Description and Download Link for Internal Rate of Return Data

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"Do Digital Technology Firms Earn Excess Profits? Alternative Perspectives."

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Summary of Data

Internal Rate of Return (IRR) is defined as the discount rate that equates the initial investment with related cash payouts and is estimated under a representative cash payout profile and constant growth rate in investment. The calculation of IRR relies on an algorithm stipulating that for each unique cash recovery rate (CRR) and an investment growth rate over a given payback period, there is a unique IRR (Ijiri 1978, 1979, 1980). We calculate the IRRs under the cash payback periods of six, eight, or ten years with an adjustment to account for intangible investments in the CRR calculation. To adjust for intangible investments, we estimate the value of internally generated intangible capital under either the Revenue-to-Intangibles model or the Price-to-Book Value model (details of which are provide below).

Our sample period spans 40 years between 1980 and 2019 and includes firm-years covered by Compustat North America Fundamentals Annual database and CRSP with $100 million in inflation-adjusted assets (adjusted to year 2000 values). We remove observations related to firms in the utilities, financials, and real estate sectors and firms with missing Global Industry Classification Standard (GICS) codes. The additional data requirements in our study result in the IRR dataset with 88,625 firm-year observations that we make publicly available for academics, researchers and practitioners at https://sites.google.com/view/rajgopal-srivastava-zhao/data.[1,2] We also include the firm identifier (GVKEY and company name from S&P Compustat, and PERMNO assigned by CRSP) along with the description of the firm's six-digit GICS industry. Please reference the original article if you use the data.

[1] We thank John Hand for the suggestion to post the data.
[2] All IRR values are winsorized at the 1st and 99th percentiles.

Calculation Details

We construct CRR as cash recovery in a year divided by the amount of invested capital at the beginning of that year. To compute cash recovery, we start with after-tax operating income and add back depreciation and amortization. Decreases in noncash working capital and proceeds from the sale of invested capital, if any, are also added back in the numerator to incorporate cash recoveries from any sale of past investment. To adjust for intangible investments, we add back the investment portions of current year R&D and MainSG&A (defined as SG&A excluding R&D) in the numerator, as well as the cumulative investment portions of R&D and MainSG&A over the duration of their respective productive lives to invested capital. Thus, gross invested capital is the sum of book value of debt, minority interest, equity, accumulated depreciation and amortization, and capitalized R&D and MainSG&A. In effect, the numerator is a close approximation of cash generated from operations, after treating outlays on capitalized R&D and MainSG&A, PP&E, net working capital, and financial assets as investments. The denominator carries all investments (PP&E, working capital, acquisitions, financial assets, and intangible expenditures) at their initial values until the time they are sold or retired.

For intangible capital adjustments, we estimate the investment portions of R&D and MainSG&A as well as their productive lives using two alternative models: the Revenue-to-Intangibles model and the Price-to-Book Value model. Under the Revenue-to-Intangibles model, we follow Iqbal, Rajgopal, Srivastava, and Zhao (2021) to simultaneously estimate the investment portion and the productive life of R&D or MainSG&A, based on their associations with future economic benefits proxied by future revenues. In separate models for R&D and SG&A, we include up to seven years of future revenues for R&D and up to five years of future revenues for SG&A.

$$MainSG\&A_{i,t} \text{ or } R\&D_{i,t} = \alpha_{Ind} + \beta_{Ind} \times Revenues_{i,t} + \sum_{k=1}^{n} \beta_{Ind,k} \times Revenues_{i,t+k} + e_{i,t} \quad (1)$$

For each six-digit GICS industry, we select the model that gives the highest adjusted R-squared. Parameter k (i.e., how many years of future revenues are associated with current year intangible investments) from the optimal model is assumed to be the productive life of investment. Parameter estimates from the optimal model are used to calculate the investment portion of R&D or MainSG&A for each firm-year (i.e., investment percent is the intercept plus sum of betas × future revenues, divided by current year R&D or MainSG&A). We calculate the value-weighted average investment portion for each industry, with the weight being the amount of firm-year R&D or MainSG&A.

Under the Price-to-Book Value model, we adapt the method in Lev, Nissim, and Thomas (2008), which finds the best association between market value and alternate book values of equity, with book values adjusted to incorporate capitalization and amortization of intangible investments assuming different useful lives. We assume that the investment portion of R&D and MainSG&A is 100 percent and 50 percent, respectively. We then calculate 35 (7 × 5) adjusted book values with capitalized R&D and MainSG&A based on different combinations of productive lives for R&D (one to seven years) and MainSG&A (one to five years). We then regress market value on the 35 adjusted book values of equity, one at a time. Both market value and book value are scaled by total assets, and we include the inverse of total assets as an additional term.

$$MarketValue_{i,t} = \alpha_{Ind} + \beta_{1,Ind} \times AdjustedBookValue_{i,t} + e_{i,t} \quad (2)$$

We select the book value (and its associated productive lives for R&D and MainSG&A) that maximizes the explanatory power (adjusted R-squared) for each six-digit GICS industry.

Next, we make assumptions about the payback period, that is, how long it takes to pay back an investment and what percentage of that payback occurs in each future period, following Salamon (1982). For example, if any investment pays back a total of $12 with a Q1 profile (Fisher and McGowan 1983), spread over *N* years, then we assume that an *N* of 9 implies a payback of $0, $0, $0, $1, $2, $3, $3, $2, and $1 in the first, second, third, fourth, fifth, sixth, seventh, eighth, and ninth year, respectively, after the initial investment. This payback assumes a gestation period of three years, a rise in recoveries over the next three years, followed by a decline. If those paybacks follow the Q1 profile and occur with a 20 percent IRR, then, following a $1 investment, the cash flows over the next nine years would be $0, $0, $0, $0.26, $0.53, $0.79, $0.79, $0.53, and $0.26, respectively, for a total of $3.17. The total inflows are almost three times larger than the initial investment, yet the IRR is only 20 percent.

We further assume that, each year, a company makes a net new investment (new outlay minus sale of old assets) that is 5 percent larger than the last year. Because the payback occurs over nine years, the undepreciated value of invested capital is a running total of the last nine years' investments and this year's investment. For example, net new investments of $100, $105, $110, $116, $122, $128, $134, $141, $148, and $155, growing at a 5 percent rate, would lead to an invested capital of $1,258 over ten years from year 0 to year nine. The cash recovery in the tenth year based on the Q1 profile would be the sum of nine recoveries, 0 percent of the ninth year investment (that is, of $t - 1$ investment), 0 percent of the eighth year investment (that is, of $t - 2$ investment), 0 percent of the seventh year investment (that is, of $t - 3$ investment), 26 percent of the sixth year investment (that is, of $t - 4$ investment), 53 percent of the fifth year investment (that is, of $t - 5$ investment), 79 percent of the fourth year investment (that is, of $t - 6$ investment), 79 percent of the third year investment (that is, of $t - 7$ investment), 53 percent of the second year investment (that is, of $t - 8$ investment), and 26 percent of the first year investment (that is, of $t - 9$ investment), amounting to $377. The CRR for the tenth year would then be $377 divided by total invested capital at the beginning of the tenth year ($1,258), which is 30 percent. CRR also includes return of principal and, therefore, it differs from IRR.

For a given payback profile (Q1 in this case), growth rate in invested capital, and IRR, there will be a unique CRR in the *N*th year. Conversely, for a given payback profile, growth rate, and CRR, there exists a unique IRR. We first calculate CRR and then derive the implied IRR as the real root of R that solves equation (3) (Baber and Kang 1996), with R being one plus implied IRR.

$$CRR_t = \left[\frac{Q_1(k)}{R^1} + \frac{Q_2(k)}{R^2} + \cdots + \frac{Q_\mathrm{N}(k)}{R^\mathrm{N}}\right]^{-1} \times \left[\frac{Q_1(k) \times G^{\mathrm{N}-1} + Q_2(k) \times G^{\mathrm{N}-2} + \cdots + Q_\mathrm{N}(k) \times G^0}{G^{\mathrm{N}-1} + G^{\mathrm{N}-2} + \cdots + G^0}\right] \quad (3)$$

Data Dictionary

IRR variables	**Cash Payout Period**
Revenue-to-Intangibles model	
IRR_m1_6	6
IRR_m1_8	8
IRR_m1_10	10
Price-to-Book Value model	
IRR_m2_6	6
IRR_m2_8	8
IRR_m2_10	10

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