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Abstract

This paper applies the framework of McGrattan and Prescott (2005) to the Japanese economy using an accounting dataset. Restricting our attention to the steady growth path in the 1980s, we show that the estimated value of intangible capital in Japan is enormous compared to the U.S. and the U.K. cases. Interestingly, it is also found that when we consider the sub-period of 1987–1989, the so-called bubble period, the price-to-book-value ratio is quite close to one. This finding might imply that the stock price surge during the bubble period was not actually a bubble.

keywords: Intangible capital, Stock prices, Price-to-book-value ratio

JEL classification: E01, E22

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1 Introduction

The elaborate model proposed by McGrattan and Prescott (2005) (henceforth MP) shows that the stock price surge in the U.S. stock market after the mid-1990s can be explained by a growth model if they consider the value of intangible capital and tax and regulations reforms. They applied the model also to the U.K. economy. After learning of their study, we naturally became interested in the applications of the model to cases in other developed countries. This note presents an examination of the Japanese case using an accounting dataset.[1]

Although macroeconomists doing Japanese studies usually address the national aggregate data of the System of National Accounts (SNA) published by the Economic and Social Research Institute (the ESRI), we use micro-level accounting data, the Corporate Financial Databank (CFD) provided by the Development Bank of Japan, for forming macro entries such as the value of physical capital and the value of intangible capital. The dataset includes accounting data of all non-financial companies listed on both the first and second sections of the stock exchanges of Tokyo, Osaka, and Nagoya. The reason we proceed with the accounting dataset is as follows.

First, the Financial Statements Statistics of Corporations by Industry (FSSCI) published by the Policy Research Institute, Ministry of Finance are used as base statistics of the SNA and the FSSCI data are not constructed from a complete census.[2] Therefore, in the SNA, there should be some measurement errors which might be critical to this quantitative analysis. Second, the coverage of the private sector in the SNA includes nonpublic enterprises. Their stock values are estimated but the method is not open to economic review. For these two reasons, the SNA data are unsuitable for examination of how the Japanese stock markets reflected corporations' capital to their stock prices. Our aggregate data constructed from the accounting dataset will fix these defects in the SNA and will reflect the realities of the Japanese stock market more precisely. Our choice will be appropriate also in the sense that stock market investors will look at information from accounting data rather than that from aggregate data such as the SNA.

Our findings can be summarized as follows. First, the estimated value of intangible capital in Japan is enormous compared to the U.S. and the U.K. cases. In light of this large value of intangible capital, the stock prices of Japanese firms were found to be undervalued throughout the 1980s. More interestingly, we find that when we consider the sub-period of 1987–1989, the price-to-book-value ratio is quite close to one. This finding might imply that the stock price surge during the bubble period was not actually a bubble. Hence, just as Irving Fisher was shown to be right by McGrattan and

[1] The data set used in this study is available from the authors upon requests.

[2] Information for those firms with capital funds of more than one billion yen is collected by complete census.

Prescott (2004), we can argue that the Japanese stock market functioned well during the bubble period.

This note is organized as follows. The next section presents results using MP for the readers' reference. Section 3 gives results for Japanese economy. Section 4 concludes the paper. The constructions of our dataset are described in the data appendix.

2 Results in MP

Here we will show the results obtained in MP for the reader's reference.

Under a balanced-growth path condition, MP shows that the total value of corporate equity (V) satisfies[3]

$$V = (1 - \tau_{dist})[(1 - \tau_x - \tau_\delta)K_m + (1 - \tau_{corp})K_u], \tag{1}$$

where K_m, K_u, τ_{dist}, τ_x and τ_{corp} respectively represent the amount of tangible capital, the amount of intangible capital, the tax rate on distributions, the investment tax credit, and the tax rate on corporate profits.[4] In addition, τ_δ, which emerges because of accelerated depreciation allowances, is given as

$$\tau_\delta = \tau_{corp}[\hat{\delta}_x + (1 - \hat{\delta}_x)(\frac{\hat{\delta}_m}{i + \pi + \hat{\delta}_m})(\frac{(1 - \delta_m)(1 + \pi) - 1 + \hat{\delta}_m}{\gamma + \eta + \pi + \hat{\delta}_m})], \tag{2}$$

where $\hat{\delta}_x$, $\hat{\delta}_m$, δ_m, γ, i, π, and η respectively denote the allowed rate of immediate expensing of investment, the allowed rate of depreciation on book value capital, the economic rate of depreciation on tangible capital, the growth rate in labor-augmenting technology, the real interest rate, the inflation rate, and the population growth rate.

Although we can construct our entry for K_u from the accounting information, following MP we will report the estimated value of intangible capital, which is given as

$$K_u = [\Pi - \frac{i}{(1 - \tau)(\gamma + \eta + \delta_m)} X_m]/(i - \gamma - \eta), \tag{3}$$

where Π is the profit of corporations and X_m is the gross investment on tangible capital.

The data appendix describes construction of the aggregate variables of V, K_m, Π, and X_m and how we calibrate the parameters of τ_{dist}, τ_x, τ_{corp}, $\hat{\delta}_x$, $\hat{\delta}_m$, δ_m, γ, i, π, and η during 1980–2003 for the Japanese economy.

[3] See sections 2 and 3 of McGrattan and Prescott (2004).

[4] Here we neglect the value of foreign capital because it is negligible for Japanese firms: following Hayashi and Prescott (2002), we estimate the amount of foreign capital and find that the ratio of estimated foreign capital to tangible capital including land is less than 3% before 1990.

3 Analysis of the Japanese Economy

The formulas described above are applicable to those economies on the balanced growth path. In general, assuming homogeneity of degree one to the production function, an economy can be said to be on a balanced growth path if the ratio of capital to output moves stably over time. Therefore, following Hayashi and Prescott (2002), we calculated the ratio with respect to the entire Japanese economy using SNA data of 1980–2003.[5] Figure 1 shows the result. The figure suggests that the capital output ratio moves stably during 1981–1989; we argue that the formula is justifiably applicable to this period. Interestingly, this period includes the so-called the "bubble era" (December 1986 – February 1991) when stock prices surged. Then, we divide 1981–1989 into two periods of 1981–1986 and 1987–1989, thereby providing additional results for the two sub-periods.

Figure 2 presents the price of tangible capital $(1-\tau_{dist})(1-\tau_x-\tau_\delta)$ and the price of intangible capital $(1-\tau_{dist})(1-\tau_{corp})$ during the period. Interestingly, those prices move stably, unlike the secular large movements, which are apparent in the U.S. and U.K. cases.[6] Capital prices are demonstrated to be stable in Japan. We will therefore concentrate on the issue of how Japanese stock markets evaluated corporate capital during the 1980s rather than the issue of secular movements of stock prices.

Table 1 shows estimates of intangible capital K_u in Japan for periods 1981–1989, 1986–1986 and 1987–1989. Overall, K_u is about 1.7 times the output; this amount is enormous compared to the U.S. and U.K. cases. On the other hand, as shown in table 2, the estimate of tangible capital in Japan is about half that of the U.S. and U.K. estimates.[7] This particular feature of the Japanese composition of capital stock might engender underevaluation of corporate values in the stock markets because stock market traders will not take into account the value of intangible capital.

We will obtain the price-to-book-value ratio (PBR) using eq. (1) as

$$PBR = \frac{V}{(1-\tau_{dist})[(1-\tau_x-\tau_\delta)K_m + (1-\tau_{corp})K_u]}. \tag{4}$$

When PBR is nearly one, we can say that the Japanese stock market functions well because, in that case, stock prices precisely reflect the value of tangible and intangible capital. Table 2 shows results for periods 1981–1989, 1986-1986, and 1987–1989.

[5] In this note, the SNA entries are based on SNA93, which became available after publication of the paper by Hayashi and Prescott, who used data of an SNA68 basis. Actually, SNA93-based entries since 1980 are available at the ESRI website.

[6] MP implies that changes in the tax rates account for most secular movements of corporate valuation in the U.S. and U.K.

[7] According to MP, during 1998–2001, the estimates of tangible and intangible capital were 1.320 and 0.349 times the output in the U.S., respectively, and 0.838 and 0.350 times the output in the U.K.

As expected, the PBR is well below one during 1981–1989. Especially during 1981–1986, the Japanese stock markets are found to have reflected only half of corporate capital in the stock prices. However, it is interesting that during 1987–1989, the so-called bubble period, the PBR is quite close to one. This finding means that, although it is usually said that the stock price surge in the bubble era was caused by irrational exuberance of investors, the investors actually assessed asset values correctly. Hence, just as Irving Fisher was shown to be right by McGrattan and Prescott (2004), we argue that Japanese stock investors were acting rationally at that period.

4 Conclusion

Following MP, we examined the Japanese economy using CFD data, which will be more appropriate to this topic than the SNA data. Our findings can be summarized as follows. First, the estimated value of intangible capital in Japan is enormous compared to the cases of the U.S. and the U.K.. With this large value of intangible capital, the stock prices of Japanese firms are found to be under-evaluated throughout the 1980s. More interestingly, results obtained using the MP model show that when we consider the sub period of 1987–1989, the PBR is approximately unity, which implies that the stock price surge during the bubble period was not actually a bubble. Just as Irving Fisher was shown to be correct by McGrattan and Prescott (2004), we can argue that Japanese stock market functioned well during the bubble period.

5 Data appendix

5.1 Aggregate variables

Instead of using the national aggregate data of the SNA, we use accounting panel data of non-financial companies to construct aggregate variables. We can obtain consistent historical data for all entries used in our analyses during fiscal years 1977–2002 (starting from April and ending at March of the next year). Entries and exits of firms took place during the period. For that reason, the number of firms differs from year to year. In all, data of 2771 firms were used during the period.

All entries in the CFD are based on book value. Therefore, we must convert them to market value variables for each company. Then, we will obtain macro variables such as capital, investment, etc. by aggregating those micro variables by year across all firms. The following items describe how we convert book-value entries into market value entries.[8]

[8] Below, we will construct current-price time series data for all the entries.

5.1.1 Tangible capital K_m

In relation to tangible capital, we will consider productive capital, inventories, and land.

We follow Hori et al. (2004; 2005) in considering productive capital. Regarding the CFD data, we have six categories for productive capital: (i) buildings [K1300], (ii) structures [K1310], (iii) machinery/equipment [K1320], (iv) ships [K1340], (v) autos/trucks [K1350], and (vi) tools/fixture [K1360].[9] First, we consider fiscal year 1977 to be the benchmark year, when the reported book values of these capital categories are assumed to be market values. As for firms which appear on the CFD data after 1977, the starting year variables are assumed to be market values. These simplifying assumptions are used due to limitations in the availability of data. Next we can obtain book-value gross investment for each category from the CFD as (i) buildings [K6270], (ii) structures [K6280], (iii) machinery/equipment [K6290], (iv) ships [K6300], (v) autos/trucks [K6310], and (vi) tools/fixture [K6320]. Then, for each company, we convert the book-value investment figures to real investment figures by dividing the former by the relative prices of capital which the price at the bench mark year for the company is set to be one.[10] Third, we cite the depreciation rates for six categories from Hayashi and Inoue (1991) and Hori et al. (2004; 2005) as (i) 4.7%, (ii) 5.64%, (iii) 9.489%, (iv) 14.7%, (v) 14.7%, and (vi) 8.838%. Then, for each company, from the capital stock at the benchmark year, we can construct the series of real tangible capital by the perpetual inventory method with the real investment obtained above and the depreciation rates. We divide the series of capital for each company by a respective benchmark year's relative price to aggregate that real capital across all companies. Thereby, we will obtain the real capital stock historical data, for which the benchmark year for all firms is set as 1977. Finally, we aggregate the capital stock and multiply the macro capital stock thus obtained with the price series of capital. Thereby, the current price representations of capital stock are obtained.

With respect to inventories, we follow Hoshi and Kashyap (1990) to construct the market-value series. We set the benchmark year for each firm just as we do for productive capital; the book values of the benchmark year are presumed to be market values. In general, the book value of inventories can differ greatly from the market value depending on the methods of inventory valuation so that we will divide our CFD inventory categories into three parts: (i) inventories for which information about the valuation method is available, (ii) inventories for which information about the method of valua-

[9] Hereafter, we report the CFD codes of the corresponding variable in square brackets.

[10] The prices of capital are cited from Bank of Japan Price Data. We use the price of "construction materials" for (i) buildings and (ii) structures, the price of "machine and equipment" for (iii) machinery/equipment and (vi) tools/fixture, and the price of "transporting machine" for (iv) ships and (v) autos/trucks.

tion is not available, and (iii) land for sales. Here, (i) includes inventories of commercial goods [K1040], inventories of finished products [K1060], inventories of half-finished goods [K1070], inventories of products in progress [K1080], inventories of materials [K1100], and inventories of merchandise and supplies [K1110], whereas (ii) includes inventories of other goods [K1120]. As stated in Hoshi and Kashyap (1990), when inventories are evaluated in the LIFO fashion, the book value differs greatly from the market value; alternatively, if inventories are evaluated in other fashions, the book value will approximate the market value. Therefore, for inventories in (i), we consider that book value equals the market value if firms do not follow the LIFO system of inventory valuation.[11] This method also applies in making current price representations of inventories in (ii). With respect to land for sales [K1050] in (iii), because we have neither information for inventory valuation method nor a price index, we assume that book values equal market values and current price representation.

On the other hand, when firms follow the LIFO system with respect to inventories in (i), we will make a market-value inventory series as follows. First, if a firm increases an inventory item from time $t-1$ to time t, the addition is presumed to be recorded on the book at the current price. Hence, The inventory stock at t is the sum of inflation adjusted value of the inventory carried from time $t-1$ to time t and the book value of the addition. Second, when a firm decreases the book value of inventory from time $t-1$ to time t, we assume that the cleared inventories are one year old and make the appropriate correction for inflation for the stock of inventory carried from time $t-1$ to time t. Finally, if a firm uses both LIFO inventory valuation and another inventory valuation method for an inventory category, then we assume that half of the inventories are valued using the LIFO method.

We can get information related to land holdings with the entries in [K1390]. Following Ogawa and Kitasaka (1998), we convert the book value variables into the market value variables as follows. In the SNA, we have information of estimated market-value land holdings of non-financial private corporations. In addition, we have book value information of land holdings for that sector in the FSSCI. We can obtain a "market value to book value ratio" by dividing the SNA values by the FSSCI values if the coverage of corporations is identical for the two statistics. However, the coverage is known to be different. Therefore, we must adjust the two statistics by producing a "coverage ratio". In both the SNA and the FSSCI, we have information of cash holdings for the non-financial corporate sector. Cash is nominal. Therefore, the difference in the amount of cash holdings between the two statistics will reflect the difference of coverage. Consequently, we can adjust the difference in the coverage and obtain appropriate market value to book

[11] We can see how firms evaluate each inventory item using the CFD information [K4610] –[K4690].

value ratios for land holdings. Finally, we obtain our market-value land holding series by multiplying the CFD land holding with the ratios.

Finally, we consider "other capital" which is the sum of tangible capital for rent [K1370], other productive capital [K1380] and other tangible capital [K1410]. Because we have no information to obtain market value series, we assume that the book value variables are equal to the market value variables.

We obtain K_m for each year by aggregating the above capital entries across firms.

5.1.2 Intangible capital K_u (X_m and Π)

Regarding intangible capital, we must estimate the values with eq.(3) in the text. Then, we need information about investment on tangible capital X_m and profits from operations Π.

For investment, we use investment on fixed capital [K6260]. We use income from operations [K2980] as corporate profits. Therefore, we obtain X_m and Π for each year. These variables are flow variables. Therefore, the book values will be equal to current market values. By applying eq. (3), we obtain the series of K_u.

5.1.3 Actual corporate value V

Finally, we will obtain the total value of corporate equity V as follows. Following MP, we define V as the sum of the actual value of outstanding equity and the value of net corporate debt. Regarding equity, we have information of the highest and the lowest stock prices within the year, [K0370] and [K0380], respectively, and information of the number of shares outstanding [K5440]. Then we can estimate the series of actual values of outstanding equity by taking the product of the average of the highest and the lowest prices and the number of equity instances in the sample.

The value of net debt is given as follows. Regarding financial assets, we consider quick assets [K0870], other liquid assets [K1130], allowance for doubtful accounts [K1270], intangible capital [K1540], other investment asset [K1760] and deferred assets [K1870]. As for financial assets, we consider total debt [K2630]. Therefore, the value of net debt is given by financial debt minus total financial assets, multiplied by one less the tax rate on distributions.[12]

5.1.4 Output

We will take ratios of above aggregate variables to output. Output is given by total sales [K2820].

[12] See footnote 23 of MP for this point.

5.2 Parameters

We next present the calibration of the parameters.

5.2.1 τ_{dist}

The tax rate for corporate distributions τ_{dist} is computed with data of the personal capital income tax and of the amount of corporate dividend because Japanese corporations only rarely make distributions by buying back shares or liquidating operations. Therefore, the relevant tax rate will be the tax rate on personal income. The amount of the dividend is given as the "amount of dividend" in the Actual State of Corporate Enterprise Seen from the Taxation Statistics (the ASCESTS) published by the National Tax Agency; the amount of dividend tax is given by "tax on dividends" in the ASCESTS. Those figures are based on fiscal years.

5.2.2 τ_{corp}

Following Japanese studies such as those by Hoshi and Kashyap (1990) and Nomura (2004), the tax rate on corporate profits τ_{corp} is computed using corporate tax data from the FSSCI, which includes the corporate income tax, the prefectural residents' tax, the municipal residents' tax, and the enterprise tax, and with the corporate income data in the ASCESTS. Those figures are available for non-financial private corporate sector on a fiscal year basis; they are consistent with the CFD data. Corporate tax are given as "corporation tax, residents' tax and enterprise tax" in the FSSCI while the corporate profit is given as an "amount of income" in the ASCESTS.

5.2.3 δ_x

In Japan, capital subsidies with investment tax credits are known to be quite small.[13] With this presumption and because of the lack of information, we set $\delta_x = 0$.

5.2.4 $\hat{\delta}_x$

As for the allowed rate of immediate expensing of investment $\hat{\delta}_x$ and the allowed rate of depreciation on book value capital $\hat{\delta}_m$, following MP, we assume that $\hat{\delta}_x = \hat{\delta}_m = \hat{\delta}$. Those figures are obtainable with the SNA data because tangible capital depreciation on the tax code is reported in the SNA. Hence, $\hat{\delta}$ is computed as the ratio of "book value depreciation" minus "replacement cost adjustment" of the subsequent year to "productive capital", which excludes land holdings. We can have those figures for the

[13] See, for example, Hoshi and Kashyap (1990), Kitasaka and Ogawa (1998), and Nomura (2004).

private non-financial sector of the SNA so that the estimated value of $\hat{\delta}$ will be consistent with the CFD data.

5.2.5 δ_m

The economic rate of depreciation on tangible capital δ_m is borrowed from Nomura (2004). The depreciation rate is computed with capital stock, which excludes land holdings. See for these values the last line of Table 3.5 on page 228 in Nomura (2004).

5.2.6 γ

The growth rate in labor augmenting technology γ is calculated following Hayashi and Prescott (2002) and is definable as the growth rate in the total factor productivity. We update their series with the newly available SNA data of SNA93 basis.

5.2.7 i

According to the log preference assumption, the real interest rate i is obtained as $i = [(1+\gamma)/\beta] - 1$, where β is the subjective discount rate. Here, we set $\beta = 0.97$.

5.2.8 π

The inflation rate π is obtained from the growth rate of the "GNP deflator" in the SNA.

5.2.9 η

The population growth rate η is given by the growth rate in the working populations in the SNA. We follow Hayashi and Prescott (2002) in computing the rate.

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Figure 1: Capital Output Ratio in Japan

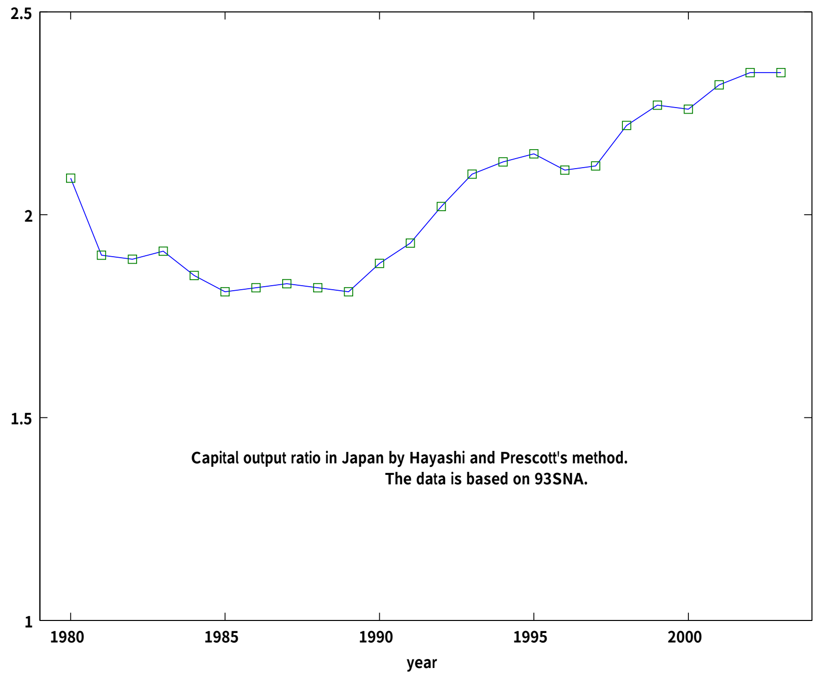

Figure 2: Capital Prices

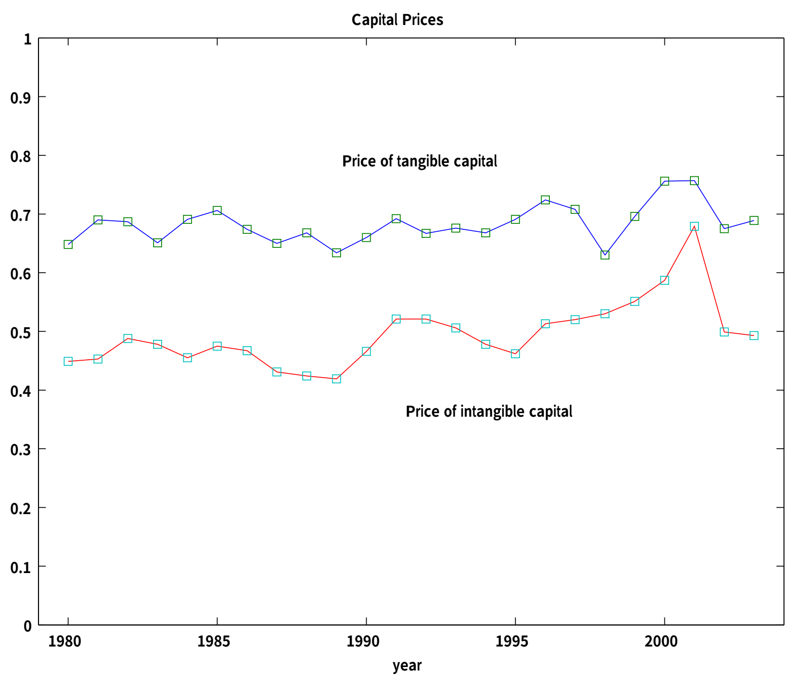

Table 1: Estimating intangible JPN capital

JPN values	1981-1989	1981-1986	1987-1989
Corporate tax rate τ_{corp}	0.413	0.405	0.428
Growth of real GDP $\gamma + \eta$	0.052	0.049	0.059
Real interest rate i	0.076	0.073	0.082
Tangible depreciation rate δ_m	0.057	0.057	0.058
Average corporate investment* X_m	0.079	0.074	0.089
Contributions to domestic pre-tax profits*			
Tangible assets $iX_m/[(1-\tau_{corp})(\gamma+\eta+\delta_m)]$	0.094	0.086	0.109
Intangible assets $(i-\gamma-\eta)K_u$	0.011	0.010	0.013
Total	0.104	0.096	0.121
Estimate of intangible capital* K_u	1.708	1.739	1.615

*these values are relative to output

Table 2: Predicted and actual JPN corporate values and PBR

JPN values	1981-1989	1981-1986	1987-1989
Corporate tax rate τ_{corp}	0.413	0.405	0.428
Tax on distributions τ_{dist}	0.226	0.211	0.257
Investment subsidy rate τ_x	0.000	0.000	0.000
Tax credit from depreciation allowance τ_σ	0.129	0.131	0.126
Estimate of intangible capital* K_u	1.708	1.739	1.615
Price of intangible capital $(1-\tau_{corp})(1-\tau_{dist})$	0.454	0.469	0.425
Value of intangible capital* $K_u(1-\tau_{corp})(1-\tau_{dist})$	0.776	0.816	0.686
Price of tangible capital $(1-\tau_\sigma)(1-\tau_{dist})$	0.674	0.686	0.650
Tangible capital* K_m	0.454	0.405	0.553
Value of tangible capital* $K_m(1-\tau_\sigma)(1-\tau_{dist})$	0.306	0.278	0.359
Total fundamental value*	1.082	1.094	1.046
Actual market values* V	0.673	0.476	1.068
PBR $V/(1-\tau_{dist})[(1-\tau_x-\tau_\delta)K_m+(1-\tau_{corp})K_u]$	0.622	0.435	1.022

*these values are relative to output