Review of Economic Dynamics 50 (2023) 131–145

Contents lists available at ScienceDirect

Review of Economic Dynamics

journal homepage: www.elsevier.com/locate/red

Taxes, regulations, and the value of U.S. corporations: A reassessment ☆

Ellen R. McGrattan [a,b,*]

[a] University of Minnesota, United States of America
[b] Federal Reserve Bank of Minneapolis, United States of America

ARTICLE INFO

Article history:
Received 22 July 2023
Available online 12 August 2023

JEL classification:
E62
E44
G18

Keywords:
Stock market
Taxation
Productive capital stocks

ABSTRACT

This paper reassesses the conclusions of McGrattan and Prescott (2005), which derived the quantitative implications of growth theory for U.S. corporate valuations. In addition to having two more decades of data, the analysis incorporates recent changes in policies that affect corporate investments, taxes, and legal-form choice. Secular trends identified in the earlier period remain, with little change in the tangible capital-output ratio or profit share of output. Corporate valuations remain high relative to the postwar average, in line with the theoretical prediction. Critical to this prediction are the decline in effective tax rate on distributions and the rise of foreign direct investment abroad. With the recent enactment of the Tax Cuts and Jobs Act, corporate valuations are predicted to rise even further relative to GDP.

1. Introduction

In this paper, I pay homage to Tom Cooley and Ed Prescott—two of the most influential macroeconomists in my lifetime—by taking quantitative predictions of neoclassical growth theory seriously when determining the overvaluation or undervaluation of U.S. corporate valuations. The specific application I have in mind is not new and in fact is something Ed and I considered many years ago (see McGrattan and Prescott (2000, 2005)). In our earlier work, we concluded that theory did well in predicting the large secular movements in corporate stock valuations relative to GDP while simultaneously predicting little change in the tangible capital-output ratio over the period 1960–2001. With two decades of additional data now available, I use this opportunity to put the theory to the test again.

Central to the analysis is a theoretical relation between the price of a company's stock and the value of tangible and intangible fixed assets that it owns. Importantly, for my purposes, the relation depends on taxation of corporate distributions and profits. Taxes affect not only the incentives for companies to invest in new capital—whether it be tangible or intangible—but also the prices of the existing stocks. Lower taxes on shareholder distributions have a positive impact on the prices of fixed assets because the government's ownership is lower. Lower taxes on corporate profits incentivize companies to increase investment in fixed assets, but can also change relative prices of taxed tangible capital and untaxed intangible capital.

☆ McGrattan acknowledges support from the NSF (Award #2214248). I thank Ioannis Koutsonikolis for excellent research assistance, and I thank conference participants and referees for valuable comments. Replication materials are available at my website. The views expressed herein are those of the author and not necessarily those of the Federal Reserve Bank of Minneapolis or the Federal Reserve System.

* Correspondence to: University of Minnesota, 1925 4th Street South, Minneapolis, MN 55455, United States of America.
E-mail address: erm@umn.edu.

https://doi.org/10.1016/j.red.2023.07.011

In the aggregate, the key relation of interest equates the market capitalization of corporate equities plus net debt and the value of all fixed assets of corporations. Checking whether this relation actually holds requires an additional step if corporations make sizable investments in intangible assets, as these assets are typically expensed and not included on corporate balance sheets. There has been progress made in including measures of some intangible assets in the national accounts, particularly the new categories of *intellectual property products* (IPP), which include research and development; software; and entertainment, literary, and artistic originals. However, there are still many assets not yet included—for example, brands, trade names, and organizational capital. Furthermore, in the case of the IPP assets, we know little about their depreciation rates and thus little about the value of the capital stocks at current cost.[1] Fortunately, theory provides a way to infer values for intangible capital stocks, because corporate profits are essentially payments to both tangible and intangible assets. I follow McGrattan and Prescott (2005) and assume that investors arbitrage away any difference in returns on these investments. Then, it is straightforward to use national accounts data on accounting profits, data on tangible capital stocks, and estimates for the rate or return and the growth rate to infer the intangible capital stocks.

A critical factor for the quantitative results of McGrattan and Prescott (2005) was the modeling of tax and regulatory systems of the United States and the United Kingdom, which were surprisingly similar over the period 1960–2001. In both countries, the most relevant change was the decline in *effective* tax rates on corporate distributions, a result of lower statutory rates and greater opportunities for tax deferral through retirement saving. We showed that the price of capital—and thus the corporate valuation—rises one for one with the decline in the share of distributions paid to the government in taxes. This rise in corporate valuations can occur without any change in the tangible capital-output ratio. Another relevant change in the tax system occurred during the 1970s, when useful lives of fixed assets were significantly shortened for the purpose of tax filing. The more quickly the fixed assets can be depreciated, the lower is the effective price of the fixed assets, and the lower is the overall value of the corporate entity.

In this update, I analyze U.S. corporate activity in the post-2000 period. Unlike McGrattan and Prescott (2005), I exclude S corporations (filing Form 1120-S), which are pass-through entities and taxed differently than C corporations (filing Form 1120). S-corporate activity has been growing over time, but these companies are not publicly traded. As a result, there is limited information about their valuations.[2] The value to GDP ratios for C corporations have remained high in the post-2000 period relative to average ratios before 2000. The average ratio over the period 2000–2022 is around 1.56, nearly double the average over the period 1960–1999.[3] The post-2000 period includes three notable stock market crashes concurrent with the technology bust of 2001–02, the Great Recession of 2008–09, and the COVID-19 pandemic. However, none of the crashes brought the market value to GDP ratio back to its historical mean. Markedly different from the patterns of corporate valuations are the patterns of corporate profits and tangible investments. Once I subtract S-corporate activity, I find that the ratios of profits and tangible investment, when divided by GDP, have not risen over the post-war period, even with the additional two decades of data included.

In recent decades, there have been three changes in the Internal Revenue Code that have affected corporate stock pricing. The Jobs and Growth Tax Relief Reconciliation Act of 2003 reduced top tax rates on dividends and capital gains to 15 percent. The Affordable Care Act of 2010 included a provision starting in 2013 for a 3.8 percent tax on net investment income. The final and most important change for evaluating corporate valuations was the Tax Cuts and Jobs Act of 2017 (TCJA17). This reform significantly lowered the tax rate on corporate income taxes—from 35 percent to 21 percent—and fundamentally changed the taxation of foreign incomes. With respect to accounting for foreign corporate income, I incorporate some theoretical modifications to McGrattan and Prescott (2005) based on later analyses of U.S. foreign direct investment abroad (see McGrattan and Prescott (2010)). Specifically, I incorporate the idea that some intangible capital can be used in a nonrivalrous way in production locations at home and abroad.

Since the largest tax change over the sample period is the lowering of corporate income taxes near the end of the sample period, I provide a range of theoretical predictions for U.S. corporate valuations, which depend on the estimate of the effective corporate income tax rate. Lower estimates for this rate yield higher estimates for predicted contributions of intangible assets in generating corporate profits and values. For example, if the effective tax on corporate income is 32 percent, theory predicts that 12 percent of profits and 33 percent of value are attributable to intangible assets. In this case, the theoretical prediction for the total corporate value is equal to 1.62 times GDP—close to the average market value of 1.56 times GDP we observed over the sample period 2000–2022. If the effective tax rate on corporate income is 21 percent, as enacted in TCJA17, then theory predicts that 24 percent of profits and 54 percent of value are attributable to intangible assets. In this case, the theoretical prediction for the total corporate value is equal to 2.36 times GDP—above the 2000–2022 average but in line with the peak value observed in 2021.

[1] For many types of intangibles, like organizational capital or sweat equity, there may never be an easy way to directly measure the investments or assets. Instead, we indirectly measure them using theories in which these assets are central and impact variables that we do observe. See, for example, Prescott and Visscher (1980) and Bhandari and McGrattan (2021).

[2] Bhandari and McGrattan (2021) developed a model to estimate values for private entities such as S corporations, but their analysis relied on microdata that is only publicly available for the year 2007.

[3] McGrattan and Prescott's (2005) theoretical prediction for the end-of-sample corporate valuation is remarkably close to the actual 2000–2022 average.

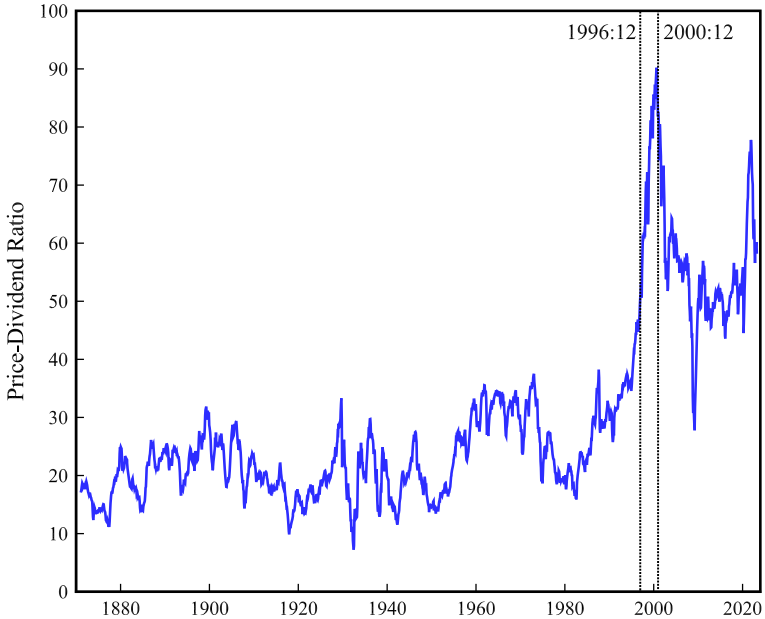

Fig. 1. S&P Price-Dividend Ratio, 1870:01-2023:03. *Notes*. The first line in the figure marks the date of Campbell and Shiller's testimony to the Board of Governors of the Federal Reserve System. The second line marks the end of the sample available for the analysis in Campbell and Shiller (2001). Source data are available from Robert Shiller.

2. Related literature

The earlier analysis of McGrattan and Prescott (2000, 2005) and the current update were most influenced by the work of Campbell and Shiller (1998, 2001) and Shiller (1996, 2015). In December of 1996, these authors testified before the Board of Governors of the Federal Reserve System and cautioned policymakers that U.S. price-dividend ratios were at extremely high levels relative to historical norms.[4] In Fig. 1, I plot the price-dividend ratio for the Standard and Poor's companies for the period 1870–2023.[5] The first vertical line marks the date of the joint testimony at the Federal Reserve. According to Campbell and Shiller's theory—which predicts a reversion to the mean—when stock prices are very high relative to dividends or earnings, "then prices will eventually fall in the future to bring the ratios back to more normal historical levels." (See Campbell and Shiller, 2001.) The second vertical coincides with the time of their updated analysis. As the figure shows, by 2001, the price-dividend ratio was well above the historical mean. In fact, over the 1870–2023 sample period, this was the highest point.

In Fig. 2, I plot the related value-to-GDP series that McGrattan and Prescott (2005) work with. Like Campbell and Shiller's (2001) sample period, theirs ends near the high point of historical stock valuations. There are two lines shown on Fig. 2: the equity value and the total value, which is the sum of the equity value and the value of net debt—debt liabilities less debt assets. (See the appendix for details on how to construct these series.) As the figure shows, most of the rise in total value is due to the rise in equity values. If I compute average ratios in the post-2000 period, I find the total value is around 1.56 times GDP, and the equity value is around 1.36 times GDP. The post-2000 period includes three notable crashes: the technology bust, the Great Recession, and the COVID pandemic. As in the case of the price-dividend ratio, none of these episodes implies a return of the value-to-GDP ratio to its historical mean.

More recent work analyzing stock valuations takes a slightly different approach than the earlier analyses of Campbell and Shiller (1998, 2001) and McGrattan and Prescott (2000, 2005). Instead of documenting possible deviations in a theoretical relation—say, between current values and historical averages, as in Campbell and Shiller (1998, 2001), or between observed valuations and fixed asset values, as in McGrattan and Prescott (2000, 2005)—the more recent work attributes observed trends in stock valuations and other variables to implied variations in technologies and preferences, using neoclassical theory as its lens. Two notable examples are Farhi and Gourio (2018) and Greenwald, Lettau, and Ludvigson (2020). In the case of Farhi and Gourio (2018), there is less attention to the rise of stock valuations, given that they compare subsamples–namely, 1984–2000 and 2001–2016–with similar price-dividend ratios. Greenwald, Lettau, and Ludvigson (2020) devote more attention to the rise in stock valuations, which they attribute primarily to changes in technology—specifically, the

[4] Two days later, Alan Greenspan, who at the time was chair of the Federal Reserve, gave a speech noting concern over "irrational exuberance." See Greenspan (1996).

[5] Data are updated monthly by Robert Shiller. See Shiller (1989) for a description of the historical data.

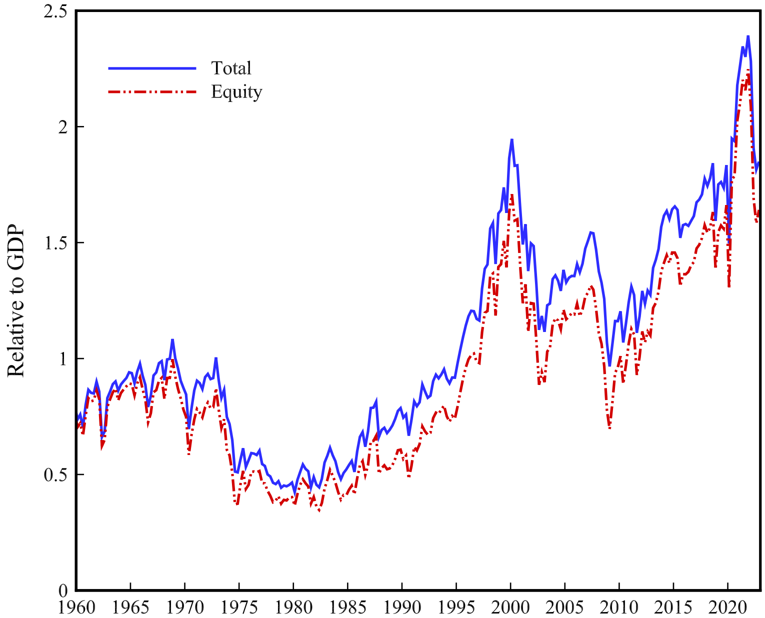

Fig. 2. Value of U.S. Corporations, 1960:1–2022:4. *Notes*. The total value is the sum of equity value plus net debt. S corporations are excluded. Underlying data are available from the Federal Reserve Board of Governors (1945–2023).

relative revenue shares. Unlike this paper, neither Farhi and Gourio (2018) nor Greenwald et al. (2020) considers the impact of changes in tax policies.

3. Theory

In this section, I review the theoretical relation used by McGrattan and Prescott (2005) to equate the value of corporate financial assets—equity plus net debt—held by corporate shareholders and the value of productive capital stocks in the corporate sector. I then discuss two updates that are needed to handle foreign versus domestic activity and non-pass-through versus pass-through incomes. What prompts these updates is the significant growth in both foreign and pass-through corporate activity since 2001. Finally, I derive the theoretical relation between national accounting profits and rental payments to capital, which can be used to infer corporate intangible capital stocks if we know the tangible stocks.

3.1. Domestic C corporations

Consider first the simplest framework needed to derive the key relation. The model economy has a household sector, corporate sector, and a simple tax. The tax system features taxes on corporate income and distributions, and subsidies to capital investment.

Households choose per capita consumption c and leisure ℓ to maximize utility, subject to a budget constraint. They receive income from corporate distributions, wages, and transfers and use the earnings for expenditures on consumption and new company shares. The maximization problem is given by

$$\max_{c_t,\ell_t,s_{t+1}} \sum_{t=0}^{\infty} \beta^t U(c_t,\ell_t) \tag{3.1}$$

$$\text{subj. to } \sum_{t=0}^{\infty} p_t\{c_t + v_t(s_{t+1}-s_t)\} \le \sum_{t=0}^{\infty} p_t\{(1-\tau_{dist})d_t s_t + w_t n_t + \psi_t\}, \tag{3.2}$$

where t indexes time, p_t is the price of consumption, s_t is the number of shares held in t, $s_{t+1}-s_t$ is new shares purchased at price v_t, d_t is the per-share distribution taxed as rate τ_{dist}, w_t is the wage rate, n_t is the fraction of time devoted to market work and equal to $1-\ell_t$, and ψ_t is the government transfer. I abstract from taxes on consumption and labor because adding them does not affect the derivation of the corporate value.

Corporations have tangible and intangible capital, hire labor, and produce output with a constant returns to scale production technology. The tangible capital k_T includes structures, equipment, inventories, and land. The intangible capital k_I includes patents, trademarks, and organizational capital. The output is given by $f(k_{Tt},k_{It},z_t n_t)$, where $\{z_t\}$ are technology parameters that grow at rate γ. These corporations maximize the present value of distributions to their shareholders, which in this case are the households:

$$\sum_{t=0}^{\infty} p_t d_t (1-\tau_{dist}) \tag{3.3}$$

$$\text{subj. to } k_{T,t+1} = (1-\delta_T) k_{Tt} + x_{Tt} \tag{3.4}$$

$$k_{I,t+1} = (1-\delta_I) k_{It} + x_{It}. \tag{3.5}$$

The distributions d are payments made to shareholders after paying wages to their workforce, wn, making new tangible investments, x_T, making new intangible investments, x_I, paying corporate taxes at rate τ_{corp}, and receiving investment subsidies at rate τ_{subs}:

$$d_t = f(k_{Tt}, k_{It}, z_t n_t) - x_{Tt} - x_{It} - w_t n_t - \tau_{corp}\pi_t + \tau_{subs} x_{Tt} \tag{3.6}$$

$$\pi_t = f(k_{Tt}, k_{It}, z_t n_t) - \delta_T k_{Tt} - x_{It} - w_t n_t, \tag{3.7}$$

where π_t is taxable accounting profits. When computing taxable profits, corporations deduct the depreciation of tangible capital and fully expense the investment of intangible capital. I implicitly assume that corporations are issuing only equity. I do so to keep the analysis simple, although it is straightforward to include debt finance in the theory.[6]

Closing the model requires that market clearing conditions hold. For the labor market, the hours supplied by the household (n_t in (3.2)) are equal to the hours demanded by corporations (n_t in (3.6)). For the equity market, the sum of shares across households indexed by h, say, $\sum_h s_t^h$, is equal to the outstanding stock normalized to 1. For the goods market, market clearing requires

$$c_t + x_{Tt} + x_{It} = f(k_{Tt}, k_{It}, z_t n_t). \tag{3.8}$$

Three equilibrium conditions that I use subsequently are

$$\frac{p_t}{p_{t+1}} = \frac{v_{t+1} + (1-\tau_{dist}) d_{t+1}}{v_t} \tag{3.9}$$

$$\frac{p_t}{p_{t+1}} = \left[(1-\tau_{corp})\left(f_1(k_{T,t+1}, k_{I,t+1}, z_{t+1}n_{t+1}) - \delta_T\right) + \tau_{subs}\,\delta_T\right]/(1-\tau_{subs}) + 1 \tag{3.10}$$

$$\frac{p_t}{p_{t+1}} = f_2(k_{T,t+1}, k_{I,t+1}, z_{t+1}n_{t+1}) - \delta_I + 1. \tag{3.11}$$

These three conditions say, among other things, that the after-tax returns to stocks and the two types of capital must be equal. The different corporate tax treatment on tangible and intangible capital leads to the differences evident in expressions (3.10) and (3.11).

Proposition 1. *An equilibrium relation specifying the price of corporate equity as a function of tax rates and corporate capital stocks is*

$$V_t = (1-\tau_{dist})\left[(1-\tau_{subs}) K_{T,t+1} + (1-\tau_{corp}) K_{I,t+1}\right], \tag{3.12}$$

where $V_t = \sum_i v_t s_{it}$, K_{Tt}, and K_{It} are aggregate values of shareholder stocks, tangible fixed assets, and intangible fixed assets, respectively.

Proof. This follows from equation (3.6), conditions (3.9)–(3.11), and the fact that the wage is equal to the marginal product of labor in equilibrium. □

There are several noteworthy features of the relation in (3.12). First, prices on both tangible and intangible capital change one for one with tax rates on distributions (or, more precisely, with $1-\tau_{dist}$) because individual investors pay τ_{dist} for each dollar that is distributed and nothing for each dollar that is reinvested.[7] Second, the relative price of tangible versus intangible capital is not 1. Subsidies such as investment tax credits for plant and equipment make investing in tangible

6 Later, I do include net debt in total corporate value, but show that financing decisions do not drive the dramatic rise in the value-to-GDP ratio between the 1960s and the post-2000 period.

7 In the U.S. tax system, capital gains are taxed upon realization. Thus, the relevant distribution tax is the personal income tax rate on dividend income if corporations pay dividends, and it is the *realized* capital gains tax rate if corporations buy back shares. If equity is held in tax-deferred retirement accounts, then the appropriate tax on distributions in (3.12) is zero even if the contributions are taxed when they are withdrawn. See McGrattan and Prescott (2005) for more details.

capital cheaper than investing in intangible capital.[8] Similarly, taxes on corporate income make investing in intangible capital—and, more generally, assets that can be expensed in the year of the investment—cheaper than investing in tangible capital, the costs of which are capitalized and depreciated over time.

First order conditions (3.10) and (3.11) can be used to show that returns to tangible and intangible capital depend on the corporate income tax rates and the investment subsidies, but not on corporate distribution tax rates. These relations provide the main insight for the following proposition from McGrattan and Prescott (2005).

Proposition 2. *If two economies A and B are identical except that (i) their tax rates on distributions are not equal, $\tau_{dist}^A \neq \tau_{dist}^B$, and (ii) the difference in transfers offsets the difference in revenues from distributions, $\psi_t^A - \psi_t^B = \tau_{dist}^A d_t^A s_t^A - \tau_{dist}^B d_t^B s_t^B$, then the equilibrium paths of the economies A and B are the same except for the price of corporate equity, V_t.*

Proof. The stand-in firm in the two economies faces the same maximization problem except for a multiplicative factor in the objective function. Similarly, the budget constraints of households place the same constraints on consumption and labor supply provided that condition (*ii*) holds. By Walras's law, the government budget constraints will also be satisfied in both economies. From (3.12), therefore, $V_t^A/(1-\tau_{dist}^A) = V_t^B/(1-\tau_{dist}^B)$. □

The main takeaway is that capital-output ratios can remain roughly constant as corporate tax rates on distributions fall, while value-output ratios rise. The tax on distributions affects the price of capital, but not the current cost. This can happen if budget sets are not affected.

There are natural extensions of the environment above that result in relatively minor changes to the formula in (3.12). For example, I can allow for tax rates that vary over time. As long as corporations continue to make non-zero investments and distributions out of retained earnings, then I simply index the tax rates in (3.12) by time. I can allow for imperfect competition and assume that corporations have some market power in either markets for their outputs or markets for their inputs. This could be possible, for example, if government regulations effectively restrict competition. If the companies make investments to achieve favorable treatment—say, by paying lobbyists—then I could interpret the investments in intangibles more broadly. If they do not, but investors still earn rents in the form of higher profits, then stock prices should reflect the value of all current and future monopoly "dividends." In this case, V_t would be equal to the summed values of fixed assets plus the value of the stream of monopoly rents. Finally, I can allow for two types of intangible assets: those that are expensed as assumed above and those that are capitalized. I simply have to include two intangible stocks: one with a price of $(1-\tau_{dist})(1-\tau_{corp})$ and one with a price of $(1-\tau_{dist})$.[9]

3.2. Including foreign activity

Because U.S. corporations operate at home and abroad, I need to include the value of fixed assets owned abroad. McGrattan and Prescott (2005) did this in a somewhat clumsy way by assuming the ratio of foreign to domestic profits—available in national accounts data—is equal to the ratio of foreign to domestic capital stocks. However, simply assuming that the ratios of tangible and intangible stocks for the U.S. parents are the same as those of their subsidiaries misses the fact that a significant amount of intangible investment—say, in research and development and branding—is done by multinational corporations at home, and the accumulated stocks—say, patents and trademarks—can be used in a nonrivalrous way in subsidiaries all over the world. This was the insight of McGrattan and Prescott (2010), which studied returns to U.S. foreign direct investment abroad. I show how to use this insight to modify the key relation in (3.12).

First consider the production technologies used by multinationals in McGrattan and Prescott (2010). Let c index countries and let j index multinationals. Multinational j operating in country c owns location-specific tangible capital, $k_{T,c}^j$, location-specific intangible capital, $k_{I,c}^j$, nonrivalrous intangible capital M^j, and hires labor n_c to produce output y_c^j:

$$y_c^j = A_c (N_c M^j)^\phi (f_c^j)^{1-\phi}$$
$$f_c^j = f(k_{T,c}^j, k_{I,c}^j, z_c^j n_c),$$

where A_c is country-specific total factor productivity and N_c is the number of locations available for j to deploy the nonrivalrous capital M^j in country c.[10] McGrattan and Prescott (2010) refer to M^j as *technology capital* to distinguish it from intangible capital that was specific to a plant in a particular locale. This technology capital is accumulated know-how

[8] When studying tax policies of the 1970s, McGrattan and Prescott (2005) derive a slightly more complicated formula that allows for capital subsidies in the form of accelerated depreciation allowances. This extension assumes that accounting and economic depreciation rates are not equal and involves tracking the value of book capital.

[9] Under TCJA17, certain R&D expenditures must be capitalized starting in 2022. All else equal, the change would imply a higher prediction for stock valuations.

[10] The country-specific total factor productivities could be different for domestic and foreign companies if there are barriers to foreign direct investment. In that case, I would index TFP by where the producer is from and where the production takes place.

from investment in R&D, brands, and organization capital that is not specific to a plant but can generate rents to the parent multinational from all operations abroad. If $\phi = 0$, I have the same production as above, and there is no essential role for foreign direct investment. On the other hand, if $\phi > 0$, there is an essential role because of the nonrivalry of intangible capital.

Next consider the implied corporate valuations. With U.S. foreign activity included, I need to change the key relation as follows:

$$V_t^{\text{US}} = (1-\tau_{\text{dist}})\left[\sum_c V_{ct}^{\text{US}} + (1-\tau_{\text{corp}})M_{t+1}^{\text{US}}\right]$$

where US now indexes all U.S. companies and multinationals and V_{ct}^{US} is the value of plant-specific fixed assets in country c.

It turns out that I can still use the simpler formulas in (3.7) and (3.12) even if I include foreign profits and values. When imputing values for intangible capital, I need to include national profit flows when computing π—with receipts to foreign direct investment—and the capital stocks associated with this foreign investment. In effect, I am assuming that the fixed asset stocks in (3.12) are worldwide aggregates and the coefficients are functions of effective tax rates that are appropriate for these aggregates.

3.3. Excluding S-corporate activity

A potential pitfall when comparing corporate stock valuations of publicly traded companies—like those in the Standard and Poor's stock market index—and values of fixed assets for all corporations published by the BEA is the mismatch in legal-form coverage. The universe of all corporations includes publicly traded C corporations, private C corporations, and S corporations. Theoretically, the salient difference is not public versus private but rather C-corporate versus S-corporate because the two legal forms are taxed differently. S corporations are entities that pass-through business earnings to the owners. These owners then include business income as part of their adjusted gross income on individual tax filings.

To see how this would change the mathematics, consider valuing an S corporation. Since the business is a pass-through, the distributions d_t are the same as the business profits, π_t:

$$\pi_t = f(k_{Tt}, k_{It}, z_t n_t) - \delta_T k_{Tt} - x_{It} - w_t n_t. \tag{3.13}$$

In this case, the implied value is given by

$$V_t = k_{T,t+1} + (1-\tau_{pers})k_{I,t+1}, \tag{3.14}$$

where τ_{pers} is the effective personal income tax rate paid on the owner's individual income tax form. This result follows from the fact that there is no longer a double taxation of capital. Because all profits are distributed, it is as if there were no tax on distribution and a tax on profit equal to the personal rate. In other words, I replace the τ_{dist} in (3.12) with a zero and the τ_{corp} with τ_{pers}.[11]

If good estimates of S-corporate values were available, then (3.14) could be tested separately for S corporations. The corporate equity values in the Flow of Funds do include estimates for S-corporate value, but these estimates assume that S corporations and C corporations have the same net worth to value ratio, less a 25 percent "liquidity" discount. Because there is no way to assess this proxy value, I opt to include only C corporations in the final analysis below.[12]

3.4. Estimating intangible stocks

Thus far, I have derived the theoretical relation between values of corporate equities and values of their fixed assets and discussed variants of the relation that are relevant for companies with foreign subsidiaries and companies that are taxed as pass-through entities. A second theoretical relation is needed to determine whether stocks are over- or undervalued. The second relation equates national accounting profits and payments to tangible and intangible capital. This relation is used to infer the intangible capital stocks that are currently not well measured.[13]

Crucial to the inference is the assumption that investors earn the same after-tax rate of return whether they invest in tangible assets or intangible assets. Let r_{Tt} and r_{It} be the marginal products of tangible and intangible capital in period t. Consider the relevant case with τ_{subs} approximately 0. Then, profits in (3.7) can be written as

[11] See, for example, McGrattan and Prescott (2017).

[12] Imputations of private C-corporate valuations are also problematic. However, there is no easy way to separately analyze private and public C corporations with BEA data, and thus I leave them in the empirical assessment of (3.12).

[13] Although the BEA has included the IPP category, there are many categories of intangible assets that are not yet included. See Corrado et al. (2005) for examples of these hard-to-measure investments.

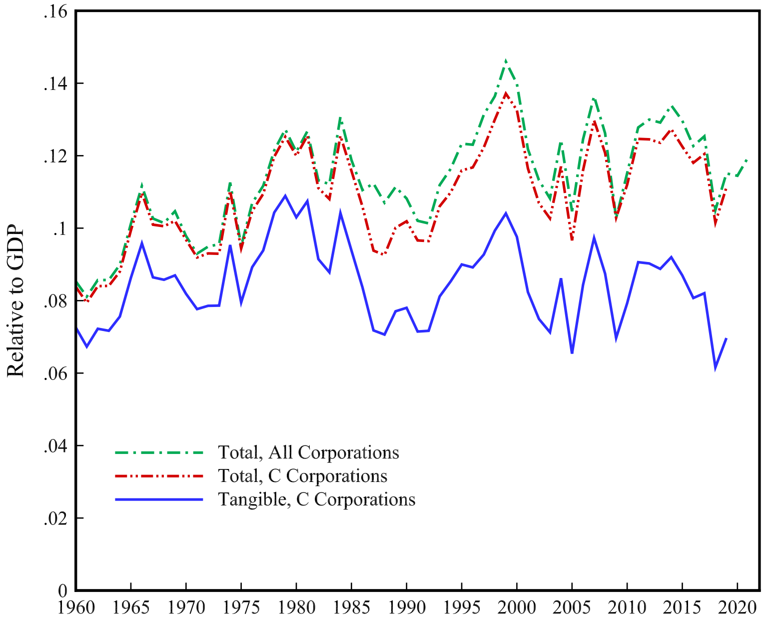

Fig. 3. Corporate Investment. *Notes*. Underlying data are available from U.S. Department of Commerce, BEA (1929–2022) and U.S. Department of the Treasury, IRS (1955–2020).

$$\begin{aligned}\pi_t &= f(k_{Tt}, k_{It}, z_t n_t) - \delta_T k_{Tt} - x_{It} - w_t n_t \\ &= r_{Tt} k_{Tt} + r_{It} k_{It} - \delta_T k_{Tt} - x_{It}, \\ &= (r_{Tt} - \delta_T) k_{Tt} + r_{It} k_{It} - (k_{I,t+1} - k_{It} + \delta_I k_{It}), \\ &= (r_{Tt} - \delta_T) k_{Tt} + (r_{It} - \delta_I) k_{It} - k_{I,t+1} + k_{It} \\ &= \frac{i_t}{1-\tau_{corp}} k_{Tt} + (i_t - g_t) k_{It}, \end{aligned} \tag{3.15}$$

where $i_t = p_t/p_{t+1} - 1$ is the real after-tax rate of return and g_t is the growth rate of intangible capital. The last equation follows from the fact that in equilibrium, the real interest rate is equal to the returns to investing in both tangible assets and intangible assets after accounting for taxes (as shown in (3.10) and (3.11)) and depends on the marginal products of capital. The coefficient on k_{Tt} in (3.15) is divided by $1 - \tau_{corp}$ because investments in structures and equipment are capitalized, and thus the returns are taxed. The coefficient on k_{It} is the after-tax return less the growth rate. Because most investments in intangible assets are expensed, the return $r_{It} - \delta_I$ is equal to the after-tax return and to i_t. The final term $g_t k_{It}$ is the growth in intangible capital. The growth rate appears because I have substituted in for investment using the intangible capital accumulation equation (3.5).

If I have estimates of pre-tax accounting profits π_t, the rate of return i_t, the growth rate g_t, and the tax rate on corporate income τ_{corp}, then I can infer the stock of intangible capital. I turn to this exercise in the next section.

4. Data

In this section, I describe the data underlying the estimates of the corporate intangible capital stock and the model-implied corporate valuations over the period 2000–2022. I first report on estimates of corporate tangible investments before and after removing S-corporate investment and BEA estimates of IPP investment. These are the series used to construct C-corporate tangible capital stocks. I then report on estimates of BEA accounting profits needed to estimate intangible capital stocks. Finally, I show data on tax rates over time for corporate incomes and distributions and discuss how the tax policies have changed over the sample.

4.1. Corporate tangibles

In Fig. 3, I plot three corporate investment series. The first, which is marked by “Total, All Corporations,” plots corporate domestic investment in equipment, structures, intellectual property products, and inventories plus foreign direct investment of U.S. companies abroad, as a ratio of GDP. (See the Appendix for details on data sources.) There has been a gradual rise in the ratio over time: it starts at a little over 8 percent in 1960 and reaches roughly 12 percent in recent years.

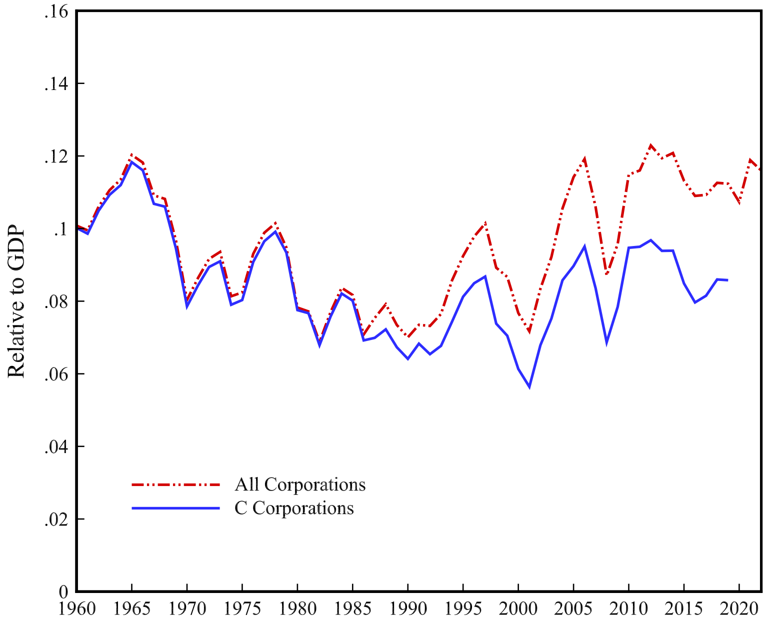

Fig. 4. Corporate Profits. *Notes.* Underlying data are available from U.S. Department of Commerce, BEA (1929–2022) and U.S. Department of the Treasury, IRS (1955–2020).

The second series, which is marked "Total, C Corporations," is constructed by subtracting investment in depreciable assets of S Corporations from the first series. Although there is some growth in S-corporate tangible investment over time, these smaller corporations do not own much capital. Instead, they rent and lease most equipment and structures. Bhandari and McGrattan (2021) provide evidence from brokered sales of S corporations, which shows that most of the value transferred upon sale is attributed to identifiable intangible assets and goodwill.

The third series, which is marked "Tangible, C Corporations," is constructed by subtracting investment in intellectual property products from the C-corporate investment series. It shows that there has been significant growth over time in IPP, in large part because of increasing investments in software and privately funded R&D. Without IPP, the investment to GDP ratio is relatively flat, with estimates around 8 percent in both the 1960s and the post-2000 period. The tangible C-corporate investment series is my estimate for x_{Tt}. My estimate for k_{Tt} is the associated current-cost stocks of non-IPP capital and inventories from the BEA, plus an estimate of corporate land reported in the Flow of Funds, less the S-corporate book value of depreciable assets.[14] As with the investment-to-GDP ratio, I find the capital-to-GDP ratio similar in the 1960s and post-2000 period. Thus, as McGrattan and Prescott (2005) noted in their earlier work, there is a relatively flat capital-output ratio but a rising value-output ratio.

With estimates for tangible investments and capital stocks, I turn next to analyzing corporate profits and tax rates, which are also inputs to estimation of the intangible stocks.

4.2. Corporate profits

In Fig. 4, I plot two measures of corporate profits. The first is national profits for all corporations. This measure of profits is relevant for gross national income as it is the sum of corporate profits earned domestically plus receipts from U.S. subsidiaries on direct investment abroad less payments to foreign parents on direct investment of affiliates in the United States. The second measure excludes an estimate of S-corporate profits included with BEA measures. This is found by taking total receipts less deductions from tax filings, assuming a 16 percent income misreporting rate, and subtracting net capital gains less losses.[15] As the figure shows, there is significant growth in income generated by S corporations—despite the fact that they have little own tangible capital. The growth is most noticeable after the enactment of the Tax Reform Act of 1986. At that point, individual tax rates had fallen enough that smaller firms could avoid the double taxation of C corporations. The latter series—with S corporations excluded—is my estimate for π in (3.7).

In addition to C-corporate accounting profits, one can construct measures of C-corporate distributions and thus compare the price-dividend ratio for a larger set of companies with that of the S&P in Fig. 1. However, when doing so, it is important to keep in mind the differences between financial accounting data and national accounting data. In Fig. 5, I plot the

[14] Current-cost estimates are not available separately for S and C corporations, but as Fig. 3 shows, S corporations own little tangible capital.

[15] See details on BEA methodology at bea.gov and the National Income and Product Account (NIPA) Table 7.16, now available for S corporations over the period 2012–2018.

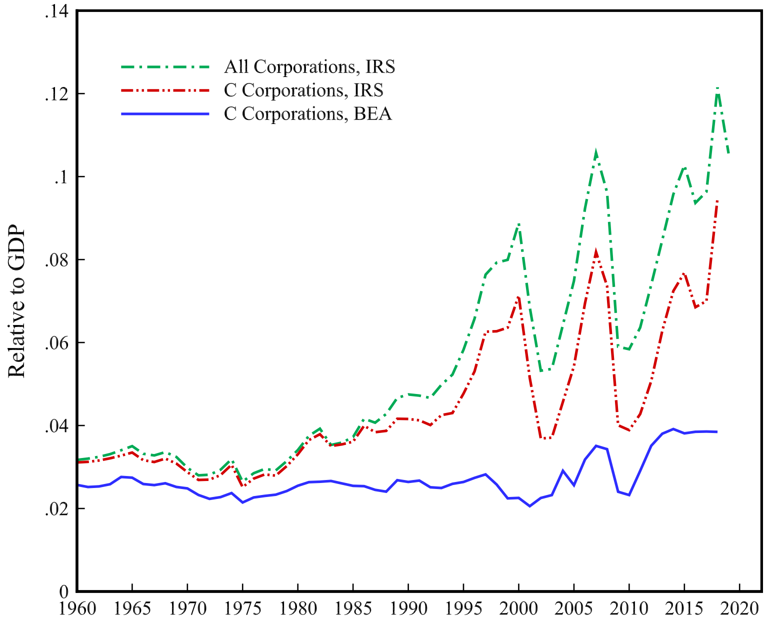

Fig. 5. Corporate Distributions. *Notes*. Underlying data are available from U.S. Department of Commerce, BEA (1929–2022) and U.S. Department of the Treasury, IRS (1955–2020).

distributions as reported on corporate tax filings, including S-corporate filings. As I did before, I divide by GDP in order to highlight any postwar trends. The picture shows a remarkable increase from a little over 3 percent in 1960 to 12 percent by 2020. There are two reasons for the rise. The first was noted above: there has been growth in S-corporate activity. Since these corporations are pass-through entities, net dividends reported by the BEA have been rising over time as S corporations grow. Taking these distributions out lowers the estimates for corporate distributions. The second reason for the rise is one of definitional differences. For example, incomes in national accounts are on a current production basis and thus exclude gains or losses.[16] The last series plotted in Fig. 5 is the BEA definition of corporate net dividends less S-corporate distributions, which is much flatter over time. If I had divided the corporate values by this series rather than GDP, I would have found as large a rise in the price-dividend ratio as that shown in Fig. 1.

Before constructing estimates of the intangible capital stocks and predictions for value-to-GDP ratios, I first need estimates of tax rates on corporate distributions and income. I turn to this next.

4.3. *Tax rates*

In this section, I discuss the main updates to the Internal Revenue Code that took place during the post-2000 period and their impact on effective tax rates on corporate distributions and incomes.

In Fig. 6, I plot the effective tax rate on distributions, τ_{dist}, over the period 1960–2022. This rate is computed as an averaged marginal rate. In other words, I compute the marginal rate on distribution income—whether it be on dividends or share repurchases—for all groups receiving any, and then I weight these rates using the fractions of distributions received. (See McGrattan and Prescott (2004) for details on the methodology.) If equity is held in tax-deferred retirement accounts, I use a rate of zero for τ_{dist}, even if taxes are paid on withdrawal.[17] As McGrattan and Prescott (2005) pointed out in earlier work, significant changes occurred during the 1980s and 1990s, when pensions shifted from being defined benefit to defined contribution plans and individual retirement accounts grew. These changes allowed individuals more corporate equity investment options and lowered the effective tax rate.

As is evident from Fig. 6, the corporate tax rate on distributions has remained low in the post-2000 period. There were two key reforms. The first was the Jobs and Growth Tax Relief Reconciliation Act of 2003, which further reduced effective tax rates on dividends and capital gains. The second was the Affordable Care Act of 2010, which included a provision for a 3.8 percent tax on net investment income starting in 2013. While the average post-2000 rate computed here is close to 12 percent—and thus lower than the 17 percent rate used by McGrattan and Prescott (2005)—both estimates are well below the average rate of 41 percent observed in the 1960s.

[16] See the BEA methodology paper on corporate profits for a complete list of adjustments.

[17] For a one-dollar investment, the investor gives up $1-\tau_{pers}$ and receives $(1-\tau_{pers})(1+i)^T$ in T periods. There is no effect on corporate value V.

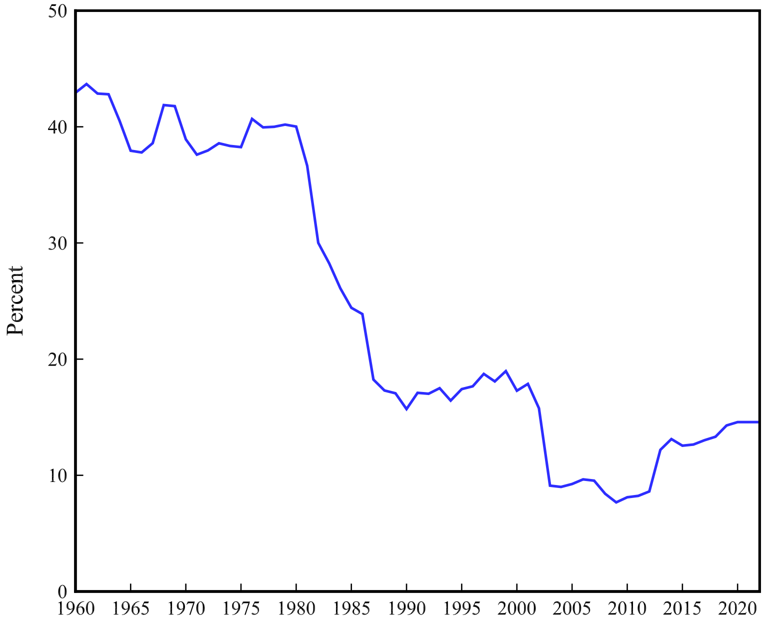

Fig. 6. Tax Rate on Corporate Distributions. *Notes*. The measure plotted is the average marginal tax rate on corporate distributions. Underlying data are available from U.S. Department of Commerce, BEA (1929–2022), U.S. Department of the Treasury, IRS (1955–2020), and the Federal Reserve Board of Governors (1945–2023).

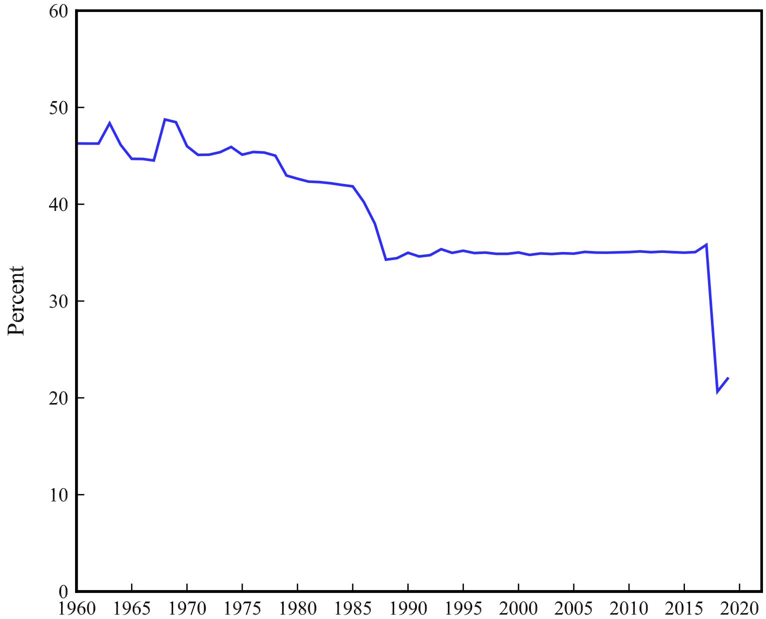

Fig. 7. Tax Rate on Corporate Income. *Notes*. The measure plotted is the corporate tax paid divided by taxable corporate income. Underlying data are available from U.S. Department of the Treasury, IRS (1955–2020).

A more significant post-2000 change occurs well into the sample period with the enactment of the Tax Cuts and Jobs Act of 2017.[18] For the purposes of the exercise here, the most important provision in TCJA17 was the lowering of the corporate income tax rate from 35 percent to 21 percent. In Fig. 7, I plot the tax paid divided by taxable corporate income from the Statistics of Income, Corporate Tax Returns. This rate is the federal rate paid domestically. It was around 45 percent in the 1960s, fell to 35 percent with the 1986 Tax Reform Act, and then fell again to 21 percent after the TCJA17. To compute an effective rate, I need to make adjustments for state and local income taxes and foreign income taxes. As these roughly offset

[18] See Barro and Furman (2018) and Gale et al. (2018) for comprehensive summaries of TCJA17.

Table 1
U.S. Corporate Values and Price Earnings Ratios.

	1960–69	2000–22
Predicted Fundamentals		
Tangible capital	0.614	1.076
Intangible capital	0.236	0.541
Total Value	0.850	1.617
Price-Earnings Ratio	12.5	25.8
Actual Market Values		
Corporate equities	0.869	1.359
Net debt	0.061	0.205
Total Value	0.931	1.564
Price-Earnings Ratio	13.7	25.0

Notes. The top panel shows the theoretical predictions for the tangible and intangible contributions to total corporate value and the associated price-earnings ratio. The bottom panel shows the contributions of equity and debt values of the total corporate value and the associated price-earnings ratio.

each other in the aggregate, I start with the federal domestic taxes and use a range of rates when estimating intangible assets.

5. Results

In this section, I use the data on fixed assets and tax rates to update predictions for the value-to-GDP ratio. I do this in two steps. I first estimate the value of corporate intangible fixed assets and use it, along with data on corporate tangible fixed assets and tax rates, to estimate V.

To infer the value of intangible capital in (3.15), I need estimates of the growth rates, g_t, and the after-tax returns, i_t. Since little has changed in terms of growth and tangible capital-output ratios over the last two decades, I use the end-of-sample estimates from McGrattan and Prescott (2005).[19] They estimate an average real growth rate of 3 percent and an average real return of 4.08 percent. The averages over the period 2000–2022 for the corporate pre-tax profits to GDP ratio, the tangible capital-to-GDP ratio, and the tax rate on corporate income are 0.0827, 1.216, and 0.32, respectively. This implies a value for intangible capital relative to GDP of 0.9.

Next, consider the equation for V in (3.12). For this I need estimates of τ_{dist} and τ_{subs}. Over the 2000–2022 period, τ_{dist} was 11.5 percent on average, and τ_{subs} was close to 0. If I substitute these values into the formula, along with my estimates for average k_T, k_I, and τ_{corp}, I estimate V equal to 1.62 times GDP. In Table 1, I report these results along with results for the 1960s. This table is analogous to Table 3 of McGrattan and Prescott (2005).[20]

To see how the choice of τ_{corp} impacts the results, I repeat the exercise, with lower values that are more in line with the estimates of foreign tax rates and post-TCJA17 rates. In Table 2, I show that as I vary the tax rate, I vary the contributions of intangible assets to corporate profits and value. The first column repeats the exercise above with τ_{corp} equal to 32 percent. In this case, I estimate that the intangible contribution to NIPA profits is 12 percent (or, 1/8.3) and the contribution to corporate value is 33 percent (or, 0.54/1.62). Lowering the tax rates increases my estimates of both contributions. If I assume the effective tax on corporate income is 25 percent—typical of many nations hosting U.S. foreign direct investment—then the contributions of intangibles to profits and value are 20 percent and 48 percent, respectively. If I assume the effective tax on corporate income is 21 percent—the new federal rate on corporate income—then the contributions of intangibles to profits and value are 24 percent and 54 percent, respectively.

In these three cases, I compute the intangible values and add them to the tangible value of 1.076. The results are plotted in Fig. 8. The average value to GDP ratio of 1.56 is shown with the dotted line and marked with an "A." The dot just above the line is the value assuming $\tau_{corp} = 0.32$. The higher values associated with the lower tax rates are marked with "B." If the corporate tax rate is 25 percent, then theory predicts the value to be roughly evenly attributed to tangible and intangible assets. As the rate falls below 25 percent, the implied intangible value consistent with observed profits and tangible assets rises above the tangible value. For τ_{corp} equal to 21 percent, the overall value is nearly 2.4 times GDP, with 1.3 times GDP arising from intangible asset value.

As a point of reference, it is useful to compare the implied intangible stocks and values found here with widely used estimates in the literature. One measure of k_{It} that has received attention is the stock of corporate IPP capital reported in the BEA fixed asset tables. Although the IPP stocks have grown faster than GDP in the post-2000 period, the last available

[19] Much has changed with respect to the federal funds rate, but this is not an appropriate rate of return for the purpose of valuing capital in the firm.

[20] McGrattan and Prescott (2005) analyzed the large subsidies of the 1970s separately from the rise in valuations from the 1960s to the late 1990s and early 2000s. For the sake of comparison, I report the same comparison they did, but extend it to include the more recent period.

Table 2
Estimated Contributions of Intangible Assets, Varying Corporate Income Tax Rates.

	Corporate Income Tax Rate (%)		
Shares	32	25	21
In NIPA profits			
Intangible capital	12	20	24
Tangible capital	88	80	76
In market values			
Intangible value	33	48	54
Tangible value	67	52	46

Notes. The top panel shows the contributions of payments to tangible and intangible capital out of NIPA profits. The bottom panel shows the contributions of values of tangible and intangible assets out of the total corporate value. Assumptions about the corporate tax rate τ_{corp} are varied across columns.

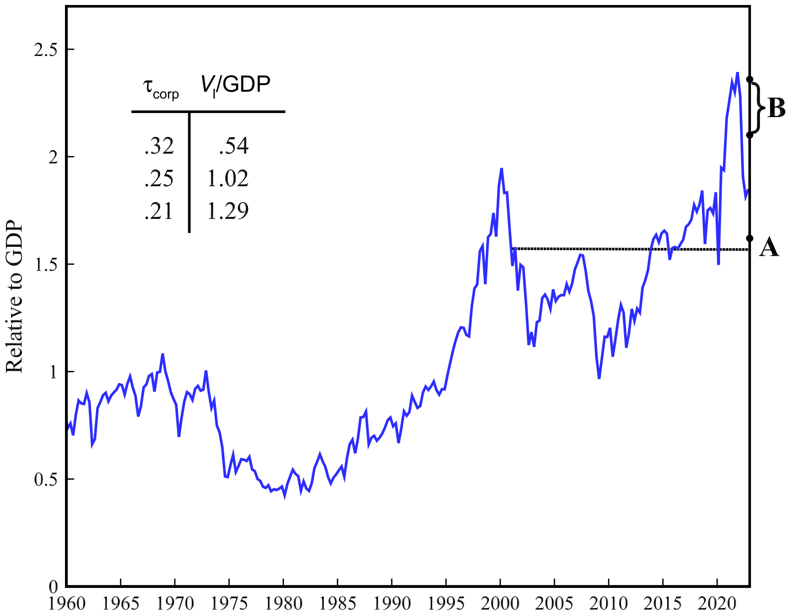

Fig. 8. Alternative Predictions for U.S. Corporate Value. *Notes*. The total value is the sum of equity value plus net debt. S corporations are excluded. The average for 2000–2022 is marked by the dotted line marked by "A." The dot just above this line is the estimate based on a corporate tax rate of 0.32. Estimates based on corporate income tax rates in the range of [0.21, 0.25] are marked by "B." Underlying data in the time series are available from the Federal Reserve Board of Governors (1945–2023).

estimate is only around 16 percent of GDP—much smaller than the intangible-output ratio of 90 percent underlying the estimates in Table 1. Multiplying this by $(1 - \tau_{dist})(1 - \tau_{corp})$ yields estimates of intangible value that would be barely visible in Fig. 8. Another widely used estimate for the intangible capital stock is constructed by applying a perpetual inventory method to 30 percent of selling and general administrative expenses. This expense category includes labor compensation and other spending related to R&D and marketing. For example, Crouzet et al. (2022) do this for publicly traded firms and find that the value for the intangible stock that they construct is close in magnitude to the value of property, plant, and equipment.[21] If I had used $k_{It} = k_{Tt} = 1.216$ and an average corporate income tax rate of 32 percent, then the predicted stock market value would be 1.8 times GDP, which is close to the actual end-of-sample value.

6. Conclusion

In this paper, I have revised the estimates of McGrattan and Prescott (2005), using data available for 2000–2022. They concluded that the most important change for predicting the rise in corporate valuations over the postwar period was the decline in the U.S. tax rate on corporate distributions. This finding is consistent with the longer sample. However, with the enactment of the TCJA17, lower corporate income rates are likely to further boost corporate investments and valuations. If

[21] This paper surveys recent attempts to characterize and measure intangible assets. See references therein.

higher valuations are a result of increased investment in intangibles, then more work is needed to measure these assets, at least indirectly, through the development of theory.

Data availability

Data will be made available on request.

Appendix A. Data appendix

Source data for this paper are as follows.

- Fig. 1. Shiller (2015), updated monthly by Robert Shiller (ie_data.xlsx). The ratio plotted is the S&P composite price (P) divided by the dividend (D).
- Fig. 2. McGrattan and Prescott (2004), updated as follows.
  - Equity value. Federal Reserve Board of Governors (1945–2023), Table L.223: Issues at market value for domestic sectors (line 2), excluding issues of S corporations (line 31). To avoid double counting, I subtract the following holdings: U.S. chartered depository institutions (line 16), property-casualty insurance companies (line 18), closed-end funds (line 24), exchange-traded funds (line 25), and brokers and dealers (line 26).
  - Net debt. Federal Reserve Board of Governors (1945–2023), corporate debt liabilities less debt assets and Investment Company Institute mutual fund holdings by type of asset. Miscellaneous liabilities and assets and U.S. direct investment assets abroad are also included. See McGrattan and Prescott (2004) for details on constructing the net debt series with source data ICI and the following Flow of Funds sectors (tables):
    Non-financial corporate business (Table L.103)
    U.S. chartered depository institutions (Table L.111)
    Property-casualty insurance companies (Table L.115)
    Life insurance companies (Table L.116)
    Closed-end funds (Table L.123)
    Exchange traded funds (Table L.124)
    Government-sponsored enterprises (Table L.125)
    Real-estate investment trusts (Table L.129)
    Brokers and dealers (Table L.130)
    Holding companies (Table L.131)
    Other financial companies (Table L.132)
    Identified miscellaneous (Tables L.232,L.233)
    Unidentified miscellaneous (Table L.234).
- Fig. 3. Corporate investments
  - U.S. Department of Commerce, BEA (1929–2022), Fixed Asset Table 4.7, Investment in private nonresidential assets by legal form of organization: equipment, structures, and intellectual property products.
  - Federal Reserve Board of Governors (1945–2023), Flow of Funds, Distribution of GDP Table F.2, Corporate inventories and Direct Investment Table F.230, U.S. direct investment abroad.
  - U.S. Department of the Treasury, IRS (1955–2020), Statistics of Income, Corporate Income Tax Returns, Balance sheet and income statement, share of corporate inventories in S corporations and change in depreciable assets in S corporations.
- Fig. 4. Corporate profits
  - U.S. Department of Commerce, BEA (1929–2022), NIPA Table 1.12, National income, corporate profits with inventory and capital consumption adjustments.
  - U.S. Department of the Treasury, IRS (1955–2020), Statistics of Income, Corporate Income Tax Returns, S-Corporate balance sheet and income statement, total receipts less deductions and net gains less losses on non-capital assets.
- Fig. 5. Corporate distributions
  - U.S. Department of the Treasury, IRS (1955–2020), Statistics of Income, Corporate Income Tax Returns, Corporate balance sheet and income statement, Distributions to shareholders, all corporations and S corporations.
  - U.S. Department of Commerce, BEA (1929–2022), NIPA Table 7.16, Relation of BEA and IRS corporate profits, NIPA net dividends.
- Fig. 6. Tax rate on distributions. U.S. Department of the Treasury, IRS (1955–2020), Statistics of Income, Individual Income Tax Returns, Sources of income. See McGrattan and Prescott (2004) for details on constructing the tax rate series.
- Fig. 7. Tax rate on corporate income. U.S. Department of the Treasury, IRS (1955–2020), Statistics of Income, Corporate Income Tax Returns, Corporate balance sheet and income statement, Taxable income and income tax paid.
- Fig. 8. See Fig. 2, Total value to GDP.

References

Barro, Robert J., Furman, Jason, 2018. Macroeconomic effects of the 2017 tax reform. Brookings Papers on Economic Activity 49 (1), 257–313.

Bhandari, Anmol, McGrattan, Ellen R., 2021. Sweat equity in U.S. private business. The Quarterly Journal of Economics 136 (2), 727–781.

Campbell, John Y., Shiller, Robert J., 1998. Valuation ratios and the long-run stock market outlook. The Journal of Portfolio Management 24 (2), 11–26.

Campbell, John Y., Shiller, Robert J., 2001. Valuation Ratios and the Long-Run Stock Market Outlook: An Update. National Bureau of Economic Research, Working Paper 8221.

Corrado, Carol, Hulten, Charles R., Sichel, Daniel E., 2005. Measuring capital and technology: an expanded framework. In: Corrado, Carol, Haltiwanger, John, Sichel, Daniel (Eds.), Measuring Capital in the New Economy. University of Chicago Press, Chicago, pp. 11–46.

Crouzet, Nicolas, Eberly, Janice C., Eisfeldt, Andrea L., Papanikolaou, Dimitris, 2022. The economics of intangible capital. The Journal of Economic Perspectives 36 (3), 29–52.

Federal Reserve Board of Governors, 1945–2023. Flow of Funds Accounts of the United States. Federal Reserve Board, Washington, D.C.

Gale, William G., Gelfond, Hillary, Krupkin, Aaron, Mazur, Mark J., Toder, Eric, 2018. Effects of the Tax Cuts and Jobs Act: A Preliminary Analysis. Urban Institute and Brookings Institution, Tax Policy Center.

Farhi, Emmanuel, Gourio, Francois, 2018. Accounting for macro-finance trends: market power, intangibles, and risk premia. Brookings Papers on Economic Activity 49 (2), 147–223.

Greenwald, Daniel L., Lettau, Martin, Ludvigson, Sydney, 2020. How the Wealth Was Won: Factors Shares as Fundamentals. National Bureau of Economic Research, Working Paper 25769.

Greenspan, Alan, 1996. The Challenge of Central Banking in a Democratic Society. Francis Boyer Lecture of American Enterprise Institute for Public Policy Research, December 5.

McGrattan, Ellen R., Prescott, Edward C., 2000. Is the stock market overvalued? Quarterly Review - Federal Reserve Bank of Minneapolis 24 (4), 20–40.

McGrattan, Ellen R., Prescott, Edward C., 2004. Data Appendix: Taxes, Regulations, and the Value of U.S. and U.K. Corporations. Federal Reserve Bank of Minneapolis Staff Report 309.

McGrattan, Ellen R., Prescott, Edward C., 2005. Taxes, regulations, and the value of U.S. and U.K. corporations. The Review of Economic Studies 72 (3), 767–796.

McGrattan, Ellen R., Prescott, Edward C., 2010. Technology capital and the U.S. current account. American Economic Review 100 (4), 1493–1522.

McGrattan, Ellen R., Prescott, Edward C., 2017. On financing retirement with an aging population. Quantitative Economics 8 (1), 75–115.

Prescott, Edward C., Visscher, Michael, 1980. Organization capital. Journal of Political Economy 88 (3), 446–461.

Shiller, Robert J., 1989. Market Volatility. MIT Press, Cambridge, MA.

Shiller, Robert J., 1996. Price-Earnings Ratios as Forecasters of Returns: The Stock Market Outlook in 1996. Yale University, Mimeo.

Shiller, Robert J., 2015. Irrational Exuberance. Third Edition, Princeton, N.J. Princeton University Press.

U.S. Department of Commerce, Bureau of Economic Analysis, 1929–2022. Survey of Current Business. U.S. Government Printing Office, Washington, D.C.

U.S. Department of the Treasury, Internal Revenue Service, 1955–2020. Statistics of Income. U.S. Government Printing Office, Washington, D.C.