Japan's Intangible Capital and Valuation of Corporations in a Neoclassical Framework

Hiroki Arato

and

Katsunori Yamada

First Draft: March 16, 2010
This version: October 29, 2010

Japan's Intangible Capital and Valuation of Corporations in a Neoclassical Framework*

Hiroki Arato[†]   Katsunori Yamada[‡]

Abstract

Employing a new accounting data set, this paper estimates the value of productive capital stocks in Japan using the neoclassical model of McGrattan and Prescott (2005). We compare those estimates to actual corporate valuations, and show that the actual value of equity plus net debt falls within a reasonable range of the theory's prediction for the value of Japanese corporations during the periods 1981-86 and 1993-97. This finding differs from previous results based on studies of aggregate data sets or based on studies of micro data sets that neglected intangible capital. We also show that the Japanese ratio of the amount of intangible capital stock to the amount of tangible capital stock is comparable to the analogous ratios for the U.S. and U.K.

keywords: Intangible capital, Fundamental value of corporations, Accounting information

JEL classification: E01, E22

1 Introduction

This paper provides a new interpretation of Japanese stock market developments since 1980, taking into account the role of intangible capital, based on the framework of McGrattan and Prescott (2005). To do so, we employ a new accounting data set, together with a national aggregate data set of the System of National Account (SNA). We show that the ratio of the amount of intangible capital stock to the amount of tangible capital stock for Japan is close to the values for the U.S. and the U.K.. Our estimates of the ratio of the actual corporate value to the fundamental value of capital stocks differ from previous studies using national aggregate data, and from previous studies using micro data sets. We show that intangible capital is an important source of actual corporate values in the Japanese stock market, despite being neglected in the previous studies of Japanese stock markets.

Numerous studies have analyzed Japanese stock price behavior since the 1980s, by estimating the ratio of actual corporate market value to the theoretically-predicted fundamental value, Tobin's average q. Previous studies, relying on differing data sets, have reached opposite conclusions, some finding that stock markets over-valued corporations, others finding that they under-valued corporations. Using micro data sets, Hoshi and Kashyap (1990) and Hayashi and Inoue (1991) estimated Tobin's average q and found it to be greater than one. They report estimates for the early 1980's of the textbook Tobin's average q of 1.56 and 1.25.[1] That is, they find that stock markets over-valued corporations relative to fundamentals. In contrast, Ando (2002) and Ando et al. (2003), using national aggregate data of the System of National Account (SNA), concluded that the Japanese stock markets under-valued the corporate capital stocks. For example, Ando et al. (2003) calculated that for the consolidated corporate sector, traditional Tobin's average q was 0.32 in 1980.

A theoretical flaw in the previous studies of Japanese stock prices is that they did not consider the value of intangible capital in estimating their measures of Tobin's average q. Stock market participants consider not only the value of tangible capital stocks but also the value of intangible capital stocks, not included in the micro-data sets so far examined. This may be why the studies examining micro data sets have found that stock markets over-value corporations. Recent analyses based on neoclassical growth models focus on intangible capital. A consensus has emerged that intangible capital plays a crucial role in important economic phenomena. Examples include secular movements of stock prices in the United States and Britain (McGrattan and Prescott 2000, McGrattan and Prescott 2004, McGrattan and Prescott 2005), the difference of profit performance between domestic and foreign operations of U.S. corporations (McGrattan and Prescott 2010a), and the business cycles in the United States in the 1990s (McGrattan and Prescott 2010b).

In this paper, we estimate the value of intangible capital in Japan by applying the elaborate dynamic general equilibrium model proposed by McGrattan and Prescott (2005).

---

[1]Since Hoshi and Kashyap (1990) and Hayashi and Inoue (1991) employed investment models with adjustment costs in partial equilibrium model frameworks, Tobin's average q above one did not necessarily imply over-valuation in the stock markets. Later we show that when we do not take into account the fundamental value of intangible capital in a general equilibrium model framework, the ratio of actual corporate value to the fundamental value of corporations exceeded one, which means that the stock market was over-valued.

Similar to Hoshi and Kashyap (1990) and Hayashi and Inoue (1991), we employ a micro data set. However, our approach differs from their studies in that we consider intangible capital and employ a new accounting data set for traded corporations from the Corporate Financial Databank (CFD). Our estimates of intangible capital in the early 1980s fall within a reasonable range in the sense that the ratio of the amount of intangible capital stock to the amount of tangible capital stock is comparable to the U.S. and U.K. cases as calculated by McGrattan and Prescott (2005). This is in the sense that the ratio of the amount of intangible capital to GDP is close to other direct evidence on intangible capital offered by Fukao et al. (2009). We show that, if we incorporate the value of intangible capital, an extended measure of Tobin's average q in the early 1980s is close to one, under a reasonable calibration.

The accounting data set we use can provide clearer evidence than the SNA, because the data set contains only information of traded companies. We argue that possible measurement errors in actual corporate value in the SNA are not negligible. The problems pertain to the estimation of the actual market values of smaller and un-traded corporations in the SNA. We show, by comparing the coverage between the Corporate Financial Databank and the SNA, that the previous estimates of Tobin's q from the SNA indicated undervaluation, not because of some malfunction in the stock markets, but rather because of the severe measurement errors of the actual value of corporation in the SNA. Relying on our new Corporate Financial Databank data set with which we can construct aggregate variables such as capital stocks and actual corporate values in a precise fashion, we show that if we do not take into account intangible capital, then the actual market values of traded corporations seem to overshoot the fundamental values of those corporations. We also show that the estimate of intangible capital from the SNA using the framework of McGrattan and Prescott (2005) is negative, which of course does not make any sense.

The Japanese stock price surge in the late 1980s remains for us an unsolved puzzle. We find that incorporating intangible capital into a neoclassical model cannot explain the stock price surge in the late 1980s. Our estimate of the fundamental value of intangible capital even declined toward the end of the 1980s from its level in the early 1980s. This goes in the opposite direction of the increase in actual market value of corporations. Regarding the stock price surge during the so-called "bubble-period," Hoshi and Kashyap (1990) and Hayashi and Inoue (1991) argue that pricing in stock markets was "correct" both during the pre-bubble period and during the bubble era. They suggested that the reason for this was that the stock price surge during the late 1980s was cancelled out by the price surge in land capital (namely, the increase in fundamental value of tangible capital). These studies, however, leave an open question as to why the land price increased so much. In this paper, we offer some conjectures about the puzzling co-movements of land prices and stock prices.

This paper is organized as follows. The next section presents our data set and discusses features of our accounting data set such as the coverage and relation to the SNA. Parameter calibrations are also presented in the section. Section 3 describes the framework for assessing the Japanese stock market, and provides the main results on the pricing in the Japanese stock markets. In section 4 we discuss on a possible extension of the present framework. Section 5 concludes the paper.

2 Data Description

2.1 Aggregate Variables

This study mainly employs micro-level accounting data from the Corporate Financial Databank (CFD) provided by the Development Bank of Japan for the construction of macro entries such as the reproducible cost of tangible capital, total profits, total investment, and total actual corporate value. The data set includes accounting data for all non-financial companies listed on the first or second section of the stock exchanges of Tokyo, Osaka, and Nagoya.[2] As pointed out in previous studies using micro data, the national aggregate data of the System of National Account (SNA) published by the Economic and Social Research Institute (ESRI) contain some problems which may impede the reliability of numerical analyses of the sort conducted in this paper. First, it is well known that the corporate stock values of private *non-listed* corporations are severely underestimated in the SNA (see, e.g., Ando 2002; Hayashi 2006). Second, the coverage of the private sector in the SNA includes public enterprises, and the method of distinguishing information on private companies from that on public ones is not open to researchers. These measurement issues are expected to be absent in the micro accounting data set of the CFD whose basic statistics are from annual security reports of traded companies. Consistent historical data for all entries used in our analysis are available for fiscal 1977-2002. (Fiscal years in Japan run from April to March of the next year). Because firms entered and exited during this period, the number of firms differs from year to year. All in all, data of 2,771 firms were used.

All entries in the CFD are based on book value. Therefore, we convert them to a market value basis for each company and then calculate aggregate variables such as capital, investment, etc., by aggregating the firm-level data for each year. The general idea in constructing macro entries is that we exploit all information listed on the debit and credit sides of the balance-sheet. We then examine the ratio of corporate actual market value (credit side) to the predicted fundamental value (debit side) using the MP framework. The following is a detailed description of how we convert book value entries into market-value entries.[3]

2.1.1 Actual Corporate Value V

We obtain the total value of corporate equity, V, as follows. Following MP, we define V as the sum of the value of net corporate debt and the actual value of outstanding equity. The value of net debt is estimated using balance-sheet items on both the credit and debit sides. In the Japanese accounting system, the debit side of the balance sheet consists of broad categories of quick assets, inventory assets, other liquid assets, allowances for doubtful accounts, tangible capital, intangible capital, other investment assets, and deferred assets in order of appearance. Among these entries, the information of inventory assets, tangible capital, and intangible capital are respectively used in constructing a series of values for

---

[2]Among previous studies on the Japanese stock market employing micro data, Hoshi and Kashyap (1990) and Hayashi and Inoue (1991) used the Nikkei Financial Data Tapes, while Hori et al. (2006) relied on the CFD.

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

tangible and intangible capital. Hence they are not considered here.

In the CFD data, financial assets consist of quick assets [K0870], other liquid assets [K1130], allowances for doubtful accounts [K1270], other investment assets [K1760] and deferred assets [K1870].[4] Financial Statements Rules, Act 8 regulates that financial commodity items (except for affiliates' shares) are encouraged to be listed on balance-sheets in a market value basis. In this paper we assume for these financial asset variables that the book value variables are equal to the market value variables.[5] We aggregate the above items to obtain the total value of a financial asset. In doing so, we need to exclude the book value of own shares [K0980], shares of parent company [K0990], and affiliates' shares [K1590] from the value of financial assets in order to take into account share cross-holdings. The Japanese financial statements are not consolidated for private accountings.[6]

The credit side of the balance sheet consists of the liability part and the net worth part. Broad categories in the liability part include current liabilities, long term liabilities, and special allowances. Broad categories in the net worth part include shareholders' equity and the amount of difference for reappraisal. As for financial debts in the CFD, we consider current liabilities [K2290], long-term liabilities [K2520], special allowances [K2620], earned reserves [K2670], amount of difference for land reappraisal [K2672], amount of difference for marketable securities reappraisal [K2674], other surplus [K2680], and amount of difference for other marketable securities reappraisal [K2782]. Though earned reserves [K2670] and the last four items of amount of difference for reappraisal come from the net worth part, we consider them as a part of financial debts. Thereby, we can exploit all the information listed in the balance sheet. On the other hand, capital fund [K2640], amount paid for newly issued stocks [K2650], capital reserves [K2660], and change in treasury stock [K2784] are not counted in the financial debts. This is because they are related to the value of outstanding equity. We have to avoid overlapping valuations when we later estimate the actual values of outstanding equity with information of the stock prices and the number of shares issued. We assume that the book value variables of financial liabilities are equal to the market value variables.[7]

Therefore, the value of net debt is given by financial liabilities minus total financial assets, multiplied by one less the tax rate on distributions.[8] Notice that the value of net debt thus constructed does not include the value of cross-holding shares.

Regarding equity, we have information on the highest and the lowest stock price within the fiscal year, [K0370] and [K0380], respectively, and information on the number of shares outstanding [K5440]. Thus, we can estimate the series of actual values of outstanding equity by using the product of the average of the highest and the lowest prices and the

---

[4]The square brackets show the CFD codes.

[5]See also Hayashi and Inoue (1991).

[6]More precisely, the value of own shares [K0980] is subtracted from the value of financial asset, and also from the actual values of outstanding equity, while the value of parent company [K0990] is subtracted from the value of financial asset, and also from the value of financial liability. Own shares [K0980] and shares of parent company [K0990] are included in quick assets [K0870], and affiliates' shares [K1590] is a part of other investment assets [K1760].

[7]Hayashi and Inoue (1991) found that for Japanese traded corporations the average maturity period for long term bank loans, which are the dominant component of long term debt, is relatively short, and that long term debts are about one half of short term debts. Hence, the discrepancy between the market value and the book value of financial debts will not be an issue.

[8]See footnote 23 of MP for details on this point.

number of shares issued in the sample.[9] However, as pointed out by Hayashi and Inoue (1991), because the Japanese financial statements are not consolidated, the market value of affiliates' stocks is included in the above estimated total actual value of corporate equity. We need to subtract the value of cross-holding shares to calculate the actual market value of non-financial listed companies owned by households. There are two ways to estimate the market value of cross holding shares using the CFD.

First, the CFD data offers information on the book value of shareholdings of affiliates [K1590] as a part of financial assets on the debit side.[10] We convert the variables into the ones in a market value basis following Hayashi and Inoue (1991) as follows. In the profit and loss statement of the CFD, there is information on the amount of dividends received from affiliates [K5600]. Exploiting that information, we aggregate the book value of affiliates' shares [K1590] for the companies that receive positive dividends from affiliates. The value is then capitalized by the average dividend-to-price ratio.[11] This market value of affiliates' shares owned by companies that receive dividends is divided by the aggregated book value of affiliates' shares owned by the same companies. This provides the factors to convert the affiliates' shares in a book basis into the ones in a market value basis. The factor is used for all the companies in the CFD, including ones which do not receive affiliates' dividends (as recorded in [K5600]) to obtain the market value of affiliates' shares.

Second and more easily, the CFD data offers information on the proportion of shares owned by private non-financial corporations as [K5440]. We can estimate the series of the actual values of outstanding equity net of the value of cross-holding shares by using the product of the average of the highest and the lowest prices, the number of shares issued in the sample, and the proportion of outstanding equities that are not owned by private non-financial corporations.

The top left panel of Figure 1 shows the estimated movements of net debt and the actual value of outstanding equity for the CFD for 1980-1999. In this panel, we show two

---

[9]We subtract the value of self-holdings of shares [K0980] from the above estimated series of actual values of outstanding equity. [K0980] is recorded in fiscal years after 1986, and it accounts for at most 0.1 % of total stock values for each fiscal year.

[10]Financial Statements Rules, Act 8 allows that the value of affiliates' shares can be listed in an acquisition cost basis so that the discrepancy between the market value and the book value can be enormous. Also, the Act rules that affiliates' shares should be recorded in the investment asset category as affiliates' shares [K1590], while they should be listed in the quick asset category for temporary holding. In the CFD, information of marketable securities [K0950] is available in the quick asset category. However, marketable securities consist of shares, bond issued by the government, corporate bond, etc., and we cannot distinguish the value of affiliates' shares out of the value of marketable securities. Hence, in this paper, we do not attribute the value of affiliates' shares for temporary holding to the value of cross-holding shares.

[11]The dividend-to-price ratio converts the total amount of dividends to the total value of shares outstanding for the companies that pay dividends. The ratio can be obtained as $\frac{\text{Total Stock Values}}{\text{Net Profit}} * \frac{\text{Net Profit}}{\text{Dividend}}$. The former term is available as the P/E ratio, and the latter term is the inverse of the dividend payout ratio. Information on the P/E ratio for the companies listed in the first or second section of Tokyo Stock Exchange is available at the website of the Tokyo Stock Exchange. We take a simple weighted average for the first or the second section P/E ratio to construct an aggregate P/E ratio. Information of net profits and dividends for private non-financial companies comes from the Financial Statements Statistics of Corporations by Industry (FSSCI) published by the Policy Research Institute, Ministry of Finance.

series for the actual value of outstanding equity net of the value of cross-holding shares. The blue line with triangle dots shows the case in which the value of cross-holding shares is estimated using information on the proportion of shares owned by private non-financial corporations. The blue line with square dots depicts the case in which the value of cross-holding shares is estimated using the method of Hayashi and Inoue (1991). These two series look comparable to each other until 1994, but the discrepancy between the two series is enormous after 1995. This discrepancy arises because of the surge in the P/E ratio in the late 90s, and because of the consequent uptick in the dividend-to-price ratio. The net debt series in the CFD gradually increase through the period.

The top right panel depicts corresponding variables from the SNA. The movement of the value of shares for the private non-financial sector resembles the series in the CFD, though in this SNA case, we do not net out the value of cross-holding shares because of lack of information. On the other hand, the movement of net debt in the SNA for the private non-financial sector draws attention when we include the value of shares in financial assets (the red line with square dots). In this case, net debt becomes negative in the late 80s, reflecting the surge of the stock prices. Because the net debt series from the CFD do not include the value of affiliates' shares, the discrepancy in the movements of net debt seen in two statistics will be a consequence of including the value of shares in the SNA part, a major part of which is affiliates' shares. The red line with square dots depicts an SNA net debt series in which we do not include the value of shares in financial assets. In this case, we then do not see a decline in net debt during the late 80s, and thus the series obtained resembles the movement of net debt in the CFD.

The bottom panel of Figure 1 shows the time series of the aggregate of the corporate value calculated from the CFD data, the movement of the NIKKEI225 stock price index, and the path of the TOPIX. As can be seen from the figure, the directions of changes in these three variables are completely the same for 1980-1999. The level discrepancy among those series will be because of the differences in the coverage. In the CFD, we have information of all non-financial companies listed on the first or second section of the stock exchanges of Tokyo, Osaka, and Nagoya, while the NIKKEI225 and TOPIX capture the first section of Tokyo Stock Exchange.

2.1.2 Tangible Capital K_m

For tangible capital K_m, we consider productive capital, inventories, and land.

We follow Hori et al. (2006) 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/fixtures [K1360]. We consider fiscal 1977 as the benchmark year, setting the reported book value of capital in this year as the market value.[12] As for firms that appear in the CFD data after 1977, the values in the first year in which they appear are assumed to be the market values. These simplifying assumptions are used due to limitations regarding the availability of data. Next, we obtain the book value gross investment for each category from the CFD for (i) buildings [K6270], (ii) structures [K6280], (iii) machinery/equipment [K6290], (iv) ships [K6300], (v) autos/trucks [K6310], and (vi)

---

[12]Unfortunately, information of capital stocks and gross investment by capital category is not available before 1977 in the CFD, and only total amount of capital and total amount of gross investment is reported.

tools/fixtures [K6320]. Then, for each company, we convert the book-value investment figures to real investment figures by dividing the former by the relative price of capital. The relative price of capital in the benchmark year for the company is set to one.[13] Next, we use the following depreciation rates for the six categories taken from Hayashi and Inoue (1991) and Hori et al. (2006): (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 in the benchmark year, we construct the real tangible capital series by the perpetual inventory method using the real investment obtained in the manner described above and the depreciation rates. We divide the capital series for each company by the relative price for the appropriate benchmark year. Then we aggregate the real capital obtained in this way across all companies. Doing so, we obtain the real capital stock historical data for which the benchmark year for all firms is set to 1977. Finally, we multiply the aggregate capital stock with the price series for capital, thus obtaining capital stock in current prices.

With respect to inventories, we follow Hoshi and Kashyap (1990) to construct the market value series. We set the benchmark year for each firm in the same way as we did for productive capital. Again, the book values in the benchmark year are assumed to be market values. In general, the book value of inventories can differ greatly from the market value depending on the method of inventory valuation. Therefore, we 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 valuation is not available, and (iii) land for sale. 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 "last in, first out " (LIFO) manner, the book value differs greatly from the market value. Alternatively, if inventories are evaluated in any other manner, the book value will approximate the market value. Therefore, for inventories in (i), we assume that the book value equals the market value if firms do not follow the LIFO method of inventory valuation.[14] We also use this method to calculate category (ii) inventories in current prices. With respect to category (iii), land for sale [K1050], we have neither information on the inventory valuation method nor a price index. Hence, we assume that book values equal market values

On the other hand, when firms follow the LIFO method with respect to category (i) inventories, we construct market value inventory series as follows. First, if an inventory item increases from time $t-1$ to time t, the addition is assumed to be recorded in the books at the current price. Hence, the inventory stock at time t is the sum of the inflation adjusted value of the inventory carried from time $t-1$ to time t and the book value of the addition. Second, when the book value of a firm's inventory decreases 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,

---

[13]The price of capital is taken from the Bank of Japan. Specifically, we use the price of "construction materials" for (i) buildings and (ii) structures, the price of "machinery and equipment" for (iii) machinery/equipment and (vi) tools/fixtures, and the price of "transport machinery" for (iv) ships and (v) autos/trucks.

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

if a firm uses both the LIFO and another inventory valuation method for an inventory category, then we assume that half of the inventories are valued using the LIFO method.

Information related to land holdings is available in the CFD under [K1390]. Following Ogawa and Kitasaka (1998), we convert the book value variables into market value variables as follows. The SNA provides information on the estimated market value land holdings of the private non-financial corporate sector. In addition, the Financial Statements Statistics of Corporations by Industry (FSSCI) published by the Policy Research Institute, Ministry of Finance, provides book value information on land holdings for the sector. Theoretically, we could obtain the market-to-book-value ratio by dividing the SNA values by the FSSCI values if the coverage of corporations were identical in the two statistics. However, in practice, the coverage is known to be different. Therefore, we need to adjust the two sets of data by calculating the coverage ratio. Both the SNA and the FSSCI contain information on cash holdings for the non-financial corporate sector. Because cash is nominal, the difference in the amount of cash holdings between the two statistics will reflect the difference in coverage. Consequently, we can adjust for the difference in coverage and obtain the appropriate market-to-book-value ratios for land holdings. Finally, we obtain our market-value land holding series by multiplying the CFD land holding with the ratios.

Next, 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.

Finally, regarding the amount of foreign capital, we have no clues in the CFD data. Hayashi and Prescott (2002) estimated the amount of foreign capital for the whole Japanese economy using the SNA, by regarding the current account balance (the sum of net exports and net factor income from abroad) to accumulations of foreign capital.[15] We replicate the procedure using information on an SNA93 basis. Note that the estimate of foreign capital thus constructed includes the amount of capital owned by the households, by the government, and by the private financial sector. We estimate the amount of foreign capital owned by the private non-financial sector by using the product of the amount of foreign capital and the ratio of domestic capital stock excluding land owned by the private non-financial sector to the total domestic capital stock excluding land. We find that the ratio of foreign capital owned by the private non-financial sector to tangible capital, excluding land owned by the same sector, is around 4% and 13% for the 80s and during 1993-97, respectively.

Figure 2 shows the results of the conversions of the CFD book value entries into the market value entries. As is expected, the market value of tangible capital exceeds tangible capital in a book value basis. Also, the difference between the market value of land and the book value of land is large. We have greater estimates for the market value of cross-holding shares when we use the conversion method of Hayashi and Inoue (1991). This is instead of the value of cross holding share estimated using information on the proportion

---

[15]Hayashi and Prescott (2002) assume that the amount of foreign capital in 1989 is 25 times of the net factor payments of the year. They estimate foreign capital for each year using information of net exports and net factor payments.

of shares owned by private non-financial corporations. In both cases, the market value variables are much greater than the book value corresponding.

2.1.3 Intangible Capital K_u (X_m and Π)

We can estimate intangible capital K_u using an equilibrium relation in a neoclassical model of MP. To do so, we need information on investment in tangible capital, X_m, and on operating profits, Π, as explained in the appendix. For gross investment, we use gross investment in fixed capital [K6260]. Regarding profits, total sales profit [K2960] is given as total sales minus sales costs. Sales costs include labor cost, tangible capital depreciations, R&D investment costs, and fixed asset taxes. However, note that sales costs do not include labor costs for corporate headquarters or other miscellaneous tangible capital cost components. Then from total sales profits, we subtract the sum of tangible capital depreciations in the nonoperating income section [K3290], in the special account section [K3690], and in the general and administrative expenses (SGA) section [K5810]. We also exclude the amount of land ownership tax [K3310], the amount of business facility tax [K5850], and labor costs for corporate headquarters in the SGA section [K5750; K5760; K5780; K5782; K5790; K5800][16] from the total sales profits. Thereby, we obtain the series of corporate profits that corresponds to the definition in the MP framework as is given in equation (24). These variables are flow variables. Therefore, the book values will be equal to current market values.

In the CFD, we also have information of intangible capital [K1540]. In Japanese accounting systems, intangible capital consists of business right, patent property, lease tenant right, right of trademark, utility model patent, design right, mineral right, fishery right, software, and other intangible capital. The book value of the intangible capital is found to be excessively small compared to the estimate of intangible capital from the model's equilibrium conditions.

2.1.4 Comparison of the CFD with the SNA

Now that we have exploited all the balance sheet information, we are ready for aggregate variables from the CFD. These are necessary for examining the ratio of actual corporate market value to the predicted fundamental value using the framework of MP. Before we proceed, we characterize more features of the CFD data set, since this data set is new to the literature. It is usual to gain an overview of the Japanese aggregate economy using the SNA. We then compare the CFD aggregates with their counterparts in the SNA for the private non-financial sector. Later we also use the SNA for calibrating the parameter values in the model.

Figure 3 shows the differences between aggregate variables constructed using the CFD, and the corresponding SNA in the private non-financial sector. The figure also contains information on variables from the FSSCI, which is a statistics base for the SNA.

The left top panel of Figure 3 shows the time series of cash holdings by private non-financial corporations in these three statistics. A noteworthy finding from the panel is that

---

[16][K5750] is wages for workers in headquarters offices, [K5760] is provision for accrued bonuses, [K5780] is provision for retirement allowances, [K5782] is retirement benefit expenses, [K5790] is retirement payment, and [K5800] is corporate pension.

the levels of cash holdings are very different among the statistics. Because cash is nominal, the differences in the levels of cash holdings will reflect the differences in the coverage of corporations among the statistics. Naturally, the SNA has the broadest coverage for the private non-financial sector. When all corporations in the FSSCI statistics are taken into account, the average coverage of the FSSCI during the period of 1980-1999 falls around 80% of the SNA. On the other hand, the average coverage of corporations by the CFD is much smaller, being around 20% of the SNA during the same period. The coverage of the CFD looks comparable to that of a FSSCI series for corporations with net worth greater than one billion yen. Notice that net worth greater than one billion yen is a requirement for companies to be traded in the Tokyo Stock Exchange, Section 2. Note also that the direction of changes in cash holdings in the three statistics resemble each other.

The top right panel of Figure 3 shows the movements of tangible capital (excluding land) during 1980-1999. The average coverage of tangible capital for all corporations in the FSSCI falls around 60% of the SNA, while that of the CFD is around 30% of the SNA.[17] Again, note that the directions of changes in the aggregates in three statistics resemble each other. The bottom left panel of the figure is land holdings. Here, we do not show the information of the FSSCI because the land holding in the FSSCI is on a book value basis, while that of the SNA is estimated in a market value basis. When we compare the CFD land holding series with the SNA corresponding, we find that the average coverage ratio is around 15% during 1980-1999.

The above findings confirm that the coverage of private non-financial corporations in the SNA and the CFD is very different from each other. From the FSSCI data, we see that the number of firms in the sector is as many as 15 thousand, while the CFD captures only 2,771 traded corporations at most. Another remarkable finding from Figure 3 is found in the bottom right panel, which depicts debt stock values for the SNA and that for the CFD. As it can be seen from the figure, despite the differences in the coverage of the two statistics, the levels of stock values are surprisingly comparable.[18] We can attribute the similarity in these two series to severe underestimations of stock values for small and un-traded corporations in the SNA for the private non-financial sector, which is previously pointed out by Ando (2002). Also, the suggestion of Ando (2002) relying on the SNA that Japanese stock markets undervalued the value of corporate capital stocks loses ground. Namely, his "undervaluation story" can result from measurement errors of actual corporate values in the SNA, not from some malfunction in the stock markets as Ando (2002) argued. Using the SNA, we cannot have a clear view for the true reason of the issue. On the other hand, our accounting data set of the CFD can provide clearer evidence because the data set contains only information of traded companies, and the actual market value of those corporations can be estimated in a precise manner.

2.2 Parameters

We next present the calibration of the parameters.

The tax rate for corporate distributions, τ_{dist}, is computed with data of the personal capital income tax and of the amount of corporate dividends. Note that Japanese corpora-

---

[17]Tangible capital excluding land is on a book value basis for comparison.

[18]Here we include the values of cross-holding shares in the CFD series, since in the SNA, the value of cross-holding shares is included in the total debt stock value.

tions rarely make distributions by buying back shares or liquidating operations. Therefore, the relevant tax rate is the tax rate on personal income. For the amount of dividends, we use the "amount of dividends" in the Actual State of Corporate Enterprises Seen from the Taxation Statistics (ASCESTS) published by the National Tax Agency. Similarly, for the amount of dividend tax, we use the "tax on dividends" in the Historical Data published by the National Tax Agency. These figures are on a fiscal year basis and are consistent with the CFD data.

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. This includes the corporate income tax, the prefectural residents' tax, the municipal residents' tax, and the enterprise tax, together with the corporate income data from the Historical Data on corporate profits by the National Tax Agency. These data are available for the private non-financial corporate sector on a fiscal year basis and are consistent with the CFD data. For corporate taxes we use "corporation tax, residents' tax and enterprise tax" from the FSSCI, while for corporate profits we use the "amount of income" from the Historical Data by the National Tax Agency.

In Japan, capital subsidies through investment tax credits for the purchase of new capital goods are known to be quite small.[19] For this reason and because of the lack of relevant information, we consider the investment tax credits to be negligible. The other important form of subsidies on tangible capital is allowed depreciation in excess of economic depreciation. In Japan, "special depreciation" is allowed by the Act on Special Measures Concerning Taxation (Act 26, 1957) in order to promote tangible capital investment. The FSSCI provides information on "special depreciation." We obtained the subsidiary rate on tangible capital, τ_x, by dividing the special depreciation series with "gross tangible capital investment" for the private non-financial sector in the SNA.

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 $\hat{\delta}_x = \hat{\delta}_m/2$. The SNA reports tangible capital depreciation based on the tax code, not the economic code. Therefore, we obtain the allowed rate of depreciation on a book-value basis using the SNA data. $\hat{\delta}_m$ is computed as the ratio of "book value depreciation" minus the "replacement cost adjustment" of the subsequent year to "productive capital excluding land holdings." These figures are available for the private non-financial sector in the SNA. The estimated value of $\hat{\delta}_m$ is consistent with the coverage of the CFD data. On the other hand, the economic rate of depreciation of tangible capital, δ_m, is borrowed from Nomura (2004). The depreciation rate is computed using capital stock excluding land holdings. These values are taken from Nomura (2004, p. 228), Table 3.5. In addition to these depreciation rates, we construct a capital depreciation rate for later use based on the tax code, and that on the economic code, taking into account land holdings in the denominator. Because Nomura (2004) does not report the economic rate of depreciation of tangible capital including land, we take the ratio of the allowed rate of depreciation on a book value including land to that excluding land. Then we take a product of the ratio and the economic rate of depreciation of tangible capital excluding land. Thus, we estimate the economic rate of depreciation of tangible capital including land.

The other parameters of the growth rate of labor augmenting technology, γ, the in-

---

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

flation rate, π, the population growth rate, η, and the real interest rate, i, are calculated following Hayashi and Prescott (2002) using the SNA information. Notice that we update their series on an SNA68 basis with the newly available SNA data on an SNA93 basis. The growth rate of labor augmenting technology is defined as the growth rate of total factor productivity. The inflation rate is obtained from the growth rate of the GDP deflator, and the population growth rate is given by the growth rate of the working-age population. Regarding the interest rate, we obtain our preferred interest rate using the equilibrium condition. On equilibrium, from the log preference assumption, the real interest rate i is obtained as $i = [(1 + \gamma)/\beta] - 1$, where β is the subjective discount factor. β can be estimated using the framework of Hayashi and Prescott (2002) from the information on the per capita consumption growth rate, and the capital output ratio. We calculate that the subjective discount factor is around $\beta = 0.9693$.

2.3 Analysis of the Japanese Economy

2.3.1 Study Period

The equations presented in Section 3 are applicable to economies on a balanced growth path. In general, assuming homogeneity of degree one in the production function, an economy can be said to be on a balanced growth path if the ratio of capital to output evolves stably over time. Therefore, following Hayashi and Prescott (2002), we calculated the ratio with respect to the entire Japanese economy using the SNA data for 1980–2003.[20] Figure 4 shows the result. The figure suggests that the capital output ratio evolved in a stable manner during 1981–1989, suggesting that we are justified in applying the equations to this period. Interestingly, the period includes the so-called "bubble era" (December 1986 – February 1991) when stock prices surged. Therefore, we divide the period 1981–1989 into two sub-periods, 1981–1986 and 1987–1989, for which we provide additional results.

From Figure 4, it may seem that the capital output ratio evolved in a stable manner during 1993-1997 as well. However, as Hayashi and Prescott (2002) suggested that the whole 1990s is a part of the transition period, we do not regard this sub-period to be on a steady state. This is because this period is not very separated from the former steady state in the 80s, and since the transition path to a new steady state would not have been completed. Nevertheless, we report later the results for 1993-1997, assuming that the economy is on a new steady state. This may be innocuous when the tax rates fluctuate only a little during the 1990s as is shown in Figure 5, and when the equation (2) may be justifiably exploited for the sub-period. On the other hand, we do not exploit equation (4) in estimating intangible capital for the 1990s, This is because equation (4) requires constancy of the interest rate and the technological growth rate, which actually was on the declining trend during the course of the transition path. Hence, we will assume that intangible capital in the 1990s is as large as that in the 1980s.

---

[20]In this paper, the SNA entries are based on SNA93, which became available after publication of the paper by Hayashi and Prescott (2002), who used data on an SNA68 basis. We use 2003SNA, making responsive to the publication year of the CFD.

2.3.2 Capital Prices

Figure 5 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 evolved in a stable manner, unlike the secular large movements seen in the United States and Britain. MP explained movements in corporate valuation in the United States and Britain using the changes in those prices. It is noteworthy that in the case of the Japanese economy, we cannot attribute the surge of actual corporate values in the late 1980s to changes in capital prices.

3 Major Results and Findings

3.1 MP's formulas

This section presents, for reference, the equilibrium relations developed by MP to assess stock valuations. Detailed derivations are in sections 2 and 3 of MP, and a general description is in the appendix. MP show that, under a balanced-growth path, the total value of corporate equity (V) satisfies

$$(1) \qquad V = (1 - \tau_{dist})[(1 - \tau_x - \tau_\delta)K_m + (1 - \tau_{corp})K_u] + K^*.$$

K^* in the above equation is the tax adjusted value of foreign capital. Because of the lack of information on the composition of foreign capital and on foreign tax systems, we use the capital price for Japanese tangible capital. For example, this simplifying assumption and the amount of foreign capital estimated following Hayashi and Prescott (2002) provide the estimate of the predicted fundamental value of foreign capital owned by the private non-financial corporations as 0.01 times the GDP during the 1980s.[21]

As can be seen from equation (1), the price of tangible capital for the stockholders is discounted by $(1 - \tau_{dist})(1 - \tau_x - \tau_\delta)$, while the price of intangible capital is discounted by $(1 - \tau_{dist})(1 - \tau_{corp})$. Distribution tax affects these prices because a dollar reinvested is not taxed, but a dollar distributed is. Subsidies to tangible investment reduce the price of tangible capital because they make investing in tangibles cheaper. The price of intangible capital depends on the corporate distribution tax, and on the corporate income tax rate. This is because investments in intangible capital are expensed and reduce taxable corporate income (MP, p.772).

From equation (1) we obtain the ratio of corporate market value to the predicted fundamental value (RATIO), i.e.:

$$(2) \qquad RATIO = \frac{V}{(1 - \tau_{dist})[(1 - \tau_x - \tau_\delta)K_m + (1 - \tau_{corp})K_u] + K^*},$$

where

$$(3) \qquad \tau_\delta = \tau_{corp}\left[\hat{\delta}_x + (1 - \hat{\delta}_x)\left(\frac{\hat{\delta}_m}{(i + \pi + \hat{\delta}_m)}\right)\left(\frac{(1 + \pi)(1 - \delta_m) - 1 + \hat{\delta}_m}{\gamma + \eta + \pi + \hat{\delta}_m}\right)\right].$$

---

[21]Note that we will be overestimating the fundamental value of foreign capital owned by the private non-financial corporations in the CFD. The coverage of the SNA private non-financial corporate sector is much wider than that of the CFD.

The formula accords with the textbook version of Tobin's average q, if we do not consider the reproducible cost of intangible capital K_u and accelerated depreciation allowances τ_δ. The quantitative implications of considering the tax-discounted value of intangible capital $(1 - \tau_{dist})(1 - \tau_{corp})K_u$ in the denominator are one of the central topics of this paper.

The estimation formula of the reproducible cost of intangible capital is derived from firms' maximization problem as follows:

$$(4) \qquad K_u = [\Pi - \frac{i}{(1 - \tau_{corp})(\gamma + \eta + \delta_m)}X_m]/(i - \gamma - \eta).$$

In the following analysis, we normalize these aggregates with output measures of GDP from the SNA.

3.2 Estimating Intangible Capital using the MP framework

We begin by explaining how we estimated intangible capital from the CFD data. Given the calibrated parameters in the top panel of Table 1, and the value of investment relative to GDP, we estimate the contributions of tangible and intangible capital to domestic pre-tax profits. The first column of Table 1 shows the estimation results for intangible capital K_u for the period 1981–1989. We find that during the 1980s, about 90% of domestic pre-tax corporate profits are derived from tangible capital. This value is quite comparable to that in the case of the United States shown in Table 2 of MP.

K_u is estimated using Equation (4). The bottom row of Table 1 shows the estimated reproducible cost of intangible capital for each period. Thus, the first column indicates that during the 1980s, K_u was 0.343 times the GDP level.[22] This estimate provides the ratio of reproducible cost of intangible capital to that of tangible capital of around 0.414 for the period of 1981–1989. MP estimate that, in 1998–2001, the reproducible costs of domestic intangible capital and domestic tangible capital were 0.65 times GDP and 1.03 times GDP, respectively, in the United States (column 5), and 0.51 times GDP and 1.45 times GDP, respectively, in Britain (column 6). Hence, these three economies seem to have similar production structures of tangible and intangible capital stocks, while Japan has the highest intangible to tangible capital stock ratio. However, it should be again remembered that the CFD data focuses on the traded private non-financial corporations, and direct comparisons of our results with those in MP require cautions regarding the difference in coverage.

Another noteworthy finding is that from the second and the third columns of Table 1, we see that K_u is higher in the former sub-period of the 1980s than in the latter sub-period. Mechanically, this is because the gross tangible investment and the growth rate

---

[22]It is also interesting to see which sector of the economy mainly accumulates the intangible capital. To do so, we divide the companies into heavy industry and light industry, like Hayashi and Inoue (1991). In this study, heavy industry includes manufacturing, farm business, mining, construction, and infrastructure. On the other hand, light industry includes sales, finance (Credit Saison Co. Ltd.), real estate, transportation and communication, and service. For the period of 1981–1989, the heavy industry is endowed with intangible capital estimate of 0.306 times GDP level, with the tangible capital estimate of 0.340 times GDP level. For the light industry, intangible capital estimate is 0.037 times GDP level with the tangible capital estimate of 0.146 times GDP level. Hence, the intangible capital estimate is mainly accumulated in the heavy industry.

is a bit higher in the latter sub-period. If we use parameters of 1981–1989 in estimating the intangible capital for the latter sub-period, we obtain that K_u is around 0.312 times the GDP level (not shown). Again, this figure is smaller than the estimate for the early 80s. Finally, if we take the book-value intangible capital from the accounting information of the CFD (intangible capital [K1540]), we find that the amount of intangible capital presented is 0.004 times the GDP level for the 80s (not shown). The reproducible cost of intangible capital in a book value basis is too small to rely on. In the Japanese accounting system, intangible capital such as business right and patent property is reported in an acquisition cost basis so that the book value of intangible capital does not reflect the market value.

Next, we show the estimate of intangible capital from the SNA data for comparison purposes. It should be remembered that as stated above, the coverage of private non-financial corporation sector in the SNA is much wider than the coverage of the CFD. The estimation of intangible capital from the SNA is possible using the following information on aggregates. In the SNA, inflation adjusted profits Π^{SNA} are given by (i) corporate profits ("3. Operating surplus" in "(21) Income and outlay accounts of private and public corporations") minus (ii) adjustments ("Change in assets" in "(2) Reconciliation c account") .[23] The gross investment series X_m^{SNA} are reported in the flow section ("5. Supporting Tables, (22) Capital Finance Accounts of Private and Public Corporations") on a fiscal year basis. They are given by the sum of (i) investment in tangible capital ("1. Gross fixed capital formation") plus (ii) investment in inventories ("3. Changes in inventories"). We use GDP for the normalization of these aggregates.

Based on the calibrated parameters for the corporate tax rate, the growth of real GDP, the real interest rate, and the tangible depreciation rate, as well as the value of investment relative to GDP and the information on profits, the fourth row of Table 1 shows the estimates of the reproducible cost of intangible capital from the SNA. As can be seen, K_u^{SNA} in this case takes a negative value, which of course does not make any sense. Mechanically, this happens because profits are too small compared to investment in the SNA. We find from the FSSCI data which are the basic statistics for the SNA for the private non-financial sector that the corporations with net wealth greater than one billion yen have a higher profits-investment ratio than the market average. Namely, smaller corporations which are included in the SNA data, but are not counted in the CFD data, tend to earn less profits relative to investment. Because of this difference in coverage, we reach a fine result on the side of the CFD, but the framework of MP does not work on the side of the SNA.

Finally, we provide other evidence on intangible capital stocks that can be measured directly. Corrado et al. (2006) and Corrado et al. (2009) (CHS) suggest a perpetual inventory method of directly measuring the amount of intangible capital using information on intangible investments and the depreciation rates for intangible stocks. They consider, for intangible investment, (i) categories of business investment in computerized information, (ii) innovative property, (iii) investment in "economic competencies", and (iv) investment in firm-specific human and structural resources.[24] According to Corrado et al. (2009), the average ratio of the reproducible cost of intangible capital to GDP in the U.S. 1990-2001

---

[23]See Hayashi (2006) for details on this adjustment of profits.

[24]See Corrado and Hulten (2010) for updates.

was 0.375 (column 5). MP argue that the amount of intangible capital from the method in Corrado et al. (2009) is conservative. This is because the depreciation rate used for R&D investments is too high, and since they may be underestimating some important intangible capital stocks such as firm specific capital. Fukao et al. (2009) follow Corrado et al. (2009) and provide a direct measure of intangible capital stock for the Japanese economy.[25] On the last row of Table 1, a direct measure of intangible capital is reported as 0.28 times GDP level for 1985-1989 in Japan.[26] As was the case in the U.S., this figure seems a bit conservative measure of intangible capital stock.

3.3   Estimation of RATIO

Table 2 shows our estimation results for RATIO using equation (2). We report the results for the period of 1993-1997, in addition to those for 1981-1986 and 1987-1989, to provide casual evidence on the stock market situation after to so-called "bubble period." We assume that the economy is on a new steady state during 1993-1997. This may be innocuous when the tax rates fluctuated only a little during the 1990s as shown in Figure 5, and when equation (2) may be justifiably exploited for the sub-period. On the other hand, the interest rate and the technological growth rate decline during the 1990s. We do not exploit Equation (4) in estimating intangible capital for the 1990s, since the equilibrium relation requires constancy of the interest rate and the technological growth rate.[27] Here, we simply assume that intangible capital in the 1990s is as large as that in the 1980s, given that these two periods are not very apart.

In this paper, we provide results of with and without land capital estimations for RATIO, because Japanese economists sometimes prefer not to include land capital when examining asset pricings in the macro economy. For example, see Ando (2002).[28] However, the results in the left panel and in the right panel suggest that our findings should remain unchanged, irrespective of inclusion of land capital into our considerations.

---

[25]See also Marrano et al. (2009) for U.K. evidence.

[26]Notice that Fukao et al. (2009) report a direct measure of intangible capital for the whole economy (0.336 times GDP level). Instead, we report intangible capital stock relative to GDP after we adjust the coverage to the one of the CFD for a comparison purpose. To compare our estimates of intangible capital stocks in the Japanese corporate sector, we adjust the coverage of their estimates by using their R&D investment data from Survey of Research and Development (SRD) published by Statistical Bureau, Ministry of Internal Affairs and Communications. The SRD is used for the estimation of R&D investment by Fukao et al. (2009), and covers all business enterprises, non-profit institutions and public organizations, and universities and colleges. We assume that intangible capital stocks produced from R&D investment by non-profit institutions, public organizations, universities, and colleges are distributed to firms proportional to the R&D investment each firm expends. Hence, all R&D investment can be regarded as expended by firms. Next, to estimate the coverage-adjusted R&D investment in the SRD, we use data of total sales across firm size. From the SRD, we can obtain the data on R&D investment by size of sales. We use the coverage adjusted investment series to obtain the coverage ratio of the CFD to the SRD. Finally, we assume that intangible capital stocks are proportional to R&D investment and obtain the direct (and corresponding) measure of intangible capital stock.

[27]See also Chen et al. (2006) and Braun et al. (2009) for the movements of the real interest rates and savings in Japan after the 80s.

[28]Using aggregate data, Ito and Iwaisako (1995) and Nakajima (2008) examined Japanese stock markets with special focus on land capital and secular changes in TFP, corporate taxes, and marginal taxes on land holdings. Stock prices predicted from these models are found not to fit the data well.

The upper part of the table shows parameter values for the prices of tangible and intangible capital. As shown in Figure 5, the prices of tangible and intangible capital evolved in a stable manner until the end of the 1990s. The middle part of Table 2 shows our estimates of reproducible costs and fundamental values of tangible and intangible capital, as well as our estimates of fundamental values of foreign capital and actual market values of private non-financial corporations in the CFD.[29] We provide two types of actual market values of corporations. One is obtained when we estimate the market value of affiliates' share following Hayashi and Inoue (1991) (denoted as Actual market values 1), The other one is obtained when we estimate the market value of affiliates' share using the CFD information on the proportion of outstanding shares owned by non-financial corporations (denoted as Actual market values 2). Finally, the lower part of the table shows the estimates of RATIO for three cases. RATIO 1 and RATIO 2 correspond to Actual market values 1 and Actual market values 2, respectively. On the other hand, the last measure of RATIO is the case when we do not consider the fundamental value of intangible capital in equation (2). It then corresponds to the textbook example of Tobin's average q. We call it Ando's RATIO.

The first finding here is that RATIO 1 and RATIO 2 fall within reasonable range around one for the period of 1981–1986. So, the framework of MP works very well to the Japanese data set as well.

When we see Ando's RATIO for the same period, we find that the actual market value of corporations *overshoot* the predicted fundamental value of corporations.[30] First, this implies that intangible capital is an important source of corporate values in the Japanese stock markets. Second, this finding is a sharp contrast with the *undervaluation* story of Ando (2002) and Ando et al. (2003). They argue that the market valuation of Japanese corporations is far below their reproduction costs. For example, Ando et al. (2003) report that for the consolidated corporate sector, a measure of Tobin's average q ranges from a low of 0.32 in 1980 to a high of 0.52 in 1998.[31] As stated above, it is well known that the corporate stock values of private *non-listed* corporations are severely underestimated in the SNA (see, e.g., Ando 2002; Hayashi 2006). This is because for un-traded corporations, which are a major component of corporations in the SNA, the value of outstanding stocks is estimated with a face value basis. Also, the coverage of the private sector in the SNA includes public enterprises. Because of these features of the SNA, the under-valuation story loses its grounds. It can result from measurement errors of actual corporate values, not from the market traders' under-valuations. Since we are focusing on the traded companies using the CFD, our estimates of RATIO will provide a reliable view on the Japanese stock markets phenomena.

Next, regarding the sub-period of 1987–1989 when the stock price surged, RATIO 1

---

[29]The estimates of reproducible cost of tangible capital K_m are based on the CFD data, the construction of which is documented above, while those of intangible capital K_u are from Table 1.

[30]Using aggregate data from the Quarterly Report of Financial Statements of Incorporated Business, Ogawa and Kitasaka (1999) found that after 1986, the discrepancy between Tobin's average q and marginal q became large. They argue that this may represent evidence of a stock price bubble during this period. Fukuta (2002) examined the necessary conditions for the absence of rational bubbles, and showed that Japanese stock prices and dividends satisfy the necessary conditions.

[31]Notice that Ando et al. (2003) do not make tax adjustments in deriving these figures. If we apply capital prices and the dividend tax rate of the 1990s calibrated in this paper to the SNA aggregates reported in Ando et al. (2003), we obtain that Tobin's average q for 1998 is around 0.717.

and RATIO 2 are too high. Notice that in this period the fundamental value of intangible capital decreases from the level in the early 1980s. Hence, model's prediction cannot replicate the observed direction of the change in the actual value of corporations in the late 1980s.

Finally, we refer to our parsimonious measure of RATIO for the 1990s. Note again that we borrow the fundamental value of intangible capital in the 1980s, instead of estimating it with Equation 4. We see from Table 2 that RATIO 1 and RATIO 2 fall within a reasonable range around one during 1993-1997, with or without taking land into account, as in the case of the early 1980s.

Before we close this section, we characterize our results with previous studies on Japanese stock markets that use micro data sets. Hoshi and Kashyap (1990) and Hayashi and Inoue (1991) have sought to analyze Japanese stock prices by estimating the ratio of actual corporate market value to the theoretically-predicted fundamental value, Tobin's average q. Hoshi and Kashyap (1990) report that the q ratio for the median firm in their sample from the Nikkei financial tape is around 1.56 on the average for the period of 1981–1987 when the q ratio is adjusted for taxes (p. 379, Hoshi and Kashyap 1990). Similarly, using the data set from the Japan Development Bank, Hayashi and Inoue (1991) report that tax adjusted series of Tobin's average q is around 1.245 on the average for the period of 1981–1986 (p.740, Hayashi and Inoue 1991). Also, note that our measure of Ando's RATIO in Table 2 is well above one. If we rely on these measures, we see that the Japanese stock markets tended to overestimate the fundamental value of corporations. However, our results show that the ratio of actual market values of corporations to the fundamental values of corporations fall within a reasonable range around one, when we consider the fundamental value of intangible capital. In this sense, our finding goes on with fine-tuning with respect to the previous findings of "over-valuations," by considering intangible capital.

4   Discussions

4.1   Two Tier Tax Rate

So far we employed the framework of MP in investigating the Japanese economy. The Japanese tax system has almost the same structures as the U.S. and the U.K. systems as was previously documented. Hence, the application of the MP framework to Japan is valid. An exceptional tax system that used to be adopted in Japan, but has been absent in the U.S. and the U.K. economies (meaning that MP did not consider), is the *two tier tax* on corporate retained earnings. The two tier tax is the preferential tax on corporate earnings which were paid as dividends. This tax was introduced in order to encourage firms' equity finances and dividend payments and was kept lower than the corporate income tax. The tax was abandoned in 1990.[32]

Following Alpanda (2010) we extend the MP framework to incorporate the two tier tax rate, and re-assess the ratio of actual market corporate value to the predicted fundamental value of corporations. When the two tier tax is available for corporations, the amount of

---

[32]See Ishi (2001) for the detailed descriptions on the two tier tax system.

dividend paid by corporations is given as

$$(5) \quad d_{1,t} = p_{1,t}y_{1,t} - x_{1m,t} - x_{1u,t} - w_t n_{1,t} - \tau_{1k}k_{1m,t}$$
$$- \tau_1[p_{1,t}y_{1,t} - \hat{\delta}_{1m}\hat{k}_{1m,t} - \hat{\delta}_{1x}x_{1m,t} - x_{1u,t} - w_t n_{1,t} - \tau_{1k}k_{1m,t}] + \tau_x x_{1m,t} + (\tau_1 - \tau_{dist}^c)d_t,$$

where τ_{dist}^c is the preferential tax rate on corporate earnings which were paid as dividends. The last term of $(\tau_1 - \tau_{dist}^c)d_t$ is the amount of corporate profits saved by the tax shelter. With this equation, equation 2 can be rewritten into

$$(6) \qquad V = (1 - \tau'_{dist})[(1 - \tau_x - \tau_\delta)K_m + (1 - \tau_{corp})K_u] + K^*,$$

where $\tau'_{dist} = (\tau_{dist} + \tau_{dist}^c - \tau_{corp})/(1 + \tau_{dist}^c - \tau_{corp})$.[33] In this paper, we borrow the ratio of the corporate tax rate to the two-tier tax rate from Alpanda (2010) to obtain that $\tau_{dist}^c = 0.3356$ for the 1980s from the corporate tax rate calibrated in this paper. We then replicate the procedure of estimating RATIO with the modified effective tax rate on corporate distributions for the sub-periods of 1981–1986 and 1987–1989. We obtain the modification results at around 17& increase in RATIO 1 and RATIO 2. Hence, RATIO 1 becomes just around one (0.996 for without-land-calibration, and 1.069 for with-land-calibration), while RATIO 2 is now around 1.2, giving a slight impression of "over-valuation."

4.2   The Role of Corporate Debt

In section 3.3 we suggested that incorporating intangible capital into a neoclassical model cannot explain the stock price surge in the late 1980s. Our estimate of the fundamental value of intangible capital even declined toward the end of the 1980s from the level in the early 1980s. Regarding the stock price surge during the so-called "bubble-period," previous studies using micro-data, such as Hoshi and Kashyap (1990) and Hayashi and Inoue (1991), showed that pricing in stock markets was correct both during the pre-bubble period and the bubble era. They suggested that the reason for this was the fact that the stock price surge during the late 1980s was cancelled out by the price surge in land capital (namely, the increase in the fundamental value of tangible capital). However, these studies left an open question as to why the land price increased so much.

Recently, Alpanda (2010) has opened a new window to understanding the movement of Japanese land prices in a framework of neoclassical growth model akin to MP. He introduces the role of corporate bonds, and corporations issued land collateralized debt to reduce their tax liabilities. The government follows a land taxation policy that is countercyclical to land prices. With these features, the collateral use of land and countercyclical land tax policy introduce a substantial magnification mechanism for asset prices. The movement of land prices can be partly but successfully explained by the model. The framework of MP abstracts from the role of corporate debts and from the tax shelter role of the land collateralization. We find that the movement of intangibles does not explain the stock price surge. A natural extension of the present framework would be to introduce corporate debts and the collateral use of land into the framework of MP to explain the Japanese stock price movement throughout the 1980s.

---

[33]See Alpanda (2010) for the derivation of τ'_{dist}.

4.3   A Sensitivity Issue

In the above analysis, real interest rates were calibrated with the assumption that β is around 0.9693. Importantly, this assumption on the subjective discount factor provided values of $i - \gamma - \eta$ nearly twice as large as those used in MP. We think that our choice of β is innocuous, since it is the model-consistent variable using the method in Hayashi and Prescott (2002). Also, Chen et al. (2006) and Braun et al. (2009) show that real interest rates were higher in Japan than in the United States during the 1980s.

Nevertheless, it will be useful to provide a sensitivity test on the choice of the subjective discount factor, or equivalently, of the real interest rate. Here we provide additional results for RATIO estimation, using two different sources of the real interest rates, (i) a time series of the real interest rate calibrated from SNA information using the method in McGrattan and Prescott (2004), and (ii) the real interest rate from an external source. Regarding (i), we constructed the productivity of capital by dividing after-tax capital income by the stock of tangible capital for the private non-financial sector in the SNA. We obtain that the real interest rate is around 0.0615 for 1981–1989. With respect to (ii), we refer to the long term prime interest rate for city banks in the Bank of Japan Website, and to the CPI inflation rate. We calculate that the real interest rate is around 0.0548.

When we use the real interest of 0.0615, we obtain that K_u is around 2.962 times the GDP level for 1981–1989. The figure provides RATIO 1 and RATIO 2 around 0.35, suggesting an excessive under-valuation in the stock markets. Also, when we use the real interest of 0.0548, we obtain that K_u is as high as 13 times the GDP level. A severe undervaluation results from the estimated level of intangible capital. However, these estimates of K_u are not reliable in terms of comparison with the estimate of K_m, in terms of international comparisons with the U.S. and U.K. cases, and in terms of direct evidence of intangible capital from Fukao et al. (2009). Consequently, our preference is for employing the subjective discount factor calibrated with the method of Hayashi and Prescott (2002) for the study of Japanese stock market valuations.

5   Conclusion

Employing the methodology developed by McGrattan and Prescott (2005), we examined Japanese stock market phenomena in the 1980s and 1990s using a micro data set from the Corporate Financial Databank. When we consider the fundamental value of intangible capital, our estimates of the ratio of corporate market value to the predicted fundamental value falls within a reasonable range of around one, for the periods of 1981-1986 and 1993-1997. This finding contrasts with previous studies of Japanese stock. Hoshi and Kashyap (1990) and Hayashi and Inoue (1991) reported estimates of textbook Tobin's average q of 1.56 and 1.25 for the early 1980s, suggesting that the stock market over-valued corporations relative to their fundamental values. On the other hand, using data from the SNA, Ando (2002) and Ando et al. (2003) argued that the Japanese stock markets undervalued the corporate capital stocks. For example, Ando et al. (2003) calculated that for the consolidated corporate sector, traditional Tobin's average q was 0.32 in l980.

We show that the previous result from micro data of *overvaluation* is due to neglecting intangible capital, which is now considered an important component of an economy's

capital stock. We also show that the previous result from aggregate SNA data of *un-dervaluation* probably reflects errors in measurement of the actual value of smaller and non-traded corporations. In this paper, we examined a new data set (Corporate Financial Databank) with which we constructed aggregate variables such as capital stocks and actual corporate values in a precise manner. Using that dataset, we showed that if we do not take into account intangible capital, the actual market value of traded corporations seems to *overshoot* the fundamental value of corporations.

We also find that incorporating intangible capital into a neoclassical model cannot explain the stock price surge in the late 1980s. Our estimate of the fundamental value of intangible capital even declined toward the end of the 1980s from its level in the early 1980s, which goes in the opposite direction of the increase in the actual market value of corporations. Regarding the stock price surge during the so-called "bubble-period," Hoshi and Kashyap (1990) and Hayashi and Inoue (1991) argued that pricing in stock markets was correct both during the pre-bubble period and the bubble era. They suggested that the reason for this was that the stock price surge during the late 1980s was cancelled out by the price surge in land capital (namely, the increase in the fundamental value of tangible capital). These studies, however, left an open question as to why the land price increased so much. A recent study by Alpanda (2010) has suggested an approach to solve the question. A natural extension of the present framework would be to introduce corporate debts and the collateral use of land as in Alpanda (2010) into the framework of McGrattan and Prescott (2005) to explain the Japanese stock price movements throughout the 1980s and the 1990s.

6   Appendix

This appendix is a reproduction of Section 3 of McGrattan and Prescott (2005) for readers' reference. The economy consists of two sectors; corporate sector denoted as 1 and non-corporate sector denoted as 2. The population in period t is denoted by N_t and grows at rate η, so $N_{t+1} = (1 + \eta)N_t$. The stand-in household's preferences are ordered by

$$(7) \qquad \sum_{t=0}^{\infty} \beta^t U(c_t, n_t) N_t$$

where c and n are *per capita* consumption and labor supply, respectively. The tangible capital inputs are measured and are denoted by k_{jm} for sector j. The intangible capital input in sector 1 is not measured and is denoted by k_{1u}. Note that sector 2 has no intangible capital input.

The output of sector j is denoted by y_j. Sector outputs are combined to produce a composite good which is used for either private consumption or government consumption or for one of the categories of investment,

$$(8) \qquad c_t + g_t + x_{1m,t} + x_{1u,t} + x_{2m,t} \leq y_t = F(y_{1,t}, y_{2,t})$$

where g is government consumption, x_{jm} is gross investment in measured tangible capital in sector j, and $x_{1,u}$ is gross investment in unmeasured intangible capital in sector 1.

The technology of sector 1 is described by

$$(9) \qquad\qquad y_{1,t} \le f^c(k_{1m,t}, k_{1u,t}, z_t n_{1,t})$$

$$(10) \qquad\qquad k_{1m,t+1} = [(1 - \delta_{1m})k_{1m,t} + x_{1m,t}]/(1 + \eta)$$

$$(11) \qquad\qquad k_{1u,t+1} = [(1 - \delta_{1u})k_{1u,t} + x_{1u,t}]/(1 + \eta).$$

Similarly,

$$(12) \qquad\qquad y_{2,t} \le f^{nc}(k_{2m,t}, z_t n_{2,t})$$

$$(13) \qquad\qquad k_{2m,t+1} = [(1 - \delta_{2m})k_{2m,t} + x_{2m,t}]/(1 + \eta).$$

All technologies have constant returns to scale. In (9) and (12), n_j is labor services in sector j and the $\{z_t\}$ are technology parameters that grow at rate γ.

The life time budget constraint of households is written as

$$(14) \quad \sum_{t=0}^{\infty} p_t\{(1 + \tau_c)c_t + v_{1s,t}(s_{1,t+1} - s_{1,t}) + v_{2s,t}(s_{2,t+1} - s_{2,t}) + b_{t+1} - b_t\}$$

$$\le \sum_{t=0}^{\infty} p_t\{(1 - \tau_d)d_{1,t}s_{1,t} + d_{2,t}s_{2,t} + (1 - \tau_b)r_{b,t}b_t + (1 - \tau_n)w_t n_t + \psi_t\},$$

where τ_c is the consumption tax rate, τ_d is the corporate distributions tax rate, τ_b is the capital tax rate, and τ_n is the labor income tax rate.

The value of shares held in corporate and non-corporate firms are $v_{1s,t}s_{1,t}$ and $v_{2s,t}s_2, t$, respectively, where v is the price and s is the number of shares held. The total number of shares outstanding is normalized to one in each sector. Government bonds are also held and denoted by b. The interest rate earned on these bonds is r_b. Transfers of the government are denoted by ψ.

The distributions paid to households are equal to what firms have after making new investments, paying wages, paying taxes, and receiving subsidies:

$$(15) \quad d_{1,t} = p_{1,t}y_{1,t} - x_{1m,t} - x_{1u,t} - w_t n_{1,t} - \tau_{1k}k_{1m,t}$$
$$- \tau_1[p_{1,t}y_{1,t} - \hat{\delta}_{1m}\hat{k}_{1m,t} - \hat{\delta}_{1x}x_{1m,t} - x_{1u,t} - w_t n_{1,t} - \tau_{1k}k_{1m,t}] + \tau_x x_{1m,t}$$

$$(16) \quad d_{2,t} = p_{2,t}y_{2,t} - x_{2m,t} - w_t n_{2,t} - \tau_{2k}k_{2m,t}$$
$$- \tau_2[p_{2,t}y_{2,t} - \hat{\delta}_{2m}\hat{k}_{2m,t} - \hat{\delta}_{2x}x_{2m,t} - w_t n_{2,t} - \tau_{2k}k_{2m,t}] + \tau_x x_{2m,t}$$

where p_j is the price of goods in sector j, w is the wage rate, τ_{jk} is the tax rate on property in sector j, τ_j is the tax rate on income in sector j, and τ_x is the investment tax credit. The term $\hat{\delta}_{1m}\hat{k}_{1m,t} + \hat{\delta}_{1x}x_{1m,t}$ is the allowed depreciation on tangible capital in sector j and is used to compute taxable income. The depreciation rates δ_{jm} and δ_{jx} are policy parameters that can be set to effectively lower the price on new capital, as in the cases of U.S. and U.K.. The rate $\hat{\delta}_{jm}$ is the allowed rate of depreciation on sector-j book "capital", which has a law of motion,

$$(17) \qquad \hat{k}_{jm,t+1} = [(1 - \hat{\delta}_{jm})\hat{k}_{jm,t} + (1 - \hat{\delta}_{jx})x_{jm,t}]/[(1 + \eta)(1 + \pi)].$$

The rate $\hat{\delta}_{jx}$ is the allowed rate of immediate expensing of investment in sector j.

In equilibrium, firms in the corporate sector choose capital and labor to solve

$$(18) \qquad \max \sum_{t=0}^{\infty} p_t d_{1,t}(1 - \tau_d)$$

subject to constraints (9)-(11) and (17) for $j = 1$. Non-corporate firms solve a similar problem

$$(19) \qquad \max \sum_{t=0}^{\infty} p_t d_{2,t}$$

subject to constraints (12)-(13) and a constraint analogous to (17) for $j = 2$. Note that $d_{2,t}$ is non-corporate income net of taxes.

Government production is included in the non-corporate sector. Government purchases and transfers are financed by tax receipts and debt issues. The period t government budget constraint must be satisfied each period and is given by

$$(20) \qquad g_t + \psi_t + r_b b_t = b_{t+1} - b_t + \text{all tax receipts.}$$

Note that all tax rates are proportional in the model economy.

We now derive a estimation formula for the equilibrium value of corporate equity.

Formula 1 (Proposition 4 in MP) *On a balanced-growth path, the total value of corporate equity, $V_t \equiv v_{1s,t} N_t$, satisfies*

$$(21) \qquad V_t = (1 - \tau_d)[(1 - \tau_x - \tau_\delta)K_{1m,t+1} + (1 - \tau_1)K_{1u,t+1}],$$

where

$$(22) \qquad \tau_\delta = \tau_1 \left[\hat{\delta}_{1x} + (1 - \hat{\delta}_{1x}) \left(\frac{\hat{\delta}_{1m}}{(i + \pi + \hat{\delta}_{1m})}\right) \left(\frac{(1 + \pi)(1 - \delta_{1m}) - 1 + \hat{\delta}_{1m}}{\gamma + \eta + \pi + \hat{\delta}_{1m}}\right)\right].$$

Here, second-order terms are dropped, i is real interest rate, and capital letters denote aggregates.

The value of intangible capital stock $K_{1u,t+1}$ is unmeasured and must be estimated. We follow the MP's indirect approach. Assuming equal after-tax returns to tangible and intangible assets, we obtain inferred stock of intangible capital.

Formula 2 Then, on a balanced-growth path, the total value of intangible capital stock, $K_{1u,t}$, satisfies

$$(23) \qquad K_{1u,t} = \frac{1}{i - \gamma - \eta}\Pi_{1,t} - \frac{i}{(1 - \tau_1)(\gamma + \eta + \delta_{1m})(i - \gamma - \eta)}X_{1m,t}.$$

where second-order terms are dropped, capital letters denote aggregates, and $\Pi_{1,t}$ is aggregate profit in corporate sector. This equilibrium relation is derived from the definition of corporate profits as

$$(24) \qquad \text{Profit}_t = p_{1,t}y_{1,t} - w_t n_{1,t} - \delta_{1m}k_{1m,t} - \tau_{1k}k_{1m,t} - x_{1u,t}.$$

References

ALPANDA, S. (2010): "Taxation, Collateral Use of Land and Japanese Asset Prices," Tech. rep.

ANDO, A. (2002): "Missing Household Saving and Valuation of Corporations: Inquiry into Japanese National Accounts I," *Journal of the Japanese and International Economies*, 16, 147–176.

ANDO, A., D. CHRISTELIS, AND T. MIYAGAWA (2003): "Inefficiency of Corporate Investment and Distortion of Savings Behavior in Japan," in *Structural Impediments to Growth in Japan*, ed. by M. Blomstrom, J. Corbett, F. Hayashi, and A. Kashyap, Chicago: University of Chicago Press, 155–190.

BRAUN, R. A., D. IKEDA, AND D. H. JOINES (2009): "Saving and interest rates in Japan: Why they have fallen and why they will remain low," *International Economic Review*, 50, 291–321.

CHEN, K., A. IMROHOROGLU, AND S. IMROHOROGLU (2006): "The Japanese Saving Rate," *American Economic Review*, 96, 1850–1858.

CORRADO, C. AND C. HULTEN (2010): "How Do You Measure a "Technological Revolution"?" *American Economic Review*, 100, 99–104.

CORRADO, C. A., C. HULTEN, AND D. SICHEL (2009): "Intangible Capital and U.S. Economic Growth," *Review of Income and Wealth*, 55, 661–685.

CORRADO, C. A., C. R. HULTEN, AND D. E. SICHEL (2006): "Intangible Capital and Economic Growth," NBER Working Papers 11948, National Bureau of Economic Research, Inc.

FUKAO, K., T. MIYAGAWA, K. MUKAI, Y. SHINODA, AND K. TONOGI (2009): "Intangible Investment In Japan: Measurement And Contribution To Economic Growth," *Review of Income and Wealth*, 55, 717–736.

FUKUTA, Y. (2002): "A test for rational bubbles in stock prices," *Empirical Economics*, 27, 587–600.

HAYASHI, F. (2006): "The Over-Investment Hypothesis," in *Long-Run Growth and Short-Run Stabilization: Essays in Memory of Albert Ando*, ed. by L. R. Klein, Cheltenham: Edward Elgar Publishing.

HAYASHI, F. AND T. INOUE (1991): "The Relation between Firm Growth and q with Multiple Capital Goods: Theory and Evidence from Panel Data on Japanese Firms," *Econometrica*, 59, 731–53.

HAYASHI, F. AND E. C. PRESCOTT (2002): "The 1990s in Japan: A Lost Decade," *Review of Economic Dynamics*, 5, 206–235.

HORI, K., M. SAITO, AND K. ANDO (2006): "What Caused Fixed Investment to Stagnate During the 1990s in Japan? Evidence from Panel Data of Listed Companies," *The Japanese Economic Review*, 57, 283–306.

HOSHI, T. AND A. K. KASHYAP (1990): "Evidence on q and Investment for Japanese Firms," *Journal of the Japanese and International Economies*, 4, 371–400.

ISHI, H. (2001): *The Japanese Tax System*, New York: Oxford University Press.

ITO, T. AND T. IWAISAKO (1995): "Explaining Asset Bubbles in Japan," NBER Working Papers 5358, National Bureau of Economic Research, Inc.

MARRANO, M. G., J. HASKEL, AND G. WALLIS (2009): "What Happened To The Knowledge Economy? Ict, Intangible Investment, And Britain'S Productivity Record Revisited," *Review of Income and Wealth*, 55, 686–716.

MCGRATTAN, E. R. AND E. C. PRESCOTT (2000): "Is the Stock Market Overvalued?" *Quarterly Review, Federal Reserve Bank of Minneapolis*, 20–40.

——— (2004): "The 1929 Stock Market: Irving Fisher Was Right," *International Economic Review*, 45, 991–1009.

——— (2005): "Taxes, Regulations, and the Value of U.S. and U.K. Corporations," *Review of Economic Studies*, 72, 767–796.

——— (2010a): "Technology Capital and the U.S. Current Account," *American Economic Review*.

——— (2010b): "Unmeasured Investment and the Puzzling U.S. Boom in the 1990s," *American Economic Journal: Macroeconomics*.

NAKAJIMA, T. (2008): "Asset Price Fluctuations in Japan: 1980-2000," *Japan and the World Economy*, 20, 129–153.

NOMURA, K. (2004): *The Measurement of Capital*, Tokyo: Keio-Gijuku-Daigaku-Shuppan (in Japanese).

OGAWA, K. AND S. KITASAKA (1998): *Capital Markets and Business Cycles: An Empirical Analysis of the Modern Japanese Economy*, Tokyo: Nihon-Keizai-Shimbun-Sha (in Japanese).

——— (1999): "Market Valuation and the q Theory of Investment," *Japanese Economic Review*, 50, 191–211.

# Figure 1: Net Debt and Stock Value Movements in the CFD
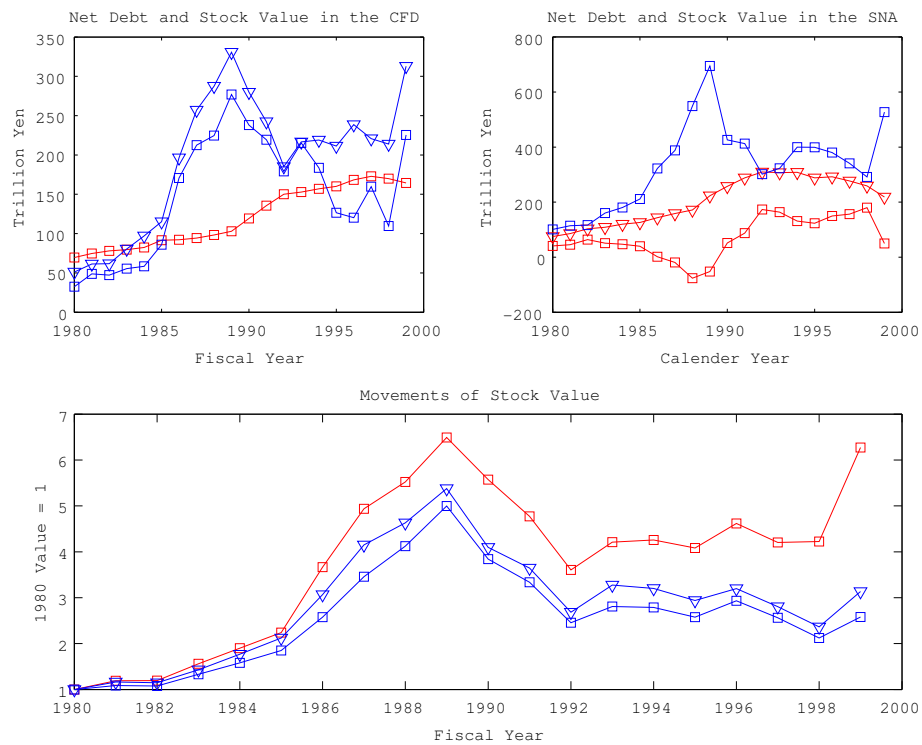
Top left; The red line shows the movement of net debt. The blue lines show the movements of actual stock values net of the value of cross holding share. The blue line with triangle dots shows the case in which the value of cross holding share is estimated using information on the proportion of shares owned by non-financial corporations, while the blue line with square dots depicts the case in which the value of cross holding share is estimated using the method of Hayashi and Inoue (1991). *Top right;* The red line with square dots shows the movement of net debt from the SNA. The red line with triangle dots shows the movement of net debt from the SNA, but the value of stock holdings is subtracted from the value of financial assets. The blue line shows the movement of stock holdings. *Bottom;* The red lines shows the movement of total actual value of outstanding equity from the CFD. We do not exclude the value of cross-holding shares. The blue line with square dots shows the movement of Nikkei 225, and the blue line with triangle dots is for TOPIX. They are normalized to one for 1980 values.

Figure 2: The Conversions of the CFD Book-Value Entries into the Market-Value Entries
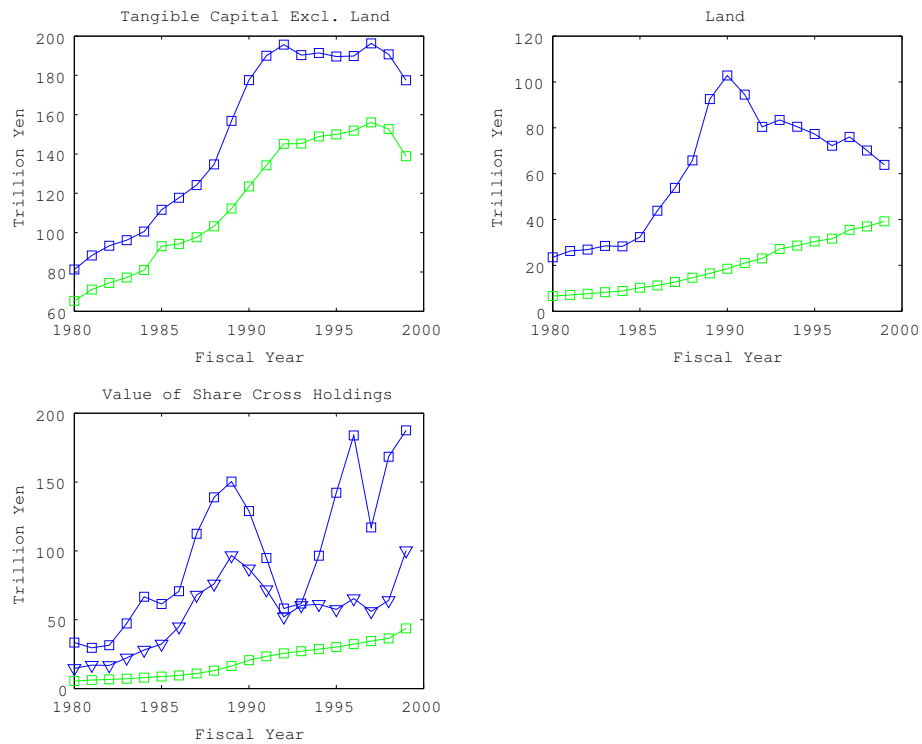

Note: Blue lines are for the movements of aggregates in market-value basis. Green lines depict the movements of aggregates in book-value basis. *Bottom left;* The blue line with square dots shows the case in which we estimate the market value of cross-holding shares by the method of Hayashi and Inoue (1991), while the blue line with triangle dots shows the case in which the value of cross holding share is estimated using information on the proportion of shares owned by non-financial corporations.

Figure 3: The difference in Coverage between the CFD, the SNA, and the FSSCI
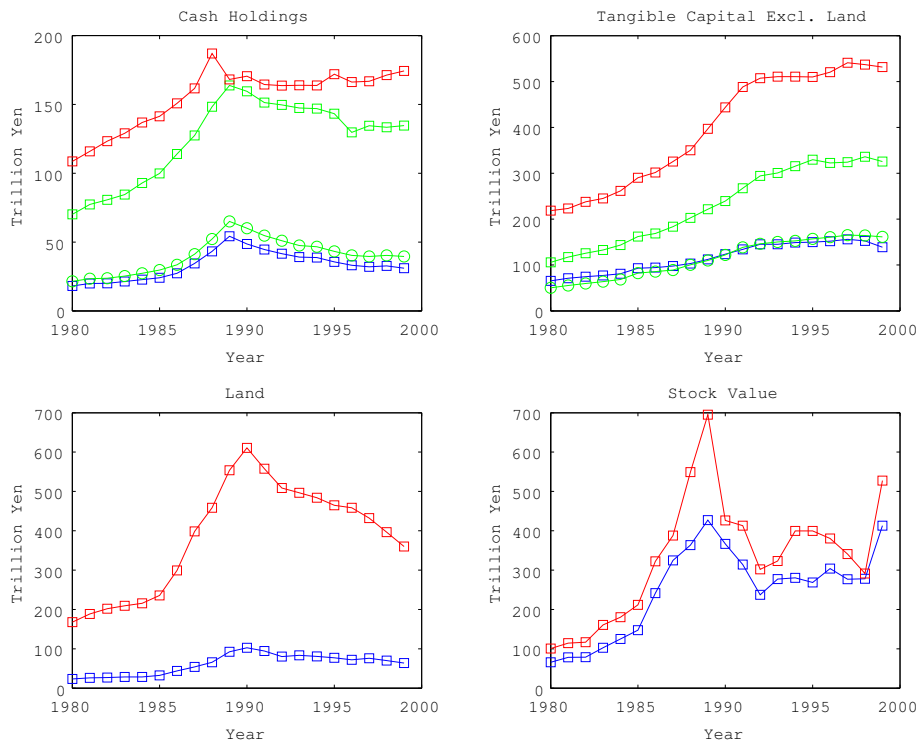
Note: Red lines show variables from the SNA, the blue lines show variables from the CFD, the green lines with square dots are the variables for the FSSCI (all corporations), and the green lines with round dots are the variables for the FSSCI (corporations with net worth greater than one billion yen). The SNA data variables are in an end-of-calendar-year basis, and the other variables are in fiscal year basis.

Figure 4: Capital-Output Ratio in Japan
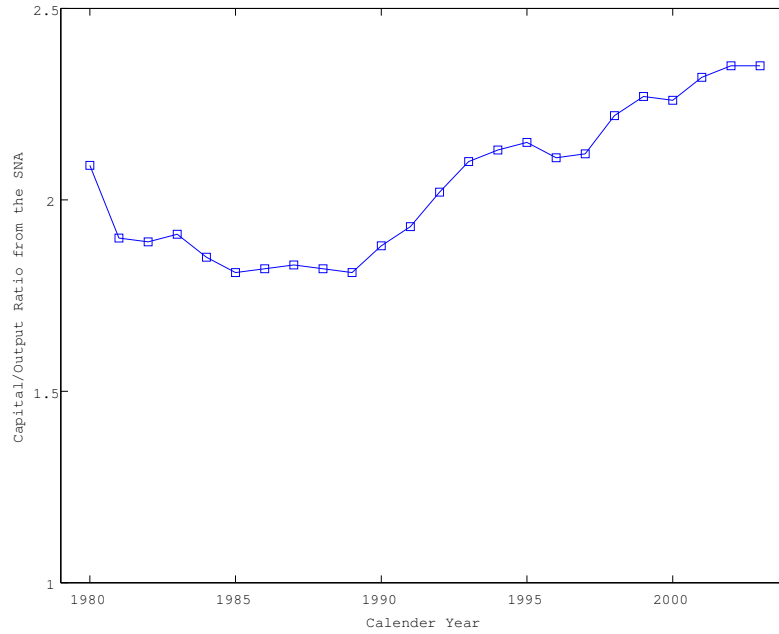
Note: The figure shows the capital-output ratio for Japan following the method of Hayashi and Prescott (2002) using 93SNA data.

Figure 5: Prices of Tangible and Intangible Capital
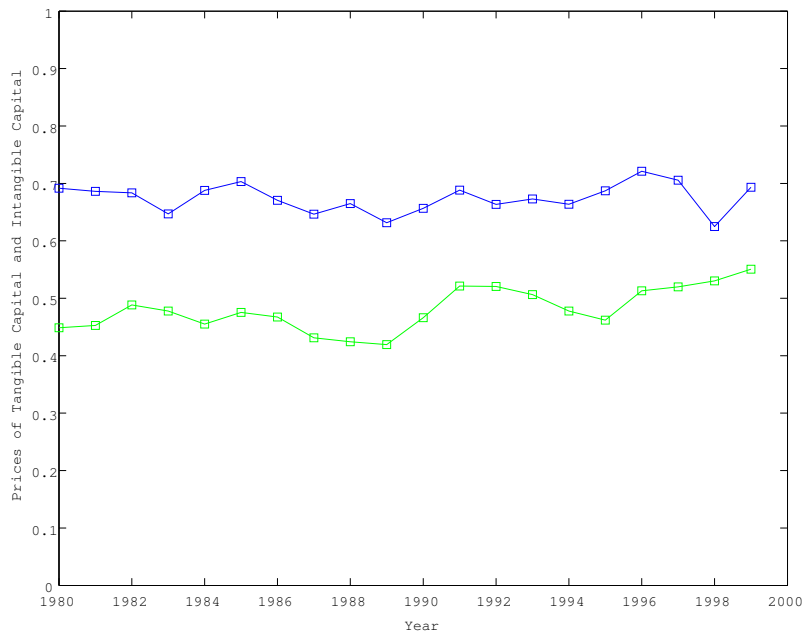
Note: The blue line shows the movement of the price of tangible capital, $(1 - \tau_{dist})(1 - \tau_x - \tau_\delta)$. The green line shows the movement of the price of intangible capital, $(1 - \tau_{dist})(1 - \tau_{corp})$.

Table 1: Estimating Intangible Capital using the MP method

	(1)	(2)	(3)	(4)	(5)	(6)
Country		JPN		JPN	US	UK
Coverage	Traded non-financial corporations			P. N. F.[a]	Whole	Whole
Period	1981-1989	1981-1986	1987-1989	1981-1989	1990-2001	1990-2001
Data	CFD			SNA	NIPA/BEA	
Corporate tax rate τ_{corp}	0.413	0.405	0.428	0.413	0.349	
Growth of real GDP $\gamma + \eta$	0.052	0.049	0.059	0.052	0.03	
Real interest rate i	0.077	0.074	0.083	0.077	0.041	
Tangible depreciation rate δ_m	0.057	0.057	0.058	0.057	0.067	
Average corporate investment* X_m	0.080	0.077	0.084	0.169	0.097	
Contributions to domestic pre-tax profits*						
Tangible assets $iX_m/[(1-\tau_{corp})(\gamma+\eta+\delta_m)]$	0.095	0.091	0.104	0.203	0.063	
Intangible assets $(i-\gamma-\eta)K_u$	0.008	0.010	0.005	-0.066	0.007	
Total II	0.104	0.102	0.108	0.136	0.07	
Estimate of intangible capital* K_u	0.343	0.407	0.192	-2.699	0.65	0.51[b]
Domestic tangible capital* K_m	0.486	0.451	0.555	1.836	1.03	1.45
Estimate of intangible capital from the CHS method[c]		0.28[d]			0.375	0.340[e]

[a]The private non-financial corporation sector in the SNA.

[b]With lack of information for consistent time series of after-tax profits, tangible capital, growth rates, and depreciation rates, MP estimated K_u for the U.K., using the ratio of U.K. to U.S. investments in R&D as the ratio of the intangible capital stocks to the U.S. economy.

[c]See Corrado et al. (2009) for technical details.

[d]For this figure, the coverage of corporations is adjusted to that of the CFD. For the whole economy, Fukao et al. (2009) reports that intangible capital stock is 0.336 times the GDP level for 1985-1989.

[e]Marrano et al. (2009) report real investment on intangible capital for the whole sector excluding for the government sector. When they take the ratio of intangible capital stock to output, they use *market sector gross value added* as a proxy of output. Hence, the ratio can be used for direct comparisons with U.S. evidence by Corrado et al. (2009) who estimated the whole sector stock of intangible capital.

*These values are relative to GDP

Table 2: Predicted and Actual Corporate Values and RATIO (CFD)

JPN values	Without land			With land		
	1981-1986	1987-1989	1993-1997	1981-1986	1987-1989	1993-1997
Corporate tax rate	0.405	0.428	0.392	0.405	0.428	0.392
Tax on distributions	0.211	0.257	0.185	0.211	0.257	0.185
Investment subsidy rate	0.009	0.008	0.007	0.009	0.008	0.007
Tax credit due to depreciation allowance	0.112	0.106	0.133	0.077	0.057	0.094
Estimate of intangible capital*	0.407	0.192	0.343[a]	0.407	0.192	0.343[a]
Price of intangible capital	0.469	0.425	0.496	0.469	0.425	0.496
Fundamental value of intangible capital*	0.191	0.082	0.170	0.191	0.082	0.170
Tangible capital*	0.346	0.369	0.390	0.451	0.555	0.548
Price of tangible capital	0.693	0.659	0.701	0.721	0.695	0.733
Fundamental value of tangible capital*	0.240	0.243	0.273	0.325	0.386	0.402
Fundamental value of foreign capital*	0.011	0.011	0.037	0.011	0.011	0.037
Total fundamental value*	0.442	0.336	0.480	0.527	0.479	0.609
Actual market values 1[b]	0.376	0.642	0.439	0.481	0.828	0.598
Actual market values 2[c]	0.458	0.785	0.561	0.563	0.972	0.719
RATIO 1[b]	0.850	1.910	0.916	0.912	1.730	0.983
RATIO 2[c]	1.035	2.337	1.168	1.067	2.029	1.182
Ando's RATIO from the CFD	1.566	2.643	1.608	1.478	2.147	1.488

[a]This table is borrowed from the estimate of intangible capital for the 80s.

[b]The market value of affiliates' shares estimated using the method in Hayashi and Inoue (1991).

[c]The market value of affiliates' shares estimated using the CFD information.

*These values are relative to GDP