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ASYMMETRIC INVESTMENT RATES

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ABSTRACT

Integrating national accounting with financial accounting, we provide firm-specific estimates of current-cost capital stocks for the entire Compustat universe, as well as an array of estimates of investment flows, economic depreciation rates, and capital and investment price deflators. The firm-level current-cost investment rate distribution is heavily right-skewed, with a small fraction of negative investment rates, 5.51%, but a huge fraction of positive investment rates, 91.64%. Despite a tiny fraction of inactive investment rates, 2.85%, firm-level investment also seems lumpy, featuring a fraction of 32.66% for positive spikes (investment rates higher than 20%). For a typical firm, 39% of total investment is completed within 20% of the sample years.

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1 Introduction

How to measure the investment rate? While largely settled at the aggregate level, as exemplified by the fixed assets accounts at Bureau of Economic Analysis (BEA), this seemingly simple problem remains a serious challenge at the firm level. A meta-analysis of the published literature from 2000 onward at top-five finance journals identifies 347 articles that contain 393 appearances of 40 different firm-level investment rates (mostly based on Compustat).[1] Across the 40 measures, the mean varies wildly from 3.38% per annum to 64.03%, the cross-sectional standard deviation from 7.13% to 128.63%, the skewness from 1.48 to 4.49, and the serial correlation from 0.14 to 0.66 (Figure 1). The giant mess of 40 different investment rates cries out for more scientifically accurate measurement.

We strive to measure accurately the firm-level investment rate by integrating economic accounting in national accounts with financial accounting in Compustat. The centerpiece of our data infrastructure is the construction of firm-specific current-cost capital stocks (the replacement costs) via perpetual inventory method. We measure investment flows as the change in net property, plant, and equipment (PPE) plus accounting depreciation. Expanding on Hayashi and Inoue (1991), we show that this investment measure likely outperforms other, more popular choices (such as capital expenditure), given a myriad of data limitations in Compustat. We calculate industry-specific capital and investment price deflators as well as economic depreciation rates based on the BEA data and assign them to all the firms within a given industry. As an important byproduct, we develop a meticulous mapping between Compustat firms and NAICS industry classification, while converting different versions of SIC codes into NAICS codes prior to June 1985.

In our 1963–2020 working sample that contains 169,828 firm-years drawn from Compustat, the current-cost investment rate (change in net PPE plus accounting depreciation scaled by current-cost capital) has an average of 23.84% per annum, which is much higher than the median of 13.03%. The cross-sectional standard deviation is 37.2%, and the serial correlation 0.34. The basic moments

[1] The top-five finance journals include Journal of Finance, Journal of Financial Economics, Review of Financial Studies, Journal of Financial and Quantitative Analysis, and Review of Finance.

for the historical-cost investment rate (change in net PPE plus accounting depreciation scaled by net PPE) differ drastically. The average is 40.27%, the median 22.78%, the standard deviation 62.9%, all of which are about 70–75% higher than their current-cost counterparts. However, the serial correlation is lower, 0.25. Relatedly, the ratio of current-cost to historical-cost capital is on average 2.11, with a median of 1.61, a standard deviation of 1.79, and a skewness of 3.58.

We trace the differences between current- and historical-cost capital stocks to the differences between economic and accounting depreciation rates. Capital and investment price adjustment plays only a secondary role. The economic depreciation rate has a mean of 6.9% per annum, a standard deviation of 1.96%, a 5th percentile of 3.69%, and a 95th percentile of 10.69%, all of which differ drastically from their accounting counterparts, 20.94%, 16.65%, 4.75%, and 50.69%, respectively.

The firm-level current-cost investment rate distribution is heavily right-skewed, with a small fraction of negative investment rates (below −1%), 5.51%, a long right tail, a skewness of 3.33, and an excess kurtosis of 14.28. The fraction of inactive investment rates (between −1% and 1%) is tiny, 2.85%. The asymmetry between the small fraction of negative rates, 5.51%, and the huge fraction of positive investment rates (above 1%), 91.64%, strongly indicates costly reversibility.[2]

The asymmetric firm-level investment rate distribution is robust to sample periods, the exclusion of firm-years with large mergers and acquisitions, in which the difference between our investment measure and capital expenditure is higher than 15% of a firm's current-cost capital, and the removal of the first three years of observations for a given firm. The asymmetry is also present in both the small- and big-firm subsamples split by the median NYSE market equity (and current-cost capital), as well as in 19 nonfinancial NAICS sectors and 58 nonfinancial private industries.

The firm-level asymmetry evidence is even stronger than the prior plant-level evidence (Cooper and Haltiwanger 2006). The firm-level fraction of negative investment rates is smaller, 5.51% versus 10.4%, and the fraction of inactive investment rates is also smaller, 2.85% versus 8.1%, yielding

[2]Our definition of negative investment rates (below −1%), inactive investment rates (between −1% and 1%), and positive investment rates (above 1%) follows exactly the definition of Cooper and Haltiwanger (2006).

a larger fraction of positive investment rates, 91.64% versus 81.5%. Sampling criteria likely play a role. Cooper and Haltiwanger include only relatively large manufacturing plants in continuous operations throughout their 1972–1988 sample. In contrast, we include firms in different industries (not just manufacturing), with no restrictions on size or age. In addition, aggregation from plants to firms also likely reduces the fractions of negative and inactive investment rates.

Despite the tiny fraction of inactive investment rates, 2.85%, firm-level investment is lumpy. With the Cooper-Haltiwanger (2006) cutoff of 20% for positive investment spikes, the spike rate is 32.66% in our sample, which is even higher than their estimate of 18.6% at the plant level. In addition, we extend Doms and Dunne's (1998) classic, plant-level tests to the firm level. To ease comparison with their balanced panel of plants, we split our unbalanced Compustat panel of firms by decade. For each decade, we include only firms with a complete coverage to yield a balanced panel. We show that averaged across six decades, about 39% of total investment is completed within just two years (20% of the sample years). For comparison, Doms and Dunne show that about 50% of total investment is done within three out of 16 years (about 20%) in their sample.

Our data infrastructure represents a major step forward in firm-level economic measurement. Another meta-analysis covers 33 studies that apply the perpetual inventory method at the firm level, starting from Lindenberg and Ross (1981). Only ten out of the 33 are published from 2000 onward at the top-five finance journals. We innovate on the prior attempts in several ways. First, most studies use small samples with only manufacturing firms. For example, building on Salinger and Summers (1983), Whited (1992) draws 325 manufacturing firms. Abel and Eberly (2001) work with about 12,000 firm-years in the 1974–1993 sample (about 600 firms per year). We instead work with the entire Compustat universe with standard sample criteria in empirical finance.

Second, most studies use capital expenditure as investment. Although our measure first appears in Hayashi and Inoue (1991), its usage is by no means standard. Third, most studies only use a single, aggregate series of implicit price deflator for fixed nonresidential investment to adjust for inflation. We instead use the BEA's industry-specific capital and investment price deflators. Finally, many studies estimate firm-specific (but constant) economic depreciation rates with the Salinger-Summers (1983) double declining-balance method. However, BEA (2003) shows the declining-balance rate to be significantly below two. We instead work with the BEA's industry-specific (and time-varying) economic depreciation rates and assign them to all the firms within an industry.[3]

Initiated by Arrow (1968), a prominent theoretical literature on costly reversibility has long established in the real options framework (Bernanke 1983; McDonald and Siegel 1986; Dixit and Pindyck 1994) and the neoclassical q-theory of investment (Abel 1983; Abel and Eberly 1994, 1996). Most evidence is from plant-level studies on manufacturing plants from the Census Bureau's Longitudinal Research Database (Caballero, Engel, and Haltiwanger 1995; Doms and Dunne 1998; Cooper and Haltiwanger 2006). A few studies offer direct firm-level evidence but only on very small samples.[4] We provide large-sample, albeit indirect, evidence for the entire Compustat universe.

Our data infrastructure is likely of broad interest. The investment rate is a central variable in corporate finance and, increasingly, in asset pricing as well. Empirically, with a more accurate investment rate measure in place, one can reexamine many established results on investment and other corporate decisions in the prior literature. Theoretically, our investment rate moments can guide the calibration and development of quantitative models in corporate finance and asset pricing. Finally, for macroeconomists, our data infrastructure is also of interest because the Census Bureau has stopped collecting relevant data such as capital retirements since the late 1980s. Compustat is one of very few micro-level datasets on which one can apply the perpetual inventory method.

[3]Chirinko and Schaller (2009) use the BEA data to compute sector-specific investment price deflators by dividing current-cost investments by chained-dollar investments (based on chain-type quantities of investments) and calculate sector-specific economic depreciation rates by dividing chained-dollar depreciation by chained-dollar capital. However, the resulting real quantities are in chained dollars, which, due to their nonadditivity (Landefeld, Moulton, and Vojtech 2003), violate the capital accumulation equation. Finally, Chirinko and Schaller construct sector-level (not industry-level) price deflators and depreciation rates and do not distinguish price deflators between capital and investment.

[4]Pulvino (1998) shows that financially constrained airliners receive lower prices when selling used aircraft and are more likely to sell to industry outsiders than unconstrained airlines. Ramey and Shapiro (2001) use equipment-level data from aerospace plants that closed in the 1990s and estimate the average market value of equipment to be only 28 cents per dollar of replacement costs. Gavazza (2011) examines commercial aircraft markets and shows that assets with a thinner market are more costly to sell, and firms hold on longer to less productive assets.

The rest of the article is organized as follows. Section 2 briefly reviews the national accounting literature, conducts a meta-analysis on prior investment rate measures in Compustat, and surveys prior attempts to apply the perpetual inventory method at the firm level. Section 3 details our construction of firm-specific current-cost capital stocks. Section 4 presents our empirical results. Finally, Section 5 concludes. A separate Internet Appendix furnishes supplementary results.

2 A Meta-Study of Investment Rates

We conduct a meta-study on investment rates to motivate our massive data work.

2.1 Economic Accounting in National Accounts

We sketch the essential elements of economic accounting for fixed assets in the U.S. National Income and Product Accounts. We only cover the basic ideas, while leaving the technical details to the original sources that we cite. We also document the basic properties of aggregate, sector, and industry investment rates. Finally, we review the main findings on plant-level investment rates.

2.1.1 A Primer on National Accounts

In the U.S. national accounts, aggregate capital is based on a top-down supply-side approach (BEA 2003; Becker et al. 2006). BEA obtains the domestic supply of each capital good from production data of capital goods producing industries. Capital purchases by government and consumers are deducted to obtain gross investment flows by asset class. To form capital stocks by asset class, BEA applies the perpetual inventory method (PIM) on gross investment series, depreciation profiles, and investment price deflators (mostly Producer Price Indexes from Bureau of Labor Statistics, BLS).

BEA derives investment flows from five major data sources: (i) economic censuses from the Census Bureau, which provide establishment-level capital expenditures; (ii) the BEA's capital flow tables as part of the input-output accounts, which provide distributions of industry investment flows by asset class; (iii) the Census Bureau's Annual Survey of Manufactures (ASM), which provides equipment and structure investments for manufacturing establishments; (iv) the Census Bureau's plant and equipment expenditures (P&E) survey, which provides nonresidential investment data for nonfarm businesses (discontinued in 1993); and (v) the Census Bureau's Annual Capital Expenditures Survey (ACES), which provides data on equipment and structure investments for private nonfarm businesses (from 1994 onward). While the top-down approach works well for aggregates, it is more challenging at the industry-asset level. Distributing investment totals by asset type across industries is based on strong assumptions on the employment-capital relation, especially for equipment investments (Meade, Rzeznik, and Robinson-Smith 2003; Becker et al. 2006).

For most asset types, BEA uses geometric depreciation rates because geometric, rather than straight-line, patterns more closely approximate actual profiles of used capital price declines in the data (Hulten and Wykoff 1981a, 1981b; Fraumeni 1997). The geometric depreciation rates are determined by dividing the declining-balance rate for each asset by its estimated service life. The declining-balance rate is estimated on average to be significantly less than the double declining-balance rate. In contrast, the double declining-balance rate is often assumed in empirical studies that apply the PIM to measure firm-level capital stocks (Salinger and Summers 1983).

BEA provides current-cost and real-cost estimates of investment, depreciation, and capital stock. Current-cost capital is the replacement value of capital stock, which is the market value of its assets to be bought or sold in a given year. Constant-dollar investments are obtained by deflating current-dollar investments with appropriate price indexes for the assets for each year. Depreciation is estimated by applying assumed depreciation rates to constant-dollar investment series. Constant-dollar capital stocks are derived by deducting depreciation from the constant-dollar investment series, both summed over all years. The constant-dollar estimates are then multiplied by the appropriate price indexes of the current year to obtain current-dollar estimates.

The detailed constant-dollar estimates for each asset type are exactly the real-cost estimates. Aggregating real-cost estimates of net stocks of different asset types within a given industry requires the weighting of the detailed constant-dollar estimates. BEA provides two real-cost estimates. The standard tables contain chain-type quantity indexes, which apply a Fisher formula with the price weights from adjacent years to pin down the annual growth rates in quantities.[5] The detailed tables contain fix-weighted constant-dollar estimates.[6] In the Fisher index, the weights reflect the composition of prices in adjacent years, rather than the weights of a single base year as in the fix-weighted constant-dollar estimates. When the base year is updated, the levels of chain-type quantities change, but their growth rates remain unchanged. In contrast, the growth rates of fix-weighted estimates change with the base year (Landefeld, Moulton, and Vojtech 2003).

BEA also provides historical-cost estimates of capital stock. The historical-cost net stock is analogous to net PPE on company financial statements. Assets are valued at the prevailing prices when first purchased. BEA derives historical-cost net stocks by subtracting historical-cost depreciation from the historical-cost investment series, summed over all years. However, differing from financial accounting, BEA has adopted geometric (rather than straight-line) depreciation patterns in its historical-cost estimates since 1997 (Fraumeni 1997).

2.1.2 The BEA's Aggregate, Sector, and Industry Investment Rates

To provide an economic benchmark with which we compare firm-level investment rates, we document the basic properties of aggregate, sector, and industry investment rates from the BEA. From the detailed tables for 63 private NAICS-industries from the BEA's fixed assets accounts, we obtain: (i) current-cost investments in private nonresidential equipment, $I_{jt}^{\mathcal{E}\$}$, and structure, $I_{jt}^{\mathcal{S}\$}$, by industry, millions of dollars, annual, 1947–2020; and (ii) current-cost capital stocks in private nonresidential equipment, $K_{jt}^{\mathcal{E}\$}$, and structure, $K_{jt}^{\mathcal{S}\$}$, by industry, millions of dollars, annual, 1947–2020.

For industry j in year t, we calculate its current-cost investment rate as $I_{jt}^{\$}/K_{jt-1}^{\$} = (I_{jt}^{\mathcal{E}\$} + I_{jt}^{\mathcal{S}\$})/(K_{jt-1}^{\mathcal{E}\$} + K_{jt-1}^{\mathcal{S}\$})$. We calculate current-cost investment rates for the 20 BEA sectors by summing up investments and capital stocks across all industries within each sector, i.e., for sector s in year t, we calculate its current-cost investment rate as $I_{st}^{\$}/K_{st-1}^{\$} =$

[5] The standard tables are at https://apps.bea.gov/iTable/iTable.cfm?ReqID=10&step=2 (as of April 2022).
[6] The detailed tables are at https://apps.bea.gov/national/FA2004/Details/Index.htm (as of April 2022).

$(\sum_{j\in s} I_{jt}^{\mathcal{E}\$} + \sum_{j\in s} I_{jt}^{\mathcal{S}\$})/(\sum_{j\in s} K_{jt-1}^{\mathcal{E}\$} + \sum_{j\in s} K_{jt-1}^{\mathcal{S}\$})$. Analogously, we calculate the aggregate current-cost investment rate as $I_t^{\$}/K_{t-1}^{\$} = (\sum_j I_{jt}^{\mathcal{E}\$} + \sum_j I_{jt}^{\mathcal{S}\$})/(\sum_j K_{jt-1}^{\mathcal{E}\$} + \sum_j K_{jt-1}^{\mathcal{S}\$})$.

Table 1 shows that the aggregate investment rate is on average 9.63% per annum in the 1963–2020 sample, with a standard deviation of 1.27%. We start the sample in 1963 to ease comparison with the Compustat sample that starts in 1963.[7] The aggregate investment rate distribution is close to normal, with tiny skewness and excess kurtosis. The investment rate moves within a relatively narrow range from 6.6% to 12.1%, with a high serial correlation of 0.83 (Panel A of Figure 2).

The investment rate distribution already shows a skewness of 1.06 at the sector level and 1.61 at the industry level. The histograms in Panels C and D of Figure 2 confirm the asymmetry. In particular, in the 1963–2020 sample all industry investment rates are positive. The minimum investment rate is 0.22% for funds, trusts, and other financial vehicles in 2013. (The 1948–2020 sample has only one negative investment rate, −0.08%, for transit and ground passenger transportation in 1958.)

The investment rate shows substantial inter-industry heterogeneity. The mean investment rate varies from 2.5% for railroad transportation to 27% for information and data processing services, whereas the standard deviation ranges from 0.8% for railroad transportation to 12.6% for securities, commodity contracts, and investments. The standard deviation in pooled industry-years is 6.1%.

2.1.3 Plant-level Investment Rates

The only data source on capital stocks and investment flows at the plant level is the Longitudinal Research Database (LRD) at the Center for Economics Studies at the Census Bureau. The LRD is based on longitudinally linking the ASM establishment-level data.

Becker et al. (2006) highlight practical difficulties with the PIM at the plant level. First, available from 1972 onward, the ASM data are left-censored for businesses that exist in 1972. The ASM sample also rotates once every five years. Only large establishments are sampled with certainty

[7] The aggregate, sector, and industry investment rates in the 1948–2020 BEA sample yield quantitatively similar results, as detailed in Table S1 and Figure S1 in the Internet Appendix.

across panels. For small establishments, the data are left-censored in the first year of a 5-year panel and right-censored in the fifth year. Because the first years of observations are not the first years of operation, how to initialize the first capital stocks becomes an important issue. A common approach is to use a plant's first book value, with and without adjusting for its industry's book value-to-capital stock ratio from the BEA. Using the unadjusted book value implicitly assumes that it equals the replacement cost, while using the adjusted book value induces measurement errors for plants within the same industry but with different assets and vintages.[8]

Second, because the detailed assets data are not available at the plant level, plant-specific investment price deflators and depreciation rates are not available either. Consequently, using industry-level price deflators and depreciation rates, while correcting for asset mix heterogeneity at the industry level, induces measurement errors due to inter-plant heterogeneity within a given industry.

Building on Caballero, Engel, and Haltiwanger (1995), Cooper and Haltiwanger (2006) draw a balanced panel with 7,000 large manufacturing plants in continuous operation in the 1972–1988 sample from up to 360,000 plants in the LRD. The sample ends in 1988 because the ASM stops collecting data on capital retirements in 1987. Since 1987, the ASM only collects the book value in economic census years (ending in 2 or 7). Investment is real gross expenditures minus real gross retirements of capital equipment. The initial capital in 1972 is the book value deflated by the 2-digit SIC-industry ratio of current-dollar book value to constant-dollar capital stock. Current-dollar investment is converted to constant-dollar with 4-digit SIC-industry capital deflators from NBER-CES manufacturing industry database. Capital depreciates at the BEA's 2-digit SIC-industry depreciation rates.

Cooper and Haltiwanger (2006) emphasize a "striking asymmetry between positive and negative investment" as the most important feature of the plant-level investment rate distribution (p. 614). The distribution is highly skewed to the right, with a fraction of 10.4% for observations with negative investment rates (less than −1%), 8.1% for inactive investment rates (less than 1% in ab-

[8]Initializing aggregate capital stocks is essentially a nonissue because the investment series are long. Data on nonresidential structures date back to 1832–1889, and data on various equipment series to 1877–1917 (Hulten 1991).

solute value), and 81.5% for positive investment rates (higher than 1%). Also, the investment rates spike above 20% in 18.6% of the observations but fall below −20% in only 1.8% of the observations. The serial correlation of the investment rates is low, only 5.8%. Despite a mean investment rate of 12.2%, the cross-sectional standard deviation is 33.7%, which indicates substantial heterogeneity.

While Cooper and Haltiwanger (2006) emphasize the asymmetry of the investment rate distribution, Doms and Dunne (1998) highlight its lumpiness. In the same 1972–1988 period, Doms and Dunne draw a balanced panel of 13,702 manufacturing plants from the LRD. For each plant, Doms and Dunne calculate a time series of the proportion of investment made in each year out of the total investment in the entire sample. The largest investment episode accounts for on average 24.5% of a plant's total investment, the second largest accounts for 14.7%, and the third largest 10.9%. As such, about one half of total investment is completed in just three years.

2.2 Firm-level Investment Rates in Compustat

We conduct a meta-analysis on firm-level investment rates in Compustat in the prior literature.[9]

2.2.1 A Giant Mess of 40 Investment Rates

We systematically search the articles published from 2000 onward at the top-five finance journals. We record their investment rates, which are mostly based on Compustat. Outside of this scope, we include three articles (Gilchrist and Himmelberg 1998; Gutierrez and Philippon 2017; Alexander and Eberly 2018), each of which adds a unique investment rate measure. In total, we have identified 347 articles that contain 393 appearances of 40 different investment rates.[10] Appendix A details

[9]Since 1993, the Census Bureau has been conducting ACES to collect firm-level data on capital stocks and investment flows for both manufacturing and non-manufacturing firms. The annual data include the book value of capital and retirements or sales of assets. Measuring current-cost capital stocks in ACES faces even more difficulties than those in ASM. Because the data start in 1993, the left-censoring problem is more severe. In addition, the sampling rotation in ACES is annual, meaning that the PIM is infeasible for many small firms. Although these two problems are absent in Compustat, ACES covers more firms than just publicly traded companies. Alas, applications of ACES in the finance literature seem scarce. We leave its exploration to future work.

[10]We focus on tangible investments but ignore intangible investments such as research and development. While tangible investments forecast returns with a negative slope, intangible investments tend to forecast returns with a positive slope (Hou et al. 2021). In addition, measuring intangible investments other than research and development at the firm level is mostly an open issue. As such, we opt not to sum up tangible and intangible investments per the BEA, which lumps investments in intellectual property products together with investments in equipment and structures.

the 40 variable definitions, and Table S2 in the Internet Appendix details the complete references.[11]

Figure 3 reports the frequency distribution of the 40 investment rates in our dataset. The three most popular measures are CAPX/AT (capital expenditure over total assets); CAPX/PPENT (capital expenditure over net PPE); and dAT/AT (the growth of total assets), which account for 34.61%, 13.74%, and 12.72%, respectively, of the 393 total appearances. The fourth most popular measure is (dPPEGT+dINVT)/AT (the change in gross PPE plus change in total inventories, scaled by total assets), which accounts for 5.34%. The top three measures add up to 61.07%. On the other end of the spectrum, 14 measures have each appeared only once, and five measures twice.

Most studies work with gross investment. Hayashi and Inoue (1991) measure gross investment as dPPENT+DP, which is change in net PPE plus accounting depreciation. However, the most popular gross investment is capital expenditure from the cash flow statement. Several studies work with net investment such as change in net PPE, but the most popular net investment measure is change in total assets, especially in asset pricing (Cooper, Gulen, and Schill 2008). However, besides investment in fixed capital, change in total assets includes investment in working capital such as cash, account receivables, and inventories, which entail low, perhaps even no adjustment costs. Finally, three popular choices of capital used to scale investment are net PPE, gross PPE, and total assets.

We obtain data on accounting variables from annual Standard and Poor's Compustat industrial files. We exclude financial firms (SIC codes between 6,000 and 6,999), firms with negative book equity, and firm-years with nonpositive total assets, net PPE, or sales. In economic models period-t stock variables are typically measured at the beginning of time t, and period-t flow variables are over period t. In Compustat, both stock and flow variables are recorded at the end of period t. When working with annual data, for the year $t = 2002$, for example, we take time-t stock variables from the 2001 balance sheet and time-t flow variables from the 2002 income or cash flow statement.

[11] After completing a first pass of our meta-analysis, we come across Mitton (2022), who reviews several popular variables, including investment, in empirical corporate finance within top-three finance journals in the 2000–2018 sample. We thank Todd Mitton for kindly sharing his data on 30 investment variables, which we use to cross-check with our dataset. Among the 30 variables, two are scaled by replacement costs of capital (which we review in depth later in Table 3), and 12 are either investment levels or investment scaled by sales. Only 16 variables are investment rates.

As such, in calculating the investment rates, capital is 1-period-lagged relative to investment.

Table 2 shows the time series averages of cross-sectional moments for the 40 investment rates in the 1963–2020 sample. As noted, Figure 1 highlights key information by plotting the mean against standard deviation and the skewness against serial correlation across the 40 measures. The mean investment rate varies wildly from 3.38% for (CAPX−DP)/AT (capital expenditure minus depreciation, scaled by total assets) to 64.03% for (CAPXV+AQC)/PPENT (capital expenditure on PPE plus acquisitions, scaled by net PPE). The standard deviation also ranges greatly from 7.13% for (CAPX−DP)/AT to 128.63% for (CAPXV+AQC)/PPENT.

The investment rate distributions are all asymmetric, with positive skewness. However, the skewness varies substantially from 1.48 for dLno/aveAT (change in long-term net operating assets over average total assets) to 4.49 for (CAPXV+AQC)/PPENT (Panel B in Figure 1). The serial correlation of investment rates also varies greatly from 0.14 for dNAT/NAT, which is growth in nonfinancial assets (total assets minus current assets plus total inventories) to 0.66 for CAPX/AT.

The fraction of negative investment rates goes from 0.01% for CAPXV/AT to 30.47% for dPPENT/PPENT (the growth of net PPE), the fraction of inactive investment rates from 1.05% for CAPXV/PPENT to 30.67% for (CAPX−DP)/AT, and the fraction of positive investment rates from 52.39% for (CAPX−DP)/AT to 98.94% for CAPXV/PPENT. As such, the asymmetry is mostly robust across all 40 measures. The high fraction of negative investment rates of, for example, asset growth (dAT/AT), 25.9%, is not comparable with the Cooper-Haltiwanger (2006) plant-level evidence. Asset growth is net investment that does not add back depreciation. Also, AT includes working capital, such as cash, which entails virtually zero downward adjustment costs.

The pairwise correlations among the 40 investment rates vary greatly (Table S3 in the Internet Appendix). The Pearson correlation ranges from 0.18 between dBe/Be (the growth of book equity) and CAPX/(PPENT−CAPX+DP) to 0.988 between CAPXV/PPENT and (CAPXV−SPPE)/PPENT (CAPXV minus sales of PPE, scaled by net PPE), with a mean of 0.56. The Spearman correlation varies from 0.23 between CAPX/(AT−CHE) (CAPX scaled by noncash assets, item AT minus cash and cash equivalents) and dBe/Be to 0.987 between (CAPX−SPPE)/avePPENT (CAPX minus SPPE, scaled by average net PPE) and (CAPX−SPPE)/PPENT, with a mean of 0.61. The wide variety of investment rates, often with low pairwise correlations, indicates a dire need of more accurate measurement.

2.2.2 An Essential Tension

Within the confines of financial accounting in Compustat, Hayashi and Inoue's (1991) investment rate measure appears to be the most conceptually accurate. The historical-cost capital, denoted K_{it}^H, is net PPE (Compustat annual item PPENT), or if not available, gross PPE (item PPEGT) minus accumulated depreciation (item DPACT). Accounting depreciation is the amount of depreciation and amortization (item DP) minus the amortization of intangibles (item AM, zero if missing).[12] The accounting depreciation rate, δ_{it}^H, is the depreciation scaled by lagged net PPE.

The historical-cost investment, I_{it}^H, is $K_{it+1}^H - (1-\delta_{it}^H)K_{it}^H$ (change in net PPE plus accounting depreciation). We view I_{it}^H as arguably the best measure of firm-level investment in Compustat. (We explain why later in Section 3.1.) The gross investment rate, I_{it}^H/K_{it}^H, is the net investment rate, $(K_{it+1}^H - K_{it}^H)/K_{it}^H$, plus δ_{it}^H. An advantage of this gross investment rate is that the capital accumulation equation, $K_{it+1}^H = I_{it}^H + (1-\delta_{it}^H)K_{it}^H$, is automatically satisfied over time for all firms.

In financial accounting, gross PPE is the accumulated historical cost of investments, and net PPE is gross PPE minus accumulated depreciation. Net PPE is part of a firm's total assets, but gross PPE is not, because the accumulated depreciation is not part of the existing assets. Using $K_{it+1}^H = I_{it}^H + (1-\delta_{it}^H)K_{it}^H$ to recursively substitute K_{is}^H, for $s = 0, 1, \ldots, t-1$, in which year 0 is the year when firm i first records fixed assets, yields $K_{it}^H = \left(K_{i0}^H + \sum_{s=0}^{t-1} I_{is}^H\right) - \sum_{s=0}^{t-1} \delta_{is}^H K_{is}^H$, in which $K_{i0}^H + \sum_{s=0}^{t-1} I_{is}^H$ is the accumulated historical cost of investments (gross PPE), and $\sum_{s=0}^{t-1} \delta_{is}^H K_{is}^H$ is the accumulated depreciation. Clearly, K_{it}^H is net PPE (Goncalves, Xue, and Zhang 2020).

[12] Because item DP includes depreciation of tangible assets and amortization of intangibles per Compustat manual, we subtract item AM from item DP. We set missing AM to zero because it has no coverage before June 1969.

However, if net PPE is more appropriate, at least conceptually, than gross PPE in measuring historical-cost capital, why do many studies use gross PPE instead? The tension originates from accounting depreciation rates, which are on average higher than the BEA's economic depreciation rates. Consequently, net PPE tends to be lower than its economic value. The mean investment rate scaled by net PPE tends to be much higher than the BEA estimate, which seems more plausible to many. Scaling by gross PPE in investment rates mitigates this discrepancy.

2.3 Open Challenge: Integrating Economic with Financial Accounting

A full solution to the essential tension is to construct firm-specific current-cost capital stocks with economic depreciation rates via the PIM (and to scale investment flows with current-cost capital stocks). To gauge where the prior literature stands on this challenge, we identify 33 studies that apply the PIM to construct firm-specific capital stocks. Only ten out of the 33 are published from 2000 onward in the top-five finance journals. Table 3 summarizes the key aspects of their methods, while leaving the technical details to the 33 original studies. Several insights emerge from this meta-analysis. Overall, despite their efforts, the essential tension has largely persisted.

First, most prior studies implement the PIM on relatively small samples that consist mostly of manufacturing firms. Salinger and Summers (1983) use 30 Dow Jones companies. Whited (1992) draws 325 manufacturing firms in Compustat. Barnett and Sakellaris (1998) draw a sample of manufacturing firms from Hall (1990) from 1960 to 1987 with about 23,200 firm-years (averaging about 829 firms per year). Abel and Eberly (2001) construct a sample about 12,000 firm-years from 1974 to 1993 (averaging 600 firms per year) in Compustat. Eberly, Rebelo, and Vincent (2012) draw a balanced panel of 776 firms that are in the top quartile of capital stocks in 1981.

Second, prior studies use a diverse set of investment flows, with no clear consensus. The most popular measure seems to be capital expenditure (Whited 1992), but several studies also take into account sales of PPE (Abel and Eberly 2001; Bloom 2009). Although our benchmark measure (change in net PPE plus accounting depreciation) first appears in Hayashi and Inoue (1991) and subsequently in Lewellen and Badrinath (1997) and Tang (2009), its usage is by no means standard.

Third, to convert current dollar to constant dollar for capital and investment, most prior studies use a single, aggregate-level series, which is typically the implicit price deflator for fixed nonresidential investment. Among a few exceptions, Hayashi and Inoue (1991) exploit the availability of detailed firm-asset data in Japan and form price deflators per asset type from different components of Wholesale Price Index from Bank of Japan. Alas, detailed firm-asset data are not available in Compustat. Bloom (2009) uses industry-level investment price deflators from the NBER-CES database, but it covers only manufacturing industries.

Fourth, many prior studies estimate economic depreciation rates with the Salinger-Summers (1983) double declining-balance method. Firm i's economic depreciation rate, δ_i, is firm-specific but constant over time, with δ_i estimated to be $2/L_i$, in which L_i is the firm's average useful life of assets (the time series average of the gross PPE-to-depreciation ratio). Several studies attempt to mitigate firm-specific noise by implementing the Salinger-Summers method at the SIC industry level (Eberly, Rebelo, and Vincent 2012). However, as noted, BEA (2003, Table C) estimates the declining-balance rate to be significantly lower than two. In particular, the average declining-balance rate for equipment is 1.65 and that for private nonresidential structures is 0.91 (p. M-29).

To initialize capital stocks, the most popular approach is to use the first available net PPE. Gross PPE is also often used. Net PPE only works when the firm's assets are relatively new, meaning that their historical costs are close to current costs. This approach also ignores the differences between accounting and economic depreciation. Some studies adjust the first net PPE with the industry-level current-to-historical-cost capital ratio. This procedure assumes that the same ratio applies to all firms within an industry in a given year. Also, the BEA constructs historical-cost capital with geometric, not straight-line, depreciation. Finally, while Compustat contains only publicly traded firms, the BEA samples from virtually all establishments, most of which belong to private firms.

3 Economic Accounting for Firm-Level Investment Rates

Our main challenge is to construct the current-cost capital stock, denoted $K^{\$}_{it}$, for the entire Compustat universe. The quantity of capital stock, denoted K_{it}, is $K^{\$}_{it}$ scaled by the capital price deflator that is applicable to firm i, denoted P^K_{it}. The quantity of capital stock accumulates as:

$$K_{it+1} = (1-\delta_{it})K_{it} + I_{it}, \tag{1}$$

in which δ_{it} is the economic depreciation rate, and I_{it} is the quantity of investment.

Let $I^{\$}_{it}$ denote the current-cost investment. The current cost and quantity are related via $I_{it} = I^{\$}_{it}/P^I_{it}$, in which P^I_{it} is the investment price deflator. The capital and investment price deflators are not identical in the BEA data, i.e., $P^K_{it} \neq P^I_{it}$ (Section 3.2). Intuitively, their underlying asset compositions differ, and relative asset prices change over time. Investment tends to include newer types of assets than existing capital stock. Accordingly, the prices of capital and investment inflate at different rates. Another difference is the timing of measurement. The capital price deflator is measured at the end of a given period, but the investment price deflator is in the middle of the period.

Rewriting equation (1) in terms of current-cost capital and investment yields:

$$\frac{K^{\$}_{it+1}}{P^K_{it+1}} = (1-\delta_{it})\frac{K^{\$}_{it}}{P^K_{it}} + \frac{I^{\$}_{it}}{P^I_{it}} \qquad \Rightarrow \qquad K^{\$}_{it+1} = \left((1-\delta_{it})\frac{K^{\$}_{it}}{P^K_{it}} + \frac{I^{\$}_{it}}{P^I_{it}}\right) P^K_{it+1}, \tag{2}$$

in which $(1-\delta_{it})K^{\$}_{it}/P^K_{it} + I^{\$}_{it}/P^I_{it}$ is the next-period quantity of capital, K_{it+1}, to be inflated with P^K_{it+1} to obtain the current cost, $K^{\$}_{it+1}$. To iterate on equation (2), we need to measure: (i) current-cost investment flows, $I^{\$}_{it}$; (ii) capital and investment price deflators, P^K_{it} and P^I_{it}; (iii) economic depreciation rates, δ_{it}; and (iv) the initial value of current-cost capital stock, $K^{\$}_{i0}$, to start the iteration. In what follows, we detail our procedures for measuring these components.

3.1 Investment Flows

We measure the current-cost investment, $I_{it}^{\$}$, as the historical-cost investment, I_{it}^{H}, which is the change in net PPE plus accounting depreciation. In what follows, we explain why this $I_{it}^{\$}$ measure is probably the best option given a myriad of data limitations in Compustat.

Expanding on Hayashi and Inoue (1991), we detail different investment flows. Let PPEGT_t, PPENT_t, and DPACT_t be the gross PPE, net PPE, and accumulated depreciation at the beginning of year t, respectively; DP_t be the accounting depreciation during year t; ACQ_t be the gross book value of fixed assets acquired during year t; ACDACQ_t be the accumulated depreciation of acquired fixed assets; $\text{NACQ}_t = \text{ACQ}_t - \text{ACDACQ}_t$ be the net book value of acquired fixed assets; SR_t be the gross book value of fixed assets disposed during year t; ACDSR_t be the accumulated depreciation for disposed fixed assets; and $\text{NSR}_t = \text{SR}_t - \text{ACDSR}_t$ be the net book value of disposed fixed assets.

In addition to capital expenditure, firms also acquire assets via mergers and acquisitions (M&A). For mergers recorded with the pooling-of-interests method, balance sheet items are directly combined. In such cases, ACQ_t includes the accumulated depreciation from the target. Based on the Compustat data on acquisition method (item ACQMETH), 9.71% of M&As involve the pooling-of-interests method. Because ACQ_t can include accumulated depreciation, we need to keep track of ACDACQ_t as accumulated depreciation and NACQ_t as net book value of acquired fixed assets.[13]

Accounting identities yield: (i) net PPE equals gross PPE minus accumulated depreciation:

$$\text{PPENT}_t = \text{PPEGT}_t - \text{DPACT}_t; \tag{3}$$

[13] In Compustat, item ACQMETH (acquisition method) is available from June 1974 onward. For firms that have had a common stock traded on NYSE, Amex, or Nasdaq, the distribution of acquisition methods is as follows: 89.17% purchase method (code 'AP'); 7.19% pooling-of-interests method (code 'AI'); 2.45% a combination of purchase method and pooling-of-interests method (code 'AE'); 1.03% reverse purchase method (code 'RP'); 0.10% a combination of reverse purchase method and purchase method (code 'RU'); 0.06% a combination of reverse purchase method and pooling-of-interests method (code 'RO'); and 0.01% a combination of all three methods (code 'RW'). In total, 9.71% of all observations involve the pooling-of-interests method. The Financial Accounting Standards Board (FASB) issues Statement No. 141 in 2001 to end the usage of the pooling-of-interests method. In Compustat, M&As via the pooling-of-interests method (or a combination that involves its use) largely stop in 2001. However, there still exist a few observations afterward, including 23 occurrences of 'AI' in as late as 2017, 15 'AE' in 2018, and 17 'RO' in 2019.

(ii) the next-period gross PPE equals the current-period gross PPE plus the gross book value of acquired fixed assets, ACQ_t, net of the gross value of disposed fixed assets during year t, SR_t:

$$\mathrm{PPEGT}_{t+1} = \mathrm{PPEGT}_t + \mathrm{ACQ}_t - \mathrm{SR}_t; \tag{4}$$

and (iii) the next-period accumulated depreciation (a stock variable) equals its current-period value plus current depreciation expense (a flow variable), plus the accumulated depreciation of acquired fixed assets, ACDACQ_t, net of the accumulated depreciation for disposed fixed assets, ACDSR_t:

$$\mathrm{DPACT}_{t+1} = \mathrm{DPACT}_t + \mathrm{DP}_t + \mathrm{ACDACQ}_t - \mathrm{ACDSR}_t. \tag{5}$$

In terms of historical-cost accounting data, investment flows can be measured equivalently as:

$$\begin{aligned}
I_{it}^H &= \mathrm{PPENT}_{t+1} - \mathrm{PPENT}_t + \mathrm{DP}_t && (6)\\
&= \mathrm{PPEGT}_{t+1} - \mathrm{PPEGT}_t - (\mathrm{DPACT}_{t+1} - \mathrm{DPACT}_t) + \mathrm{DP}_t && (7)\\
&= \mathrm{PPEGT}_{t+1} - \mathrm{PPEGT}_t - \mathrm{ACDACQ}_t + \mathrm{ACDSR}_t && (8)\\
&= (\mathrm{ACQ}_t - \mathrm{ACDACQ}_t) - (\mathrm{SR}_t - \mathrm{ACDSR}_t) && (9)\\
&= \mathrm{NACQ}_t - \mathrm{NSR}_t, && (10)
\end{aligned}$$

in which equation (7) follows from equation (3), (8) from (5), and (9) from (4). As noted, we measure the historical-cost investment, I_{it}^H, as the change in net PPE plus accounting depreciation per equation (6). Both items PPENT and DP have broad coverage in Compustat.

From equation (8), I_{it}^H as the change in gross PPE, while ignoring ACDACQ and ACDSR, can be problematic. In pooling-of-interests mergers, ACDACQ can be substantial, if the target has a lot of accumulated depreciation. For disposed assets that are near the end of their service lives, the accumulated depreciation of disposed assets, ACDSR, can be close to the original costs, SR. Alas, ACDACQ and ACDSR are not covered by Compustat. In our 1963–2020 sample, the change in gross PPE has a slightly lower coverage of 169,501 firm-years versus 169,862 firm-years for I_{it}^H per equation (6). More important, the time-series average of the median difference scaled by absolute I_{it}^H is -17.2%. As such, the change in gross PPE underestimates investment by a substantial amount.

Measuring investment, I_{it}^H, as NACQ minus NSR per equation (10) is not feasible. First, NACQ includes acquired fixed assets via not only capital expenditures but also M&As. However, for M&As, Compustat only provides the cash payment for a target (item AQC). A breakdown across different assets, especially PPE, is not available. Acquired PPE (item ACQPPE) is available from 2011 onward only for a very limited sample of several hundred firms.

Second, NSR includes disposed fixed assets via both sales and retirement. Neither is well covered by Compustat. For asset sales, item SPPE measures only the proceeds received, not the net book value of disposed assets. To fill the gap, one needs the gain or loss from asset sales, but no good data are available. In Compustat, sale of property, plant and equipment and investments—(gain) loss (item SPPIV) is available only from 1987 onward. Gain (loss) on sale of property (item SRET) is virtually unavailable. The retirement of PPE (item PPEVR) is available only from 1969 to 1994.

We assume the current-cost investment, $I_{it}^\$$, equals the historical-cost investment, I_{it}^H. For acquired assets, their historical costs are close to their current costs. Assets acquired via capital expenditures are recorded at the current costs. Except for the pooling-of-interests mergers (footnote 13), assets acquired via M&As are recorded at the fair values (current costs). For disposed assets, their historical costs are typically not equal to their current costs. One possible proxy for the current costs is the sales of PPE (item SPPE) from the statement of cash flows. However, item SPPE ignores asset-for-equity and asset-for-debt sales (Slovin, Sushka, and Polonchek 2005) and other disposition methods, such as exchanges of nonmonetary assets, involuntary conversion (fire, flood, theft, and condemnation), and retirement (Kieso, Weygandt, and Warfield 2019, chapter 10). Other possibilities include spin-offs and changes in consolidation status (when a subsidiary is no longer consolidated). As such, item SPPE underestimates the frequency and magnitude of disinvestment.

However, our investment measure per equation (6) likely overstates the frequency and amount of disinvestment. Net PPE can decrease not only from capital retirements and sales of PPE but also from restructuring charges, impairment losses, and foreign currency translations, all of which do not involve actual disinvestment (Wahlen, Baginski, and Bradshaw 2018, chapter 8). In particular, U.S. Generally Accepted Accounting Principles require that the values of long-lived assets must be reevaluated periodically for impairment and written down in the presence of impairment losses. However, asset values are not allowed to adjust upward in reevaluation via write-ups.

Finally, because historical- and current-cost investment flows are identical and their capital stocks are both positive, the fractions of negative investment rates, with 0% as the cutoff, should be identical across historical- and current-cost measures. The fractions differ slightly with −1% as the cutoff for negative investment rates because capital stocks in the denominator differ.

3.2 Capital and Investment Price Deflators

Ideally, if data were available on detailed asset types and their amounts that a firm employs in any period, we could combine this information with asset-specific price deflators and economic depreciation rates to construct firm-level capital and investment price deflators and depreciation rates. Alas, the firm-level information on detailed assets is not available. To deal with this data challenge, we construct industry-specific price deflators and depreciation rates based on the BEA data and assign them to all the firms within a given industry. The implicit assumption is that firms within the same industry have the same asset composition. Although far from perfect, we view this procedure as arguably the best option in the presence of the data limitations.

3.2.1 Assigning Firms to BEA's NAICS Industries

The BEA provides fixed assets data for 63 private industries in 20 sectors based on the North American Industry Classification System (NAICS). To assign a firm in Compustat to an industry or a sector in BEA in a given fiscal year, we use its historical NAICS code (item NAICSH). We drop firms that have ever been classified as non-private and discard firm-years with unclassified NAICS codes. The coverage of item NAICSH starts in June 1985.

Prior to June 1985, firm-level NAICS codes are not available. Accordingly, we need to use Standard Industry Classification (SIC) codes to make industry assignments indirectly. Because historical SIC codes are not available in Compustat until June 1987, we obtain SIC codes from CRSP (item SICCD) at a firm's fiscal year end. We convert SIC codes into NAICS codes using the 1987 SIC to 1997 NAICS concordance table from the U.S. Census Bureau. We drop firms that have ever been classified as non-private and discard firm-years with unclassified or missing SIC codes.

Because the mapping between SIC and NAICS is not one-to-one, one SIC code can be assigned to multiple BEA industries. To deal with this issue, we aggregate the fixed assets data for the assigned industries before computing industry-specific price deflators and economic depreciation rates. In the 1950–2020 sample, our mapping procedure produces a unique industry classification for 91.76% of all firm-years (74.02% before June 1985 and 99.98% afterwards). The classification remains constant over time for 70.92% of firms and changes only once for 19%, twice for 5.95%, and three or more times for 4.12% of firms. Appendix B details our firm-industry mapping procedure.

3.2.2 Industry-specific Capital and Investment Price Deflators

From the detailed tables for 63 private industries from BEA's fixed assets accounts, we obtain: (i) current-cost (current-dollar) capital stocks in private non-residential equipment, $K_{jt}^{\mathcal{E}\$}$, and structure, $K_{jt}^{\mathcal{S}\$}$, by industry, annual, 1947–2020; (ii) fixed-cost (constant-dollar) capital stocks in private non-residential equipment, $K_{jt}^{\mathcal{E}}$, and structure, $K_{jt}^{\mathcal{S}}$, by industry, annual, 1947–2020; (iii) current-cost investments in private non-residential equipment, $I_{jt}^{\mathcal{E}\$}$, and structure, $I_{jt}^{\mathcal{S}\$}$, by industry, annual, 1947–2020; and (iv) fixed-cost investments in private non-residential equipment, $I_{jt}^{\mathcal{E}}$, and structure, $I_{jt}^{\mathcal{S}}$, by industry, annual, 1947–2020. We calculate industry j's capital and investment price deflators as $P_{jt}^{K} = (K_{jt}^{\mathcal{E}\$} + K_{jt}^{\mathcal{S}\$})/(K_{jt}^{\mathcal{E}} + K_{jt}^{\mathcal{S}})$ and $P_{jt}^{I} = (I_{jt}^{\mathcal{E}\$} + I_{jt}^{\mathcal{S}\$})/(I_{jt}^{\mathcal{E}} + I_{jt}^{\mathcal{S}})$, respectively.[14]

As suggested by the BEA staff, we use the detailed tables (not the standard tables). First, the

[14]The fixed-cost data are measured in mid-year 2012 dollars. Because current-cost investment are also in mid-year dollars, the investment price deflator equals one in 2012. However, because current-cost capital stocks are measured in end-of-year dollars, the 2012 capital price deflator differs slightly from one.

numbers from the standard tables are rounded to \$0.1 billion. Such large rounding errors make price deflators imprecise for small industries in early years. In contrast, the numbers from the detailed tables are rounded to \$1 million. Second, the detailed tables provide both fixed-cost and current-cost data that can be used to back out the price deflators. The standard tables provide chain-type quantity indexes but not the fixed-cost data. Finally, the standard tables include residential fixed assets.

When calculating the investment price deflator, we require the current-cost and fixed-cost investments to be both above \$10 million. (The current-cost and fixed-cost capital stocks are always above \$10 million.) First, current-cost investments can be very small for some industries in early years. The price deflators can be imprecise, as the data are rounded to \$1 million. Second, investments are occasionally negative, yielding unreliable price deflators. The current-cost and fixed-cost investments can even have oppositive signs (due to changing relative prices). The resulting price deflators would be negative.[15] Finally, because not all firms can be assigned to a BEA industry (and industry-specific price deflators can be missing), we also construct sector-level price deflators. We aggregate investments and capital stocks for the industries within each of the 20 sectors and recompute the sector-level price deflators. Because sector-level investments and capital stocks are much larger, we do not need to impose the \$10 million minimum when computing the price deflators.

In the current-cost capital accumulation equation (2), price adjustment appears via the growth rate of capital price deflators, P^K_{it+1}/P^K_{it}, and the ratio of capital-to-investment price deflators, P^K_{it+1}/P^I_{it}. Accordingly, we report the moments of (net) growth rates, $P^K_{it+1}/P^K_{it}-1$, in Table 4 and the moments of P^K_{it+1}/P^I_{it} in Table 5 based on the BEA data. From Table 4, the aggregate inflation rate of capital goods in the 1963–2020 sample is on average 4.14% per annum, with a standard deviation of 3.4% and a serial correlation of 0.66. Across the 20 sectors, the inflation rate varies from 2.55% for information to 5.9% for mining. Across the 63 industries, the inflation rate ranges

[15] One such instance occurs in industry "Transit and ground passenger transportation" in 1947. During this year, the industry has a positive investment of \$202 million in structure but a negative investment of \$194 million in equipment, giving rise to a total current-cost investment of \$8 million. However, equipment has experienced higher inflation rates than structure from 1947 to 2012. Consequently, in 2012 dollars the amount of investment in structure (\$1,953 million) becomes smaller than the amount of disinvestment in equipment (\$2,592 million), giving rise to a total fixed-cost investment of −\$639 mllion. The resulting price deflator then has a negative value of −0.0125.

from 2.36% for broadcasting and telecommunications to 6.15% for oil and gas extraction.

Table 5 shows that the ratio of capital-to-investment price deflators, P^K_{it+1}/P^I_{it}, is on average 0.91 in the 1963–2020 sample, with a small standard deviation of 0.09 and a high serial correlation of 0.97. Across the 20 sectors, the average P^K_{it+1}/P^I_{it} varies from 0.8 for professional, scientific, and technical services to 0.99 for agriculture, forestry, fishing, and hunting. Across the 63 industries, the average P^K_{it+1}/P^I_{it} ranges from 0.7 for computer systems design and related services to 1.02 for oil and gas extraction (the only industry with the average ratio above one).[16]

3.2.3 Applying Industry-level Price Deflators to Specific Firms

When applying the price deflators to individual firms, we use industry-specific price deflators (if not available, sector-specific price deflators). Sector-level deflators are used for less than 1% of the firm-years. As noted, because the conversion from SIC to NAICS codes is not one-to-one, one firm can be assigned to multiple BEA industries. To handle this issue, we aggregate investments and capital stocks across the assigned industries and recompute the price deflators with the aggregates.

The capital and investment price deflators from the BEA are computed for calendar years. However, the fiscal years of firms do not always end in December. As such, we need to adjust for the differences. For the capital price deflator, we use linear interpolation to impute its level for all the possible fiscal year ending months. For example, the price deflator for the fiscal year ending in March 1998 (three months away from December 1997 and nine months from December 1998) is calculated as $(12-3)/12 = 75\%$ of the 1997 deflator plus $(12-9)/12 = 25\%$ of the 1998 deflator.

The adjustment for the investment price deflator is more involved. Investment is a flow variable over a time interval, which is mostly 12 months. However, firms can change the ending month of fiscal years and cause the intervals to differ from 12 months.[17] We identify the midpoint of an interval

[16] Because the growth rate of investment price deflator does not appear in equation (2), we delegate the $P^I_{it+1}/P^I_{it}-1$ moments to the Internet Appendix. Table S6 shows that the aggregate inflation rate of investment goods in the 1963–2020 sample is on average 3.81% per annum, with a standard deviation of 3.43% and a serial correlation of 0.57. Across the 20 sectors, the inflation rate varies from 2.64% for information to 4.98% for mining. Across the 63 industries, the inflation rate ranges from 2.48% for broadcasting and telecommunications to 5.21% for oil and gas extraction.

[17] The interval can range from one to 23 months. If a firm changes its fiscal year ending month from November to

and calculate its relative distance from the midpoints (June) of the two adjacent calendar years. The distance then determines the weights in linear interpolation. The closer the interval midpoint is to the June of a given calendar year, the higher the weight assigned to the price deflator of that calendar year.[18] For instance, for the 6-month investment interval ending in June 1998, the midpoint is March 1998, which is nine months away from June 1997 and three months from June 1998. Accordingly, we set the investment price deflator to be 25% of the 1997 deflator plus 75% of the 1998 deflator.

3.3 Economic Depreciation Rates

We assign the BEA-based industry-level depreciation rates to firms within a given industry.

3.3.1 Industry-specific Economic Depreciation Rates

From the detailed tables for 63 private industries from BEA's fixed assets accounts, we obtain: (i) fixed-cost depreciations in private non-residential equipment, $D^{\mathcal{E}}_{jt}$, and structure, $D^{\mathcal{S}}_{jt}$, by industry, annual, 1947–2020; (ii) fixed-cost capital stocks in private non-residential equipment, $K^{\mathcal{E}}_{jt}$, and structure, $K^{\mathcal{S}}_{jt}$, by industry, annual, 1947–2020; and (iii) fixed-cost investments in private non-residential equipment, $I^{\mathcal{E}}_{jt}$, and structure, $I^{\mathcal{S}}_{jt}$, by industry, annual, 1947–2020.

For industry j in year t, we calculate its economic depreciation rate as:

$$\delta_{jt} = \frac{D^{\mathcal{E}}_{jt} + D^{\mathcal{S}}_{jt}}{(K^{\mathcal{E}}_{jt-1} + K^{\mathcal{S}}_{jt-1}) + 0.5 \times (I^{\mathcal{E}}_{jt} + I^{\mathcal{S}}_{jt})}. \tag{11}$$

In the denominator of equation (11), we add 50% of current investments because the BEA does so when calculating the depreciation amount at the asset level. In particular, the BEA assumes that investments depreciate immediately without any time lags. As such, equation (11) allows us

December immediately after the latest annual report, the gap between the last and next fiscal years would be one month. If a firm changes its fiscal year ending month from December to November immediately before the upcoming report, the gap between the two fiscal years would be 23 months. We exclude investments over intervals longer than 24 months, which are most likely due to missing data or errors. About 1% of firms have investment intervals that differ from 12 months. However, dropping these firms would reduce the sample size for current-cost capital stocks by about 9% because we need the full histories of these firms to implement the PIM.

[18] The BEA assumes that investment occurs in the middle of a calendar year. Accordingly, the investment price deflator is also measured at the mid-year. We make the same assumption that firm-level investment occurs in the midpoint of its applicable fiscal interval in Compustat. As such, we implement the linear interpolation via the relative distance of the midpoint to the midpoints (June) of the two nearest calendar years.

to uncover the implicit depreciation rates implied by the BEA's fixed-cost data.[19]

Equation (11) uses fixed-cost data rather than current-cost data to calculate the economic depreciation rate, δ_{jt}, which appears in both the quantity-based capital accumulation equation (1) and its current-cost version in equation (2). The depreciation rate, δ_{jt}, differs from the current-cost rate, $\delta^{\$}_{jt} = (D^{\mathcal{E}\$}_{jt} + D^{\mathcal{S}\$}_{jt})/((K^{\mathcal{E}\$}_{jt-1} + K^{\mathcal{S}\$}_{jt-1}) + 0.5 \times (I^{\mathcal{E}\$}_{jt} + I^{\mathcal{S}\$}_{jt}))$, in which all the variables in the right-hand side are in current costs. Because the price deflators for depreciation, capital, and investment all differ from one another, $\delta^{\$}_{jt}$ does not reduce to δ_{jt}.

The BEA publishes industry-specific economic depreciation rates in the detailed tables from its fixed assets accounts.[20] However, when calculating these depreciation rates, the BEA includes both normal depreciation and "other changes in volume of assets" (OCVA, the amount of damages from natural disasters such as hurricanes). Conceptually, OCVA reduces capital stocks. The BEA treats OCVA as part of depreciation (not disinvestment). However, as a form of write-downs, OCVA is implicitly treated as part of our investment measure in Compustat. Also, the BEA does not provide the combined depreciation rates across equipment and structure or the sector-level rates. As such, we calculate the depreciation rates per equation (11) instead of using the BEA's posted rates.

Table 6 shows the economic depreciation rates that we calculate from the BEA data per equation (11) in the 1963–2020 sample. The aggregate δ_t is on average 5.71% per annum with a small standard deviation of 0.48%. Within the 20 NAICS sectors, the average δ_{st} varies from 2.78% for educational services to 11.63% for construction. Within the 63 private industries, the average δ_{jt} ranges from 2.73% for railroad transportation to 14.67% for truck transportation. The depreciation rates are persistent, with many sector- and industry-level serial correlations above 0.99. The depreciation rates are also stable, with sector-level standard deviation varying from 0.11% for accommodation

[19]To calculate the depreciation rates for 1947, we need the 1946 fixed-cost capital stocks, which are not directly available. However, the capital accumulation equation (1) holds very well in early years. We impute the 1946 capital stocks via the 1947 data on capital, investment, and depreciation. In addition, we do not need to impose the $10 million minimum because both the numerator and denominator of equation (11) are always above $10 million.

[20]In response to conversations with us from late November to early December 2020, the BEA has revised its industry-specific depreciation rates in its 2021 annual update. The BEA used to calculate the depreciation rates based on the "free-running" capital stocks data that are not adjusted for natural disasters and transfers across industries. The 2021 edition has based the depreciation rates on the published (and properly adjusted) capital and investment data.

and food services to 1.74% for professional, scientific, and technical services, and the industry-level standard deviation from 0.08% for railroad transportation to 3.72% for computer systems design and related services. The 1947–2020 evidence is largely similar (Table S8, the Internet Appendix).

3.3.2 Applying Industry-level Economic Depreciation Rates to Specific Firms

For firms that cannot be assigned to an industry, we calculate the depreciation rates at the sector level. We aggregate depreciation, investment, and capital stocks across all the industries within each sector before applying equation (11). When assigning the depreciation rates to individual firms, we use the industry-specific rates whenever available. Otherwise we use the sector-specific rates. Sector-level depreciation rates are used for less than 1% of the firm-years. In addition, prior to June 1985, when a firm is assigned to multiple BEA industries based on its SIC code, we aggregate the data across all the assigned industries before applying equation (11).

To convert calendar- to fiscal-year depreciation rates, we compute monthly depreciation rates as their matching annual rates divided by 12. We then sum up the 12 monthly rates during a fiscal year. For example, the depreciation rate for the fiscal year ending in March 1998 is 9/12 of the 1997 rate plus 3/12 of the 1998 rate. When calculating a depreciation rate over an interval that is not 12 months, we add up the monthly rates over the calendar months within the interval. When the investment interval is not 12 months, we also need to adjust the depreciation amount when measuring investment: $I_{it}^{H} = \text{PPENT}_{t+1} - \text{PPENT}_{t} + \text{DP}_{t} \times L_{it}/12$, in which L_{it} is the number of months within the interval. We use this adjustment only for calculating current-cost capital stocks. When studying (annual) investment rates, we include only investments over a 12-month interval.

3.4 The Initial Values of Current-Cost Capital Stocks

To initialize the current-cost capital, $K_{i0}^{\$}$, we adopt the PIM based on the age of firm i's oldest assets. This approach is inspired by Salinger and Summers (1983), but our method differs in many details. We start from the acquisition date of the firm's oldest assets (not its founding date). Because we aim to estimate the replacement cost of capital that the firm currently owns, we do not need to account for its investments that have been fully depreciated or disposed.

At the end of a firm's first year with available net and gross PPE in Compustat (year 0), we estimate the firm's asset age (since acquiring its oldest assets), denoted A_i, as its average asset age times two (rounded to the nearest integer). The average asset age is accumulated depreciation (item DPACT) divided by depreciation (item DP minus item AM, zero if missing).[21] As detailed in Appendix C, if investment remains constant, the age distribution of assets in gross PPE is uniform. Because the age of the newest asset is zero, the age of the oldest asset would be two times the average asset age. This asset age approximation works well even with growing investments (Appendix C).

We construct the initial capital stock, $K^{\$}_{i0}$, by iterating on equation (2) from a starting year of $-A_i$. To accommodate the availability of industry-level data, we truncate $-A_i$ to ensure that the calendar year starts no earlier than 1948.[22] This truncation affects about 7.7% of firms. To impute investment flows from year $-A_i$ to year 0 ($A_i + 1$ years), we distribute the gross PPE at year 0, PPEGT_{i0}, equally, i.e., investment in each year equals $\mathrm{PPEGT}_{i0}/(A_i + 1)$. Also, the beginning-of-year capital stock is assumed to be zero in year $-A_i$. Finally, we set $K^{\$}_{i0}$ to zero if PPEGT_{i0} is zero.

We also explore two alternative approaches to initializing $K^{\$}_{i0}$. The first is to set $K^{\$}_{i0}$ to be firm i's first available net PPE in Compustat. In our 1950–2020 sample, at the end of a firm's first year with available net PPE, the mean of oldest asset age is 9.1 years, and the median is 6 years. The 5th and 25th percentiles are three and four years, whereas the 75th and 95th percentiles are 11 and 22 years, respectively. The evidence prompts us to use this simple method only as a robustness check. In the second approach, we set $K^{\$}_{i0}$ to be firm i's first available PPENT times the ratio of current-cost to historical-cost capital stocks for the BEA industry to which the firm belongs.[23]

[21] We require both accumulated depreciation and depreciation to be positive. When item DPACT is missing, we impute it as the difference between gross PPE and net PPE. When a firm's asset age is missing (about 8.3% of the firms in our sample), we impute it as the median asset age of the firms that appear in Compustat during the same year.

[22] The starting year of 1948 maximizes our sample coverage. Firms with non-December fiscal year end in Compustat require linear interpolation that uses the industry-level BEA data on price deflators and depreciation rates in 1947.

[23] To compute the current-to-historical cost ratios, we use data from the standard tables of BEA's fixed assets accounts because historical-cost data are not available from the detailed tables. The data from the standard tables are rounded to \$0.1 billion. To mitigate the impact of rounding errors, we require both current-cost and historical-cost capital stocks to be at least \$1 billion. The ratios computed directly from the BEA data are available only at the end of cal-

4 Empirical Results

4.1 Firm-level Current-cost Investment Rates

Table 7 shows the time series averages of cross-sectional moments of current-cost investment rates, $I^{\$}_{it}/K^{\$}_{it}$, in the 1963–2020 sample. This working sample contains in total 169,828 firm-years. For each fiscal year we winsorize the firm-level $I^{\$}_{it}/K^{\$}_{it}$ at the 1%–99% level. The average $I^{\$}_{it}/K^{\$}_{it}$ is 23.84% per annum, which is substantially higher than the median of 13.03%. The cross-sectional standard deviation is large, 37.2%. The skewness is 3.33, and excess kurtosis (relative to the kurtosis of three for the normal distribution) 14.28. The first-order autocorrelation estimated from cross-sectional regressions of current-cost investment rates on lagged investment rates is 0.34.

The fraction of negative $I^{\$}_{it}/K^{\$}_{it}$ (below -1%) is small, only 5.51%, and the fraction of inactive $I^{\$}_{it}/K^{\$}_{it}$ (between -1% and 1%) is tiny, only 2.85%. As such, the asymmetry between the fractions of negative and positive investment rates, 5.51% versus 91.64%, strongly indicates costly reversibility in Compustat firms. The asymmetry is also present in the negative versus positive investment spike rates. With the Cooper-Haltiwanger (2006) cutoff of 20% for investment spikes, the fraction of negative spikes is only 1.26%, which is much lower than 32.66% for the fraction of positive spikes. With alternative cutoff rates of 30%, 40%, and 50%, the contrast is between 0.73%, 0.44%, and 0.28% for negative spikes and 20.7%, 14.49%, and 10.8% for positive spikes, respectively. Figure 4 shows the histogram of the pooled firm-years of current-cost investment rates. Clearly, the firm-level $I^{\$}_{it}/K^{\$}_{it}$ distribution is heavily right-skewed, with a long right tail.

Table 7 also shows the moments of real investment rates, defined as $I_{it}/K_{it} \equiv (I^{\$}_{it}/K^{\$}_{it})(P^K_{it}/P^I_{it})$, in which P^K_{it} and P^I_{it} are capital and investment price deflators, respectively. Because the P^K_{it}/P^I_{it} ratio is on average less than one (Table 5), the mean I_{it}/K_{it} is 20.43%, which is lower than the mean $I^{\$}_{it}/K^{\$}_{it}$ of 23.84%. The standard deviation of I_{it}/K_{it} is also lower, 31.48% versus 37.2%. The fractions of both negative and positive spike rates are also lower. However, the skewness, kurtosis,

endar years. To apply them to firms in Compustat, we use linear interpolation to pin down their values for all fiscal year ending months. This procedure is identical to our interpolation for capital price deflators (Section 3.2). Finally, when the current-to-historical cost ratios are missing at the industry level, we use the ratios computed at the sector level.

serial correlation, and the fractions of negative and inactive investment rates are largely similar. We focus on current-cost rather than real investment rates because the latter might be sensitive to the choice of base year in capital and investment price deflators (Landefeld, Moulton, and Vojtech 2003).

We also examine an alternative investment rate, (CAPX−SPPE)/$K_{it}^{\$}$, which is item CAPX minus SPPE (zero if missing) scaled by current-cost capital. As shown in Figure 3, item CAPX is the most popular measure of investment in the prior literature. We also subtract item SPPE to account for disinvestment. The mean investment rate falls to 19.36%, but the standard deviation drops more to 24.7%. The skewness and kurtosis decrease slightly, but the serial correlation rises to 0.51. More important, this alternative measure understates the fraction of negative investment rates to only 1.81%. The fractions of investment spikes are also lower.

The properties of current-cost investment rates are robust to alternative ways of initializing current-cost capital (Table S9, the Internet Appendix). Initializing with net PPE yields a mean investment rate of 25% and a standard deviation of 39%. Both are close to the mean of 23.8% and the standard deviation of 37.2% in the benchmark estimation, respectively. Initializing with industry-adjusted net PPE again yields similar estimates, 22.9% and 35%, respectively. The serial correlation and fractions of negative and inactive investment rates are all quite similar. Table S9 also shows that using industry-adjusted net PPE as current-cost capital without going through the PIM recursion yields more different results. The mean rises to 29.2%, the standard deviation to 46.3%, and the serial correlation falls to 0.27. We view this evidence as validating our benchmark PIM procedure.[24]

4.1.1 Comparison with the Plant-level Evidence

It is informative to compare the properties of firm-level current-cost investment rates with the Cooper-Haltiwanger (2006) plant-level evidence reviewed in Section 2.1.3. The firm-level distribu-

[24]The two alternative procedures do yield somewhat different initial values of capital stocks. In untabulated results, we show that in the 1950–2020 sample, the ratio of $K_{i0}^{\$}$ to the first available net PPE is on average 1.32, with a median of 1.14. The 5th and 25th percentiles are 0.78 and 0.98, whereas the 75th and 95th percentiles are 1.42 and 2.22, respectively. The ratio of $K_{i0}^{\$}$ to industry-adjusted net PPE is on average 0.95, with a median of 0.83. The 5th and 25th percentiles are 0.55 and 0.68, whereas the 75th and 95th percentiles are 1.01 and 1.59, respectively.

tion has a lower fraction of negative investment rates than the plant-level distribution, 5.51% versus 10.4%. The inactive fraction is also smaller at the firm level, 2.85% versus 8.1%. As such, the firm-level distribution is even more asymmetric, with a longer right tail, than the plant-level distribution. Firm-level investment rates are also more persistent, with a higher serial correlation, 0.34 versus 0.058. Figure S2 in the Internet Appendix, which is borrowed from Cooper and Haltiwanger's (2006) Figure 1, shows the histogram of plant-level investment rates in their sample. A comparison with Figure 4 on firm-level investment rates in Compustat shows that the firm-level distribution is more dispersed and more asymmetric with a longer right tail. The firm-level distribution varies from −0.4 to 1.6, whereas the plant-level distribution ranges only from −0.2 to 0.8.

Sample criteria most likely play a role. To avoid the ASM's sampling rotation that prevents the application of PIM, Cooper and Haltiwanger (2006) include only large manusfacturing plants in continuous operations throughout their entire sample period. In contrast, such sample rotation does not exist in Compustat that covers all public traded companies. In addition, Compustat includes firms in different industries (not just manufacturing), with no restrictions on size or age. As such, our firms are substantially more heterogeneous than Cooper and Haltiwanger's manufacturing plants, giving rise to a more dispersed investment rate distribution.

More important, aggregation from plants to firms strengthens the asymmetry evidence that indicates costly reversibility but weakens the inaction evidence. Negative investments by some plants can be offset by positive investments by other plants within the same firm. Inactive investments by some plants can be offset by active investments by other plants. This within-firm aggregation most likely gives rise to a smaller fraction of negative investment rates at the firm level, 5.51% versus 10.4%, and a smaller fraction of inactive investment rates, 2.85% versus 8.1%. Aggregation also contributes to a higher serial correlation of investment rates, 0.34 versus 0.058.[25]

[25] A related issue is aggregation across heterogenous capital goods. Firms in the data use heterogeneous capital goods. The capital composition likely varies across firms, especially firms in different industries in Compustat. Buying a few laptops gets lumped into an increase in net PPE in the same way as constructing a new building. This capital heterogeneity is also likely responsible for the smaller fraction of firm-level inactive investment rates.

4.1.2 Differences between Current-cost and Historical-cost Investment Rates

Table 8 shows the properties of historical-cost investment rates, I_{it}^H/K_{it}^H, measured as change in net PPE plus accounting depreciation scaled by net PPE. The mean I_{it}^H/K_{it}^H is 40.27% per annum and its standard deviation 62.9%, both of which are about 70% higher than their counterparts for current-cost investment rates, $I_{it}^{\$}/K_{it}^{\$}$, 23.84% and 37.2%, respectively. The serial correlation of I_{it}^H/K_{it}^H is 0.25, which is lower than 0.34 for $I_{it}^{\$}/K_{it}^{\$}$. The skewness, kurtosis, and the fractions of negative and inactive investment rates are largely comparable. However, the positive investment spike rates are much higher for I_{it}^H/K_{it}^H. With the cutoff of 20%, for example, the positive spike rate is 53.94% for I_{it}^H/K_{it}^H in contrast to only 32.66% for $I_{it}^{\$}/K_{it}^{\$}$. The firm-level I_{it}^H/K_{it}^H distribution in Panel A of Figure 5 further confirms its longer right tail than $I_{it}^{\$}/K_{it}^{\$}$.

Because we measure current-cost investment as its historical cost, $I_{it}^{\$} = I_{it}^H$, the differences between I_{it}^H/K_{it}^H and $I_{it}^{\$}/K_{it}^{\$}$ originate only from the differences between K_{it}^H and $K_{it}^{\$}$. Table 8 shows that the $K_{it}^{\$}/K_{it}^H$ ratio is on average 2.11, with a median of 1.61 and a standard deviation of 1.79. The $K_{it}^{\$}/K_{it}^H$ ratio is also right-skewed (Panel B of Figure 5). The skewness is 3.58. The 1st and 5th percentiles are 0.83 and 1.01, but the 95th and 99th are 4.85 and 13.5, respectively.

We trace the differences between current- and historical-cost capital stocks further to the differences between economic and accounting depreciation rates. From Table 8, the economic depreciation rate, δ_{it}, is on average 6.9%, which is close to the median of 6.86%. Also, δ_{it} is relatively stable, with a standard deviation of 1.96%. Its 1st and 5th percentiles are 3.27% and 3.69%, whereas the 95th and 99th are 10.69% and 13.25%, respectively. In contrast, the accounting depreciation rate, δ_{it}^H, is on average 20.94%, with a high standard deviation of 16.65%. Its 1st and 5th percentiles stay low at 2.86% and 4.75%, whereas the 95th and 99th hit 50.69% and 103.19%, respectively. The histogram of δ_{it} in Panel C of Figure 5 is close to a normal distribution. In contrast, the histogram in Panel D shows the large dispersion and long right tail for δ_{it}^H.

Table 8 shows that the differences between δ_{it} and δ_{it}^H are the main driving force behind the differences between current- and historical-cost capital. When we replace δ_{it} with δ_{it}^H in our benchmark PIM estimation, the ratio of the benchmark $K_{it}^{\$}$ to this alternative $K_{it}^{\$}$ is on average 1.93, which is close to the mean $K_{it}^{\$}/K_{it}^H$ ratio of 2.11. The investment rate scaled by the alternative $K_{it}^{\$}$ has a mean of 39.33%, which is close to the historical-cost mean of 40.27%. Its standard deviation of 60.91% is also close to the standard deviation of I_{it}^H/K_{it}^H, 62.9%.

Price adjustment, which is another major component of our PIM estimation, plays only a secondary role in explaining the differences between $K_{it}^{\$}$ and K_{it}^H. When we set both capital and investment price deflators to one (no price adjustment), the ratio of the benchmark $K_{it}^{\$}$ to the alternative $K_{it}^{\$}$ is on average 1.13. The investment rate has a mean of 24.42% and a standard deviation of 36.26%, both of which are close to our benchmark estimates of 23.84 and 37.2%, respectively.

4.1.3 Differences between Current-cost Capital and Gross PPE

Table 8 shows that gross PPE is much closer to current-cost capital, $K_{it}^{\$}$, than net PPE. The $K_{it}^{\$}$/PPEGT ratio is on average 0.98, with a standard deviation of 0.42 and a skewness of 3.23. The 1st and 5th percentiles are 0.51 and 0.64, but the 95th and 99th are 1.61 and 3.48, respectively. However, its median is only 0.88. Intuitively, gross PPE differs from $K_{it}^{\$}$ by setting economic depreciation rates, δ_{it}, to zero and ignoring the inflation rates in capital and investment prices. The former overstates, but the latter understates, the magnitude of gross PPE relative to $K_{it}^{\$}$. Because δ_{it} is generally higher than the inflation rates, the former effect dominates quantitatively and yields the $K_{it}^{\$}$ estimates that are generally smaller than gross PPE, as shown in Panel C of Figure 5.

In addition, because accounting depreciation rates deviate more from economic depreciation rates than just setting the latter to zero, net PPE deviates more from current-cost capital than gross PPE. As such, although conceptually shaky (because it ignores depreciation), gross PPE is a better proxy for current-cost capital than net PPE in practice. Relatedly, gross PPE is also a better proxy for current-cost (fixed) capital than total assets, which include working capital and goodwill. In particular, the $K_{it}^{\$}$/AT ratio is on average only 0.53, with a median of 0.43.

Table 8 shows that historical-cost investment rates scaled by gross PPE, I^H_{it}/PPEGT, are relatively close to current-cost investment rates in term of basic moments. However, their differences remain economically important. The difference is on average 2.66%, with a standard deviation of 9.64%. The 1st and 5th percentiles are −32.6% and −6.8%, and the 95th and 99th are 16.9% and 50.9%, respectively, as illustrated in Panel F in Figure 5. In all, although gross PPE is a useful shortcut, our $K^{\$}_{it}$ estimates seem more accurate in measuring the replacement cost of capital.

4.2 Comparative Statics

In this subsection we document how our key results in, for example, Table 7 and Figure 4, respond to changes in our baseline empirical design. In accordance with Mitton (2002), we view robustness as a matter of degree and focus "less on defending the robustness of a result and more on understanding why a result is robust in some specifications and not in others (p. 532)." In all experiments, we continue to winsorize each year at the 1–99% level in the full sample to ensure that subsample results are not affected by differences in winsorization. Overall, we find that the distributional asymmetry of current-cost investment rates is quite robust, but some key moments, such as mean and standard deviation, do change in economically significant ways.

4.2.1 Sample Period, Mergers and Acquisitions (M&As), Firm Age, and Firm Size

In the first perturbation to our baseline design, we halve the sample into two in the time dimension, 1963–1991 and 1992–2020. From Table 9, the investment rate moments are largely comparable across the two subsamples. The latter sample has a slightly higher mean, 25.38% versus 22.31%, a higher standard deviation, 40.79% versus 33.6%, a higher skewness, 3.4 versus 3.25, and a higher fraction of negative investment rates, 5.86% versus 5.16%. Panels A and B in Figure 6 confirm that the current-cost investment rate distribution is heavily right-skewed in both subsamples.

In the second experiment we quantify the impact of large M&As by excluding the firm-years with the difference between investment and capital expenditure higher than 15% of current-cost capital, i.e., $(I - \text{CAPX})/K^{\$} > 15\%$. This screen drops about 9.41% of firm-years. The 15% cutoff is commonly used in the investment literature (Whited 1992).[26] From Table 9, imposing the screen drops the mean investment rate from 23.8% to 17.6% and the standard deviation from 37.2% to 25.7%. However, the skewness (as the standardized third moment) rises from 3.33 to 3.83, and kurtosis from 14.28 to 24.55. The autocorrelation also increases from 0.34 to 0.43. Because the screen drops positive investment rates, the fraction of negative rates rises from 5.51% to 6%, but the fraction of positive investment spikes (> 20%) falls from 32.7% to 26.7%. Imposing a deeper cutoff of 5% on the M&A screen excludes about 18.5% of the firm-years, but the results are largely similar to those with the 15% cutoff. The skewness, in particular, goes up further to 4.09. Finally, the histograms in Panels C and D of Figure 6 confirm the distributional asymmetry without large M&As.

In the third experiment we exclude the first three years of observations for a given firm (Age > 3). This screen removes about 11.46% of firm-years. Because firms that have recently experienced initial public offerings tend to invest more (Lyandres, Sun, and Zhang 2008), the mean investment rate falls to 19.8%, and the standard deviation to 29.7%. However, the skewness rises to 3.8, and kurtosis to 21.6. The fraction of negative investment rates goes up slightly to 5.57%, but the fraction of positive investment spikes (>20%) falls slightly to 29.2%. The impact of excluding the first five years of data for any firm is larger, but going in the same direction. Finally, Panels E and F of Figure 6 confirm the distributional asymmetry with the firm age screens.

In the fourth experiment, for each fiscal year, we split the full sample into two, small and big, based on the NYSE median of the beginning-of-fiscal year market equity (ME). The small-ME sample has in total 130,892 firm-years, and the big-ME sample 36,954. The mean investment rate is higher in small firms, 24.75% versus 20.32%, and the cross-sectional standard deviation is also

[26] More precisely, prior studies exclude observations with the target's assets at least 15% of the acquirer's total assets. For example, Gonçalves, Xue, and Zhang (2020) identify M&As by taking the maximum of acquisitions (item AQC) in Compustat and the total value of acquisitions from the Securities Data Company (SDC) dataset (zero if missing in both databases). The 15% cutoff screens out about 5.9% of their firm-years. We view our new screen of $(I - \text{CAPX})/K^{\$} > 15\%$ as more accurate and effective. First, Compustat item AQC only accounts for cash acquisitions, which include non-PPE assets but exclude noncash acquisitions. Second, the SDC data start in 1978 but have meaningful coverage only from 1981 onward. Third, given our focus on current-cost investment rates, scaling by current-cost capital is more relevant than scaling by book assets. Finally, because current-cost capital is in general smaller than book assets (Table 8), our new screen is more stringent, dropping 9.41% of the firm-years.

higher, 38.9% versus 27%. Because of aggregation over more plants and more heterogeneous capital goods, big firms have a higher autocorrelation of investment rates, 0.44 versus 0.32, but a lower fraction of negative investment rates, 2.87% versus 6.31%. Big firms also have higher skewness, 3.98 versus 3.14, and higher excess kurtosis, 24.2 versus 12.6 than small firms.

Splitting the sample around the NYSE median current-cost capital has a larger impact on the investment rate moments. The mean is 26.56% in small firms but only 12.91% in big firms. The standard deviation is also higher in small firms, 40.3% versus 15.54%. However, the big-$K^{\$}$ sample has a higher skewness, 3.79 versus 3.02, a higher kurtosis, 30 versus 11.5, and a substantially lower fraction of positive investment spikes (>20%), 16.3% versus 37.08%. Finally, the last four panels of Figure 6 shows the distributional asymmetry in the subsamples split by two measures of firm size.

4.2.2 NAICS Sectors and Industries

We next study how the firm-level investment rate distribution varies across the 19 nonfinancial NAICS sectors and 58 industries. Table S10 in the Internet Appendix shows the number of Compustat firms per year across the sectors and industries from 1963 to 2020. Across the sectors, the average number of firms ranges from 11 for agriculture, forestry, fishing, and hunting to 1,038 for durable goods. The minimum number of firms in a given year varies from only one for health care and social assistance to 347 for durable goods. In fact, the minimum number of firms is below ten for ten out of the 19 sectors. Across the industries, the average number of firms varies from only two for two industries to 402 for computer and electronic products. The minimum number of firms goes from only one in 14 different industries to 91 in machinery.

Because the number of firms in a given year can be small in some sectors and industries, cross-sectional moments are unreliable, even after averaging over time. As such, we opt to calculate the investment rate moments by pooling all the firm-years within a given sector or industry. To set the background, Table 10 first shows the panel data moments for the entire sample. Relative to the time series averages of cross-sectional moments in Table 7, the panel mean is slightly higher, 25.4% versus 23.8%. The panel standard deviation is much higher, 46.7% versus 37.2%. So are the skewness, 5.52 versus 3.33, and kurtosis, 47.4 versus 14.3. However, the median, serial correlation, and fractions of negative investment rates and positive spikes are largely comparable.

Across the 19 sectors, the mean investment rate ranges from 8.93% for utilities to 41.84% for the information sector, and the standard deviation varies from 18.34% for utilities to 72.5% for information. More important, the investment rate distributions are all right-skewed, with the skewness varying from 2.27 in management of companies and enterprises to 14.66 in utilities. The latter sector is an outlier, as the second highest skewness is only 5.92 for retail trade. The fraction of negative investment rates is the lowest in utilities, 2.77%, the second lowest in retail trade, 4.25%, and the highest in management of companies and enterprises, 11.85%.

Across the 58 nonfinancial industries, the mean investment rate ranges from 8.93% for utilities to 49.74% for information and data processing services, and the standard deviation varies from 18.34% for utilities to 100.27% for real estate. The investment rate distributions are again all right-skewed, with the skewness varying from 2.27 in management of companies and enterprises to 14.66 in utilities. The second lowest skewness is 2.62 for real estate, and the second highest is 9.15 for railroad transportation. The fraction of negative investment rates remains the lowest in utilities, 2.77%, and the highest in real estate, 24.24%. The fraction of 3.57% in railroad transportation is the second lowest, and 11.85% for management of companies and enterprises the second highest.

Figure 7 shows the histogram of the firm-level investment rate distribution for each sector. The histograms are all heavily right-skewed in a similar way as in the histogram of the full sample in Figure 4. Sector 22 (utilities) stands out in that despite its long right tail, has most of its probability mass concentrated around its median, giving rise to an extremely high excess kurtosis of 297.35 (Panel C). This feature likely reflects the regulated nature of this sector, which limits competition.

4.3 Is Firm-level Investment Lumpy?

Despite the tiny fraction of inactive investment rates (2.85%), the large positive investment spike rates in Table 7 indicate that firm-level investment is lumpy. In this subsection, we further quantify the lumpiness via the Doms-Dunne (1998) style tests. We show that firm-level investment is indeed lumpy, but the lumpiness is somewhat weaker than the plant-level evidence.

As noted, for each plant in their balanced panel, Doms and Dunne (1998) calculate the fraction of investment in each year out of the total investment in the time series. About one half of the total investment is completed in just three years (about 20% of the total number of years). To ease comparison, we split our unbalanced Compustat sample by decade. For each decade, we include only firms with complete coverage to obtain a balanced panel. For each firm in a given panel, we rank its current-cost investment rates in the time series in a descending order. We compute the fraction of the ranked investment in each year out of the total absolute value of investments in the time series. Figure 8 shows the fractions averaged across all firms within a given balanced panel.

Firm-level current-cost investment is lumpy. In the 1963–1970 panel, averaged across 768 firms, the top two years account for 41.4% of total investment (Panel A). In the 2011–2020 panel, across 1,281 firms, the top two years account for 43.45% of total investment over the decade (Panel F). Averaged across all six decades, about 39% of total investment is completed in two years (20% of the total number of years). Replacing current-cost investment rates with real investment rates yields quantitatively similar results (Figure S3 in the Internet Appendix). In particular, averaged across the six decades, about 40% of total real investment is completed within two years.

Restricting the analysis on balanced panels might entail selection bias. To mitigate this concern, we also split the sample into 11 groups based on firm age (the number of years in Compustat): 5–9, 10–14, …, 55–58 years. We drop firms with fewer than five years of investment rates to minimize noise. Each group is an unbalanced panel. For each firm in a given group, we rank its time-series current-cost investment rates in the descending order. We calculate the fraction of the ranked investment in each year out of the total absolute value of investment in the time series. Figure 9 shows the fractions averaged across all the firms within a given group.

Firm-level current-cost investment is again lumpy. From Panel A, in the 5–9 years age group, about 52.1% of total investment is completed within two years. From Panel F, in the 30–34 years group, about 35.9% of total investment is completed within seven years (about 20% of the total number of years). In the 55–58 years group, about 30.9% of total investment is done within 12 years (Panel K). Averaged across all the age groups, about 39% of total investment is done within the top 20% of the years. Replacing current-cost investment rates with real investment rates again yields quantitatively similar results (Figure S4 in the Internet Appendix). In particular, averaged across all the age groups, 42.4% of total real investment is completed within the top 20% of the years.

5 Conclusion

Integrating economic accounting in national accounts with financial accounting, we estimate firm-specific current-cost capital stocks for the entire Compustat universe. We also offer a myriad of estimates of investment flows, economic depreciation rates, capital and investment price deflators, as well as a meticulous mapping between Compustat firms and NAICS industry classification.

The firm-level current-cost investment rate distribution is heavily right-skewed, with a small fraction of negative investment rates, 5.51%, versus a huge fraction of positive investment rates, 91.64%. The asymmetry evidence is even stronger than the Cooper-Haltiwanger (2006) plant-level evidence. Despite a tiny fraction of inactive investment rates, 2.85%, firm-level investment is also lumpy, featuring a fraction of 32.66% for positive spikes (investment rates higher than 20%). For a typical firm, about 39% of total investment is completed within 20% of the sample years. The latter two estimates on lumpiness are largely comparable with prior plant-level estimates.

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Table 1 : The BEA's Current-cost Investment Rates, 1963–2020

From the detailed tables for 63 private NAICS-industries from the BEA's fixed assets accounts, we obtain: (i) current-cost investments in private nonresidential equipment, $I_{jt}^{\mathcal{E}\$}$, and structure, $I_{jt}^{\mathcal{S}\$}$, by industry, millions of dollars, annual, 1947–2020; and (ii) current-cost capital stocks in private nonresidential equipment, $K_{jt}^{\mathcal{E}\$}$, and structure, $K_{jt}^{\mathcal{S}\$}$, by industry, millions of dollars, annual, 1947–2020. For industry j in year t, we calculate its current-cost investment rate as $I_{jt}^{\$}/K_{jt-1}^{\$} = (I_{jt}^{\mathcal{E}\$} + I_{jt}^{\mathcal{S}\$})/(K_{jt-1}^{\mathcal{E}\$} + K_{jt-1}^{\mathcal{S}\$})$. We also calculate current-cost investment rates for the 20 BEA sectors (and the aggregate economy) by summing up investments and capital stocks across all the industries within each sector (and the whole economy). For sector s in year t, its current-cost investment rate is $I_{st}^{\$}/K_{st-1}^{\$} = (\sum_{j\in s} I_{jt}^{\mathcal{E}\$} + \sum_{j\in s} I_{jt}^{\mathcal{S}\$})/(\sum_{j\in s} K_{jt-1}^{\mathcal{E}\$} + \sum_{j\in s} K_{jt-1}^{\mathcal{S}\$})$, and the aggregate current-cost investment rate is $I_{t}^{\$}/K_{t-1}^{\$} = (\sum_{j} I_{jt}^{\mathcal{E}\$} + \sum_{j} I_{jt}^{\mathcal{S}\$})/(\sum_{j} K_{jt-1}^{\mathcal{E}\$} + \sum_{j} K_{jt-1}^{\mathcal{S}\$})$. All moments are in percent, except for skewness (Skew), excess kurtosis (Kurt, relative to the kurtosis of three for the normal distribution), and the first-order autocorrelation (ρ_1).

	Mean	Std	Skew	Kurt	Min	Median	Max	ρ_1
Panel A: Time series of aggregate investment rates								
Aggregate	9.63	1.27	−0.09	−0.60	6.56	9.49	12.08	0.83
Panel B: Pooled Panels of sector (industry) investment rates								
Sector	10.59	4.55	1.06	1.04	2.48	9.61	28.31	0.95
Industry	11.39	6.13	1.61	4.39	0.22	10.08	46.36	0.93
Panel C: Time series of sector investment rates								
Agriculture, forestry, fishing, and hunting	9.25	2.51	0.15	−0.85	4.61	8.82	14.03	0.89
Mining	9.42	3.28	1.70	4.06	4.31	8.63	22.52	0.81
Utilities	6.31	1.12	0.47	−0.55	4.34	6.05	8.76	0.82
Construction	16.60	4.69	−0.23	−0.87	7.06	16.94	24.25	0.81
Nondurable goods	9.98	1.89	0.64	−0.16	6.74	9.58	15.32	0.90
Durable goods	10.34	2.48	0.63	−0.09	6.20	9.95	17.47	0.85
Wholesale trade	16.99	5.86	0.20	−1.25	7.25	16.25	28.31	0.92
Retail trade	8.94	1.72	−0.86	−0.30	4.59	9.38	11.39	0.89
Transportation and warehousing	6.61	1.49	0.47	−0.86	4.02	6.26	9.67	0.82
Information	12.23	2.02	0.45	−0.08	8.64	11.83	18.23	0.81
Finance and insurance	15.57	4.46	−0.14	−0.99	5.87	15.58	22.82	0.91
Real estate and rental and leasing	11.14	3.46	0.37	−0.83	4.70	10.02	18.35	0.85
Professional, scientific, and technical services	17.14	3.23	0.96	1.07	12.05	16.83	27.41	0.85
Management of companies and enterprises	7.33	3.34	0.11	−1.44	2.48	6.67	13.28	0.98
Administrative and waste management services	12.72	2.33	1.49	2.81	9.15	12.27	20.25	0.75
Educational services	6.34	1.67	0.39	−1.07	3.71	6.04	9.41	0.93
Health care and social assistance	10.53	1.84	1.37	1.23	8.48	10.08	15.72	0.93
Arts, entertainment, and recreation	9.14	2.36	1.46	3.45	5.59	8.77	18.18	0.83
Accommodation and food services	8.97	2.22	0.69	0.89	4.40	9.03	15.20	0.87
Other services, except government	6.33	1.55	0.38	−0.20	3.71	6.20	10.15	0.91
Panel D: Time series of industry investment rates								
Farms	8.90	2.63	0.13	−0.88	4.05	8.55	14.00	0.89
Forestry, fishing, and related activities	14.20	3.63	0.74	0.65	7.16	13.93	25.39	0.60
Oil and gas extraction	8.71	3.34	2.31	7.22	4.18	7.82	23.71	0.78
Mining, except oil and gas	10.98	4.44	0.75	0.11	4.64	10.95	22.67	0.90
Support activities for mining	13.65	5.54	0.712	0.82	4.03	12.89	31.85	0.79
Utilities	6.31	1.12	0.47	−0.55	4.34	6.05	8.76	0.82
Construction	16.60	4.69	−0.23	−0.87	7.06	16.94	24.25	0.81
Food and beverage and tobacco products	9.06	1.24	0.42	−0.91	6.87	8.73	11.56	0.83
Textile mills and textile product mills	7.09	3.09	0.47	−0.08	2.67	7.53	16.38	0.91
Apparel and leather and allied products	7.96	4.55	0.60	−0.10	1.81	8.19	19.91	0.94
Wood products	10.92	3.51	0.47	−0.43	4.13	10.05	19.54	0.85

	Mean	Std	Skew	Kurt	Min	Median	Max	ρ_1
Panel D: Time series of industry investment rates (continued)								
Paper products	10.06	3.02	0.46	−0.23	4.24	9.55	18.18	0.85
Printing and related support activities	11.56	3.71	−0.23	−0.77	4.72	12.13	19.75	0.92
Petroleum and coal products	8.74	2.58	0.47	−0.55	4.70	8.31	15.05	0.72
Chemical products	11.13	2.84	0.90	0.56	6.84	10.80	19.57	0.85
Plastics and rubber products	13.45	3.80	0.64	−0.26	6.26	12.82	21.56	0.87
Nonmetallic mineral products	8.73	2.36	0.41	−0.08	4.39	8.50	15.18	0.73
Primary metals	6.47	2.29	1.14	0.86	3.11	5.76	13.09	0.89
Fabricated metal products	9.60	2.57	0.91	0.32	5.52	9.05	16.72	0.85
Machinery	10.38	3.56	0.35	−0.93	4.86	9.80	18.12	0.89
Computer and electronic products	12.96	4.52	0.23	−0.56	5.62	12.97	24.26	0.86
Electrical equipment, appliances, and components	11.13	4.29	0.43	−0.90	4.87	10.70	21.48	0.89
Motor vehicles, bodies and trailers, and parts	14.46	3.59	−0.01	−0.33	6.27	14.90	22.23	0.66
Other transportation equipment	10.44	3.31	1.48	3.67	5.53	9.73	23.54	0.76
Furniture and related products	11.25	3.34	0.16	−0.37	4.17	11.39	18.70	0.82
Miscellaneous manufacturing	11.77	3.27	0.80	−0.32	6.44	10.80	19.74	0.91
Wholesale trade	16.99	5.86	0.20	−1.25	7.25	16.25	28.31	0.92
Retail trade	8.94	1.72	−0.86	−0.30	4.59	9.38	11.39	0.89
Air transportation	11.16	5.50	1.25	1.02	4.02	9.05	26.61	0.79
Railroad transportation	2.49	0.80	0.91	0.07	1.42	2.21	4.74	0.86
Water transportation	9.19	2.97	0.49	−0.69	4.21	8.63	16.16	0.80
Truck transportation	20.76	5.53	0.26	−0.38	9.41	20.32	34.22	0.55
Transit and ground passenger transportation	5.87	2.08	0.74	0.13	3.05	5.77	12.19	0.71
Pipeline transportation	6.75	3.00	1.04	0.84	2.99	6.43	15.54	0.70
Other transportation and support activities	7.34	2.04	1.00	1.41	3.93	7.01	14.07	0.70
Warehousing and storage	7.21	2.54	0.51	−0.46	2.99	6.71	13.31	0.75
Publishing industries (includes software)	14.02	2.50	0.15	−0.29	9.19	13.95	19.99	0.76
Motion picture and sound recording industries	11.38	4.13	−0.14	−1.47	4.70	11.77	18.09	0.93
Broadcasting and telecommunications	11.55	2.54	0.23	−0.60	7.43	11.32	18.51	0.86
Information and data processing services	27.00	8.01	0.35	−0.76	13.21	25.91	42.54	0.77
Federal Reserve banks	12.02	9.19	1.44	2.05	1.98	10.58	42.45	0.89
Credit intermediation and related activities	16.11	3.72	−0.36	−0.12	5.65	16.03	23.49	0.81
Securities, commodity contracts, and investments	21.73	12.55	0.40	−1.26	5.45	17.85	46.36	0.95
Insurance carriers and related activities	13.14	5.85	0.04	−1.37	4.45	13.78	23.80	0.95
Funds, trusts, and other financial vehicles	9.10	5.59	−0.07	−0.39	0.22	9.92	23.30	0.87
Real estate	8.15	4.11	0.56	−1.15	2.68	6.18	17.36	0.89
Rental and leasing services and lessors of intangible assets	23.13	7.43	0.78	0.50	8.16	21.85	43.19	0.79
Legal services	13.10	3.71	0.35	−1.09	7.95	12.61	21.08	0.79
Miscellaneous professional, scientific, and technical services	17.12	2.96	0.37	−0.42	12.21	17.26	24.59	0.78
Computer systems design and related services	21.53	6.86	1.68	3.47	12.58	20.56	46.07	0.84
Management of companies and enterprises	7.33	3.34	0.11	−1.44	2.48	6.67	13.28	0.98
Administrative and support services	17.34	2.91	0.41	−0.15	11.37	16.90	25.16	0.69
Waste management and remediation services	8.81	3.79	1.31	1.78	3.93	8.16	20.93	0.88
Educational services	6.34	1.67	0.39	−1.07	3.71	6.04	9.41	0.93
Ambulatory health care services	12.88	2.38	0.96	0.39	9.52	11.95	19.58	0.86
Hospitals	9.53	1.97	1.29	0.49	7.26	8.86	14.41	0.95
Nursing and residential care facilities	10.91	2.79	0.65	0.01	6.84	10.82	18.39	0.89
Social assistance	9.37	2.07	0.29	−0.61	5.53	9.30	13.68	0.69
Performing arts, spectator sports, museums, and related activities	8.60	1.92	1.00	2.40	5.21	8.50	15.76	0.73
Amusements, gambling, and recreation industries	9.49	2.79	1.47	2.80	5.83	8.91	19.65	0.84
Accommodation	7.53	2.72	1.33	2.64	3.56	7.18	17.17	0.80
Food services and drinking places	10.78	2.57	−0.38	−0.99	5.20	11.30	15.46	0.91
Other services, except government	6.33	1.55	0.38	−0.20	3.71	6.20	10.15	0.91

Table 2 : Time Series Averages of Cross-sectional Moments for 40 Firm-level Investment Rates in Compustat, 1963–2020

All investment rates are winsorized at the 1%–99% level each year (fiscal years ending in a calendar year). f_{-} is the fraction of negative investment rates ($< -1\%$), and f_0 is the fraction of inactive investment rates (between -1% and 1%). Both fractions are computed before winsorization (with no visible changes after winsorization). The mean, standard deviation (Std), the percentiles, f_{-}, and f_0 are all in percent. The investment rates are scaled by 1-year-lagged capital, except for a few with the average of current and 1-year-lagged capital. Appendix A details the variable definitions.

	Start	#Obs.	Mean	Std	Skew	Kurt	1st	5th	25th	50th	75th	95th	99th	ρ_1	f_{-}	f_0
CAPX/AT	1963	174,575	7.82	8.41	2.64	8.69	0.19	0.80	2.79	5.25	9.50	24.18	50.16	0.66	0.01	8.92
CAPX/PPENT	1963	174,470	33.22	38.22	3.16	12.82	1.14	4.45	12.59	21.72	38.32	100.80	250.61	0.39	0.01	1.08
dAT/AT	1963	178,300	14.04	33.96	2.58	10.09	−41.84	−21.09	−1.60	7.04	19.15	73.84	196.14	0.20	25.91	4.98
(dPPEGT+dINVT)/AT	1963	174,279	8.70	16.16	1.76	7.12	−31.70	−10.16	1.25	5.90	12.81	37.18	85.91	0.28	16.76	9.60
Inv/AT	1971	140,852	10.73	15.91	2.54	9.39	−19.63	−3.04	2.70	6.50	13.37	40.12	93.16	0.31	6.28	7.63
CAPX/PPEGT	1963	173,939	18.08	21.95	3.23	13.01	0.59	2.32	6.61	11.31	20.25	57.24	143.30	0.50	0.01	2.04
dPPEGT/AT	1963	176,979	6.66	12.52	2.11	9.07	−25.66	−5.96	1.22	4.09	8.99	28.34	70.20	0.34	11.51	13.87
(dPPENT+DP)/PPENT	1963	177,412	40.28	62.90	3.47	15.84	−38.02	−3.95	11.05	22.78	45.33	141.65	423.85	0.25	6.01	1.48
(CAPX−SPPE)/PPEGT	1963	173,939	17.13	21.65	3.18	12.76	−6.20	1.30	6.03	10.71	19.38	55.58	139.87	0.48	1.86	2.64
(CAPX−SPPE)/AT	1963	174,575	7.32	8.12	2.53	8.20	−3.04	0.44	2.50	4.95	9.09	23.03	47.60	0.63	1.53	10.05
dPPENT/AT	1963	178,130	3.96	10.24	2.59	10.79	−17.87	−5.74	−0.53	1.61	5.49	21.73	58.36	0.31	20.61	25.65
(CAPX+AQC)/AT	1971	156,073	10.42	13.35	2.96	10.59	0.09	0.68	2.90	6.08	12.13	36.01	81.14	0.37	0.23	8.51
CAPXV/AT	1963	175,818	8.21	9.02	2.68	8.97	0.20	0.83	2.87	5.46	9.93	25.70	54.13	0.63	0.01	8.78
(CAPX−SPPE)/PPENT	1963	174,470	31.58	37.94	3.10	12.50	−11.09	2.55	11.47	20.54	36.89	98.59	45.99	0.39	2.05	1.42
(CAPX+AQC−SPPE)/AT	1971	156,073	9.80	13.08	2.93	10.62	−4.12	0.27	2.55	5.69	11.57	34.52	79.30	0.35	1.90	9.62
(CAPXV−SPPE)/AT	1963	175,818	7.72	8.73	2.60	8.57	−2.92	0.47	2.59	5.15	9.51	24.55	51.66	0.61	1.49	9.88
dPPEGT/PPEGT	1963	176,979	17.17	34.98	3.02	13.89	−47.23	−13.49	2.81	8.86	20.37	74.01	220.32	0.27	13.77	5.04
dPPENT/PPENT	1963	178,130	18.78	52.54	3.42	15.96	−55.04	−24.56	−3.32	6.23	22.40	101.79	338.91	0.17	30.47	5.43
(dPPENT+DP)/AT	1963	177,412	8.45	11.53	2.68	10.20	−12.22	−0.99	2.46	5.41	10.41	29.42	69.19	0.40	4.71	9.45
(CAPXV−SPPE)/PPEGT	1963	175,189	17.78	22.83	3.23	13.14	−6.00	1.36	6.14	10.96	20.00	58.05	148.78	0.47	1.81	2.57
dBe/Be	1963	173,570	14.61	48.28	3.00	14.66	−67.92	−35.10	−2.93	7.31	18.51	86.90	302.80	0.15	25.30	3.77
(CAPX−SPPE)/avePPENT	1963	174,449	25.67	22.13	1.64	3.52	−12.91	2.67	11.44	19.78	33.52	71.03	115.04	0.51	2.07	1.34
dNoa/AT	1963	173,959	8.61	22.60	2.22	8.43	−35.12	−16.60	−2.12	4.36	13.45	48.13	123.81	0.17	29.15	7.52
dLno/aveAT	1963	156,965	8.47	13.38	1.48	5.02	−27.13	−6.57	1.95	5.80	12.03	34.14	65.70	0.26	11.17	8.23
dNca/AT	1963	174,140	6.71	18.22	2.82	11.63	−26.13	−9.80	−1.07	2.43	8.64	37.77	107.59	0.20	25.06	15.26
dBe/AT	1963	175,214	6.32	20.57	2.27	10.24	−36.25	−17.48	−1.33	3.43	9.22	38.88	117.57	0.22	23.25	9.04
(CAPXV+AQC)/PPENT	1971	156,108	64.03	128.63	4.49	23.53	0.65	4.26	13.86	26.68	55.33	238.47	930.84	0.26	0.27	1.15
CAPXV/PPENT	1963	175,713	34.20	40.19	3.21	13.19	1.17	4.52	12.68	22.07	39.27	104.54	264.92	0.38	0.01	1.05
CAPXV/PPEGT	1963	175,189	18.73	23.13	3.27	13.30	0.62	2.38	6.73	11.57	20.87	59.68	151.73	0.48	0.01	1.98
(CAPX+IVCH−SIV)/ (PPENT+IVAEQ+IVAO)	1971	127,812	37.60	61.79	3.61	18.08	−66.15	−0.66	11.15	21.67	41.81	128.45	422.03	0.24	3.53	1.51
(dPPENT+WDP+DPC)/PPEGT	1971	164,132	26.89	46.09	3.67	17.26	−28.67	−2.78	6.55	13.77	28.81	99.47	312.94	0.43	5.94	2.39
dNAT/NAT	1963	171,802	19.60	54.48	3.39	15.87	−50.90	−24.19	−2.48	6.92	22.29	102.58	355.38	0.14	28.63	5.29
CAPX/(AT−INVT)	1963	173,208	9.54	9.50	2.44	7.46	0.24	1.07	3.68	6.78	11.76	28.43	55.61	0.63	0.01	7.19
(CAPX+AQC)/PPEGT	1971	155,471	31.52	59.50	4.29	21.64	0.34	2.12	7.02	13.49	28.44	118.91	419.73	0.33	0.26	2.24
CAPX/(PPENT−CAPX+DP)	1963	174,085	31.72	35.37	3.13	12.59	1.19	4.48	12.40	21.20	36.89	94.50	232.35	0.41	0.01	1.05
(CAPXV−SPPE)/(AT−ACT)	1963	172,457	19.94	24.10	2.95	11.11	−6.62	1.39	6.76	12.76	23.46	64.05	151.41	0.44	1.82	3.29
(CAPXV−SPPE)/PPENT	1963	175,713	32.57	39.90	3.16	12.96	−10.78	2.62	11.57	20.91	37.88	101.99	260.65	0.37	2.00	1.37
(CAPX−DP)/AT	1963	174,403	3.38	7.13	2.64	9.59	−7.51	−3.11	−0.26	1.48	4.56	16.78	40.17	0.56	16.94	30.67
CAPX/(AT−CHE)	1963	174,423	9.80	11.54	2.92	10.65	0.23	0.99	3.29	6.23	11.43	31.59	71.62	0.60	0.00	6.43
dNCAT/NCAT	1963	177,030	17.10	43.08	3.01	13.11	−46.18	−21.97	−1.75	7.38	21.52	87.99	267.13	0.17	27.00	5.01

Table 3 : Prior Firm-Level Studies with the Perpetual Inventory Method

This table reviews 33 prior studies that apply the perpetual inventory method to construct firm-specific current-cost capital stocks. We only highlight their key elements, while leaving the full technical details of implementation to the original sources.

Paper	Sample	Investment flows	Price deflators	Depreciation rates	Initial capital stock
Lindenberg and Ross (1981)	246 firms in Compustat, 1960–1977	"gross investment (book) in plant and equipment" (p. 10)	Nonresidential fixed investment price deflator	Accounting depreciation rate, DP/PPENT; also estimate the rate of technological progress	PPENT
Salinger and Summers (1983)	30 Dow Jones companies, 1959–1978	"Investment for years $1959-L+1$ to 1978 proportional to aggregate investment and consistent with gross property, plant, and equipment in 1959" (p. 279)	Consumer Price Index (CPI)	double declining: 2/the average PPEGT/DP	Determined jointly with investment
Smirlock, Gilligan, and Marshall (1984)	231 manufacturing firms	change in gross PPE	GNP implicit price deflator	constant, 5%	book value in 1961
Fazzari, Hubbard, and Petersen (1988)	Manufacturing firms, 1970–1984, Value Line	"capital spending" (p. 193)	Implicit price deflator for fixed nonresidential investment	single declining: 1/the average PPEGT/DP	"the value of net plant (adjusted to market value with aggregate data)" (p. 193)
Hall (1990)	mostly Compustat firms 1979–1987	not specified	GNP deflator for fixed nonresidential investment	Accounting depreciation rate	PPENT
Hoshi and Kashyap (1990)	580 Japanese manufacturing firms	change in book value of capital plus depreciation	the wholesale price index for investment goods	firm-specific but constant δ, either average exponential rate, $1-\alpha^{1/L_i}$, L_i: average life	not specified
Hayashi and Inoue (1991)	687 Japanese manufacturing firms, 1977–1986	change in net PPE plus accounting depreciation	Price of nonresidential buildings and structures as the construction material component of Wholesale Price Index (WPI) from Bank of Japan; price of machinery and instruments and tools as weighted averages of subcomponents in WPI; price of transportation equipment as the matching component of WPI; price of land as the urban land prices index	4.7% for nonresidential buildings; 5.64% for structures; 9.489% for machinery; 14.7% for transportation equipments; 8.838% for instruments and tools; 0% for land	"the book value of capital for the 1962 fiscal year" (p. 738)
Blundell, Bond, and Devereux (1992)	532 U.K. manufacturing firms from Datastream	total new fixed assets	"implicit price deflator for gross fixed investment by manufacturing industry" (p. 254)	8.19% for plant and machinery; 2.5% for buildings	"historic cost valuations of the capital stock in the first year of data, usually 1968" (p. 254)
Whited (1992)	325 manufacturing firms in Compustat, 1972–1986	capital expenditure on PPE	GNP price deflator for nonresidential investment, tax-adjusted	double declining: 2/the average PPEGT/DP	PPEGT
Lang and Stulz (1994)	1,449 Compustat firms in 1984	change in gross PPE	implicit GNP price deflator	constant, 5% or first observation	book value of PPE in 1970
Bond and Meghir (1994)	626 U.K. manufacturing firms from Datastream	total new fixed assets	"implicit price deflator for gross fixed investment by manufacturing industry" (p. 218)	8.19% for plant and machinery; 2.5% for land and buildings	"historic cost valuations of capital stock for the first year of data available (usually 1968)" (p. 218)

Paper	Sample	Investment flows	Price deflators	Depreciation rates	Initial capital stock
Hubbard, Kashyap, and Whited (1995)	428 manufacturing firms in Compustat, 1976–1987	capital expenditure on PPE	GNP price deflator for nonresidential investment	double declining: 2/the average PPEGT/DP	PPEGT
Leahy and Whited (1996)	772 manufacturing firms in Compustat, 1981–1987	capital expenditure on PPE	GNP price deflator for nonresidential investment	double declining: 2/the average PPEGT/DP	PPEGT
Eberly (1997)	Global Vantage industrial database, 1981–1994	capital expenditure	implicit price deflator for nonresidential investment/ the producer price index	2-digit SIC-industry, double declining: 2/the average PPEGT/DP	not specified
Lewellen and Badrinath (1997)	678 Compustat firms, 1975–1991	change in PPENT plus accounting depreciation	GNP deflator for fixed nonresidential investment	straight-line depreciation	missing values
Barnett and Sakellaris (1998)	manufacturing firms from Hall (1990)	capital expenditure on PPE	GNP deflator for fixed nonresidential investment	accounting depreciation rate	PPENT
Erickson and Whited (2000)	737 manufacturing firms in Compustat, 1992–1995	capital expenditure on PPE	nonresidential investment price deflator, tax-adjusted	double declining: 2/the average PPEGT/DP	PPEGT
Abel and Eberly (2001)	Compustat, 1974–1993, 604 firms on average per year	capital expenditure on PPE minus sales of PPE	implicit price deflator for nonresidential investment from Economic Report of the President	2-digit SIC-industry, double declining: 2/the average PPEGT/DP	net PPE
Gomes (2001)	Compustat, 1979–1988	spending on PPE minus capital retirements	deflator for nonresidential fixed investment from DRI	double declining: 2/the average PPEGT/DP	PPEGT
Chirinko and Schaller (2004)	193 Canadian firms, 1973–1986	capital expenditure on PPE	implicit price index for business investment in machinery and equipment	double declining: 2/the average PPEGT/DP	net PPE
Hennessy (2004)	278 manufacturing firms in Compustat, 1992–1995	capital expenditure on PPE	nonresidential investment price deflator, tax-adjusted	double declining: 2/the average PPEGT/DP	PPEGT
Bloom, Bond, and Reenen (2007)	U.K. manufacturing firms from Datastream	total new fixed assets minus sales of fixed assets	"an aggregate series for investment goods prices" (p. 413)	a constant rate of 8%	inflation-adjusted net book value of tangible fixed assets
Gan (2007a)	847 Japanese manufacturing firms	change in net PPE plus accounting depreciation	same in Hayashi and Inoue (1991)	same in Hayashi and Inoue (1991)	book value of assets in 1960
Gan (2007b)	420 Japanese manufacturing firms	change in net PPE plus accounting depreciation	same in Hayashi and Inoue (1991)	same in Hayashi and Inoue (1991)	book value of assets
Gaspar and Massa (2007)	About 847 firms per year, Compustat	change in net PPE	consumer price index	a constant rate of 5%	first available net PPE
Benfratello, Schiantarelli, and Sembenelli (2008)	Italian manufacturing firms	investment in plants and machinery	the aggregate business investment price index	a constant rate of 5%	"the accounting value" (p. 216)

Paper	Sample	Investment flows	Price deflators	Depreciation rates	Initial capital stock
Bloom (2009)	Compustat, 1981–2000	capital expenditure on PPE minus sales of PPE	industry-level investment price deflators, from NBER-CES manufacturing database	industry-level depreciation rates from NBER-CES manufacturing database	PPENT
Chirinko and Schaller (2009)	Compustat, 1980–2001	CAPX; for substantial acquisition, change in PPEGT plus PPE retirements (item PPEVR); for substantial disinvestment, change in PPENT plus economic depreciation	BEA sector-specific investment price deflators based on chain-type quantities, tax-adjusted	BEA sector-specific current-cost depreciation rates based on chain-type quantities	PPENT deflated with industry-specific investment price, adjusted for industry-specific current-cost/PPENT ratios
Eberly, Rebelo, and Vincent (2012)	776 Compustat firms, 1981–2003, top quartile on capital stock in 1981	capital expenditure on PPE	implicit price deflator for nonresidential investment from Economic Report of the President	2-digit SIC industry, double declining: 2/the average PPEGT/DP	net PPE
Panousi and Papanikolaou (2012)	Compustat, 1970–2005	CAPX	price deflator for fixed nonresidential investment	3-digit SIC industry, double declining	gross PPE
Moyen and Platikanov (2013)	Compustat, 1988–2009	CAPX	producer price index for finished goods: capital equipment	double declining: 2/the average PPEGT/DP	gross PPE
Bustamante (2016)	Compustat, 1980–2014	CAPX minus SPPE	nonresidential investment deflator	accounting depreciation	gross PPE
Belo, Gala, Salomao, and Vitorino (2022)	Compustat, 1975–2016	change in PPENT plus accounting depreciation	equipment and structure deflators	accounting depreciation	net PPE

Table 4 : Annual Growth Rates in the BEA's Capital Price Deflators, 1963–2020

From the detailed tables for 63 private industries from BEA's fixed assets accounts, we obtain: (i) current-cost (current-dollar) capital stocks in private non-residential equipment, $K_{jt}^{\mathcal{E}\$}$, and structure, $K_{jt}^{\mathcal{S}\$}$, by industry, annual, 1947–2020; and (ii) fixed-cost (constant-dollar) capital stocks in private non-residential equipment, $K_{jt}^{\mathcal{E}}$, and structure, $K_{jt}^{\mathcal{S}}$, by industry, annual, 1947–2020. Industry j's capital price deflator is $P_{jt}^K = (K_{jt}^{\mathcal{E}\$} + K_{jt}^{\mathcal{S}\$})/(K_{jt}^{\mathcal{E}} + K_{jt}^{\mathcal{S}})$, and its growth rate is $P_{jt+1}^K/P_{jt}^K - 1$. We calculate capital price deflators for the 20 BEA sectors by aggregating across all the industries within each sector. Sector s's capital price deflator is $P_{st}^K = (\sum_{j\in s} K_{jt}^{\mathcal{E}\$} + \sum_{j\in s} K_{jt}^{\mathcal{S}\$})/(\sum_{j\in s} K_{jt}^{\mathcal{E}} + \sum_{j\in s} K_{jt}^{\mathcal{S}})$. The aggregate capital price deflator is $P_t^K = (\sum_j K_{jt}^{\mathcal{E}\$} + \sum_j K_{jt}^{\mathcal{S}\$})/(\sum_j K_{jt}^{\mathcal{E}} + \sum_j K_{jt}^{\mathcal{S}})$. All moments are in percent, except for skewness (Skew), excess kurtosis (Kurt, relative to three for the normal distribution), and the serial correlation (ρ_1).

	Mean	Std	Skew	Kurt	Min	Median	Max	ρ_1
Panel A: Time series of aggregate growth rates of capital price deflators								
Aggregate	4.14	3.40	1.36	3.93	−3.87	3.23	17.95	0.66
Panel B: Pooled Panels of sector (industry) growth rates of capital price deflators								
Sector	4.04	3.69	1.60	7.68	−12.12	3.38	31.28	0.61
Industry	3.98	3.61	1.57	6.96	−14.68	3.30	34.80	0.63
Panel C: Time series of sector growth rates of capital price deflators								
Agriculture, forestry, fishing, and hunting	4.10	3.18	1.65	4.82	−3.57	2.94	17.02	0.68
Mining	5.90	8.48	0.83	1.64	−12.12	5.17	31.28	0.46
Utilities	4.23	3.60	1.34	2.84	−2.96	3.24	18.05	0.62
Construction	3.78	3.29	2.17	6.39	−0.72	3.31	18.43	0.70
Nondurable goods	3.96	3.20	1.64	4.11	−2.17	3.43	16.89	0.70
Durable goods	3.83	3.21	1.57	3.63	−2.44	3.36	16.17	0.69
Wholesale trade	3.60	3.04	1.17	1.64	−2.66	2.92	13.48	0.75
Retail trade	4.26	3.13	0.87	2.12	−4.07	3.42	14.76	0.60
Transportation and warehousing	3.86	3.61	2.58	10.78	−1.81	3.16	22.18	0.62
Information	2.55	3.56	0.73	0.97	−3.11	2.19	14.54	0.64
Finance and insurance	3.91	3.17	1.28	2.81	−2.78	3.10	15.76	0.71
Real estate and rental and leasing	3.93	2.88	0.96	2.80	−3.96	3.42	14.09	0.61
Professional, scientific, and technical services	3.65	2.94	0.75	0.99	−3.05	3.45	11.71	0.68
Management of companies and enterprises	4.35	3.28	0.84	1.57	−4.04	3.67	14.94	0.62
Administrative and waste management services	4.00	3.32	1.44	3.20	−2.46	3.17	16.48	0.67
Educational services	4.53	3.09	1.05	1.37	−1.32	3.85	14.80	0.52
Health care and social assistance	3.89	3.36	0.86	2.21	−5.24	3.09	15.28	0.74
Arts, entertainment, and recreation	4.15	3.23	1.32	5.20	−4.98	3.20	17.64	0.62
Accommodation and food services	4.14	3.12	1.02	4.09	−5.26	3.39	15.99	0.61
Other services, except government	4.25	3.14	0.75	3.04	−5.45	3.40	14.95	0.65
Panel D: Time series of industry growth rates of capital price deflators								
Farms	4.12	3.17	1.57	4.69	−3.83	3.03	16.90	0.68
Forestry, fishing, and related activities	3.94	3.53	2.33	7.15	−0.94	2.92	19.88	0.61
Oil and gas extraction	6.15	9.67	0.85	1.70	−14.68	5.43	34.80	0.41
Mining, except oil and gas	4.33	3.39	1.29	3.60	−4.72	3.28	16.98	0.68
Support activities for mining	5.41	6.48	1.19	1.98	−6.95	4.48	27.08	0.57
Utilities	4.23	3.60	1.34	2.84	−2.96	3.24	18.05	0.62
Construction	3.78	3.29	2.17	6.39	−0.72	3.31	18.43	0.70
Food and beverage and tobacco products	3.99	3.08	1.46	3.37	−2.30	3.47	15.80	0.69
Textile mills and textile product mills	4.16	3.25	1.61	4.62	−2.74	3.59	17.62	0.66
Apparel and leather and allied products	4.21	3.07	1.38	4.20	−3.19	3.59	16.54	0.62
Wood products	4.06	3.21	1.51	3.59	−2.64	3.51	16.33	0.68

	Mean	Std	Skew	Kurt	Min	Median	Max	ρ_1
Panel D: Time series of industry growth rates of capital price deflators (continued)								
Paper products	3.86	3.40	1.83	4.51	−1.58	3.22	17.82	0.72
Printing and related support activities	3.93	3.33	1.85	5.18	−1.93	3.23	18.16	0.70
Petroleum and coal products	4.03	3.27	1.56	3.34	−1.80	3.43	16.57	0.72
Chemical products	3.83	3.17	1.63	4.19	−2.48	2.95	16.74	0.69
Plastics and rubber products	3.87	3.32	1.97	5.76	−1.74	3.32	18.32	0.68
Nonmetallic mineral products	3.99	3.24	1.57	3.36	−1.98	3.26	16.33	0.72
Primary metals	3.85	3.19	1.53	3.37	−2.26	3.41	15.95	0.69
Fabricated metal products	3.77	3.28	1.68	3.86	−2.13	3.24	16.43	0.69
Machinery	3.74	3.17	1.55	3.36	−2.26	3.22	15.63	0.71
Computer and electronic products	3.72	3.11	1.53	3.85	−2.73	3.35	15.90	0.69
Electrical equipment, appliances, and components	3.75	3.19	1.52	3.69	−2.73	2.98	16.22	0.67
Motor vehicles, bodies and trailers, and parts	3.72	3.41	1.77	4.07	−1.94	3.19	17.19	0.69
Other transportation equipment	3.99	3.26	1.34	2.99	−3.37	3.19	15.68	0.66
Furniture and related products	3.99	3.09	1.50	3.85	−2.65	3.45	16.07	0.66
Miscellaneous manufacturing	3.70	3.07	1.61	4.36	−2.70	3.18	15.99	0.64
Wholesale trade	3.60	3.04	1.17	1.64	−2.66	2.92	13.48	0.75
Retail trade	4.26	3.13	0.87	2.12	−4.07	3.42	14.76	0.60
Air transportation	3.97	3.17	0.82	0.89	−2.85	3.66	12.76	0.69
Railroad transportation	3.82	4.17	3.39	16.77	−1.23	2.65	27.22	0.55
Water transportation	3.77	3.78	2.04	5.20	−1.11	2.67	19.12	0.63
Truck transportation	3.36	2.95	1.21	0.60	−0.40	2.90	10.64	0.84
Transit and ground passenger transportation	3.75	3.76	2.90	12.58	−0.78	2.68	23.49	0.61
Pipeline transportation	4.45	4.82	0.86	2.11	−6.59	3.20	21.53	0.28
Other transportation and support activities	3.73	3.85	2.78	11.55	−1.39	2.44	23.54	0.65
Warehousing and storage	4.30	3.12	0.76	1.65	−4.18	3.58	14.04	0.61
Publishing industries (includes software)	3.92	3.46	1.22	2.64	−3.77	3.21	16.59	0.73
Motion picture and sound recording industries	3.85	3.01	0.32	1.63	−5.46	3.39	12.90	0.65
Broadcasting and telecommunications	2.36	3.67	0.62	0.61	−3.49	1.91	14.30	0.63
Information and data processing services	3.48	3.96	0.33	−0.53	−4.60	3.16	12.37	0.78
Federal Reserve banks	4.26	3.49	0.51	−0.15	−3.50	3.44	12.97	0.62
Credit intermediation and related activities	3.94	3.28	1.46	3.29	−2.02	3.09	16.76	0.75
Securities, commodity contracts, and investments	3.44	3.90	0.69	0.56	−4.57	2.44	13.51	0.56
Insurance carriers and related activities	3.77	2.94	0.89	2.60	−4.05	3.42	14.00	0.52
Funds, trusts, and other financial vehicles	4.33	3.09	0.73	1.89	−4.38	3.67	14.22	0.51
Real estate	4.09	3.01	0.74	3.21	−5.25	3.51	14.67	0.53
Rental and leasing services and lessors of intangible assets	3.33	3.50	0.85	−0.06	−2.38	2.12	11.67	0.89
Legal services	3.86	2.94	0.77	1.83	−3.24	3.86	13.68	0.51
Miscellaneous professional, scientific, and technical services	3.59	2.86	0.92	1.29	−2.78	3.33	11.47	0.68
Computer systems design and related services	3.78	4.01	0.19	−0.71	−4.30	3.83	12.22	0.76
Management of companies and enterprises	4.35	3.28	0.84	1.57	−4.04	3.67	14.94	0.62
Administrative and support services	3.79	3.14	0.83	0.88	−2.81	3.50	12.39	0.67
Waste management and remediation services	4.16	3.54	1.69	4.25	−2.12	3.21	18.48	0.65
Educational services	4.53	3.09	1.05	1.37	−1.32	3.85	14.80	0.52
Ambulatory health care services	3.81	3.51	1.05	1.86	−4.15	3.13	15.75	0.78
Hospitals	3.88	3.34	0.70	2.23	−5.79	3.24	15.01	0.73
Nursing and residential care facilities	4.10	3.33	0.94	2.34	−4.89	3.32	15.32	0.69
Social assistance	4.17	3.11	1.10	3.10	−4.16	3.45	15.47	0.61
Performing arts, spectator sports, museums, and related activities	4.03	3.24	1.57	5.74	−4.25	3.09	18.11	0.59
Amusements, gambling, and recreation industries	4.22	3.25	1.13	4.80	−5.46	3.38	17.31	0.64
Accommodation	4.38	3.35	0.66	3.69	−6.52	3.65	16.36	0.63
Food services and drinking places	3.83	2.96	1.36	3.98	−3.43	3.18	15.53	0.59
Other services, except government	4.25	3.14	0.75	3.04	−5.45	3.40	14.95	0.65

Table 5 : The BEA's Ratios of Capital-to-investment Price Deflators, 1963–2020

From the detailed tables for 63 private industries from BEA's fixed assets accounts, we obtain: (i) current-cost (current-dollar) capital stocks in private non-residential equipment, $K_{jt}^{\mathcal{E}\$}$, and structure, $K_{jt}^{\mathcal{S}\$}$, by industry, annual, 1947–2020; (ii) fixed-cost (constant-dollar) capital stocks in private non-residential equipment, $K_{jt}^{\mathcal{E}}$, and structure, $K_{jt}^{\mathcal{S}}$, by industry, annual, 1947–2020; (iii) current-cost investments in private non-residential equipment, $I_{jt}^{\mathcal{E}\$}$, and structure, $I_{jt}^{\mathcal{S}\$}$, by industry, annual, 1947–2020; and (iv) fixed-cost investments in private non-residential equipment, $I_{jt}^{\mathcal{E}}$, and structure, $I_{jt}^{\mathcal{S}}$, by industry, annual, 1947–2020. Industry j's capital and investment price deflators are $P_{jt}^{K} = (K_{jt}^{\mathcal{E}\$} + K_{jt}^{\mathcal{S}\$})/(K_{jt}^{\mathcal{E}} + K_{jt}^{\mathcal{S}})$ and $P_{jt}^{I} = (I_{jt}^{\mathcal{E}\$} + I_{jt}^{\mathcal{S}\$})/(I_{jt}^{\mathcal{E}} + I_{jt}^{\mathcal{S}})$, respectively. We calculate capital and investment price deflators for the 20 BEA sectors (and the aggregate economy) by summing up fixed-cost depreciations, capital stocks, and investments across all the industries within each sector (and the whole economy). Industry j's ratio of capital-to-investment price deflators is calculated as P_{jt+1}^{K}/P_{jt}^{I}. "Std" stands for standard deviation, "Skew" skewness, "Kurt" excess kurtosis relative to three for the normal distribution), and "ρ_1" the serial correlation.

	Mean	Std	Skew	Kurt	Min	Median	Max	ρ_1
Panel A: Time series of aggregate ratios of capital-to-investment price deflators								
Aggregate	0.91	0.09	0.78	−0.29	0.79	0.88	1.12	0.972
Panel B: Pooled Panels of sector (industry) ratios of capital-to-investment price deflators								
Sector	0.91	0.11	0.00	0.16	0.61	0.91	1.34	0.966
Industry	0.91	0.12	−0.69	1.27	0.44	0.92	1.38	0.960
Panel C: Time series of sector ratios of capital-to-investment price deflators								
Agriculture, forestry, fishing, and hunting	0.99	0.06	0.53	−0.78	0.90	0.98	1.11	0.939
Mining	0.98	0.07	−0.13	−0.72	0.84	0.98	1.14	0.735
Utilities	0.93	0.06	0.36	−0.78	0.83	0.93	1.06	0.945
Construction	0.96	0.06	−0.57	−0.35	0.82	0.98	1.08	0.935
Nondurable goods	0.94	0.06	0.70	−0.73	0.87	0.92	1.06	0.956
Durable goods	0.92	0.07	0.55	−0.58	0.81	0.91	1.08	0.964
Wholesale trade	0.87	0.10	0.74	−0.62	0.73	0.84	1.09	0.968
Retail trade	0.91	0.09	1.05	0.16	0.79	0.88	1.13	0.967
Transportation and warehousing	0.94	0.08	−0.25	−0.70	0.77	0.94	1.08	0.920
Information	0.82	0.14	1.45	1.23	0.65	0.77	1.21	0.983
Finance and insurance	0.83	0.13	0.98	−0.28	0.68	0.79	1.14	0.972
Real estate and rental and leasing	0.92	0.08	0.24	−0.70	0.76	0.90	1.09	0.934
Professional, scientific, and technical services	0.80	0.15	0.67	−0.80	0.61	0.76	1.12	0.970
Management of companies and enterprises	0.89	0.14	1.66	2.74	0.70	0.85	1.34	0.976
Administrative and waste management services	0.87	0.10	0.63	−0.55	0.71	0.85	1.11	0.946
Educational services	0.92	0.08	0.95	0.75	0.79	0.90	1.13	0.952
Health care and social assistance	0.89	0.10	0.90	−0.11	0.77	0.87	1.13	0.981
Arts, entertainment, and recreation	0.93	0.08	−0.11	−0.81	0.77	0.94	1.08	0.958
Accommodation and food services	0.95	0.06	0.90	−0.20	0.87	0.93	1.11	0.950
Other services, except government	0.95	0.09	1.46	1.57	0.85	0.92	1.21	0.969
Panel D: Time series of industry ratios of capital-to-investment price deflators								
Farms	0.99	0.06	0.56	−0.72	0.90	0.98	1.12	0.943
Forestry, fishing, and related activities	0.98	0.04	0.31	−0.33	0.91	0.98	1.10	0.772
Oil and gas extraction	1.02	0.06	0.19	−0.20	0.90	1.02	1.18	0.548
Mining, except oil and gas	0.99	0.05	0.15	−0.63	0.91	0.99	1.13	0.889
Support activities for mining	0.86	0.11	0.03	−1.24	0.67	0.87	1.04	0.910
Utilities	0.93	0.06	0.36	−0.78	0.83	0.93	1.06	0.945
Construction	0.96	0.06	−0.57	−0.35	0.82	0.98	1.08	0.935
Food and beverage and tobacco products	0.93	0.06	0.59	−1.02	0.85	0.91	1.06	0.962
Textile mills and textile product mills	0.94	0.06	0.89	−0.06	0.87	0.94	1.11	0.950
Apparel and leather and allied products	0.94	0.09	1.19	1.26	0.82	0.92	1.20	0.963
Wood products	0.94	0.07	0.44	−0.89	0.83	0.93	1.08	0.952

	Mean	Std	Skew	Kurt	Min	Median	Max	ρ_1
Panel D: Time series of industry ratios of capital-to-investment price deflators (continued)								
Paper products	0.97	0.04	0.38	−0.94	0.91	0.96	1.04	0.887
Printing and related support activities	0.94	0.06	0.76	−0.08	0.86	0.92	1.08	0.951
Petroleum and coal products	0.94	0.06	0.42	−0.93	0.85	0.92	1.07	0.919
Chemical products	0.93	0.07	0.62	−0.89	0.84	0.91	1.07	0.946
Plastics and rubber products	0.97	0.04	0.59	−0.60	0.91	0.96	1.06	0.901
Nonmetallic mineral products	0.92	0.08	0.16	−1.23	0.78	0.92	1.07	0.952
Primary metals	0.93	0.07	0.27	−1.00	0.82	0.92	1.06	0.961
Fabricated metal products	0.94	0.06	0.12	−1.04	0.83	0.94	1.05	0.948
Machinery	0.90	0.08	0.53	−0.98	0.78	0.88	1.06	0.958
Computer and electronic products	0.91	0.08	0.85	0.19	0.77	0.90	1.12	0.947
Electrical equipment, appliances, and components	0.93	0.07	0.72	−0.30	0.82	0.91	1.09	0.929
Motor vehicles, bodies and trailers, and parts	0.94	0.06	−0.02	−0.75	0.82	0.94	1.05	0.893
Other transportation equipment	0.91	0.08	0.55	−0.76	0.79	0.90	1.09	0.940
Furniture and related products	0.93	0.07	0.62	−0.13	0.81	0.92	1.11	0.957
Miscellaneous manufacturing	0.90	0.09	0.83	−0.19	0.77	0.87	1.13	0.973
Wholesale trade	0.87	0.10	0.74	−0.62	0.73	0.84	1.09	0.968
Retail trade	0.91	0.09	1.05	0.16	0.79	0.88	1.13	0.967
Air transportation	0.95	0.10	−1.71	2.52	0.64	1.00	1.06	0.868
Railroad transportation	0.97	0.04	0.39	0.61	0.90	0.98	1.12	0.812
Water transportation	0.89	0.14	−1.00	0.10	0.50	0.92	1.04	0.930
Truck transportation	0.97	0.03	0.18	−1.23	0.91	0.96	1.02	0.903
Transit and ground passenger transportation	0.89	0.11	−0.11	−1.27	0.70	0.90	1.08	0.904
Pipeline transportation	0.81	0.20	−0.51	−1.25	0.46	0.86	1.05	0.955
Other transportation and support activities	0.97	0.06	−0.31	−0.45	0.85	0.98	1.09	0.922
Warehousing and storage	0.89	0.10	0.17	−1.30	0.73	0.89	1.07	0.963
Publishing industries (includes software)	0.87	0.12	0.61	−0.38	0.71	0.87	1.16	0.971
Motion picture and sound recording industries	0.82	0.17	1.00	0.69	0.56	0.79	1.30	0.976
Broadcasting and telecommunications	0.82	0.17	1.80	2.66	0.64	0.76	1.38	0.986
Information and data processing services	0.81	0.15	−0.25	−0.96	0.51	0.83	1.03	0.946
Federal Reserve banks	0.82	0.19	0.76	0.27	0.50	0.79	1.33	0.934
Credit intermediation and related activities	0.83	0.12	0.81	−0.60	0.67	0.79	1.11	0.963
Securities, commodity contracts, and investments	0.74	0.19	0.99	−0.17	0.50	0.68	1.18	0.944
Insurance carriers and related activities	0.87	0.12	0.82	0.36	0.67	0.84	1.20	0.923
Funds, trusts, and other financial vehicles	0.96	0.11	0.16	0.35	0.74	0.98	1.23	0.890
Real estate	0.97	0.06	−0.89	1.10	0.79	0.98	1.07	0.857
Rental and leasing services and lessors of intangible assets	0.88	0.13	−0.94	−0.13	0.59	0.91	1.03	0.962
Legal services	0.82	0.16	0.09	−0.89	0.53	0.82	1.14	0.927
Miscellaneous professional, scientific, and technical services	0.82	0.14	0.57	−0.98	0.64	0.78	1.10	0.966
Computer systems design and related services	0.70	0.21	0.94	−0.33	0.44	0.63	1.19	0.969
Management of companies and enterprises	0.89	0.14	1.66	2.74	0.70	0.85	1.34	0.976
Administrative and support services	0.83	0.13	0.48	−0.83	0.61	0.77	1.10	0.941
Waste management and remediation services	0.94	0.06	0.60	−0.20	0.84	0.93	1.09	0.930
Educational services	0.92	0.08	0.95	0.75	0.79	0.90	1.13	0.952
Ambulatory health care services	0.85	0.12	0.83	−0.40	0.69	0.80	1.12	0.974
Hospitals	0.91	0.09	0.96	0.23	0.79	0.89	1.15	0.979
Nursing and residential care facilities	0.91	0.09	0.05	−1.24	0.78	0.93	1.08	0.955
Social assistance	0.93	0.07	0.76	−0.46	0.83	0.90	1.12	0.921
Performing arts, spectator sports, museums, and related activities	0.92	0.10	−0.14	−0.57	0.70	0.93	1.13	0.952
Amusements, gambling, and recreation industries	0.94	0.07	−0.02	−0.93	0.81	0.94	1.06	0.954
Accommodation	0.98	0.04	0.58	−0.22	0.90	0.97	1.09	0.914
Food services and drinking places	0.93	0.07	0.69	−0.54	0.81	0.90	1.09	0.963
Other services, except government	0.95	0.09	1.46	1.57	0.85	0.92	1.21	0.969

Table 6 : The BEA's Economic Depreciation Rates, 1963–2020

From the detailed tables for 63 private industries from BEA's fixed assets accounts, we obtain: (i) fixed-cost depreciations in private non-residential equipment, $D^{\mathcal{E}}_{jt}$, and structure, $D^{\mathcal{S}}_{jt}$, by industry, annual, 1947–2020; (ii) fixed-cost capital stocks in private non-residential equipment, $K^{\mathcal{E}}_{jt}$, and structure, $K^{\mathcal{S}}_{jt}$, by industry, annual, 1947–2020; and (iii) fixed-cost investments in private non-residential equipment, $I^{\mathcal{E}}_{jt}$, and structure, $I^{\mathcal{S}}_{jt}$, by industry, annual, 1947–2020. For industry j in year t, we calculate its economic depreciation rate as $\delta_{jt} = (D^{\mathcal{E}}_{jt} + D^{\mathcal{S}}_{jt})/((K^{\mathcal{E}}_{jt-1} + K^{\mathcal{S}}_{jt-1}) + 0.5 \times (I^{\mathcal{E}}_{jt} + I^{\mathcal{S}}_{jt}))$. We also calculate economic depreciation rates for the 20 BEA sectors (and the aggregate economy) by summing up fixed-cost depreciations, capital stocks, and investments across all the industries within each sector (and the whole economy). In particular, for sector s in year t, its depreciation rate is $\delta_{st} = (\sum_{j\in s} D^{\mathcal{E}}_{jt} + \sum_{j\in s} D^{\mathcal{S}}_{jt})/((\sum_{j\in s} K^{\mathcal{E}}_{jt-1} + \sum_{j\in s} K^{\mathcal{S}}_{jt-1}) + 0.5 \times (\sum_{j\in s} I^{\mathcal{E}}_{jt} + \sum_{j\in s} I^{\mathcal{S}}_{jt}))$, and the aggregate depreciation rate is $\delta_t = (\sum_j D^{\mathcal{E}}_{jt} + \sum_j D^{\mathcal{S}}_{jt})/((\sum_j K^{\mathcal{E}}_{jt-1} + \sum_j K^{\mathcal{S}}_{jt-1}) + 0.5 \times (\sum_j I^{\mathcal{E}}_{jt} + \sum_j I^{\mathcal{S}}_{jt}))$. All moments are in percent, except for skewness (Skew), excess kurtosis (Kurt, relative to the kurtosis of three for the normal distribution), and the first-order autocorrelation (ρ_1).

	Mean	Std	Skew	Kurt	Min	Median	Max	ρ_1
Panel A: Time series of aggregate economic depreciation rates								
Aggregate	5.71	0.48	0.51	−0.25	4.90	5.61	6.79	0.994
Panel B: Pooled Panels of sector (industry) economic depreciation rates								
Sector	5.90	2.21	1.00	1.06	2.36	5.37	14.28	0.999
Industry	6.49	2.51	0.96	1.27	2.36	6.32	15.82	0.999
Panel C: Time series of sector economic depreciation rates								
Agriculture, forestry, fishing, and hunting	7.36	0.47	0.77	−0.21	6.75	7.26	8.39	0.988
Mining	7.20	0.61	−1.64	0.98	5.84	7.42	7.71	0.940
Utilities	3.40	0.26	−1.05	−0.26	2.84	3.52	3.69	0.995
Construction	11.63	1.35	0.06	−0.65	9.18	11.67	14.28	0.990
Nondurable goods	6.86	0.34	0.04	−1.36	6.27	6.85	7.41	0.998
Durable goods	6.86	0.45	0.62	−1.24	6.34	6.64	7.64	0.997
Wholesale trade	9.01	0.63	0.18	−1.37	8.02	8.99	10.07	0.980
Retail trade	4.63	0.64	0.85	−0.66	3.83	4.27	6.04	0.998
Transportation and warehousing	5.01	0.65	−0.18	−0.76	3.72	5.01	6.19	0.997
Information	5.04	0.95	1.85	2.40	4.25	4.61	7.94	0.998
Finance and insurance	6.58	1.33	0.47	−0.92	4.73	6.14	9.22	0.998
Real estate and rental and leasing	5.20	0.74	0.10	−0.51	3.99	5.30	6.73	0.990
Professional, scientific, and technical services	7.65	1.74	0.59	−1.38	5.88	6.82	10.63	0.997
Management of companies and enterprises	3.85	0.41	1.08	0.82	3.26	3.75	5.01	0.998
Administrative and waste management services	6.46	1.62	0.85	−0.67	4.43	5.58	9.91	0.999
Educational services	2.78	0.40	0.84	−0.90	2.36	2.60	3.51	0.998
Health care and social assistance	4.59	1.05	0.70	−0.69	3.38	4.31	6.84	1.000
Arts, entertainment, and recreation	4.94	0.34	−0.20	−1.27	4.34	4.96	5.45	0.986
Accommodation and food services	5.24	0.11	0.22	−1.13	5.08	5.24	5.45	0.954
Other services, except government	3.80	0.40	0.73	−0.09	3.18	3.73	4.73	0.994
Panel D: Time series of industry economic depreciation rates								
Farms	7.22	0.49	0.59	−0.25	6.48	7.18	8.23	0.987
Forestry, fishing, and related activities	9.26	0.76	−0.30	−0.49	7.41	9.26	10.53	0.980
Oil and gas extraction	7.01	0.65	−1.76	1.17	5.59	7.27	7.41	0.939
Mining, except oil and gas	7.87	0.85	0.18	−1.05	6.52	7.79	9.48	0.992
Support activities for mining	9.15	0.69	−0.77	0.03	7.48	9.22	10.25	0.956
Utilities	3.40	0.26	−1.05	−0.26	2.84	3.52	3.69	0.995
Construction	11.63	1.35	0.06	−0.65	9.18	11.67	14.28	0.990
Food and beverage and tobacco products	6.13	0.40	−0.13	−1.18	5.48	6.18	6.78	0.999
Textile mills and textile product mills	6.59	0.22	−0.39	−0.53	6.13	6.63	6.97	0.984
Apparel and leather and allied products	6.03	0.27	0.20	−1.07	5.59	6.02	6.56	0.967
Wood products	8.23	0.43	0.00	−1.44	7.49	8.20	8.87	0.979

	Mean	Std	Skew	Kurt	Min	Median	Max	ρ_1
Panel D: Time series of industry economic depreciation rates (continued)								
Paper products	7.74	0.31	−0.56	−1.09	7.11	7.85	8.12	0.994
Printing and related support activities	8.43	0.14	0.36	−0.47	8.20	8.42	8.76	0.955
Petroleum and coal products	5.90	0.51	0.14	−1.18	5.12	5.75	6.78	0.995
Chemical products	6.88	0.45	0.92	−0.19	6.38	6.71	7.89	0.996
Plastics and rubber products	9.14	0.26	−0.13	−0.35	8.60	9.16	9.62	0.985
Nonmetallic mineral products	6.85	0.38	0.59	−1.12	6.36	6.72	7.56	0.987
Primary metals	5.33	0.23	−0.20	−0.15	4.84	5.34	5.74	0.994
Fabricated metal products	6.21	0.42	0.74	−0.95	5.76	5.98	6.98	0.998
Machinery	5.99	0.32	0.49	−1.11	5.59	5.87	6.57	0.993
Computer and electronic products	7.31	0.50	0.34	−1.54	6.64	7.07	8.13	0.992
Electrical equipment, appliances, and components	7.06	0.12	−0.33	0.00	6.76	7.07	7.31	0.922
Motor vehicles, bodies and trailers, and parts	9.77	0.31	−1.11	0.13	9.00	9.89	10.17	0.975
Other transportation equipment	6.27	0.57	0.81	0.21	5.50	6.21	7.73	0.995
Furniture and related products	7.41	0.53	0.36	−1.36	6.73	7.25	8.44	0.993
Miscellaneous manufacturing	7.65	0.53	0.42	−0.48	6.82	7.68	8.71	0.992
Wholesale trade	9.01	0.63	0.18	−1.37	8.02	8.99	10.07	0.980
Retail trade	4.63	0.64	0.85	−0.66	3.83	4.27	6.04	0.998
Air transportation	6.30	0.15	0.66	−0.58	6.08	6.26	6.60	0.934
Railroad transportation	2.73	0.08	0.11	−1.14	2.62	2.74	2.87	0.985
Water transportation	6.74	0.24	0.02	−0.21	6.20	6.72	7.19	0.977
Truck transportation	14.67	0.68	−0.55	−0.97	13.23	14.90	15.49	0.985
Transit and ground passenger transportation	5.22	1.29	0.77	−0.92	3.73	4.52	8.04	0.997
Pipeline transportation	3.31	0.58	0.94	−0.76	2.72	3.00	4.46	0.994
Other transportation and support activities	6.20	0.75	0.55	1.27	4.74	6.37	8.54	0.990
Warehousing and storage	4.43	0.70	−0.14	−0.83	3.35	4.61	5.91	0.992
Publishing industries (includes software)	7.99	0.88	1.39	0.42	7.31	7.56	10.04	0.992
Motion picture and sound recording industries	5.29	0.55	−0.13	−0.47	4.11	5.21	6.20	0.987
Broadcasting and telecommunications	4.54	0.76	1.68	1.98	3.85	4.17	6.84	0.998
Information and data processing services	10.80	2.12	0.84	−0.08	8.13	10.58	15.82	0.985
Federal Reserve banks	5.02	1.09	1.54	1.14	3.95	4.57	7.82	0.975
Credit intermediation and related activities	7.36	1.84	0.17	−1.09	4.51	7.00	10.65	0.998
Securities, commodity contracts, and investments	5.83	1.09	0.62	−0.18	4.35	5.81	8.49	0.990
Insurance carriers and related activities	5.18	0.63	0.36	−1.21	4.41	5.05	6.45	0.993
Funds, trusts, and other financial vehicles	2.80	0.11	0.59	−0.04	2.64	2.80	3.11	0.981
Real estate	3.47	0.30	0.73	−0.72	3.08	3.35	4.05	0.992
Rental and leasing services and lessors of intangible assets	12.44	0.75	−0.18	−1.25	11.17	12.53	13.63	0.965
Legal services	6.36	1.68	0.61	−1.42	4.64	5.43	9.18	0.995
Miscellaneous professional, scientific, and technical services	7.87	1.34	0.43	−1.52	6.31	7.39	10.00	0.996
Computer systems design and related services	7.77	3.72	0.79	−1.08	4.25	5.33	14.61	0.997
Management of companies and enterprises	3.85	0.41	1.08	0.82	3.26	3.75	5.01	0.998
Administrative and support services	7.53	2.47	0.42	−1.54	4.77	6.42	11.48	0.999
Waste management and remediation services	5.23	0.58	0.73	0.87	4.33	5.25	6.91	0.984
Educational services	2.78	0.40	0.84	−0.90	2.36	2.60	3.51	0.998
Ambulatory health care services	6.22	1.49	0.53	−0.95	4.34	5.74	9.12	0.999
Hospitals	3.91	0.99	0.92	−0.31	2.80	3.64	6.22	0.999
Nursing and residential care facilities	4.23	0.58	−0.19	−1.53	3.28	4.20	4.97	0.997
Social assistance	4.34	0.53	0.45	−1.06	3.63	4.17	5.32	0.994
Performing arts, spectator sports, museums, and related activities	4.49	0.36	1.07	0.31	4.05	4.38	5.36	0.988
Amusements, gambling, and recreation industries	5.24	0.39	−0.81	−0.65	4.39	5.38	5.69	0.988
Accommodation	3.84	0.25	0.06	−0.71	3.44	3.89	4.36	0.989
Food services and drinking places	6.97	0.20	−0.75	−0.57	6.55	7.01	7.23	0.970
Other services, except government	3.80	0.40	0.73	−0.09	3.18	3.73	4.73	0.994

Table 7 : Empirical Properties of Firm-level Current-cost Investment Rates in Compustat, 1963–2020

Current-cost investment rate, $I^{\$}_{it}/K^{\$}_{it}$, is current-cost investment (change of net PPE plus accounting depreciation, item DP minus item AM (missing AM set to zero) scaled by current-cost capital. Real investment rate, I_{it}/K_{it}, is $(I^{\$}_{it}/K^{\$}_{it})(P^K_{it}/P^I_{it})$, in which P^K_{it} and P^I_{it} are capital and investment price deflators, respectively. (CAPX−SPPE)/$K^{\$}_{it}$ is capital expenditures minus sales of PPE, scaled by current-cost capital. All moments are in percent, except for the number of firm-years (#Obs.), skewness (Skew), excess kurtosis (Kurt, relative to the kurtosis of three for the normal distribution), and the serial correlation (ρ_1). f_- is the fraction of negative investment rates (below −1%), and f_0 the fraction of inactive investment rates (between −1% and 1%). $f^-_{0.2}$, $f^-_{0.3}$, $f^-_{0.4}$, and $f^-_{0.5}$ are the fractions of negative investment rate spikes below −20%, −30%, −40%, and −50%, and $f^+_{0.2}$, $f^+_{0.3}$, $f^+_{0.4}$, and $f^+_{0.5}$ the fractions of positive investment rate spikes above 20%, 30%, 40%, and 50%, respectively.

	#Obs.	Mean	Std	Skew	Kurt	1st	5th	25th	50th	75th	95th	99th	ρ_1
$I^{\$}_{it}/K^{\$}_{it}$	169,828	23.84	37.20	3.33	14.28	−23.32	−1.97	6.19	13.03	26.70	87.07	241.82	0.34
I_{it}/K_{it}	169,828	20.43	31.48	3.30	14.15	−20.43	−1.72	5.42	11.37	23.07	73.97	204.65	0.33
(CAPX−SPPE)/$K^{\$}_{it}$	166,889	19.36	24.71	3.08	11.99	−5.79	1.44	6.46	11.89	22.00	63.80	157.23	0.51
		f_-	f_0	$f^-_{0.2}$	$f^-_{0.3}$	$f^-_{0.4}$	$f^-_{0.5}$	$f^+_{0.2}$	$f^+_{0.3}$	$f^+_{0.4}$	$f^+_{0.5}$		
$I^{\$}_{it}/K^{\$}_{it}$		5.51	2.85	1.26	0.73	0.44	0.28	32.66	20.70	14.49	10.80		
I_{it}/K_{it}		5.42	3.26	1.08	0.58	0.33	0.21	28.19	17.34	11.88	8.76		
(CAPX−SPPE)/$K^{\$}_{it}$		1.81	2.72	0.36	0.22	0.15	0.10	27.52	15.85	10.26	7.24		

Table 8 : Differences between Current-cost and Historical-cost Investment Rates in Compustat, 1963–2020

This table shows the moments of current-cost investment rates, $I^{\$}_{it}/K^{\$}_{it}$ (same in Table 7), historical-cost investment rates, I^{H}_{it}/K^{H}_{it}, change in net PPE plus accounting depreciation (item DP minus item AM, missing AM set to zero) scaled by net PPE; $K^{\$}_{it}$/PPENT, the ratios of current-cost capital over historical-cost capital (net PPE); δ_{it}, economic depreciation rates; δ^{H}_{it}, accounting depreciation rates (accounting depreciation over net PPE); $K^{\$}_{it}$/alt. $K^{\$}_{it}$ with δ^{H}_{it}, the ratios of current-cost capital over an alternative construction of $K^{\$}_{it}$, in which δ_{it} is replaced with δ^{H}_{it}; $K^{\$}_{it}$/alt. $K^{\$}_{it}$, no price adjustment, the ratios of current-cost capital over an alternative construction of $K^{\$}_{it}$ with no price adjustment, i.e., $P^{K}_{it} = P^{I}_{it} = 1$ (capital and investment price deflators are both one); $I^{\$}_{it}$/alt. $K^{\$}_{it}$ with δ^{H}_{it}, current-cost investment rates with the first alternative construction of $K^{\$}_{it}$; and $I^{\$}_{it}$/alt. $K^{\$}_{it}$, no price adjustment, current-cost investment rates with the second alternative construction of $K^{\$}_{it}$. The table also show the moments of $K^{\$}_{it}$/PPEGT, the ratio of current-cost capital over gross PPE; $K^{\$}_{it}$/AT, the ratio of current-cost capital over total assets; I^{H}_{it}/PPEGT, the ratio of investment over gross PPE; and $I^{\$}_{it}/K^{\$}_{it} - I^{H}_{it}$/PPEGT, the difference between the current-cost investment rate and I^{H}_{it}/PPEGT. The investment rate moments are in percent, except for the number of firm-years (#Obs.), skewness (Skew), excess kurtosis (Kurt, relative to three for the normal distribution), and the serial correlation (ρ_1). f_{-} is the fraction of negative investment rates (below −1%), and f_0 the fraction of inactive investment rates (between −1% and 1%). $f^{-}_{0.2}$, $f^{-}_{0.3}$, $f^{-}_{0.4}$, and $f^{-}_{0.5}$ are the fractions of negative investment rate spikes below −20%, −30%, −40%, and −50%, and $f^{+}_{0.2}$, $f^{+}_{0.3}$, $f^{+}_{0.4}$, and $f^{+}_{0.5}$ the fractions of positive investment rate spikes above 20%, 30%, 40%, and 50%, respectively.

	#Obs.	Mean	Std	Skew	Kurt	1st	5th	25th	50th	75th	95th	99th	ρ_1
$I^{\$}_{it}/K^{\$}_{it}$	169,828	23.84	37.20	3.33	14.28	−23.32	−1.97	6.19	13.03	26.70	87.07	241.82	0.34
I^{H}_{it}/K^{H}_{it}	177,412	40.27	62.90	3.47	15.84	−38.02	−3.95	11.05	22.78	45.33	141.65	423.85	0.25
$K^{\$}_{it}/K^{H}_{it}$	169,828	2.11	1.79	3.58	16.82	0.83	1.01	1.29	1.61	2.16	4.85	13.50	0.90
δ_{it}	169,792	6.90	1.96	0.65	1.37	3.27	3.69	5.91	6.86	7.60	10.69	13.25	0.98
δ^{H}_{it}	169,828	20.94	16.65	2.01	6.08	2.86	4.75	10.81	16.10	26.23	50.69	103.19	0.79
$K^{\$}_{it}$/alt. $K^{\$}_{it}$ with δ^{H}_{it}	167,237	1.93	1.54	3.20	13.90	0.85	1.00	1.20	1.48	2.00	4.39	11.47	0.93
$K^{\$}_{it}$/alt. $K^{\$}_{it}$, no price adjustment	169,680	1.13	0.21	1.78	6.25	0.76	0.88	1.00	1.08	1.20	1.51	2.08	0.96
$I^{\$}_{it}$/alt. $K^{\$}_{it}$ with δ^{H}_{it}	167,344	39.33	60.91	3.32	14.27	−33.93	−3.26	9.70	21.37	44.72	142.32	397.84	0.31
$I^{\$}_{it}$/alt. $K^{\$}_{it}$, no price adjustment	169,697	24.42	36.26	3.27	14.09	−25.35	−2.28	7.29	14.43	27.69	85.22	236.05	0.29
$K^{\$}_{it}$/PPEGT	169,509	0.98	0.42	3.23	14.86	0.51	0.64	0.78	0.88	1.03	1.61	3.48	0.91
$K^{\$}_{it}$/AT	169,828	0.53	0.39	1.22	1.48	0.04	0.09	0.24	0.43	0.73	1.30	1.90	0.97
I^{H}_{it}/PPEGT	176,864	21.47	34.16	3.48	15.62	−21.41	−2.11	5.82	11.82	23.66	77.37	227.45	0.33
$I^{\$}_{it}/K^{\$}_{it} - I^{H}_{it}$/PPEGT	169,509	2.66	9.64	1.04	10.89	−32.55	−6.79	−0.39	1.35	4.22	16.91	50.92	0.48

	f_{-}	f_0	$f^{-}_{0.2}$	$f^{-}_{0.3}$	$f^{-}_{0.4}$	$f^{-}_{0.5}$	$f^{+}_{0.2}$	$f^{+}_{0.3}$	$f^{+}_{0.4}$	$f^{+}_{0.5}$
$I^{\$}_{it}/K^{\$}_{it}$	5.51	2.85	1.26	0.73	0.44	0.28	32.66	20.70	14.49	10.80
I^{H}_{it}/K^{H}_{it}	6.01	1.48	2.18	1.45	0.99	0.66	53.94	37.64	27.53	21.05
$I^{\$}_{it}$/alt. $K^{\$}_{it}$ with δ^{H}_{it}	5.81	1.65	1.92	1.24	0.83	0.56	50.56	35.62	26.57	20.61
$I^{\$}_{it}$/alt. $K^{\$}_{it}$, no price adjustment	5.63	2.42	1.42	0.83	0.50	0.32	35.40	21.75	14.82	10.93
I^{H}_{it}/PPEGT	5.59	2.87	1.16	0.64	0.35	0.21	28.92	17.99	12.46	9.20

Table 9 : Comparative Statics, Properties of Firm-level Current-cost Investment Rates in Compustat, 1963–2020

Current-cost investment rate, $I^{\$}_{it}/K^{\$}_{it}$, is current-cost investment (change of net PPE plus accounting depreciation, item DP minus item AM, missing AM set to zero) scaled by current-cost capital. All moments are in percent, except for the number of firm-years (#Obs.), skewness (Skew), excess kurtosis (Kurt, relative to the kurtosis of three for the normal distribution), and the serial correlation (ρ_1). f_- is the fraction of negative investment rates (below -1%), and f_0 the fraction of inactive investment rates (between -1% and 1%). $f^-_{0.2}$, $f^-_{0.3}$, $f^-_{0.4}$, and $f^-_{0.5}$ are the fractions of negative investment rate spikes below $-20\%, -30\%, -40\%$, and -50%, and $f^+_{0.2}$, $f^+_{0.3}$, $f^+_{0.4}$, and $f^+_{0.5}$ the fractions of positive investment rate spikes above $20\%, 30\%, 40\%$, and 50%, respectively. $(I-\text{CAPX})/K^{\$} \leq 15\%$ excludes firm-years in which the difference between current-cost investment and capital expenditures (item CAPX) is higher than 15% of current-cost capital, $K^{\$}$. $(I-\text{CAPX})/K^{\$} \leq 5\%$ excludes firm-years in which $I-$CAPX is higher than 5% of $K^{\$}$. Age> 3 excludes the first three years of observations for a given firm, and Age> 5 drops the first five years of observations. For each calendar year, we also split the sample around the median NYSE market equity at the beginning of fiscal year into two subsamples (Small ME and Big ME), and we split around the median NYSE $K^{\$}$ at the beginning of fiscal year into two subsamples (Small $K^{\$}$ and Big $K^{\$}$).

	#Obs.	Mean	Std	Skew	Kurt	1st	5th	25th	50th	75th	95th	99th	ρ_1
Benchmark	169,828	23.84	37.20	3.33	14.28	−23.32	−1.97	6.19	13.03	26.70	87.07	241.82	0.34
1963–1991	76,971	22.31	33.60	3.25	13.78	−22.82	−1.67	6.52	12.86	24.95	79.53	218.09	0.34
1992–2020	92,857	25.38	40.79	3.40	14.78	−23.83	−2.26	5.86	13.19	28.45	94.61	265.55	0.34
$(I-\text{CAPX})/K^{\$} \leq 15\%$	153,841	17.58	25.68	3.83	24.55	−23.25	−2.71	5.63	11.52	21.40	56.62	131.97	0.43
$(I-\text{CAPX})/K^{\$} \leq 5\%$	138,331	16.09	24.95	4.09	28.36	−23.31	−3.54	5.10	10.40	19.23	52.68	128.26	0.42
Age> 3	150,349	19.76	29.71	3.80	21.60	−22.24	−1.98	5.87	12.02	23.22	66.38	163.98	0.31
Age> 5	132,253	17.79	26.29	4.13	27.42	−20.44	−1.73	5.68	11.35	21.18	57.23	137.14	0.30
Small ME	130,892	24.75	38.93	3.14	12.62	−23.31	−3.20	5.73	13.12	28.23	93.25	235.28	0.32
Big ME	36,954	20.32	27.06	3.98	24.20	−8.92	1.64	7.47	12.85	22.65	65.63	149.28	0.44
Small $K^{\$}$	136,107	26.56	40.30	3.02	11.50	−23.26	−2.57	6.44	14.51	30.50	98.71	241.94	0.33
Big $K^{\$}$	33,721	12.91	15.54	3.79	30.00	−13.10	−0.72	5.63	9.77	16.03	35.82	75.81	0.32

	f_-	f_0	$f^-_{0.2}$	$f^-_{0.3}$	$f^-_{0.4}$	$f^-_{0.5}$	$f^+_{0.2}$	$f^+_{0.3}$	$f^+_{0.4}$	$f^+_{0.5}$
Benchmark	5.51	2.85	1.26	0.73	0.44	0.28	32.66	20.70	14.49	10.80
1963–1991	5.16	2.34	1.27	0.74	0.44	0.27	31.81	19.23	13.05	9.50
1992–2020	5.86	3.35	1.26	0.73	0.43	0.29	33.51	22.18	15.93	12.10
$(I-\text{CAPX})/K^{\$} \leq 15\%$	6.01	3.12	1.37	0.80	0.48	0.30	26.73	14.59	9.05	6.15
$(I-\text{CAPX})/K^{\$} \leq 5\%$	6.60	3.44	1.51	0.89	0.53	0.33	23.10	12.60	7.86	5.38
Age> 3	5.57	3.00	1.20	0.68	0.40	0.26	29.22	17.26	11.35	8.02
Age> 5	5.45	3.09	1.08	0.60	0.33	0.20	26.42	14.70	9.27	6.37
Small ME	6.31	3.33	1.49	0.88	0.52	0.33	34.20	22.31	15.89	11.92
Big ME	2.87	1.20	0.41	0.18	0.09	0.06	27.52	15.17	9.61	6.80
Small $K^{\$}$	5.85	3.10	1.42	0.85	0.51	0.32	37.08	24.30	17.25	12.94
Big $K^{\$}$	4.50	2.06	0.66	0.29	0.13	0.08	16.30	7.21	3.92	2.49

Table 10 : Panel Data Moments of Firm-level Current-cost Investment Rates by NAICS Sectors and Industries, 1963–2020

All moments are in percent, except for the number of firm-years (#Obs.), skewness (Skew), excess kurtosis (Kurt), and the autocorrelation (ρ_1). f_- is the fraction of negative investment rates (below −1%), f_0 the fraction of inactive investment rates (between −1% and 1%), $f^-_{0.2}$ the fractions of negative investment rate spikes below −20%, and $f^+_{0.2}$ the fractions of positive investment rate spikes above 20%.

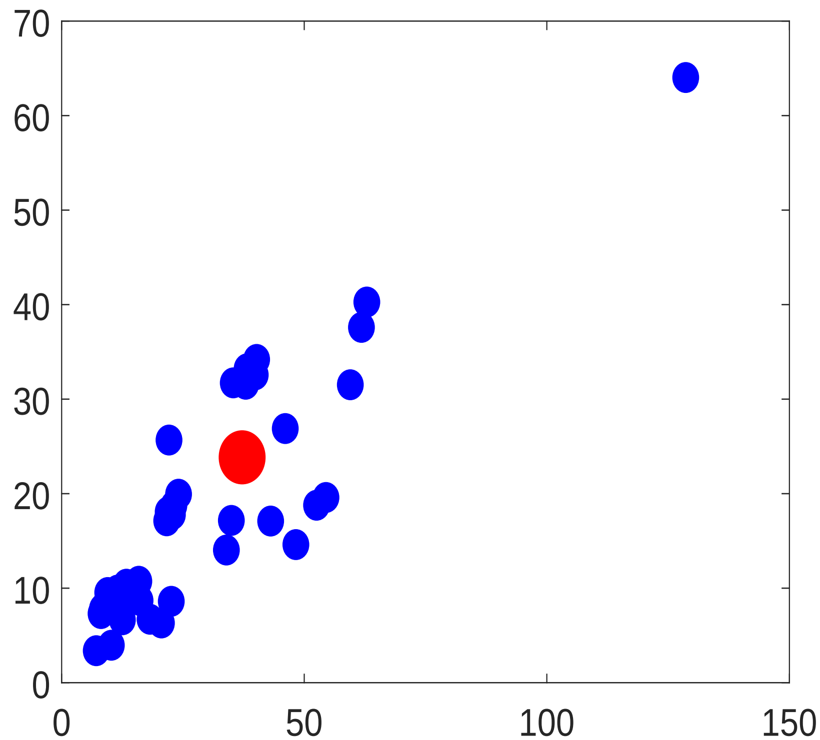
	#Obs.	Mean	Std	Skew	Kurt	1st	5th	50th	95th	99th	ρ_1	f_-	f_0	$f^-_{0.2}$	$f^+_{0.2}$
Aggregate	169,828	25.39	46.70	5.52	47.42	−20.89	−2.28	12.78	94.45	242.52	0.34	5.84	2.93	1.38	33.89
Panel A: 19 nonfinancial NAICS sectors															
Agriculture, forestry, fishing, and hunting	629	19.94	36.89	3.99	20.07	−28.04	−9.03	11.48	71.68	201.40	0.15	8.74	3.02	3.50	25.91
Mining	9,156	25.60	45.48	3.94	22.66	−29.64	−11.81	13.72	101.58	249.64	0.23	11.62	3.91	3.13	37.65
Utilities	7,721	8.93	18.34	14.66	297.35	−9.46	1.64	6.62	19.47	52.41	0.38	2.77	1.26	0.41	4.84
Construction	2,810	29.81	52.75	4.03	22.77	−32.39	−14.69	16.14	119.80	274.64	0.24	10.75	2.46	4.23	42.31
Nondurable goods	33,672	20.77	38.09	5.76	50.34	−17.37	−1.30	11.31	74.13	186.58	0.25	5.26	3.23	1.05	26.91
Durable goods	60,187	22.75	38.43	5.34	47.03	−18.19	−1.46	12.49	80.99	191.58	0.32	5.32	2.94	1.07	32.35
Wholesale trade	7,537	30.74	53.01	4.34	25.13	−26.25	−3.90	15.71	117.50	302.05	0.30	6.36	2.63	2.00	41.46
Retail trade	11,450	23.59	38.74	5.92	56.11	−16.20	−0.06	13.46	79.37	182.81	0.42	4.25	2.38	0.79	34.04
Transportation and warehousing	5,343	21.03	35.30	5.39	42.90	−19.59	−2.47	12.47	65.94	179.42	0.32	5.91	3.43	1.35	33.09
Information	14,534	41.84	72.50	4.60	30.54	−20.61	−0.98	19.25	159.73	376.04	0.39	4.98	2.35	1.27	48.60
Real estate and rental and leasing	1,581	36.88	66.36	4.27	25.08	−28.22	−9.93	19.19	144.27	372.56	0.44	8.92	4.36	3.10	49.08
Professional, scientific, and technical services	8,851	37.01	63.38	4.75	33.54	−25.23	−2.15	19.02	139.53	336.57	0.37	5.68	2.96	1.75	48.24
Management of companies and enterprises	135	23.31	34.99	2.27	5.77	−17.64	−9.12	11.23	96.39	165.52	0.41	11.85	1.48	2.96	31.85
Administrative and waste management services	4,505	33.48	57.84	4.72	33.56	−24.80	−3.45	16.82	126.85	312.56	0.38	6.24	2.26	1.71	44.31
Educational services	888	28.46	47.72	3.65	17.53	−26.42	−2.96	14.87	115.98	259.54	0.33	6.87	3.83	1.69	40.09
Health care and social assistance	3,188	38.92	60.77	3.38	14.76	−29.61	−5.32	19.57	146.34	339.11	0.35	7.18	2.10	2.60	49.44
Arts, entertainment, and recreation	1,971	29.94	56.68	4.26	23.15	−23.40	−6.43	13.54	116.02	339.11	0.29	8.02	3.70	2.03	37.85
Accommodation and food services	3,943	24.28	45.77	4.52	27.80	−26.87	−9.73	12.59	94.22	240.78	0.28	10.98	3.75	2.18	35.28
Other services, except government	1,250	23.51	48.77	5.19	34.35	−24.75	−3.78	10.46	90.23	274.64	0.17	7.44	4.16	1.60	29.28
Panel B: 58 nonfinancial NAICS industries															
Farms	554	18.48	31.27	3.70	17.57	−28.53	−7.58	11.57	62.48	179.88	0.03	8.12	2.71	3.07	25.09
Forestry, fishing, and related activities	75	30.74	64.11	2.92	8.66	−28.04	−21.75	9.36	231.39	303.86	0.31	13.33	5.33	6.67	32.00
Oil and gas extraction	5,424	25.20	45.94	3.88	20.97	−32.39	−12.59	13.60	100.09	259.54	0.23	12.44	3.50	3.28	36.69
Mining, except oil and gas	1,879	21.21	42.36	4.97	37.78	−28.13	−11.20	10.56	86.16	200.01	0.13	11.02	5.48	3.19	29.32
Support activities for mining	1,859	31.12	46.59	3.39	17.72	−29.05	−9.57	19.30	114.68	256.25	0.29	9.84	3.50	2.64	48.74
Utilities	7,721	8.93	18.34	14.66	297.35	−9.46	1.64	6.62	19.47	52.41	0.38	2.77	1.26	0.41	4.84
Construction	2,810	29.81	52.75	4.03	22.77	−32.39	−14.69	16.14	119.80	274.64	0.24	10.75	2.46	4.23	42.31
Food and beverage and tobacco products	5,909	16.73	30.32	6.89	65.74	−16.83	−1.25	10.56	49.93	142.56	0.29	5.13	2.62	1.02	21.75
Textile mills and textile product mills	2,563	15.73	27.85	5.89	52.09	−17.54	−3.18	9.47	53.10	129.77	0.27	6.83	3.75	1.09	20.99
Apparel and leather and allied products	4,187	18.95	35.68	7.13	87.95	−15.72	−1.91	10.20	66.85	171.55	0.31	5.83	3.68	0.81	26.34
Wood products	1,191	19.65	35.10	5.62	55.57	−21.00	−6.93	11.31	72.56	159.78	0.22	10.75	5.12	1.60	31.23
Paper products	2,394	16.69	25.10	6.03	56.99	−14.81	−0.36	11.24	51.19	123.74	0.24	4.34	1.84	0.75	22.22
Printing and related support activities	1,231	18.11	24.50	5.71	56.17	−11.42	0.42	13.07	53.18	120.69	0.31	4.06	1.87	0.49	27.70
Petroleum and coal products	2,125	14.11	23.73	6.99	77.41	−11.76	0.02	9.29	44.14	120.04	0.23	4.19	2.45	0.66	15.34
Chemical products	14,665	25.73	46.14	4.80	33.91	−18.70	−1.17	12.64	101.92	243.56	0.23	5.20	3.83	1.25	32.62
Plastics and rubber products	2,594	19.02	32.86	5.53	44.16	−23.81	−3.07	11.91	62.86	165.52	0.16	6.48	1.89	1.50	26.56
Nonmetallic mineral products	1,984	13.93	22.53	6.24	70.18	−17.51	−1.48	9.48	43.29	116.70	0.23	5.59	2.92	0.96	17.59
Primary metals	3,407	14.13	25.28	6.79	75.96	−15.27	−1.31	8.08	46.85	125.81	0.27	5.34	4.05	0.82	18.14
Fabricated metal products	6,638	17.22	28.29	5.93	57.35	−18.99	−1.84	10.80	53.71	131.76	0.27	5.56	2.67	1.19	24.90

	#Obs.	Mean	Std	Skew	Kurt	1st	5th	50th	95th	99th	ρ_1	f_-	f_0	$f_{0.2}^-$	$f_{0.2}^+$
Panel B: 58 nonfinancial NAICS industries, continued															
Machinery	11,252	20.09	34.31	5.32	41.39	−19.30	−1.70	11.67	68.70	166.47	0.30	5.40	3.24	1.17	28.40
Computer and electronic products	23,297	28.26	45.17	4.88	40.81	−18.68	−0.81	15.24	102.53	228.32	0.34	4.85	2.78	1.11	40.31
Electrical equipment, appliances, and components	5,127	21.71	35.82	5.05	36.49	−17.54	−1.81	12.48	75.64	187.08	0.29	5.54	2.05	1.05	30.29
Motor vehicles, bodies and trailers, and parts	4,021	20.89	30.59	5.42	46.90	−15.22	−0.93	13.83	66.44	158.73	0.29	4.97	1.72	0.72	31.73
Other transportation equipment	2,707	16.60	25.63	6.90	82.12	−17.06	−1.01	11.14	50.12	112.98	0.29	5.02	3.44	1.15	24.79
Furniture and related products	2,507	17.01	25.60	5.14	46.36	−16.29	−1.27	10.61	53.58	130.15	0.28	5.19	3.11	0.84	25.61
Miscellaneous manufacturing	8,163	27.33	42.79	4.35	26.38	−19.96	−1.01	15.71	95.85	226.19	0.29	5.02	2.21	1.25	40.06
Wholesale trade	7,537	30.74	53.01	4.34	25.13	−26.25	−3.90	15.71	117.50	302.05	0.30	6.36	2.63	2.00	41.46
Retail trade	11,450	23.59	38.74	5.92	56.11	−16.20	−0.06	13.46	79.37	182.81	0.42	4.25	2.38	0.79	34.04
Air transportation	1,147	26.04	46.86	4.82	30.93	−20.53	−2.57	14.20	90.91	260.22	0.31	6.63	3.14	1.13	35.48
Railroad transportation	448	8.38	21.76	9.15	105.79	−16.46	−0.03	4.28	30.16	59.62	0.48	3.57	6.03	0.67	8.26
Water transportation	425	16.37	35.56	5.64	43.05	−23.39	−8.28	9.22	58.08	186.58	0.38	8.94	7.29	2.82	20.94
Truck transportation	1,351	23.54	23.95	3.42	23.94	−15.96	−1.58	19.81	62.48	110.24	0.21	5.63	2.29	1.11	49.37
Transit and ground passenger transportation	222	37.84	53.99	3.63	16.00	−18.89	0.66	24.83	102.39	303.87	0.51	4.05	1.80	1.35	57.21
Pipeline transportation	728	13.54	29.75	6.37	53.87	−23.70	−3.12	7.58	43.64	167.26	0.19	5.36	2.61	1.51	13.60
Other transportation and support activities	1,466	22.06	34.88	5.20	39.86	−19.33	−1.60	13.68	69.42	175.35	0.29	5.25	3.75	1.09	34.24
Warehousing and storage	75	16.21	36.00	4.58	27.51	−25.50	−13.28	7.13	72.25	257.16	0.33	10.67	4.00	4.00	20.00
Publishing industries (includes software)	6,393	39.68	67.47	4.94	37.51	−20.15	−0.18	18.81	146.27	344.73	0.41	4.52	2.53	1.14	47.65
Motion picture and sound recording industries	1,639	36.11	64.60	4.41	27.61	−24.32	−4.80	16.88	144.52	372.56	0.37	6.83	2.50	1.89	44.48
Broadcasting and telecommunications	3,810	38.67	70.94	4.09	21.04	−20.58	−1.18	15.61	154.63	399.15	0.44	5.14	1.68	1.26	41.15
Information and data processing services	3,251	49.74	82.04	4.63	30.02	−20.58	−1.11	26.41	175.14	414.35	0.30	5.08	2.61	1.20	59.21
Real estate	66	44.16	100.27	2.62	6.86	−49.77	−22.03	7.02	274.64	478.68	0.19	24.24	13.64	12.12	33.33
Rental and leasing services and lessors of intangible assets	1,515	36.56	64.51	4.43	27.42	−26.39	−8.04	19.56	137.70	372.56	0.44	8.25	3.96	2.71	49.77
Legal services	271	30.62	50.01	2.94	10.45	−25.98	−9.67	13.48	121.46	267.67	0.24	8.49	3.32	2.21	40.22
Miscellaneous professional, scientific, and technical services	5,628	32.86	55.78	4.64	31.91	−25.98	−2.68	17.22	123.23	288.46	0.36	6.08	2.83	2.01	44.55
Computer systems design and related services	3,168	44.27	74.52	4.55	29.84	−22.47	−1.04	22.74	167.21	386.75	0.39	5.02	3.19	1.26	54.67
Management of companies and enterprises	135	23.31	34.99	2.27	5.77	−17.64	−9.12	11.23	96.39	165.52	0.41	11.85	1.48	2.96	31.85
Administrative and support services	3,323	33.70	57.87	4.67	32.52	−24.75	−2.75	17.11	128.87	297.35	0.43	5.81	2.29	1.59	44.93
Waste management and remediation services	1,265	32.90	57.30	4.78	35.78	−26.28	−5.66	15.81	121.75	329.12	0.27	7.67	2.21	2.06	42.92
Educational services	888	28.46	47.72	3.65	17.53	−26.42	−2.96	14.87	115.98	259.54	0.33	6.87	3.83	1.69	40.09
Ambulatory health care services	2,005	42.21	60.93	3.25	14.04	−29.05	−3.52	23.47	151.31	336.76	0.39	5.79	1.85	2.24	54.86
Hospitals	485	28.65	47.52	4.28	26.47	−29.84	−8.97	15.54	117.14	285.54	0.42	8.87	1.86	3.51	39.59
Nursing and residential care facilities	587	37.46	70.43	3.26	11.80	−33.72	−7.32	13.53	166.48	374.67	0.20	10.05	2.56	2.73	38.50
Social assistance	111	32.23	47.80	3.30	17.71	−31.02	−17.32	20.99	119.38	171.56	0.06	9.91	5.41	4.50	52.25
Performing arts, spectator sports, museums, and related activities	1,330	29.21	53.44	4.42	25.40	−21.80	−6.30	14.58	103.37	339.11	0.41	7.74	3.16	1.95	39.77
Amusements, gambling, and recreation industries	673	31.63	63.34	3.98	19.57	−26.28	−7.34	12.01	134.55	374.67	0.15	8.17	5.20	2.08	34.18
Accommodation	1,085	19.44	46.75	5.51	37.67	−26.01	−9.77	7.84	78.91	272.44	0.22	12.17	5.44	1.94	25.25
Food services and drinking places	2,858	26.12	45.27	4.16	24.23	−27.78	−9.73	14.42	97.83	237.18	0.30	10.53	3.11	2.27	39.08
Other services, except government	1,250	23.51	48.77	5.19	34.35	−24.75	−3.78	10.46	90.23	274.64	0.17	7.44	4.16	1.60	29.28

Figure 1 : Mean versus Standard Deviation and Skewness versus the Serial Correlation Across the 40 Investment Rates in Compustat, 1963–2020

The data of the blue circles are detailed in Table 2 (columns "Mean," "Std," "Skew," and "ρ_1") across the 40 investment rates. The data of the larger red circles are for our baseline current-cost investment rates detailed in Table 7.

Panel A: Mean versus standard deviation



Panel B: Skewness versus serial correlation

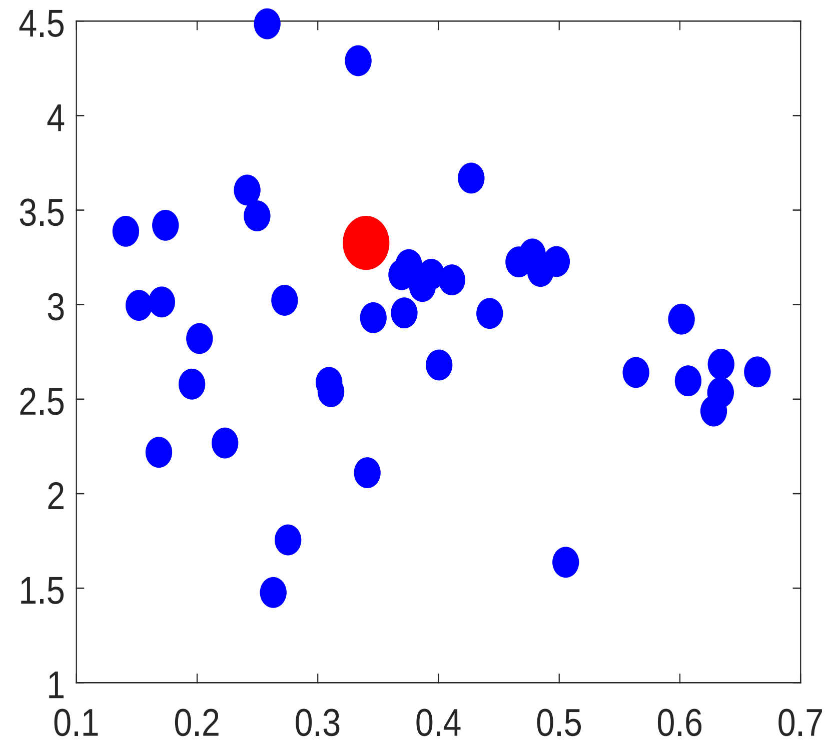


Figure 2 : The BEA's Current-cost Investment Rates, 1963–2020

From the detailed tables for 63 private NAICS-industries from the BEA's fixed assets accounts, we obtain: (i) current-cost investments in private nonresidential equipment, $I^{\mathcal{E}\$}_{jt}$, and structure, $I^{\mathcal{S}\$}_{jt}$, by industry; and (ii) current-cost capital stocks in private nonresidential equipment, $K^{\mathcal{E}\$}_{jt}$, and structure, $K^{\mathcal{S}\$}_{jt}$, by industry. For industry j in year t, we calculate its current-cost investment rate as $I^{\$}_{jt}/K^{\$}_{jt-1} = (I^{\mathcal{E}\$}_{jt} + I^{\mathcal{S}\$}_{jt})/(K^{\mathcal{E}\$}_{jt-1} + K^{\mathcal{S}\$}_{jt-1})$. We also calculate current-cost investment rates for the 20 BEA sectors (the aggregate economy) by summing up investments and capital stocks across all the industries within each sector (the whole economy). Panel A shows the time series of aggregate investment rates in percent. Panel B plots the times series means of investment rates against standard deviations both in percent across the 63 industries. Panel C is the histogram of the pooled sector investment rates (58×20 sector-years). Finally, Panel D is the histgram of the pooled industry investment rates (58×63 industry-years). The y-axis is the fraction (in percent) of firm-years in the histograms.

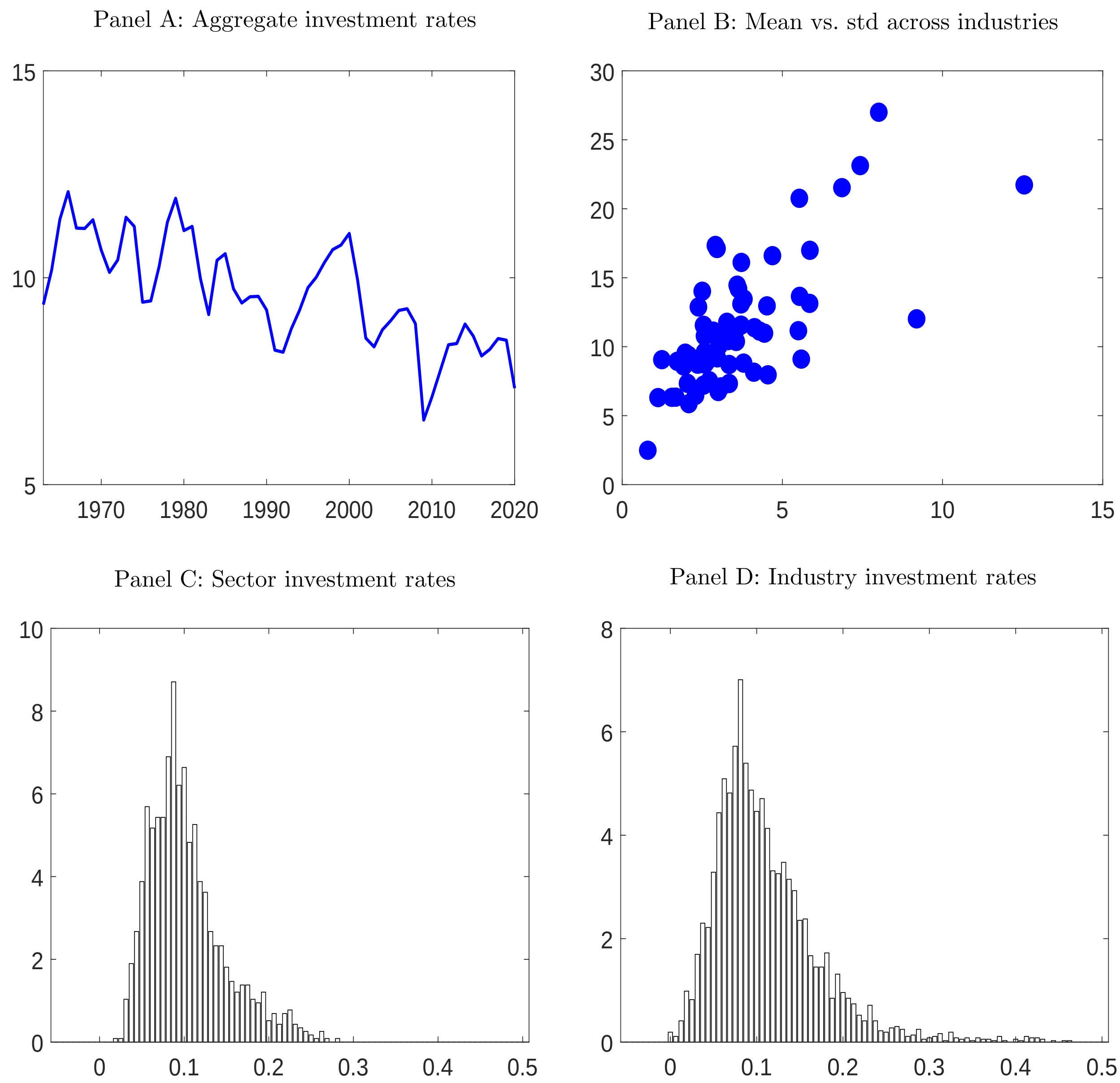


Figure 3 : The Frequency Distribution of 40 Firm-level Investment Rates in the Finance Literature, 2000–2022

Based on Table S2, we present the frequency distribution of the 40 investment rates based on Compustat. For each measure ranked in descending order on the horizontal axis, the vertical axis gives the fraction (in percent) of the number of appearances within the total of 393. The 40 measures are: (1) CAPX/AT; (2) CAPX/PPENT; (3) dAT/AT; (4) (dPPEGT+dINVT)/AT; (5) Inv/AT; (6) CAPX/PPEGT; (7) dPPEGT/AT; (8) (dPPENT+DP)/PPENT; (9) (CAPX−SPPE)/PPEGT; (10) (CAPX−SPPE)/AT; (11) dPPENT/AT; (12) (CAPX+AQC)/AT; (13) CAPXV/AT; (14) (CAPX−SPPE)/PPENT; (15) (CAPX+AQC−SPPE)/AT; (16) (CAPXV−SPPE)/AT; (17) dPPEGT/PPEGT; (18) dPPENT/PPENT; (19) (dPPENT+DP)/AT; (20) (CAPXV−SPPE)/PPEGT; (21) dBe/Be; (22) (CAPX−SPPE)/avePPENT; (23) dNoa/AT; (24) dLno/aveAT; (25) dNca/AT; (26) dBe/AT; (27) (CAPXV+AQC)/PPENT; (28) CAPXV/PPENT; (29) CAPXV/PPEGT; (30) (CAPX+IVCH−SIV)/(PPENT+IVAEQ+IVAO); (31) (dPPENT+WDP+DPC)/PPEGT; (32) dNAT/NAT; (33) CAPX/(AT−INVT); (34) (CAPX+AQC)/PPEGT; (35) CAPX/(PPENT−CAPX+DP); (36) (CAPXV−SPPE)/(AT−ACT); (37) (CAPXV−SPPE)/PPENT; (38) (CAPX−DP)/AT; (39) CAPX/(AT−CHE); and (40) dNCAT/NCAT. Appendix A details the variable definitions.

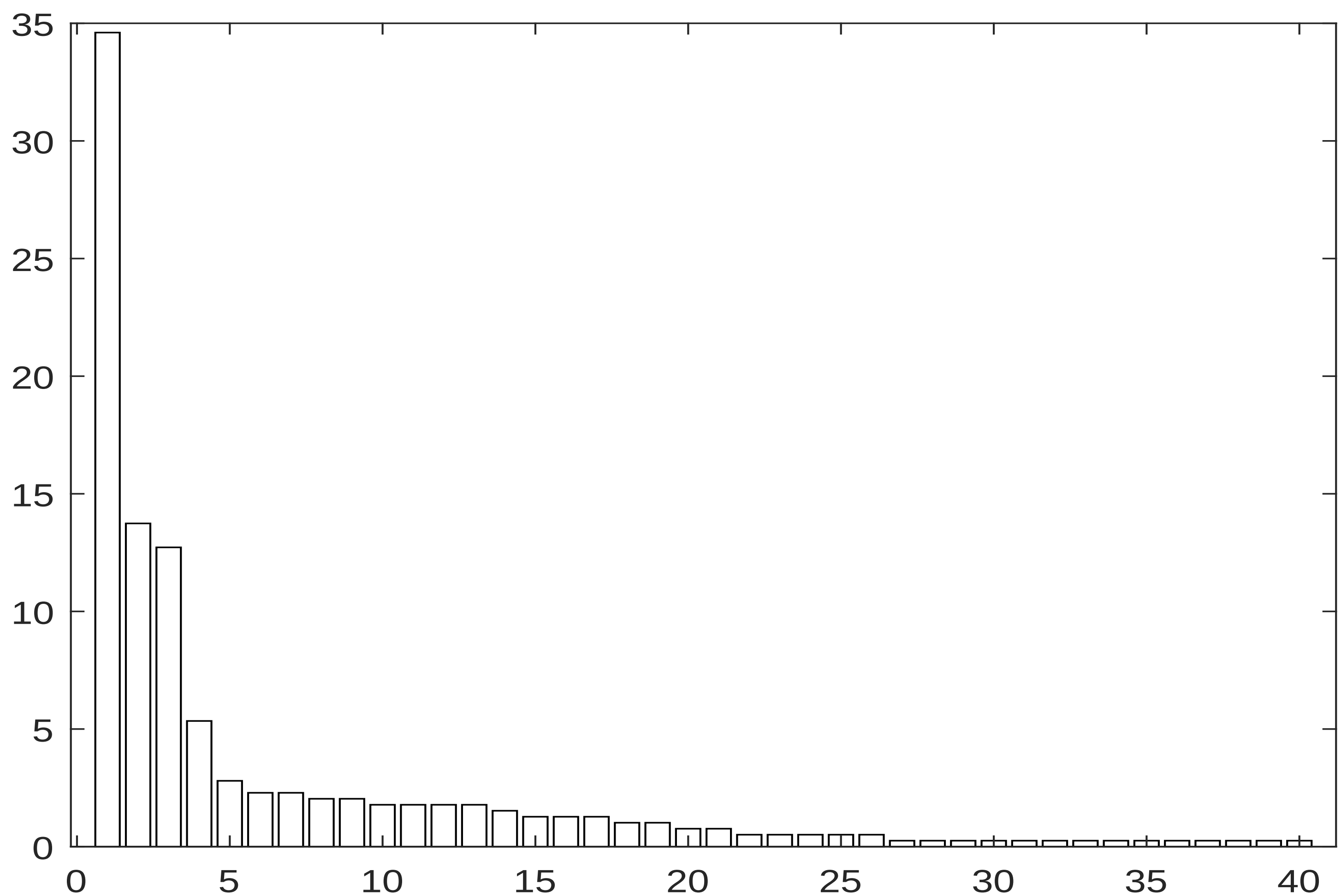


Figure 4 : The Firm-level Current-cost Investment Rate Distribution in Compustat, 169,828 Firm-years, 1963–2020

Section 3 details the measurement of current-cost investment rates, $I_{it}^{\$}/K_{it}^{\$}$. The y-axis is the fraction (in percent) of firm-years.

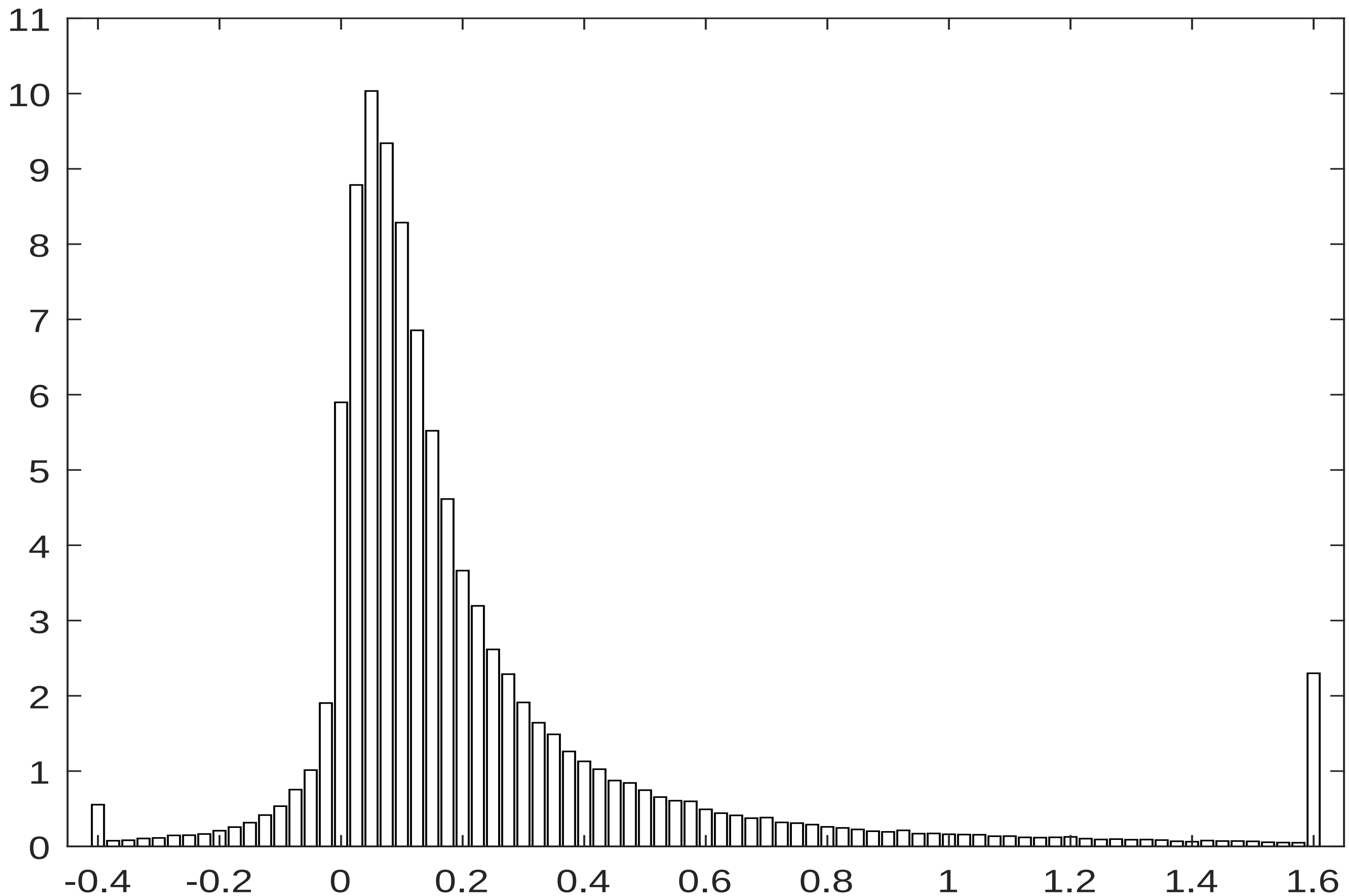


Figure 5 : Differences between Current- and Historical-cost Investment Rates, 1963–2020

I_{it}^H/K_{it}^H is investment over net PPE; $K_{it}^{\$}$ is current-cost capital; δ_{it} is firm-level economic depreciation rates based on the BEA's depreciation rates; δ_{it}^H is accounting depreciation over net PPE; $K_{it}^{\$}$/PPEGT is $K_{it}^{\$}$ over gross PPE; and $I_{it}^{\$}/K_{it}^{\$} - I_{it}^H$/PPEGT is the difference between current-cost investment rates and investment over gross PPE. The y-axis in each panel is the fraction (in percent) of firm-years.

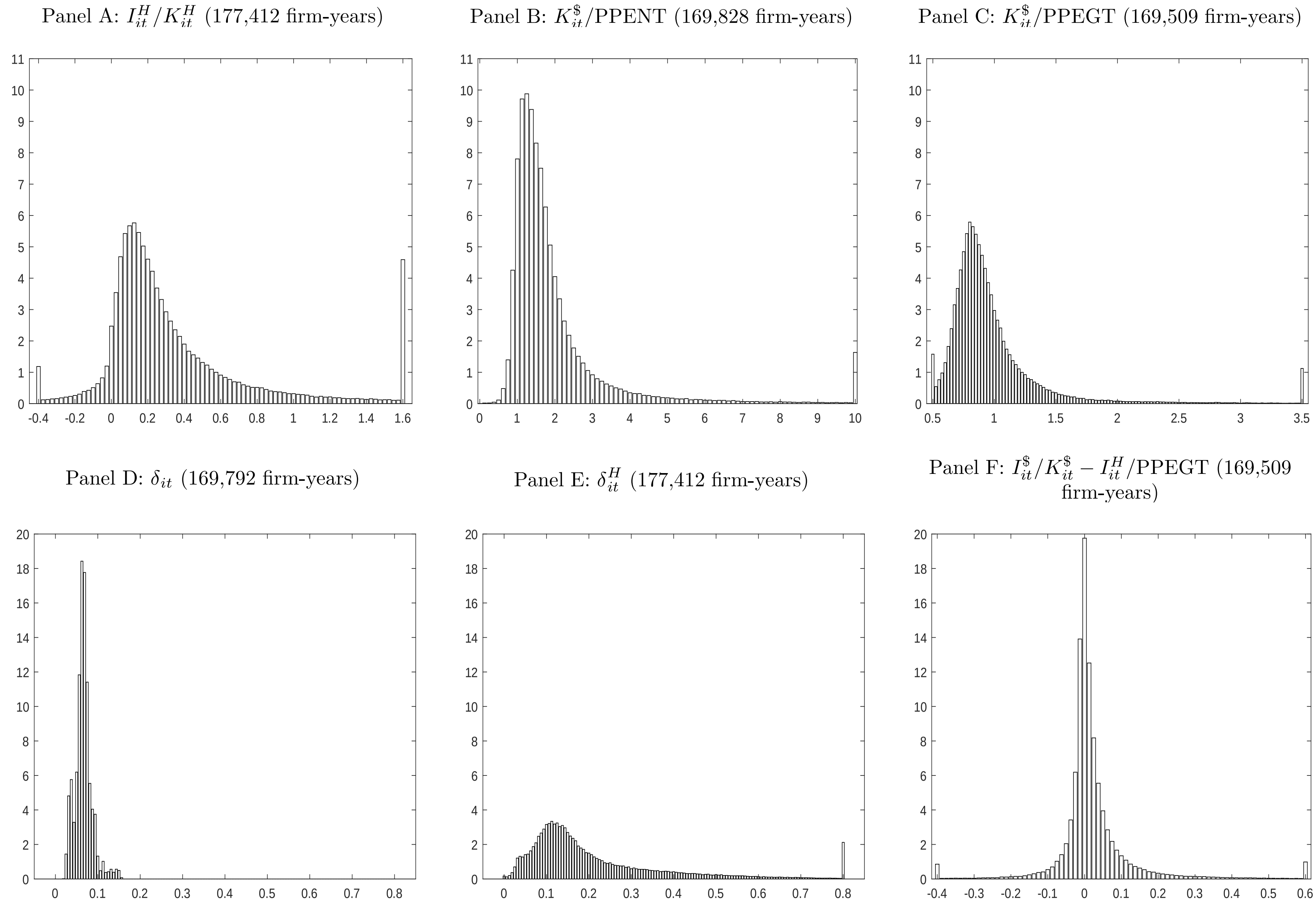
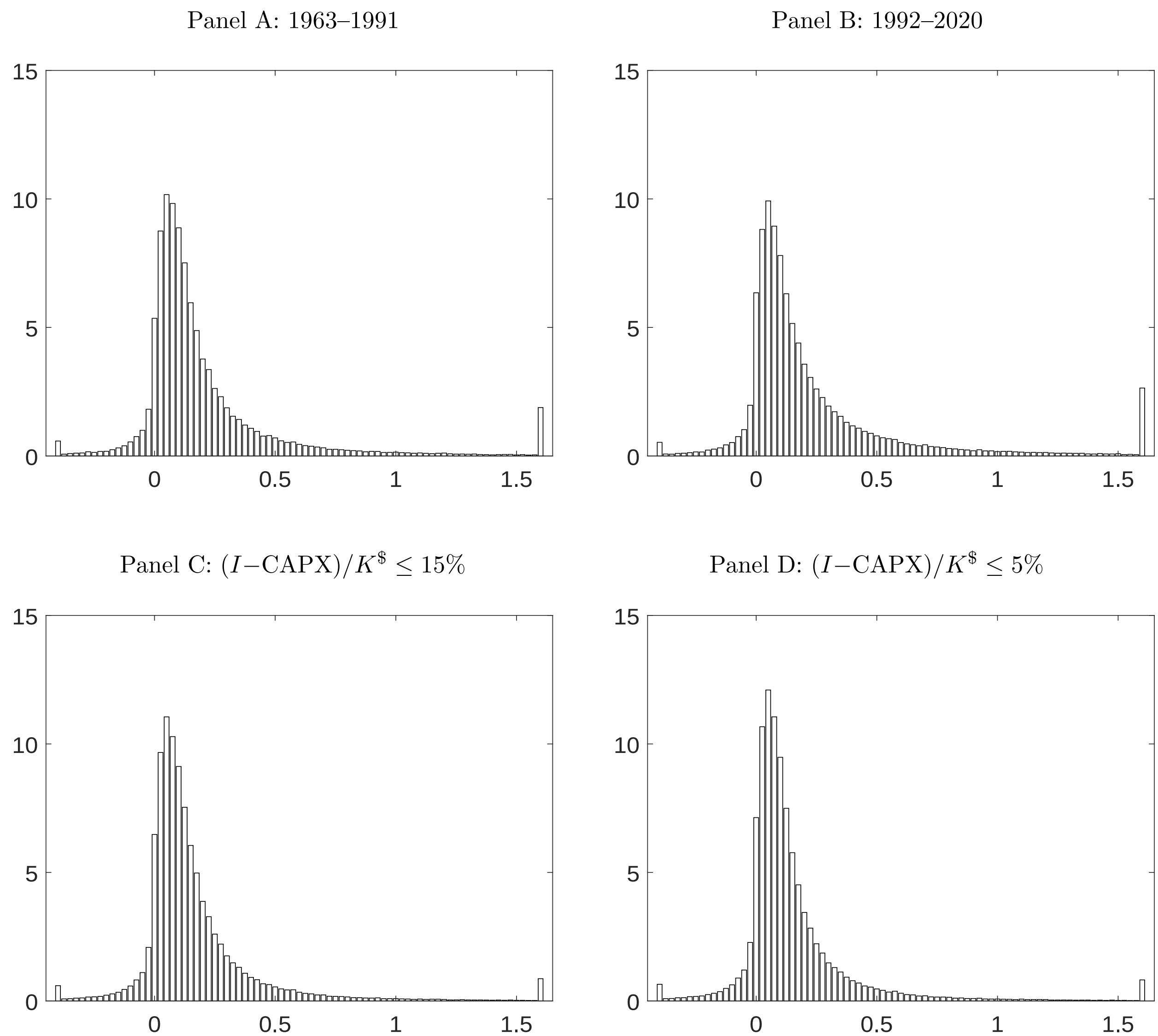
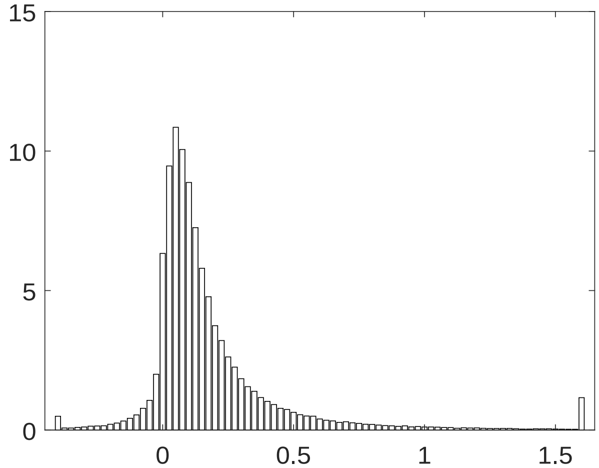


Figure 6 : Comparative Statics, the Firm-level Current-cost Investment Rate Distribution in Compustat, 1963–2020

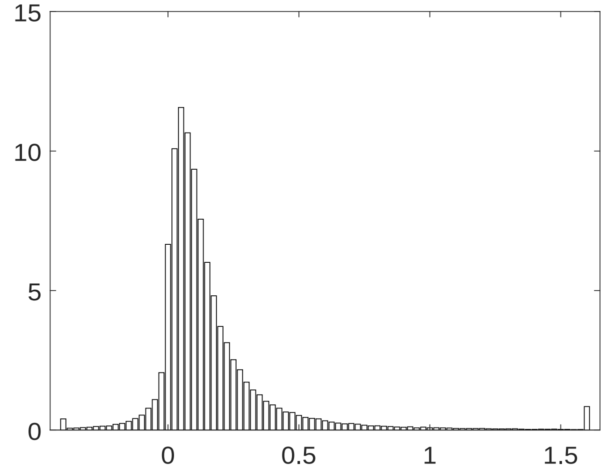
This figure shows the investment rate distribution for ten comparative statics: (i) the first half sample, 1963–1991; (ii) the second half sample, 1992–2020; (iii) $(I-\text{CAPX})/K^{\$} \leq 15\%$, no firm-years with the difference between current-cost investment and capital expenditures (item CAPX) higher than 15% of current-cost capital, $K^{\$}$; (iv) $(I-\text{CAPX})/K^{\$} \leq 5\%$, no firm-years firm-years with $I-\text{CAPX}$ higher than 5% of $K^{\$}$; (v) Age> 3, no first three years of observations for a given firm; (vi) Age> 5, no first five years of observations; (vii) Small ME, the small market equity sample; (viii) Big ME, the big market equity sample; (ix) Small $K^{\$}$, the small current-cost capital sample; and (x) Big $K^{\$}$, the big current-cost capital sample.



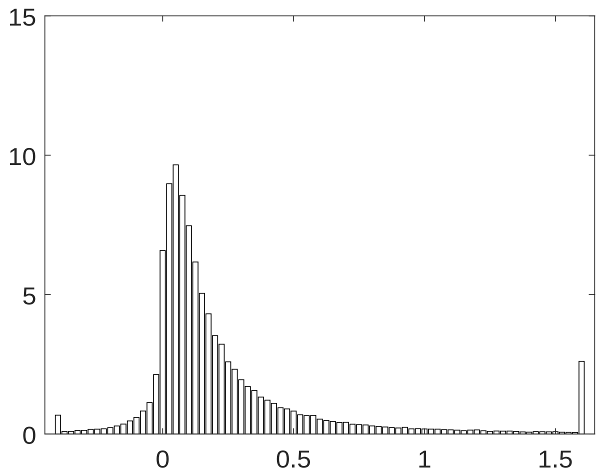
Panel E: Age > 3



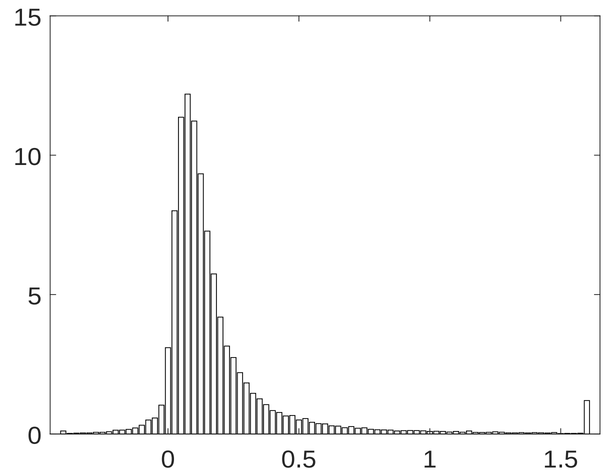
Panel F: Age > 5



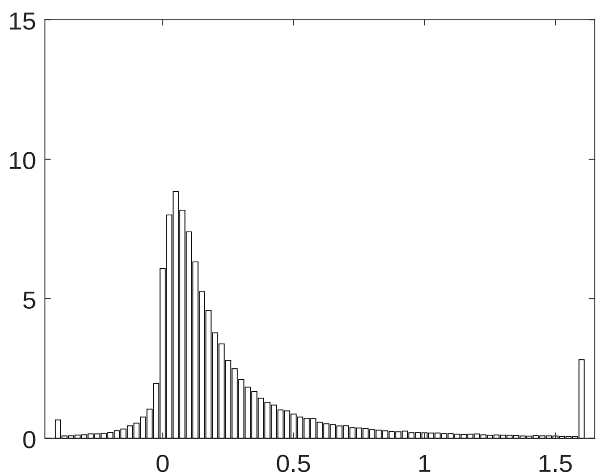
Panel G: Small ME



Panel H: Big ME



Panel I: Small $K^{\$}$



Panel J: Big $K^{\$}$

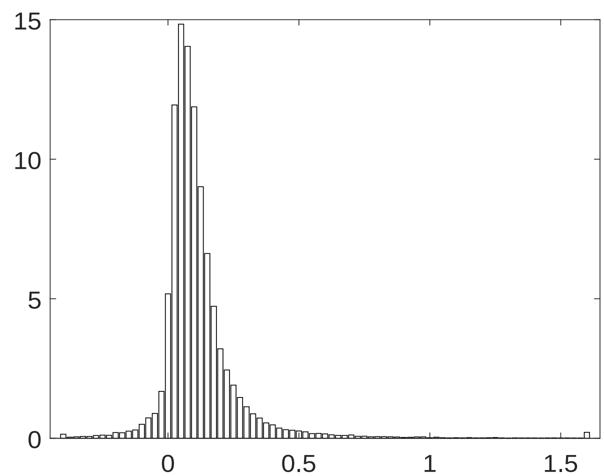
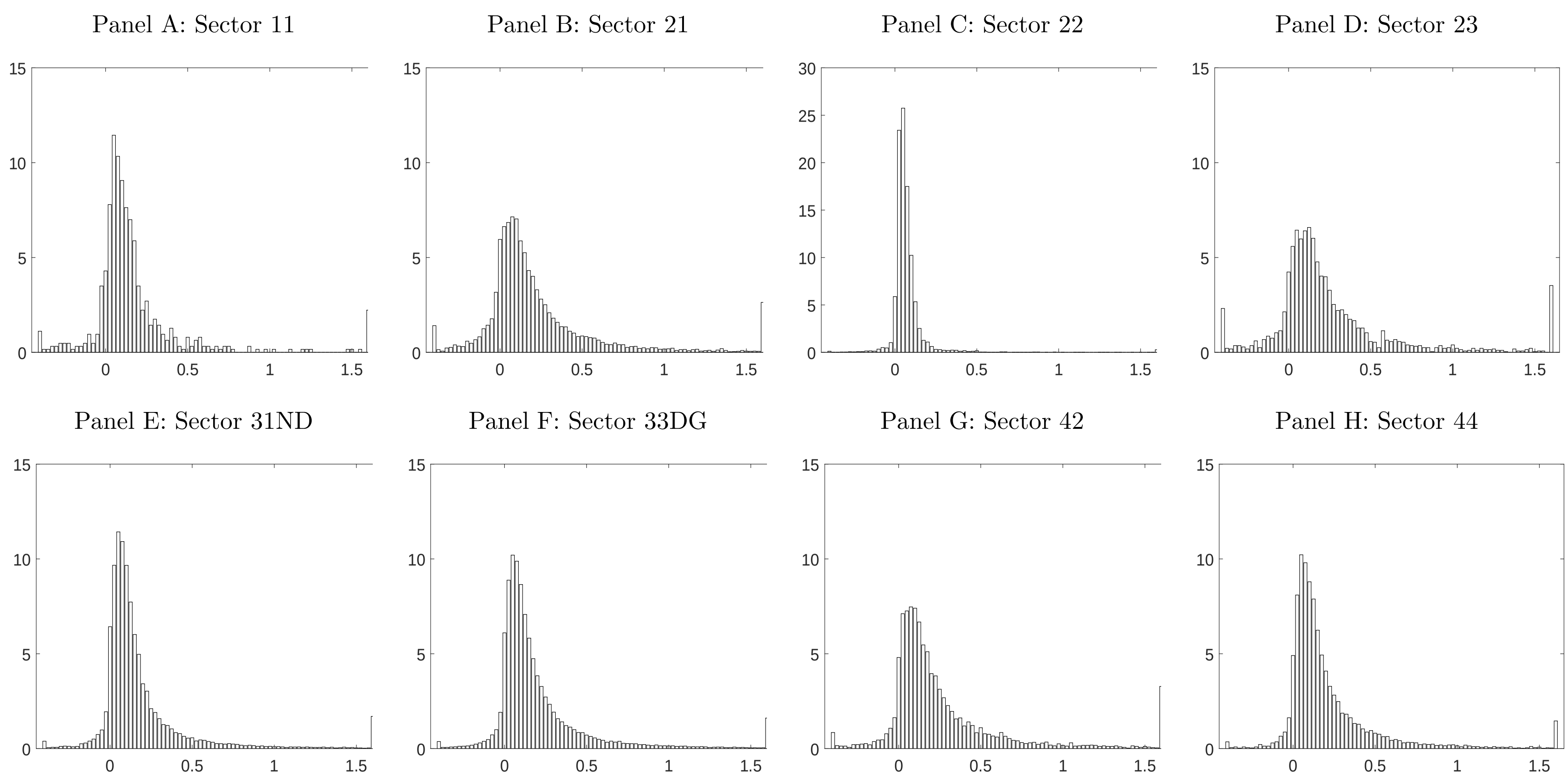


Figure 7 : The Firm-level Current-cost Investment Rate Distribution in Compustat, 19 NAICS Nonfinancial Sectors, 1963–2020

This figure shows the investment rate distribution in each of the 19 NAICS nonfinancial sectors: Sector 11, Agriculture, forestry, fishing, and hunting; 21, Mining; 22, Utilities; 23, Construction; 31ND, Nondurable goods; 33DG, Durable goods; 42, Wholesale trade; 44, Retail trade; 48TW, Transportation and warehousing; 51, Information; 53, Real estate and rental and leasing; 54, Professional, scientific, and technical services; 55, Management of companies and enterprises; 56, Administrative and waste management services; 61, Educational services; 62, Health care and social assistance; 71, Arts, entertainment, and recreation; 72, Accommodation and food services; 81, Other services, except government.



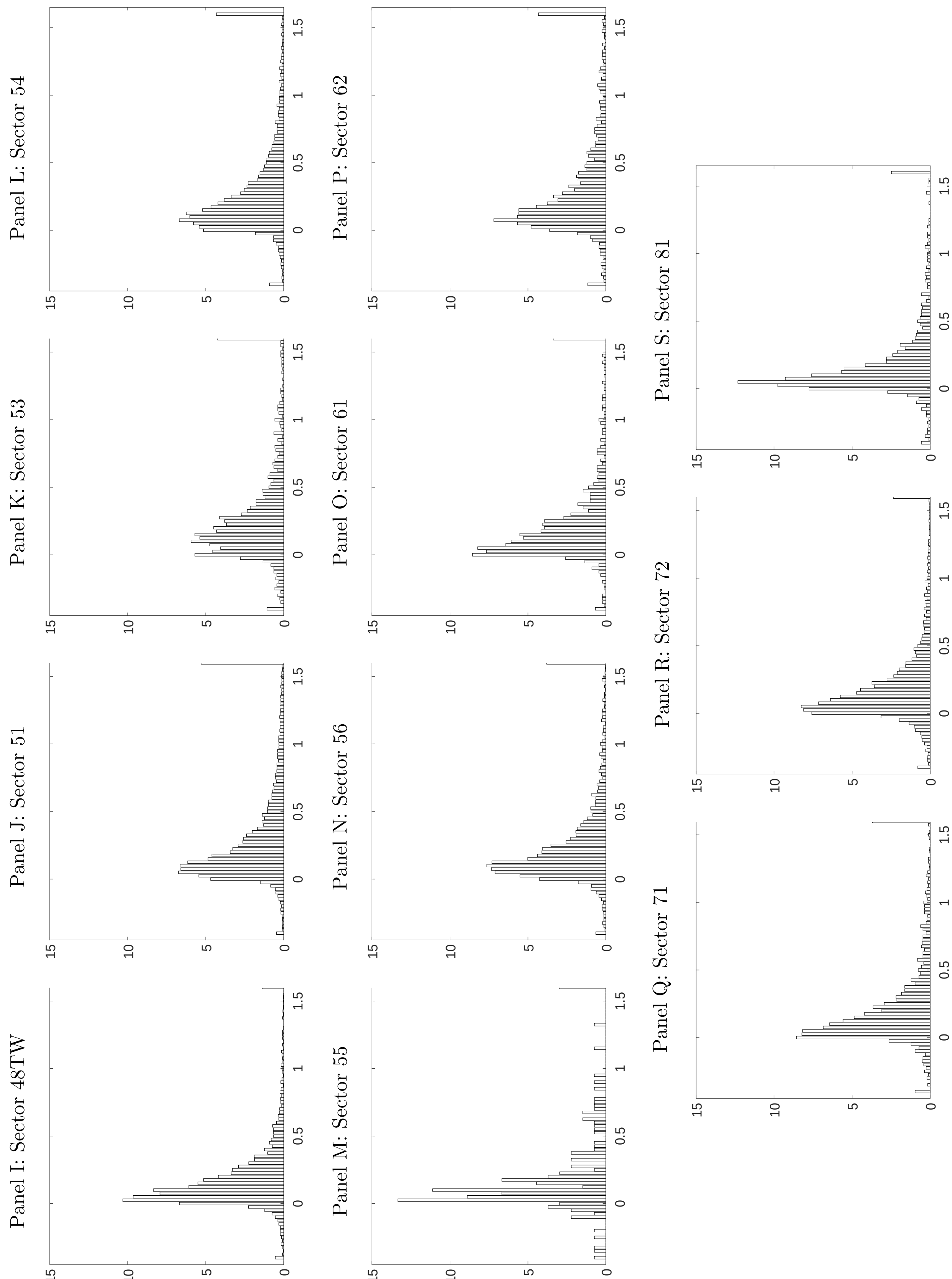
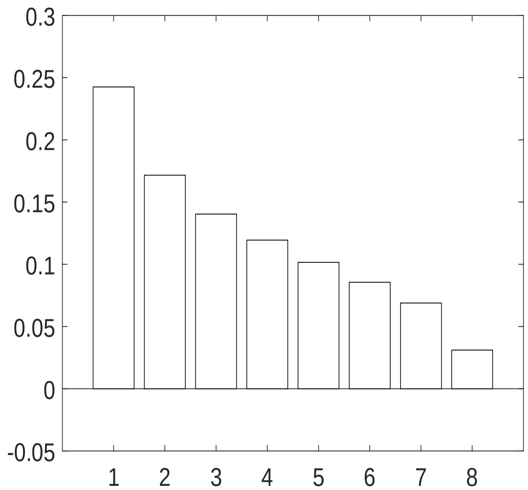

Panel I: Sector 48TW
Panel J: Sector 51
Panel K: Sector 53
Panel L: Sector 54
Panel M: Sector 55
Panel N: Sector 56
Panel O: Sector 61
Panel P: Sector 62
Panel Q: Sector 71
Panel R: Sector 72
Panel S: Sector 81

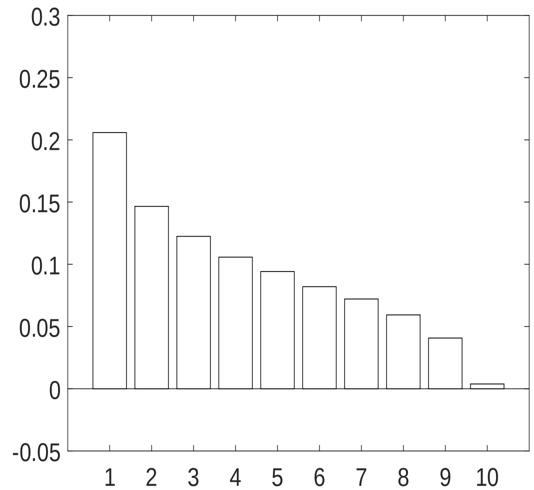
Figure 8 : Average Current-cost Investment Shares by Current-cost Investment Rate Rank by Decade, 1963–2020

For each decade, we include only firms with a complete coverage to obtain a balanced panel. For each firm in a given panel, we rank its current-cost investment rates in the time series in the descending order. We calculate the fraction of the ranked investment made in each year out of the sum of the absolute values of investments in the time series. The figure shows the fractions averaged across all the firms in a given balanced panel. In each panel title, the first number is the number of firms, and the second number is the total investment share covered by the top two years.

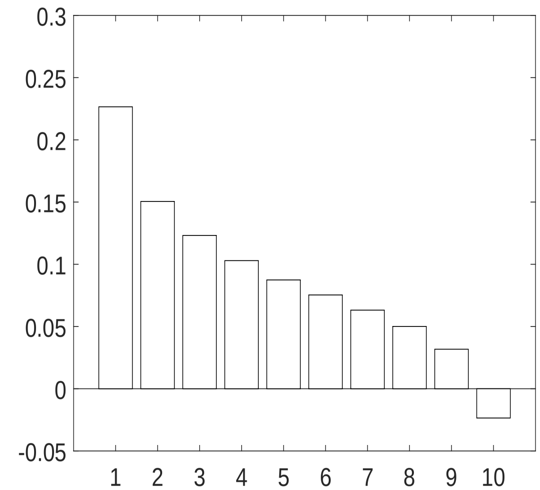
Panel A: 1963–1970 (768, 41.41%)



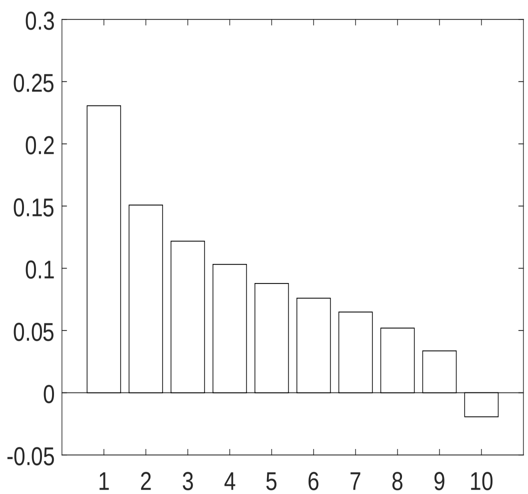
Panel B: 1971–1980 (1,218, 35.24%)



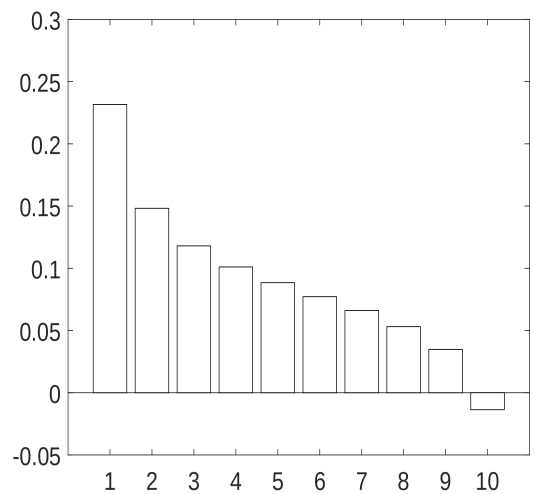
Panel C: 1981–1990 (1,361, 37.71%)



Panel D: 1991–2000 (1,490, 38.14%)



Panel E: 2001–2010 (1,637, 37.98%)



Panel F: 2011–2020 (1,281, 43.45%)

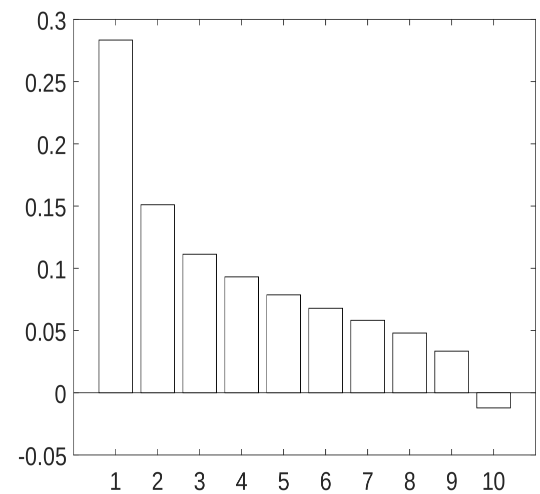
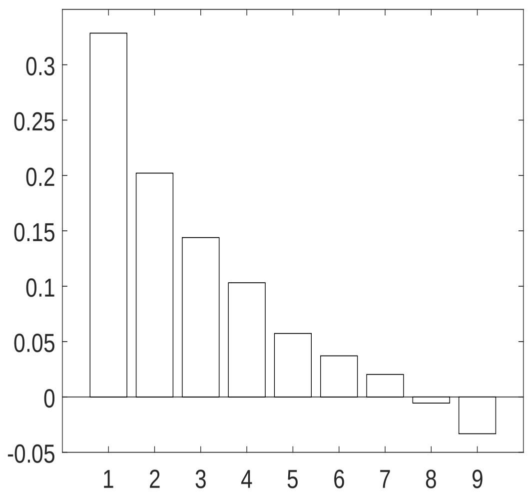


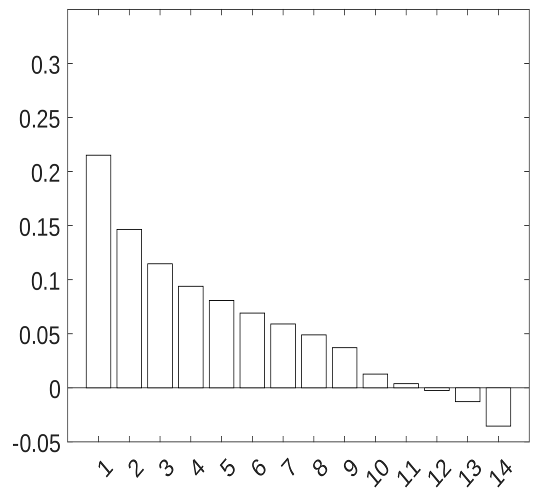
Figure 9 : Average Current-cost Investment Shares by Current-cost Investment Rate Rank by Firm Age, 1963–2020

We split the sample into 11 groups based on firm age (the number of years for a given firm in Compustat): 5–9, 10–14, . . ., 55–58. We drop firms with fewer than five years of current-cost investment rates. For each firm in a given group, we rank its current-cost investment rates in the time series in the descending order. We calculate the fraction of the ranked investment in each year out of the sum of the absolute values of investments in the time series. The figure shows the fractions averaged across all the firms in a given group. In each panel title, the first number is the maximum number of firms, and the second number is the total investment share covered by the top two years.

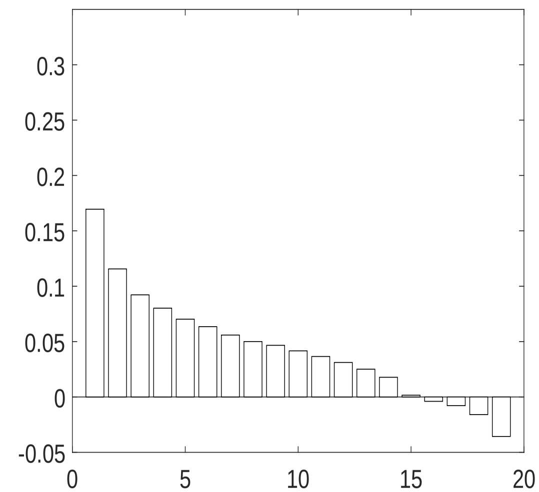
Panel A: 5–9 years (3,541, 52.12%)



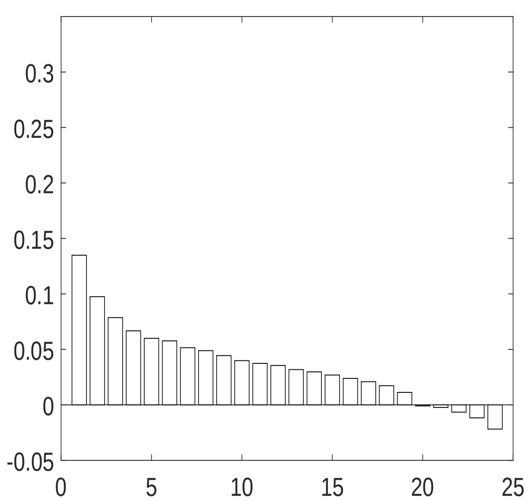
Panel B: 10–14 years (2,061, 46.01%)



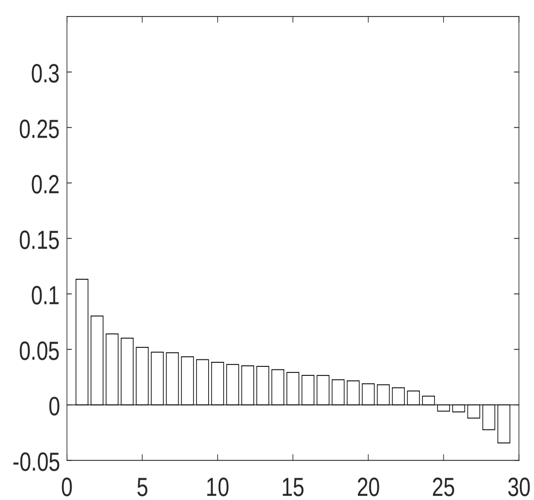
Panel C: 15–19 years (1,287, 42.94%)



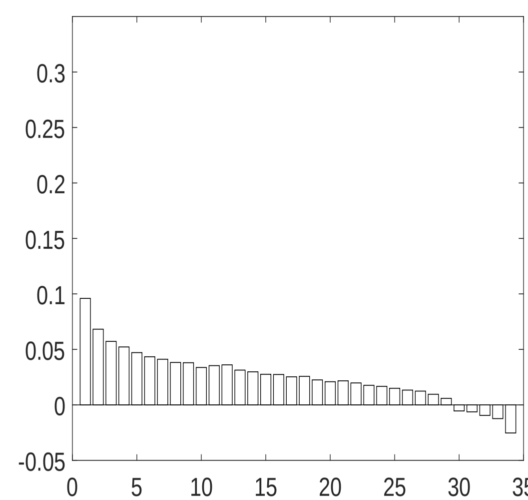
Panel D: 20–24 years (964, 40.35%)



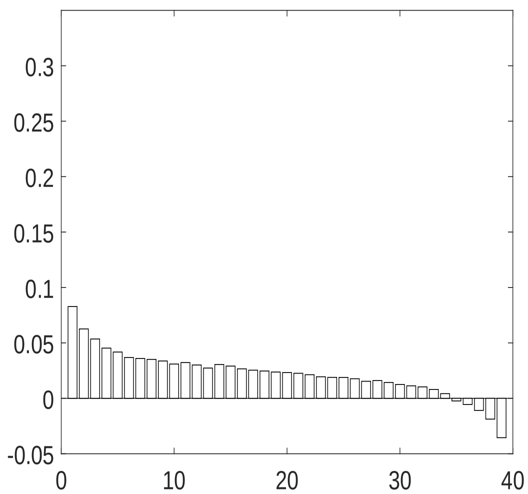
Panel E: 25–29 years (615, 38.25%)



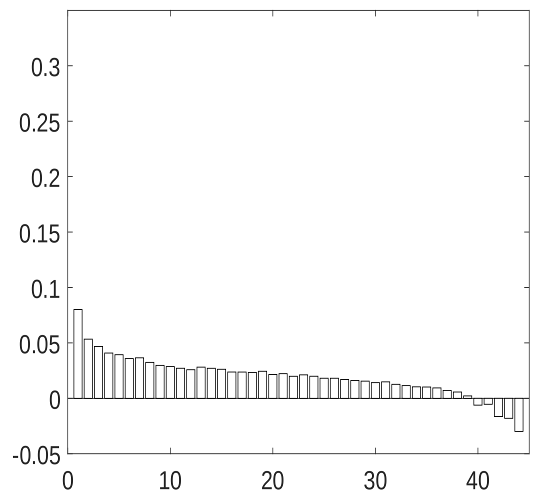
Panel F: 30–34 years (370, 35.9%)



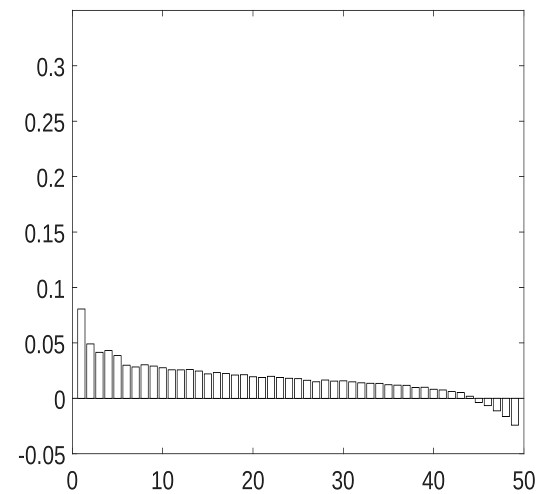
Panel G: 35–39 years (251, 34.22%)



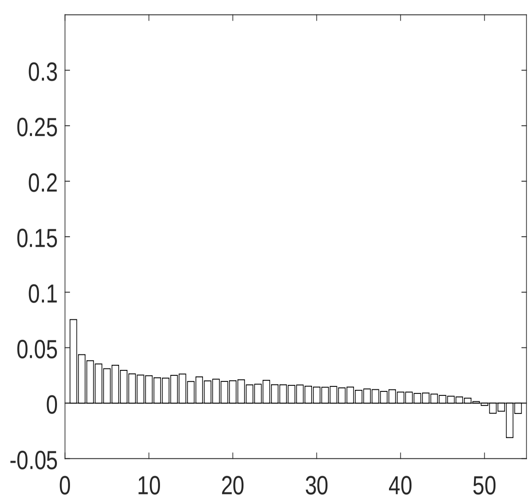
Panel H: 40–44 years (136, 33.89%)



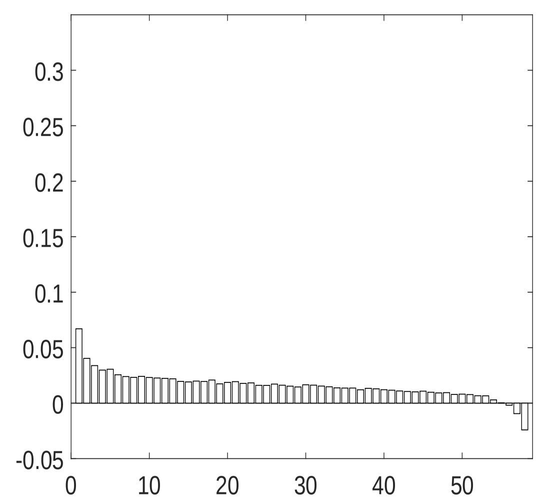
Panel I: 45–49 years (197, 35.2%)



Panel J: 50–54 years (90, 34.67%)



Panel K: 55–58 years (154, 30.89%)



A The 40 Investment Rates in the Finance Literature

The 40 investment rates are measured as follows: (1) CAPX/AT is capital expenditures (Compustat annual item CAPX) over total assets (item AT). (2) CAPX/PPENT is item CAPX over net PPE (item PPENT). (3) dAT/AT is the growth rate of item AT. (4) (dPPEGT+dINVT)/AT is change in gross PPE (item PPEGT) plus change in total inventories (item INVT), scaled by item AT. (5) Inv/AT is for firms reporting format codes 1–3 item CAPX plus increase in investments (item IVCH) plus acquisitions (item AQC) plus other uses of funds (item FUSEO) minus sales of PPE (item SPPE) minus sale of investments (item SIV), all scaled by item AT, and for firms reporting format code 7 item CAPX plus item IVCH plus acquisitions (item AQC) minus item SPPE minus item SIV minus other investing activities (item IVACO), all scaled by item AT.

(6) CAPX/PPEGT is item CAPX over item PPEGT. (7) dPPEGT/AT is the change of item PPEGT scaled by item AT. (8) (dPPENT+DP)/PPENT is the change of item PPENT plus depreciation and amortization (item DP) minus the amortization of intangibles (item AM, zero if missing), scaled by item PPENT. (9) (CAPX−SPPE)/PPEGT is item CAPX minus item SPPE, scaled by item PPEGT. (10) (CAPX−SPPE)/AT is item CAPX minus item SPPE, scaled by item AT. (11) dPPENT/AT is change in item PPENT over item AT. (12) (CAPX+AQC)/AT is item CAPX plus item AQC, scaled by item AT. (13) CAPXV/AT is item CAPXV over item AT. (14) (CAPX−SPPE)/PPENT is item CAPX minus item SPPE, scaled by item PPENT. (15) (CAPX+AQC−SPPE)/AT is item CAPX plus item AQC minus item SPPE, scaled by item AT. (16) (CAPXV−SPPE)/AT is item CAPXV minus item SPPE, scaled by item AT.

(17) dPPEGT/PPEGT is the growth rate of item PPEGT. (18) dPPENT/PPENT is the growth rate of item PPENT. (19) (dPPENT+DP)/AT is the change in item PPENT plus item DP, scaled by item AT. (20) (CAPXV−SPPE)/PPEGT is item CAPXV minus item SPPE, scaled by item PPEGT. (21) dBe/Be is the growth rate of total common equity (item CEQ). (22) (CAPX−SPPE)/avePPENT is item CAPX minus item SPPE, scaled by the average of current and 1-year-lagged item PPENT. (23) dNoa/AT is change in net operating assets over item AT; net operating assets = operating assets (item AT minus cash and short-term investments, item CHE) minus operating liabilities (item AT minus debt in current liabilities, item DLC, minus total

long-term debt, item DLTT, minus minority interest, item MIB, minus preferred stock—carrying value, item PSTK, minus item CEQ). We set missing items DLC, DLTT, MIB, and PSTK to zero.

(24) dLno/aveAT is the change in net PPE plus change in intangibles (item INTAN) plus change in other long-term assets (item AO) minus change in other long-term liabilities (item LO) plus item DP, scaled by the average of current and 1-year-lagged item AT. (25) dNca/AT is the change in noncurrent operating assets (item AT minus item ACT minus item IVAO), scaled by item AT. (26) dBe/AT is the change in item CEQ over item AT. (27) (CAPXV+AQC)/PPENT is capital expenditures on PPE (item CAPXV) plus item AQC, scaled by item PPENT. (28) CAPXV/PPENT is item CAPXV over item PPENT. (29) CAPXV/PPEGT is item CAPXV over item PPEGT.

(30) (CAPX+IVCH−SIV)/(PPENT+IVAEQ+IVAO) is item CAPX plus item IVCH minus item SIV, scaled by item PPENT plus investment and advances—equity method (item IVAEQ) and investments and advances—other (item IVAO). (31) (dPPENT+WDP+DPC)/PPEGT is change in net PPE plus pretax writedown (item WDP, zero if missing) plus depreciation and amortization from statement of cash flow (item DPC), scaled by item PPEGT. (32) dNAT/NAT is the growth rate of nonfinancial assets (item AT minus item ACT plus item INVT).

(33) CAPX/(AT−INVT) is item CAPX scaled by item AT minus item INVT. (34) (CAPX+AQC)/PPEGT is item CAPX plus item AQC, scaled by item PPEGT. (35) CAPX/(PPENT−CAPX+DP) is item CAPX scaled by item PPENT minus item CAPX plus item DP. (36) (CAPXV−SPPE)/(AT−ACT) is item CAPXV minus item SPPE, scaled by item AT minus item ACT. (37) (CAPXV−SPPE)/PPENT is item CAPXV minus item SPPE, scaled by item PPENT. (38) (CAPX−DP)/AT is item CAPX minus item DP, scaled by item AT. (39) CAPX/(AT−CHE) is item CAPX scaled by item AT minus item CHE. (40) dNCAT/NCAT is the growth rate of noncash total assets (item AT minus item CHE).

B Assigning Firms to BEA's NAICS Industries

The NAICS was established in 1997 by the Office of Management and Budget (OMB) to replace the SIC. The NAICS is erected on a production-oriented conceptual framework, which groups establishments into industries with similar production processes. NAICS emphasizes the classification of new and emerging industries, service industries, and industries that produce advanced technologies.

NAICS is a hierarchical coding system that contains up to six digits. The first two fields, NAICS sectors, designate general categories of economic activity; the third field, subsector, further defines the sector; the fourth field is the industry group; the fifth field is the NAICS industry; and the sixth field represents the national industry (a zero indicates that the country industry is identical to the NAICS industry). The 6-digit NAICS codes offer a finer classification than the 4-digit SIC codes.

There have been five editions of NAICS: 1997, 2002, 2007, 2012, and 2017. Compustat and CRSP include all five editions, whereas the BEA has used the first four. The current BEA industry classifications, which are released with the comprehensive update of the Industry Economic Accounts in November 2018, are based on the 2012 NAICS.[27] The BEA provides the mapping from the 2012 NAICS to its industry codes in its fixed assets accounts. The fixed assets accounts contain 63 private industries in 20 sectors.[28] Because of the time series continuity of the NAICS editions, the current BEA industry classification can be applied to older NAICS editions after adjusting for two industries in the "Information" sector.[29] The current BEA classification can be applied without adjustments to the new 2017 NAICS codes, which appear in Compustat and CRSP.

To assign a firm in Compustat to a BEA industry or sector in a given fiscal year, we use the firm's historical NAICS code (item NAICSH). Compustat contains 1,557 unique values of historical NAICS. Only 17 cannot be directly assigned to BEA industries. Among the 17, 11 values are 2-digit sector-level codes (11, 21, 33, 48, 49, 51, 53, 54, 56, 62, and 71) and two are 3-digit subsector-level codes (336 and 541). We assign these codes to matching BEA sectors. Four out of the 17 values are unclassified (NAICS starting with 9999). We discard the firm-years in question. We also drop firms that have ever been classified as non-private (NAICS starting with 92 or 491). Finally, there is no industry classified as "Federal Reserve Banks" (NAICS starting with 5210) in Compustat. As such, we have in total 62 private industries in our sample. The coverage of NAICSH starts in June

[27]The Industry Economic Accounts cover 71 industries in 21 sectors from 1997 onward. Excluding five industries from the "Government" sector yields 66 private industries in 20 sectors.

[28]Compared with the main economic accounts, the differences in the fixed assets accounts are: (i) The "Retail" sector is not broken down into four industries; (ii) "Federal reserve banks, credit intermediation, and related activities" is separated into two industries: "Federal Reserve banks" and "Credit intermediation and related activities;" and (iii) The "Real Estate" industry is not broken down into "Housing" and "Other industries."

[29]For "Broadcasting and Telecommunications", we add the 3-digit code of 513 from the 1997 edition. For "Information and Data Processing Services", we add 514 from the 1997 edition and 516 from the 2002 edition.

1985. Although historical NAICS is also available in CRSP, its coverage starts only in June 2004 and adds little beyond Compustat. As such, we do not use the CRSP data on NAICS.

Prior to June 1985, because firm-level NAICS codes are not available in Compustat, we use SIC codes to assign firms to industries. Because historical SIC codes are not available in Compustat until June 1987, we obtain SIC codes from CRSP (item SICCD) at a firm's fiscal year end. SIC codes are 4-digit integers between 100 and 9999. The first two digits indicate a major group, the first three denote an industry group, and all four refer to an industry.

In CRSP, there exist 1,613 unique values of historical SIC. Among them 321 codes cannot be directly assigned to BEA industries: (i) 165 are from the 1972 SIC edition (but not in the 1987 edition); (ii) 15 are for public entities (9199–9661); (iii) 1 is "postal service" (4310); (iv) 2 are missing codes (0 and 9999); (v) 2 are for unclassified entities (9910 and 9990); and (vi) the remaining 156 codes are from editions older than 1972 or are simply data errors.

To handle the complexities, we convert the 1972 SIC codes to the 1987 codes using concordance tables from the 1987 SIC manual. We drop firms that have ever been classified as non-private (SIC starting with 91–97 or 43). We discard the firm-years with unclassified or missing SIC codes (starting with 99 or equal to 0). Finally, we discard the codes from the pre-1972 SIC editions in CRSP for two reasons. SIC has experienced significant changes over time. As such, converting pre-1972 editions to the 1987 edition is likely to produce unreliable industry assignments. More important, random checks show that it is difficult to distinguish the pre-1972 SIC codes from data errors.

The next step is to convert SIC codes into NAICS codes via the 1987 SIC to 1997 NAICS concordance table from the U.S. Census Bureau and to use the converted NAICS codes to assign firms to the BEA industries. Because the conversion from SIC to NAICS is not one-to-one, one SIC code can be matched into multiple BEA industries. In particular, in our 1950–2020 sample, 81.76% of the 1987 SIC codes are assigned to a unique BEA industry, 15.27% to two industries, 2.05% to three industries, and 0.92% to four or more industries. In addition, the SIC codes can have only two or three significant digits, while ending with 0s. We match such a SIC code to all BEA industries into which the 4-digit SIC codes that start with the same two or three digits have been mapped. Doing so increases non-unique industry assignments. If we include all possible 2- or

3-digit SIC codes, 74.29% of the 1987 SIC codes are assigned to a unique BEA industry, 16.98% to two industries, 4.71% to three industries, and 4.02% to four or more industries.

Finally, to maximize the coverage of firm history, which is important for computing the initial values of current-cost capital stocks, we use the Compustat sample that includes (typically two or three) years prior to a firm's initial public offerings. To deal with missing industry classifications in a firm's history, we apply the first available classification to earlier years. For missing observations after the first classification, we use the most recent classification from the past.

C Estimating Asset Age

In Section 3.4 we estimate average asset age as accumulated depreciation (Compustat annual item DPACT) divided by depreciation (item DP minus AM, zero if missing) and the asset age (since acquiring its oldest asset) as two times the average asset age. In this appendix, we use three numerical examples to show that our asset age approximation seems to work well.

Panel A of Table A1 shows the example with a constant, annual investment of \$1 for ten years. Asset is homogeneous with a service life of five years, implying a straight-line depreciation rate of 20% per year. At the end of the service life, an asset is retired immediately. As such, the stream of retirement equals zero from year 0 to year 4 but \$1 from year 5 onward. The end-of-period PPEGT rises steadily from \$1 at year 0 to \$5 at year 4, but remains at \$5 from year 5 onward because retirement takes effect in year 5. Accordingly, annual depreciation, which equals prior PPEGT times 20%, rises steadily from \$0.2 at year 1 to \$0.8 at year 4, but remains at \$1 from year 5 onward. The reason is that retired assets, which are taken off the balance sheet, no longer depreciate. The end-of-period DPACT then rises from \$0.2 at year 1 to \$2 in year 4 but remains at \$2 afterward as retired assets no longer add to the account. PPENT is PPEGT minus DPACT.

For gross PPE, its average asset age is the weighted average of asset age with the weights given by the investment amounts of the assets. For instance, year 1's average asset age, 0.5, equals year 0's investment, \$1, times its age in year 1, which is one, plus year 1's investment, \$1, times its age in year 1, which is zero, all scaled by the total investments across the two years, \$2. Analogously, year 2's average asset age equals $(\$1 \times 2 + \$1 \times 1 + \$1 \times 0)/\$3 = 1$, and so on. For year 5, the average asset age equals $(\$1 \times 4 + \$1 \times 3 + \$1 \times 2 + \$1 \times 1 + \$1 \times 0)/\$5 = 2$. The $1 investment in year 0, which has been fully depreciated, no longer enters the calculation. The oldest asset age rises steadily from one in year 1 to four in year 4 but remains at four in year 5 onward. The reason is that retired assets from the $1 investment in year 0 are removed from PPEGT at the end of year 5, capping the oldest asset age at four.

While we can work out the precise average and oldest asset age within this example, such detailed vintage-investment data are not available in Compustat. We can only estimate asset age based on the available data. As noted, we estimate average asset age as DPACT divided by depreciation and oldest asset age as average asset age times two. Panel A shows that our estimation is accurate once a firm reaches its "steady state," in which investment equals retirement. The remaining panels in Table A1 show that our approximation remains accurate even if investment growth rates are non-zero.

Table A1 : Examples of Estimating Asset Age

This table presents examples with investment growth rates of zero, 10%, and −10%, respectively. The straight-line depreciation rate is 20%. Asset is homogeneous with a service life of five years. At the end of its service life, an asset is retired immediately. PPEGT, PPENT, and DPACT are gross PPE, net PPE, and accumulated depreciation at the end of a period, respectively. Average asset age is the weighted average of asset age weighted by the investment amounts of the assets. Oldest asset age is the oldest vintage of assets. DPACT/DP is our estimate of average asset age. $A_i = 2 \times \text{DPACT/DP}$ is our estimate of oldest asset age.

Year	0	1	2	3	4	5	6	7	8	9	10
Panel A: Constant investment, 20% straight-line depreciation (5 years service life)											
Investment	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Retirement	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
PPEGT	1.00	2.00	3.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Depreciation	0.00	0.20	0.40	0.60	0.80	1.00	1.00	1.00	1.00	1.00	1.00
DPACT	0.00	0.20	0.60	1.20	2.00	2.00	2.00	2.00	2.00	2.00	2.00
PPENT	1.00	1.80	2.40	2.80	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Average asset age	0.00	0.50	1.00	1.50	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Oldest asset age	0.00	1.00	2.00	3.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
DPACT/DP		1.00	1.50	2.00	2.50	2.00	2.00	2.00	2.00	2.00	2.00
A_i		2.00	3.00	4.00	5.00	4.00	4.00	4.00	4.00	4.00	4.00
Panel B: 10% investment growth, 20% straight-line depreciation (5 years service life)											
Investment	1.00	1.10	1.21	1.33	1.46	1.61	1.77	1.95	2.14	2.36	2.59
Retirement	0.00	0.00	0.00	0.00	0.00	1.00	1.10	1.21	1.33	1.46	1.61
PPEGT	1.00	2.10	3.31	4.64	6.11	6.72	7.39	8.13	8.94	9.83	10.82
Depreciation	0.00	0.20	0.42	0.66	0.93	1.22	1.34	1.48	1.63	1.79	1.97
DPACT	0.00	0.20	0.62	1.28	2.21	2.43	2.67	2.94	3.24	3.56	3.92
PPENT	1.00	1.90	2.69	3.36	3.89	4.28	4.71	5.18	5.70	6.27	6.90
Average asset age	0.00	0.48	0.94	1.38	1.81	1.81	1.81	1.81	1.81	1.81	1.81
Oldest asset age	0.00	1.00	2.00	3.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
DPACT/DP		1.00	1.48	1.94	2.38	1.99	1.99	1.99	1.99	1.99	1.99
A_i		2.00	2.95	3.87	4.76	3.98	3.98	3.98	3.98	3.98	3.98
Panel C: −10% investment growth, 20% straight-line depreciation (5 years service life)											
Investment	1.00	0.90	0.81	0.73	0.66	0.59	0.53	0.48	0.43	0.39	0.35
Retirement	0.00	0.00	0.00	0.00	0.00	1.00	0.90	0.81	0.73	0.66	0.59
PPEGT	1.00	1.90	2.71	3.44	4.10	3.69	3.32	2.99	2.69	2.42	2.18
Depreciation	0.00	0.20	0.38	0.54	0.69	0.82	0.74	0.66	0.60	0.54	0.48
DPACT	0.00	0.20	0.58	1.12	1.81	1.63	1.47	1.32	1.19	1.07	0.96
PPENT	1.00	1.70	2.13	2.32	2.29	2.06	1.85	1.67	1.50	1.35	1.21
Average asset age	0.00	0.53	1.07	1.63	2.21	2.21	2.21	2.21	2.21	2.21	2.21
Oldest asset age	0.00	1.00	2.00	3.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
DPACT/DP		1.00	1.53	2.07	2.63	1.99	1.99	1.99	1.99	1.99	1.99
A_i		2.00	3.05	4.14	5.26	3.98	3.98	3.98	3.98	3.98	3.98