697	0.2536	0.0605	0.0904	0.0590	0.0643	0.0726	0.0473	0.0957	0.0954
2015	0.0427	0.0435	0.1076	0.0924	0.1051	0.1075	0.0369	0.0323	0.0715	0.0299	0.2197	0.3438	0.0765	0.0807	0.0871	0.0931	0.0799	0.0858	0.0577	0.0722
2016	0.0642	0.0578	0.0888	0.1124	0.1178	0.1063	0.2698	0.2635	0.1505	0.1026	0.2417	0.1669	0.1000	0.0768	0.0656	0.0338	0.0635	0.0653	0.1027	0.0885
Avg.	0.0707	0.0833	0.0666	0.0848	0.0734	0.0870	0.1249	0.1308	0.0771	0.0835	0.1788	0.2007	0.0655	0.0758	0.0444	0.0587	0.0509	0.0615	0.0711	0.0858

Source: Authors' estimations based on data from the National Data by National Bureau of Statistics of China. http://data.stats.gov.cn/

Table 2: Summary statistics of 37 industrial sectors, 2001-2016 Varibale Obs Median

Variable	Obs	Median	Mean	Std. Dev.	Min	Max
Depreciation Rate by Perpetual Inventory Method $_{(t)}$	589	0.0629	0.0698	0.0825	-0.7753	0.6119
Depreciation Expense as Accounting Item $_{(t)}$ / Total Value of Fixed Assets $_{(t-1)}$	589	0.0735	0.0837	0.0896	-0.7857	0.9575
Total Profits After Tax $_{(t)}$ / Total Value of Fixed Assets $_{(t-1)}$	589	0.1811	0.1996	0.1415	-0.1642	0.9102
Total Value of Fixed Assets $_{(t)}$ / Total Assets $_{(t)}$	589	0.3632	0.3831	0.1212	0.1458	0.7853
State Capital $_{(t)}$ / Actual Receipt Capital $_{(t)}$	589	0.1188	0.2045	0.2079	0.0016	0.9621
Year	589	2009	2008.533	4.6016	2001	2016

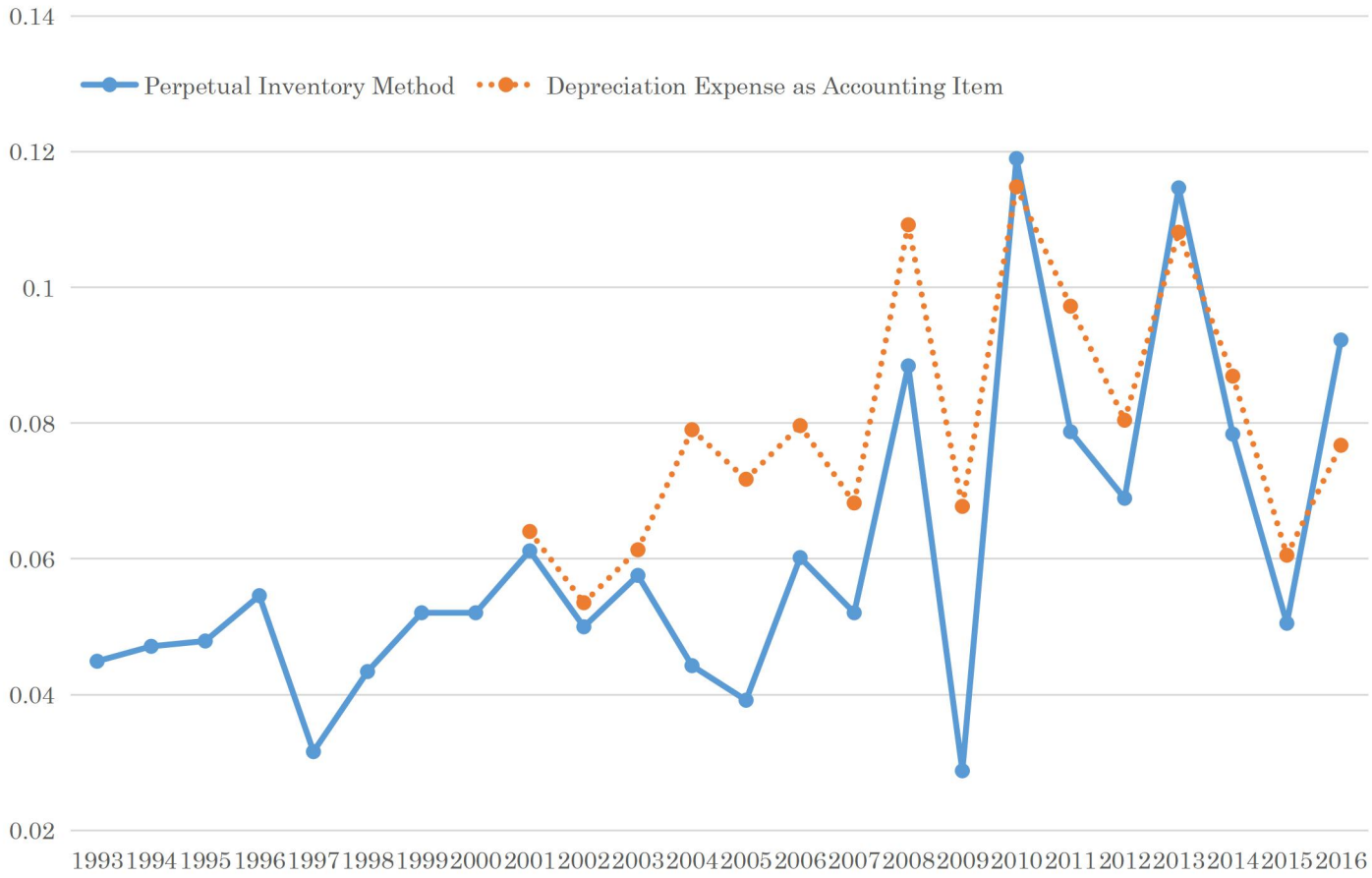
Source: Authors' estimations based on data from the National Data by National Bureau of Statistics of China. http://data.stats.gov.cn/

Table 3: Determinants of depreciation rate by Perpetual Inventory Method and Depreciation Expense as Accounting Item of 37 industrial sectors, 2001-2016 (Panel estimation with fixed effect and robust standard errors (FE))

Independent Variables	Dependent Variable = Depreciation Rate by Perpetual Inventory Method (t)			Dependent Variable = Depreciation Expense as Accounting Item (t) / Total Value of Fixed Assets (t-1)		
Total Profits After Tax $_{(t)}$ / Total Value of Fixed Assets $_{(t-1)}$	0.1415 **	0.1732 ***	0.1414 **	0.2471 ***	0.2941 ***	0.2498 ***
	(0.0578)	(0.0554)	(0.0547)	(0.0826)	(0.0901)	(0.0805)
Total Value of Fixed Assets $_{(t)}$ / Total Assets $_{(t)}$		0.0467	0.0632		0.1971 *	0.1881 **
		(0.0528)	(0.0462)		(0.0989)	(0.0851)
State Capital $_{(t)}$ / Actual Receipt Capital $_{(t)}$		0.1022 **	0.1029		0.1130	0.1558
		(0.0480)	(0.0631)		(0.0806)	(0.0933)
Constant	-4.5772 ***	-6.954 ***	-0.0202	-0.6241	-4.821 *	-0.0985
	(1.1734)	(2.1304)	(0.0347)	(1.6072)	(2.6368)	(0.0628)
Year（Trend）	0.0023 ***	0.0035 ***		0.0003	0.0024 *	
	(0.0006)	(0.0010)		(0.0008)	(0.0013)	
Year 2001 (Dropped)						
Year2002			-0.0175			-0.0135
			(0.0159)			(0.0129)
Year2003			-0.0088			0.0099
			(0.0068)			(0.0059)
Year2004			0.0020			0.0109
			(0.0087)			(0.0095)
Year2005			-0.0085			0.019 **
			(0.0111)			(0.0089)
Year2006			-0.0048			0.0109
			(0.0138)			(0.0100)
Year2007			-0.0054			0.0073
			(0.0090)			(0.0070)
Year2008			0.044 ***			0.0608 ***
			(0.0132)			(0.0101)
Year2009			-0.0119			0.0345
			(0.0225)			(0.0334)
Year2010			0.0578 ***			0.0642 ***
			(0.0166)			(0.0160)
Year2011			0.0297 *			0.0544 ***
			(0.0155)			(0.0182)
Year2012			0.0438			0.0457 *
			(0.0261)			(0.0254)
Year2013			0.0473 *			0.0508 *
			(0.0263)			(0.0257)
Year2014			0.041 ***			0.0397 ***
			(0.0126)			(0.0127)
Year2015			0.0048			0.0198
			(0.0150)			(0.0154)
Year2016			0.049 **			0.0382 *
			(0.0202)			(0.0212)
Observations	589	589	589	589	589	589
R-squared	0.0741	0.0886	0.1443	0.0872	0.1096	0.1426
Number of id	37	37	37	37	37	37

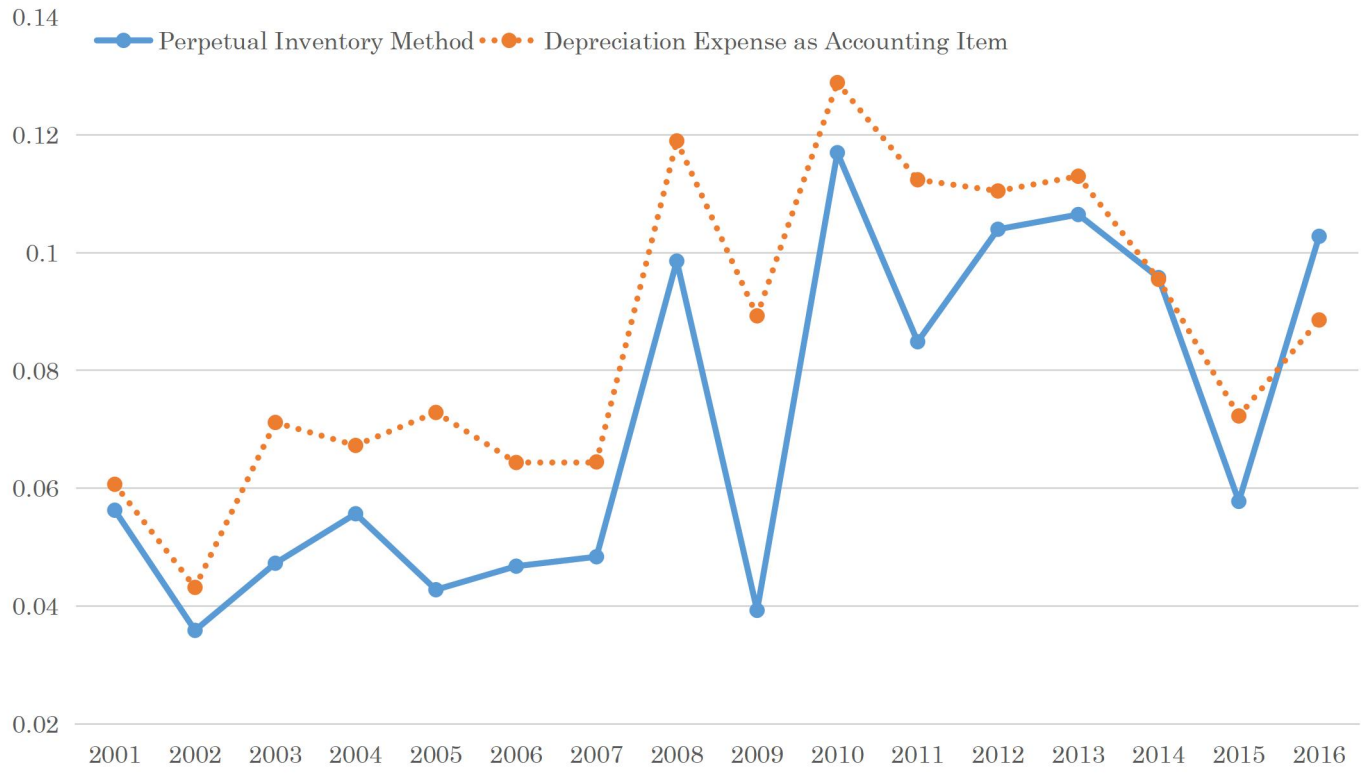
Note: Robust standard errors in parentheses (FE), *** p<0.01, ** p<0.05, * p<0.1.

Figure 1: Deprecation rate of national total calculated by Perpetual Inventory Method for the period 1993-2016，and by Depreciation Expense as Accounting Item for the period 2001-2016



Source: Authors' estimations based on data from the National Data by National Bureau of Statistics of China. http://data.stats.gov.cn/

Figure 2: The transition of the average depreciation rate according to the Perpetual Inventory Method and Depreciation Expense as Accounting Item of 37 industries for the period 2001-2016



Source: Authors' estimations based on data from the National Data by National Bureau of Statistics of China. http://data.stats.gov.cn/