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Indian Equity Markets: Measures of Fundamental Value*

In this paper, we take a critical look at the relationship between the value of capital stock in the Indian corporate sector and the valuation of claims to this capital stock in capital markets. We address the question of whether Indian equity valuations over the period 1991–2008 are consistent with three key market fundamentals: corporate capital stock, after tax corporate cash flows, and net corporate debt. Our analysis extends the neo-classical growth model to include intangible capital and key features of the tax code. Unlike the standard partial equilibrium valuation framework, our paradigm allows us to explicitly capture the interaction between the growth in per capita consumption and interest rates, which fundamentally changes the role of the present value of growth opportunities in explaining a run up in equity prices. In a general equilibrium model with production, growth per se will not increase the value of equity relative to GDP. A second advantage is that it allows us to examine dividends and stock prices relative to GDP. These series are themselves non-stationary; however, they appear to be co-integrated with GDP. Examining these aggregate values relative to GDP induces stationarity and is a natural normalization that eliminates the need for adjustments due to inflation. Finally, it provides a framework to evaluate policy changes such as altering dividend taxation on stock prices.

We specify the price per share of corporate equity as a function of tax rates and capital stocks and define an equilibrium relationship between the market value of equity and the reproduction value of the tangible and

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intangible capital, to which the equity represents claim. Next, we estimate the intangible capital stock in India and use this to develop estimates for equilibrium equity valuations. The challenge in estimating equity valuation is that we do not have readily available measures for the intangible capital stock in India. We estimate this stock of intangible capital for the two periods 1991–2004 and 2005–2008 using three different techniques. We have chosen these periods to capture a structural break in the data. Indian equity valuations as a fraction of GDP were fairly constant over the period 1991–2004, rising sharply starting in 2005.

We begin by using the methodology in McGrattan and Prescott (2005). Next, we use the measures in Corrado et al. (2005) for the U.S. economy to infer the corresponding capital stock levels in India. We conclude by constructing our own measures using actual investment data for India.

The McGrattan and Prescott approach uses data on corporate profits and assumes that after-tax returns to both tangible and intangible capital are equal. This facilitates an estimate of the stock of intangible capital. An advantage of this approach is that it does not require any knowledge of the rate of depreciation of intangible capital. Corrado et al. (2006) provide estimates for the value of various forms of intangible capital in the U.S. based on investment data. Since we did not have access to a data set for India that details the investment in intangible capital for all the categories considered in Corrado et al., we tease out information from their data to estimate the stock of intangible capital in India. Working with investment data for innovative property and brand equity and assuming that depreciation rates for tangible capital are similar in the U.S. and India, we use the transformation rates for flows into stocks implied by their data for our estimation.

Further, using India-specific investment data on Innovative Property, which includes R&D and Technical knowledge and Brand Equity, we construct direct measures of the stock of these types of intangible capital and compare them with our earlier estimates derived using the Corrado et al. (2006) data. While these estimates for the intangible capital stock are similar to each other, they are lower than the estimates using the McGrattan–Prescott methodology. One reason is the high depreciation rates used by Corrado et al. (2006); another possibility is that organizational capital, in particular investment in learning-by-doing, is probably underestimated in their analysis.

We relate the price earnings ratio and Tobin's q , defined as the ratio of the market value of equity and net debt to tangible capital at replacement cost, to the quantities identified in our model formulation. In the absence of intangible

capital, the equilibrium value of q is 1. Unfortunately, in an economy with changing tax rates and significant intangible capital the usefulness of q_t is limited. In a setting with corporate taxes, distribution taxes (that is, taxes on dividends and capital gains) and subsidies to investment (for example, investment tax credits) not only is its equilibrium value not 1, but it is significantly impacted by changes in the tax code, particularly those changes in the tax rates on corporate distributions which have varied considerably in India from year to year. Thus q_t may differ from 1 either because of over or undervaluation in capital markets or simply as a result of changes in the tax rates—the ratio per se does not distinguish between the two.

A measure closely related to q is the price earnings (P/E) ratio—the ratio of the stock price to earnings per share, or in the aggregate the value of equity normalized by its after-tax corporate profits. We parse its mechanics and usefulness for Indian equity markets and conclude that both q and P/E ratios, which implicitly abstract from tax rates and intangible capital, offer inadequate measures of under and over valuation of capital markets. In particular, for economies with sizable secular growth in intangible capital, as has been observed in India over the last 15–20 years, these metrics offer limited analytical utility.

Our analysis suggests that an optimistic estimate of the fundamental value of the current Indian equity market is about 1.2, considerably lower than the 1.6 value observed in 2008. One effect that we have not accounted for is demand from foreign institutional investors. If the effect of this is to change the marginal investor, the relevant marginal rate of substitution will change, and with it valuations as well. These are issues that we plan to pursue in subsequent research.

Introduction

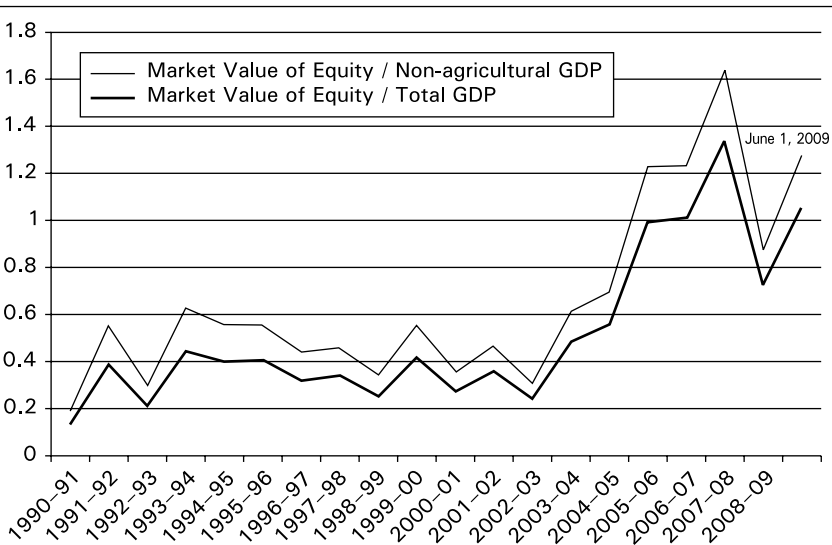
Indian equity markets had their inception in the early 1830s with trading in shares of banks and cotton mills.¹ The first organized exchange—the Native Share and Stock Brokers' Association (forerunner of the Bombay Stock Exchange)—was established in 1887, making it the oldest in Asia (Bajpai, 2004). By India's independence in 1947, the number of exchanges

1. The market experienced its first crash in 1865. The run up in stock prices prior to the crash was a consequence of the increased demand for Indian cotton precipitated by the disruption of cotton supplies from America due to the American Civil War.

had increased to seven and the market capitalization of listed companies was approximately Rs 10 billion (0.11 GDP).² In the subsequent forty odd years, however, equity markets languished, and by 1990, although market capitalization of equity had increased to Rs 697.16 billion in nominal terms, its relative value was only 0.135 GDP (Figure 1).

Following economic reforms instituted after the balance of payments crisis in 1991, equity valuations increased sharply. By 1993, equity values had risen to about 0.4 GDP and remained at approximately that level for almost 12 years.³ Beginning in 2005, Indian equities went through a period of exponential growth culminating in a peak value of Rs 67.46 trillion (1.56 GDP) in early 2008. This propelled India into the “trillion-dollar club”

FIGURE 1. Market Value of Equity / GDP



Source: Market Value of Equity is for the CMIE COSPI set. GDP data is from National Accounts.
 Note: The top line plots market value of equity as a multiple of non-agricultural GDP. The bottom line plots market value of equity as a multiple of GDP.

2. In the section “An Equilibrium Valuation Model,” we argue that in case of India, a more accurate representation is obtained if we normalize valuations with respect to non-agricultural GDP (NAGDP) rather than GDP.

3. Since real GDP growth over this period was 8 percent a year, the near constancy of the market value of equity/GDP ratio implies that equity markets also appreciated at this rate, doubling every 9 years.

and the Bombay Stock Exchange (BSE) became a “top ten” exchange in terms of market capitalization. However, by the end of 2008, Indian equity valuations had dropped to around 0.83 GDP and by March 2009 even further to 0.7 GDP. India had exited the “trillion-dollar club”.⁴

These large swings in equity valuation were not limited to India alone. Starting in the mid-90s, there was a considerable increase in U.S. equity prices to an extent that prompted then Federal Reserve Chairman, Alan Greenspan, to characterize the run up as “irrational exuberance”.

These dramatic changes in valuation suggest the possibility that at least part of this fluctuation was a response to changes in determinants other than the underlying factors of production or technology. Largely as a consequence of this run up, the possibility of departures of stock price valuations from “equilibrium or fundamental values” has gained center stage in academic research. In the 1970s and 1980s, the halcyon days of the efficient market hypothesis, the prevailing paradigm was that stock prices were an unbiased estimate of some underlying “fundamental” or “intrinsic” value. If at any point in time, the observed price of an asset is a fair indicator of its intrinsic worth, over and undervaluation become meaningless constructs. What these underlying fundamental values actually were, was left unspecified and for good reason: there was no explicit theoretical framework linking the value of the capital stock to prices of claims to this capital stock—debt and equity—prevailing in the capital markets.⁵ The first models (Prescott and Mehra, 1980; Brock, 1982; Donaldson and Mehra, 1984; Cox et al., 1985) to make these connections appeared in the early 1980s; however, they were ill suited to the task of quantifying over and undervaluation in capital markets, as they abstracted from two key ingredients: intangible capital⁶ and taxes. The equilibrium conditions in these models required that the value of the claims to the capital stock be equal to the tangible capital of the firm or, equivalently, that their ratio (Tobin’s q) be 1. This was not empirically observed; together with the models’ inability to address the equity premium

4. By early June 2009, the market capitalization of Indian equities was again USD 1 trillion.

5. See Bosworth (1975) for an early empirical study linking stock prices to economic activity.

6. Unlike tangible capital, intangible capital cannot be measured directly: it includes brand names, scientific and technical knowledge, patents, and organizational capital. As an example, consider the difference between owning a thousand trucks (tangible capital) and running a trucking company that owns a thousand trucks. The difference in the value of the trucking business and the thousand trucks is a measure of intangible capital. I thank Ajay Shah for this example.

puzzle, this cast doubt on the models' usefulness as measurement tools to provide a benchmark for capital markets valuations. In 2005, McGrattan and Prescott (2005) extended the standard growth model to incorporate both intangible capital and taxes. In doing so, they were able to account for the secular movements in the value of U.S. equity relative to GDP. The extended standard growth model can serve as a reference for over and undervaluation in capital markets. Their analysis highlights the importance of the role that intangible capital and distribution taxes play in explaining variations in equity valuation.

In this paper, we take a critical look at the relationship between the value of the capital stock in the Indian corporate sector and the valuation of claims to this capital stock in capital markets. We address the question of whether Indian equity valuations over the period 1991–2008 are consistent with three key market fundamentals: corporate capital stock, after tax corporate cash flows, and net corporate debt. Our analysis extends the neo-classical growth model⁷ to include intangible capital and key features of the tax code. This paradigm has several advantages. Unlike the standard partial equilibrium valuation framework,⁸ it allows us to capture explicitly the interaction between the growth in per capita consumption and interest rates. This interaction fundamentally changes the role of the present value of growth opportunities (PVGO) in explaining a run up in equity prices. In a general equilibrium model with production, growth per se will not increase the value of equity relative to GDP.⁹ A second advantage is that it allows us to examine dividends and stock prices relative to GDP. These series are themselves nonstationary; however, they appear to be co-integrated with GDP. Examining these aggregate values relative to GDP induces stationarity and is a natural normalization in this theoretical setting. It also eliminates the need for adjustments due to inflation. Finally, it provides a framework to evaluate policy changes such as the effect of changes in dividend taxation on stock prices.

7. This model and its stochastic variants are a central construct in contemporary finance, public finance, and business cycle theory. It is the basis for much of our economic intuition and has been used extensively by, among others, Abel et al. (1989), Auerbach and Kotlikoff (1987), Barro and Becker (1989), Brock (1979), Cox, Ingersoll and Ross (1985), Donaldson and Mehra (1984), Lucas (1988), Kydland and Prescott (1982), McGrattan and Prescott (2005) and Merton (1971).

8. See for example Fama and Miller (1972).

9. For an elaboration see Kiley (2004).

Although our framework is well suited to examining secular movements in the value of equity relative to GDP, it is not a suitable framework to address high frequency price movements in the stock market. In fact, we know of no framework that can satisfactorily account for these movements in terms of the underlying fundamentals. High frequency volatility remains a puzzle.¹⁰

This paper is organized as follows: in the second section, we derive an equilibrium relationship between the value of equity and net debt and the value of tangible and intangible corporate capital. Corporate tax rates and tax rates on distributions to equity and debt holders figure prominently in these relationships. We calibrate the economy in the third section. In the fourth section, using firm level investment data on intangible capital from CMIE, we estimate the intangible capital stock. In the fifth section, we use the relationships developed in the second section to obtain estimates of Indian equity valuation. In doing so, we are able to provide a theoretically grounded sense of market efficiency. In the next section, we take a critical look at two popular valuation metrics, Tobin's q and the price earnings (P/E) ratio and examine their appropriateness in light of the theory developed in the second section. The final section concludes the paper.

An Equilibrium Valuation Model

Overview

We extend standard growth theory by incorporating intangible capital and use it to value the Indian equity market.¹¹ Our model is similar to that

10. The “volatility puzzle” has its origins in the important early work of Shiller (1981) and LeRoy and Porter (1981), which found evidence of excessive volatility of stock prices relative to the underlying dividend/earnings process. These studies use a constant interest rate, an assumption subsequently relaxed by Grossman and Shiller (1981) who addressed the issue of varying interest rates. They concluded that although this reduced the excess volatility, Shiller's conclusion could not be overturned for reasonable values of the coefficient of relative risk aversion.

11. The importance of intangible capital, both for growth accounting and corporate valuation has received considerable attention. See papers by Bond and Cummins (2000), Corrado et al (2005), McGrattan and Prescott (2001 and 2005) and Hall et al. (2000) and Hall (2001) and the volume by Corrado et al. (2005). Bond and Cummins stress the importance of brand names for valuing corporations like Coca Cola. Hall stresses the importance of “e-capital,” for valuing high tech companies.

analysed by McGrattan and Prescott (2005) and our exposition closely follows their paper. One implication of the model is that the value of corporate equity and debt should be equal to the value of the productive assets in the corporate sector. The challenge is to find the value of these assets in terms of the consumption good. The table below classifies the components of corporate capital stock and the claims to this capital stock. In the model, in the absence of all taxes, the equilibrium relationship specifying the price of equity (p_t) and net debt (b_t) as a function of corporate capital stocks is

$$p_t + b_t = k_{m,t+1} + k_{u,t+1} \quad (1)$$

where $k_{m,t}$ and $k_{u,t}$ are, respectively, the tangible (measured) and intangible (unmeasured) capital stock.

TABLE 1. Basic Balance Sheet

<i>Corporate capital stock</i>	<i>Claims to corporate capital</i>
Tangible Capital k_m	Equity p
Fixed corporate capital	Net Debt b
Inventory stocks	
Corporate land	
Intangible Capital k_u	
Brand names	
Patents	
Organizational capital	

Source: Author.

In Table 1, capital stocks are measured or estimated in terms of their reproduction cost, while the values of debt and equity are market values. The empirical counterpart of tangible corporate capital is the sum of fixed corporate capital stocks, inventory stocks, and the value of corporate-owned land. Intangible capital includes brand names, patents, and forms of organizational capital. Intangible capital is not measured directly and as Indian National Accounts do not report its value, it must be estimated. One approach to estimate the value of intangible corporate assets is to attribute the return on capital used in the corporate sector to both tangible and intangible capital and assume that the after-tax returns to both types of capital are equal. We detail this and other estimation procedures in the fourth section.

Model Formulation

To derive an equilibrium relationship between the value of productive capital and the market value of corporations, we initially assume that all the firms are equity financed.¹² Following McGrattan and Prescott (2005), we also abstract from uncertainty, as it is an unimportant feature for our results. We take note of the findings in Bosworth et al. (2007) who point out the heterogeneity in the contribution of different sectors of the economy to India's growth rate. The large agriculture sector in India has a very low capital labor ratio and little of its capital is publicly traded. Since the focus of this paper is on capital valuation in securities markets, we exclude the agriculture sector from our analysis and only model the non-agricultural sector.¹³ One implication of our approach is that when we normalize capital valuations relative to GDP, we will use only the contribution to GDP of the non-agricultural sector (NAGDP). Within the non-agricultural sector, we introduce a dichotomy between workers and shareholders (Danthine et al., 2008; Mankiw and Zeldes, 1991). This distinction is particularly germane to the Indian context as workers generally do not hold equity either directly or indirectly and hence may have different future marginal rates of substitution compared to stockholders as their consumption growth rates may differ. In valuing equity, we use the marginal rates of substitution of the stockholders.

In light of the discussion above, we model the economy as one with two agents, workers and shareholders who take prices as given. There is also one firm that maximizes its value taking prices as given. These single entities, the workers, shareholders, and the firm are respectively "stand in" representatives of a continuum of such agents distributed on the unit interval. We abstract from population growth in the analysis below, as it does not change the valuation relation we derive but simplifies the notation and allows us to use per capita and aggregate quantities interchangeably. We will re-introduce it when we calibrate the model.¹⁴

12. We relax this assumption when we discuss our results.

13. Equivalently, the reader may view the Indian economy as being split into two disjoint sectors, one of them being the agriculture sector. For a balanced growth model with integrated agricultural, services and manufacturing sectors see Kongsamut et al. (2001). Their model features a rapidly declining agricultural sector which is beginning to be observed in India.

14. In the absence of intangible capital, tax rates and subsidies our model reduces to the standard decentralized growth model. Thus setting these quantities to zero in the fifth section gives us the equilibrium valuation implied by the standard model.

The Worker

The representative worker supplies labour (n_t^w) inelastically and consumes his aggregate wages ($w_t n_t^w$). The worker does not trade securities and thus does not borrow or save. He maximizes the present value of his present and future utility of consumption (c_t^w):

$$\max_{\{c_t^w, n_t^w\}} \sum_{t=0}^{\infty} \beta^t v(c_t^w)$$

subject to (P1)

$$c_t^w \leq w_t n_t^w \quad \text{and} \quad n_t^w \leq 1$$

The solution to this problem is $c_t^w = w_t$ and $n_t^w = 1$ since there is no presumed disutility of work.

The Shareholder

The shareholder owns all the securities (z_t) in the economy and consumes the aggregate dividends (d_t). There is one perfectly divisible equity share outstanding. Shareholders do not supply any labor. The representative shareholder also maximizes the present value of his utility of consumption (c_t^s):

$$\max_{\{c_t^s, z_t\}} \sum_{t=0}^{\infty} \beta^t u(c_t^s)$$

subject to (P2)

$$c_t^s + p_t z_{t+1} \leq (p_t + d_t(1 - \tau_d))z_t + \pi_t \quad \text{and} \quad 0 \leq z_t \leq 1$$

where p_t is the price per share, τ_d is the tax on dividends or share buy backs and π_t is the value of taxes rebated back to the shareholder in lump sum form. The budget of shareholder specifies that his consumption plus the value of shares that he carries over to the next period be less than or equal to the value of the portfolio at the beginning of the period plus government transfers.

The Firm

The firm uses labor and capital (tangible and intangible) to produce output y_t . It is characterized by a constant returns to scale production function $y_t = f(k_{m,t}, k_{u,t}, \lambda_t n_t^f)$ with productivity growth rate γ so that

$$\lambda_{t+1} = (1 + \gamma) \lambda_t$$

Firms act competitively to maximize shareholder value using the marginal rate of substitution provided by the representative shareholder. It solves:

$$\max_{\{x_{u,t}, x_{m,t}, n_t^f\}} p_t + d_t = \max_{\{x_{u,t}, x_{m,t}, n_t^f\}} \sum_{j=0}^{\infty} \frac{\beta^j u_1(c_{t+j}^s)}{u_1(c_t^s)} d_{t+j}$$

subject to (P3)

$$d_t = f(k_{m,t}, k_{u,t}, \lambda_t n_t^f) - w_t n_t^f - x_{m,t} - x_{u,t} - \text{taxes} + \text{subsidies}$$

$$k_{u,t+1} = (1 - \delta_u) k_{u,t} + x_{u,t}$$

$$k_{m,t+1} = (1 - \delta_m) k_{m,t} + x_{m,t}$$

$$\text{taxes} = \tau_c (f(k_{m,t}, k_{u,t}, \lambda_t n_t^f) - w_t n_t^f - k_{m,t} \delta_m - x_{u,t})$$

$$\text{Subsidies} = \tau_s x_{m,t}$$

where τ_s is the subsidy for investment in tangible capital (such as an investment tax credit), τ_c is the corporate tax rate, $x_{m,t}$ and $x_{u,t}$ represent tangible and intangible investment at time t and δ_u and δ_m are the depreciation rates for these capital stocks respectively. n_t^f is the per capita labor demanded by the firm.

In (P3) the first constraint defines the dividend as output net of wages, investments, taxes, and subsidies. The second and third are the standard laws of motion of capital stock, both tangible and intangible. The constraint on taxes recognizes that wages, intangible investment, and depreciation of tangible capital are tax-deductible expenses. The final constraint defines the subsidy to capital investment.

The rate of return, defined by the marginal rate of substitution of the stockholders in this economy, is:

$$1 + r_{t+1} = \frac{u_1(c_t^s)}{\beta u_1(c_{t+1}^s)}$$

Equilibrium in this economy is defined by per capita sequences of consumption (c_t^s, c_t^w), investment ($x_{m,t}, x_{u,t}$) and labor (n_t^w, n_t^f) that simultaneously satisfy:

- a) the necessary and sufficient first order conditions for the firm's problem

$$(1 + r_{t+1}) = \frac{(1 - \tau_c)[f_1(k_{m,t}, k_{u,t}, \lambda_t n_t^f) - d_m]}{(1 - \tau_s)} + 1 \quad (2)$$

$$(1 + r_{t+1}) = f_2(k_{m,t}, k_{u,t}, \lambda_t n_t^f) - d_u + 1 \quad (3)$$

$$w_t = f_3(k_{m,t}, k_{u,t}, \lambda_t n_t^f) \quad (4)$$

- b) the necessary and sufficient first order conditions for the shareholders problem:

$$u_t(c_t^s) p_t = \beta u_t(c_{t+1}^s)(p_{t+1} + d_{t+1}(1 - \tau_d)) \quad (5)$$

- c) market clearing conditions:

$$z_t = 1$$

$$n_t^w = n_t^f = 1$$

$$c_t^w + c_t^s = f(k_{m,t}, k_{u,t}, \lambda_t n_t^f) - x_{m,t} - x_{u,t} + \pi_t$$

where π_t = taxes – subsidies

Equations 2 and 3 equate the marginal return on tangible and intangible capital to the marginal rate of substitution of the shareholders while equation 4 defines the wage rate. It follows from (2), (3) and (5) that the equilibrium relation specifying the price per share of corporate equity as a function of tax rates and capital stocks is

$$p_t = (1 - \tau_d)[(1 - \tau_s)k_{m,t+1} + (1 - \tau_c)k_{u,t+1}] \quad (6)$$

which is also the total equity value.

Equation 6 represents the equilibrium, full information, rational valuation relationship between the market value of equity, and the reproduction value of the tangible and intangible capital, to which the equity represents claim. In the next section, we estimate the intangible capital stock in India and then use (6) in the fourth section to develop estimates for equilibrium equity valuations. In the fifth section, we will use (6) to evaluate the theoretical appropriateness of other commonly used valuation techniques.

Calibration

In the following analysis (Table 2), we have split the time period 1991–2008 into two sub-periods 1991–2004 and 2005–2008 since 2005 marked the beginning of a substantial run up in the equity markets.¹⁵

TABLE 2.

<i>Parameter</i>	<i>1991–2004</i>	<i>2005–2008</i>
Population Growth Rate of shareholders (ζ)	0.015	0.015
Growth Rate of Technology (γ)	0.052	0.088
Growth of Real NAGDP ($\gamma + \eta$)	0.067	0.103
Growth of Real Consumption (ν)	0.049	0.049
Estimated over the period 1991–2008		
Discount Factor (β)	0.96	0.96
Elasticity of Intertemporal Substitution (η)	0.33	0.33
Real Interest Rate Implied by Model Parameters (r_t)	0.141	0.141
Effective Corporate Tax Rate on PBDIT (τ_c)	0.098	0.159
Distribution Tax Rate (τ_d)	0.10	0.125
Investment Tax Credit (τ_s)	0	0
Growth of Real NAGDP ($\gamma + \zeta$)	0.067	0.103
Profits Before Interest and Taxes (CP)	0.156	0.192
Corporate Tangible Capital (k_m)	0.783	0.939

The parameters that need to be “calibrated” are those related to the shareholders $\{\beta, \zeta, u(\cdot)\}$; the firm $\{\delta_m, \gamma, x_m, k_m$ *after tax cash flows (CF)* $\}$ and the policy parameters $\{\tau_c, \tau_d, \tau_s\}$. Some of these parameters are well documented in the literature; others are not. Table 2 details the parameter values that we use for the Indian economy. We explain below the motivation for choosing these values.

We choose ζ to match the population growth of the shareholders. The population growth rate for this group we believe is lower than the general population growth rate (1.7 percent) or for the working age population (2 percent). We calibrate the growth rate of productivity γ by matching $\gamma + \zeta$ to the average real growth rate of output from the non-agricultural sector (NAGDP). As discussed earlier, we use this growth rate rather than

15. The theory that we have developed is meant to deal with low frequency movements in the underlying factors of production and technology and averaging over the 2005–08 period assumes that this trend will continue.

the growth rate of GDP as agriculture in India uses very little capital, and is likely to have a markedly different aggregate production function than the one that characterizes the non-agricultural sector. We choose $\beta = 0.96$ as it is a standard value for the discount factor in much of the macroeconomic literature. Our theory requires that the tax τ_c , be the effective tax rate faced by the suppliers of capital to the firm. Since interest payments are tax deductible this effective rate is much lower than the marginal corporate tax rate. Each year we estimate the effective corporate tax rate from data on corporate taxes paid and profits before interest and taxes and then take the appropriate averages: $\tau_c = \text{actual corporate taxes paid} / \text{profits before interest and taxes}$. We calibrate τ_d to the marginal tax rate. We note that the tax rate on dividends has changed frequently and we will revisit this issue when we discuss our results. We fix $\tau_s = 0$, as there is no investment tax credit in India. To calibrate the interest rate, we use Constant Relative Risk Aversion (CRRA) preferences with elasticity of intertemporal substitution $\eta = 1 / 3$ and calculate the marginal rate of substitution of the shareholders. We use the average growth rate of per capita of consumption over the entire period 1991–2008 for this calibration.

$$r \approx \frac{1}{\beta} + v / \zeta - 1$$

It is well known that the real interest rate implied by the growth model is counterfactually high in economies with high growth rates and this is probably the case in our model.¹⁶

We use data on net private stock of corporations to estimate k_m . It is expressed as a fraction of the non-agricultural output. We estimate the after tax cash flow to debt and equity holders (net of depreciation of tangible capital and investment in intangible capital), CF by making appropriate adjustments corporate profits before depreciation, interest, and taxes. It is also expressed relative to NAGDP. We assume that the economic depreciation rate is equal to the accounting depreciation rate, which averages 5 percent when measured relative to k_m . The depreciation rates allowed by the Indian tax code are far more generous; net of inflation they average to around 5 percent, which is what is reported in the Indian National Accounts.

16. High growth rates that characterize developing economies are unlikely to continue indefinitely and hence are not likely to be observed in steady state. For example, a growth rate of 6 percent implies a doubling in standard of living every twelve years compared to a doubling every thirty six years in the U.S.

Methodology for Estimating Intangible Capital Stock

The challenge in using the relationship developed in equation (6) for equity valuation is that we do not have readily available measures for the intangible capital stock in India. We estimate the intangible capital stock using three different techniques. We begin by using the methodology in McGrattan and Prescott (2005). Next, we use the measures in Corrado et al. (2005) for the U.S. economy to infer the corresponding capital stock levels in India. We conclude by constructing our own measures using actual investment data for India.

The McGrattan and Prescott Methodology

McGrattan and Prescott start by using data on corporate profits and assume that after-tax returns to both tangible and intangible capital are equal. This enables them to estimate the stock of intangible capital. An advantage of their approach is that it does not require knowledge of the rate of depreciation of intangible capital.

We illustrate their approach in a world without taxes. The accounting concept that corresponds to the model counterpart of pre tax corporate profits is profits before interest and taxes (PBIT) can be written as

$$PBIT = y_t - w_t n_t^f - x_{u,t} - \delta_m k_{m,t}$$

Using the first order conditions (2) and (3) and the fact that the production function displays constant returns to scale that is,

$$f_1(k_{m,t}, k_{u,t}, \lambda_t n_t^f) k_{m,t} + f_2(k_{m,t}, k_{u,t}, \lambda_t n_t^f) k_{u,t} + w_t n_t^f = y_t$$

we can re write (PBIT) as

$$PBIT = r_t k_{m,t} + (\delta_u + r_t) k_{u,t} - x_{u,t}$$

Finally using the fact that on a balanced growth path

$$x_{u,t} = (\gamma + \eta + \delta_u) k_{u,t}$$

$$PBIT = r_t k_{m,t} + (r_t - \gamma - \eta) k_{u,t}$$

In the presence of taxes this expression is modified to

$$PBIT = \frac{r_t}{1 - \tau_c} k_{m,t} + (r_t - \gamma - \eta) k_{u,t} \quad (7)$$

where we remind the reader that τ_c is defined as

$$\tau_c = \frac{\text{corporate taxes paid}}{\text{PBIT}}$$

It is the average tax rate on PBIT, not the marginal corporate tax rate.

The intangible capital stock can thus be estimated from equation (7) in terms of the observed parameters of the economy. We note that in deriving (7) we have assumed that the economy is (approximately) on a balanced growth trajectory, a condition that may not have been true in India in the early 1990s.

Using values in Table 2, we can estimate the average value of the intangible capital for the two periods 1991–2004 and 2005–2008. As mentioned earlier, we have chosen these periods to capture a structural break in 2005. Indian equity valuations as a fraction of GDP were fairly constant over the period 1991–2004, rising sharply starting in 2005. Our estimates are presented in Table 3.

TABLE 3. Average Values Measured as a Fraction of Non-agricultural GDP

	1991–2004	2005–2008
After Tax Cash Flows	0.1754	0.1991
Estimate of Intangible Capital	0.447	0.883

Alternative Estimates of Intangible Capital in India—1

Corrado et al. (2006) provide estimates for the value of various forms of intangible capital in the U.S. based on investment data. The investment data is presented in Table 4 below and the corresponding estimates of intangible capital in Table 5.

TABLE 4. Intangible Investment (U.S 2000–2003 annual average)

	Billions of dollars	Percentage of GDP
Intangible Investment	1226	11.19%
Computerized Information	173	1.58%
Innovative Property	468	4.27%
R&D (Scientific)	231	2.11%
Non-scientific	237	2.16%
Economic Competencies	586	5.35%
Brand equity	161	1.47%
Firm-specific resources	425	3.88%

Source: From Corrado et al (2006), Table 2.

TABLE 5. Estimate of Intangible Capital Stock (U.S 2003)

	<i>Billions of dollars</i>	<i>Percentage of GDP</i>
Intangible Capital Stock	3636	33.18%
Computerized Information	512	4.67%
Innovative Property	1786	16.30%
R&D (Scientific)	922	8.41%
Non-scientific	864	7.88%
Economic Competencies	1338	12.21%
Brand equity	272	2.48%
Firm-specific resources	1066	9.73%

Source: From Corrado et al (2006), Table 3.

Corrado et al. (2006) report that for the period 2000–03, the aggregate U.S. investment in intangible assets averaged 11.19 percent of GDP and estimate that these investment levels translate into a stock of intangible capital valued at 33.18 percent of GDP. As Tables A1 and A2 show (see the Appendix), due to differing depreciation rates the rate of transformation of investment flows into capital stock vary considerably.

Unfortunately, we do not have access to a data set for India that details the investment in intangible capital for all the categories considered by Corrado et al. (2006). We can, however, tease out information from their data (Tables 4 and 5) to estimate the stock of intangible capital in India. Since, we have investment data for innovative property (both scientific and non scientific) and brand equity (Table 6), if we assume that depreciation rates for tangible capital are similar in the U.S. and India, we can use the transformation rates for flows into stocks implied by their data for our estimation. Our capital stock estimates are reported in Table 7.

Alternative Estimates of Intangible Capital in India—2

Since we have investment data on Innovative Property, which includes R&D and Technical knowledge and Brand Equity, we can also construct direct

TABLE 6. Intangible Investment (India 2004–2008 annual average)

	<i>Billions of INR</i>	<i>Percentage of NAGDP</i>
Intangible Investment		
Computerized Information		
Innovative Property	393	1.11%
R&D (Scientific)	99	0.28%
Non-scientific	294	0.83%
Economic Competencies		
Brand equity	286	0.81%
Firm-specific resources		

TABLE 7. India 2008: Estimate of Intangible Capital Stock Using Corrado et al (2006)

	<i>Billions of INR</i>	<i>Percentage of NAGDP</i>
Intangible Capital Stock		
Computerized Information		
Innovative Property	1,467	4.15%
R&D (Scientific)	394	1.11%
Non-scientific	1,073	3.03%
Economic Competencies		
Brand equity	482	1.36%
Firm-specific resources		

measures of the stock of these types of intangible capital and compare them with our earlier estimates derived using the Corrado et al. (2006) data. To do so, we use the law of motion for capital stock relative to non-agricultural GDP

$$\frac{k_{t+1}}{y_{t+1}} = \left[\frac{k_t}{y_t} (1 - \delta) + \frac{x_t}{y_t} \right] \frac{1}{(1 + \gamma + \eta)} \quad (8)$$

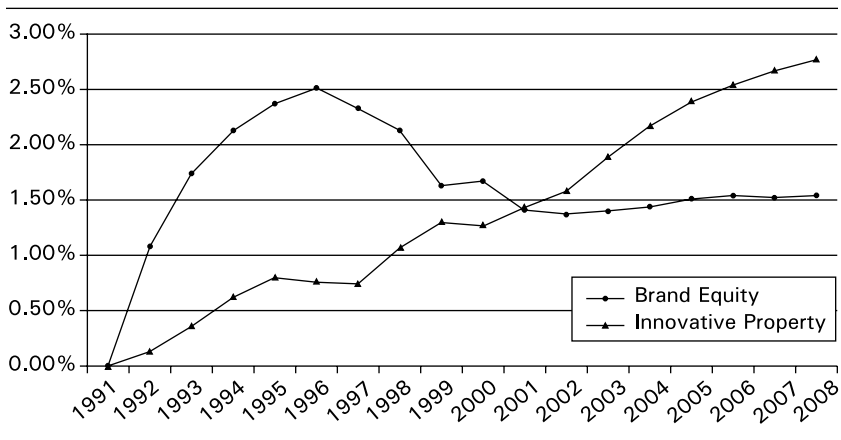
$\frac{k_0}{y_0}$: given

For a given initial capital stock, the future capital stock at any date t can be calculated by recursively using equation (8). We initialize the capital stock to zero in 1990 and use a variety of depreciation rates for our estimates. Given that depreciation rates for intangible capital are high (Corrado et al. (2006) report rates as high as 60 percent) the initialization assumption is innocuous. The contribution of an investment to the stock of the asset is only 25 percent after two half-lives so investments made prior to 1990 have little effect on the capital stock levels in the late 1990s. A depreciation rate of 20 percent implies a half-life of less than 3.5 years while a rate of 30 percent reduces the half-life of the investment to 2.3 years. We report our estimates in Table 8 for the depreciation rates used by Corrado et al. (2006). Capital stock levels for alternate depreciation rates are shown in Tables A1 and A2 in the Appendix.

It is comforting to note that the estimates that we get from the Corrado et al. (2006) measures are similar to those using investment data and their depreciation rates. One advantage of using investment flows is that it explicitly allows us to vary the depreciation rate and examine its effect on the capital stock. In Figure 2 we show the evolution of the stock of brand equity (advertising and marketing) and innovative property. We also observe

TABLE 8. India 2008: Estimate of Intangible Capital Stock Using Investment Data

	<i>Billions of INR</i>	<i>Percentage of GDP</i>
Intangible Capital Stock		
Computerized Information		
Innovative Property	1295	3.66%
R&D (Scientific)	315	0.89%
Royalties, Technical Knowledge	980	2.77%
Economic Competencies		
Brand equity	545	1.54%
Firm-specific resources		

FIGURE 2. Intangible Capital

Source: Investment in advertising and marketing from CMIE BB.

that while intangible capital associated with advertising and marketing has stabilized as a fraction of GDP, innovative property capital is still increasing. This leads us to conclude that Indian equity valuations relative to GDP will continue to rise as the stock of intangible capital approaches its steady state value.

Finally, we use the estimates in Tables 7 and 8 to construct estimates of the entire intangible capital stock in India. We report this in table 9. In constructing Table 9, we have assumed that investments in firm-specific resources in India mimic those in the U.S. Although we do not have investment data for this category we feel that investment in human and organizational capital is likely to be similar in India especially for large firms. In addition, we use the estimates of intangible capital from the Indian National Accounts for the category of Computerized Information.

TABLE 9. Estimate of Intangible Capital Stock (India 2008)

	<i>Following Corrado et al (2006)</i>		<i>Using investment data</i>	
	<i>Rs. (billion)</i>	<i>% GDP</i>	<i>Rs. (billion)</i>	<i>% GDP</i>
Intangible Capital Stock	5724	16.17%	5,947	16.81%
Computerized Information	296	0.84%	296	0.84%
Innovative Property	1463	4.13%	1,295	3.66%
R&D (Scientific)	394	1.11%	315	0.89%
Royalties, Technical Knowledge	1069	3.02%	980	2.77%
Economic Competencies	3893	11.00%	3,988	11.27%
Brand equity	450	1.27%	545	1.54%
Firm-specific resources	3443	9.73%	3,443	9.73%
Other intangibles (from accountants)	368	1.04%	368	1.04%

While these estimates for the intangible capital stock are similar to each other, they are lower than the estimates that we obtain using the McGrattan-Prescott methodology. One reason is the high depreciation rates used by Corrado et al. (2006), another possibility is that organizational capital, in particular investment in learning by doing, is probably underestimated in their analysis.¹⁷

Equilibrium Equity Values

In this Section, we use the theoretical framework developed earlier and our estimates of intangible capital to compute equilibrium values for corporate securities in India and compare these to observed values. We begin by documenting the average observed values for both debt and equity in Table 10 and predicted fundamental values in Table 11.

Although we have abstracted from debt in deriving our valuation relationship (equation 6) the empirical counterpart of claims to the corporate

TABLE 10. Average Observed Corporate Values for India

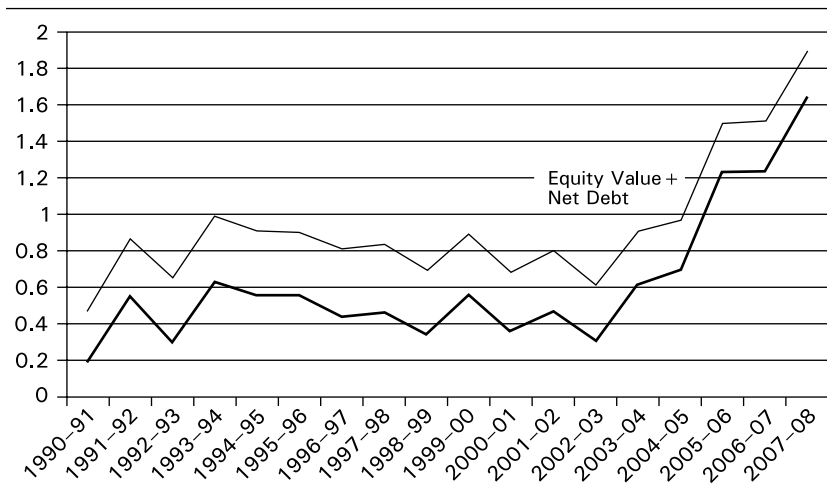
	<i>1991–2004</i>	<i>2005–2008</i>
Corporate equities	0.452	1.200
Net corporate debt	0.335	0.268
Total relative to NAGDP	0.787	1.468
Total relative to earnings	17.378	18.272

17. The reader is referred to McGrattan and Prescott (2005) and the commentary by Edward Prescott at the end of the chapter by Corrado et al. (2005) for a discussion on organization capital.

TABLE 11 . Predicted Fundamental Corporate Values for India

	1991–2004	2005–2008
McGrattan–Prescott		
Contribution of Domestic tangible capital ¹⁸	0.701	0.821
Contribution of Domestic intangible capital ¹⁹	0.362	0.650
Foreign capital	0.000	0.000
Total relative to NAGDP	1.063	1.471
Corrado et al		
Domestic tangible capital		0.774
Domestic intangible capital		0.152
Foreign capital		0.000
Total relative to NAGDP		0.926
Using Investment Data		
Domestic tangible capital		0.774
Domestic intangible capital		0.168
Foreign capital		0.000
Total relative to NAGDP		0.942

capital stock is the market value of the corporate sector, which includes both equity and net debt. The total market value of the corporate sector is plotted in Figure 3.

FIGURE 3. Total Value / NAGDP

Source: Market Value of Equity is for the CMIE COSPI set. Net Corporate Debt is for all non-financial firms from CMIE BB. GDP data is from National Accounts.

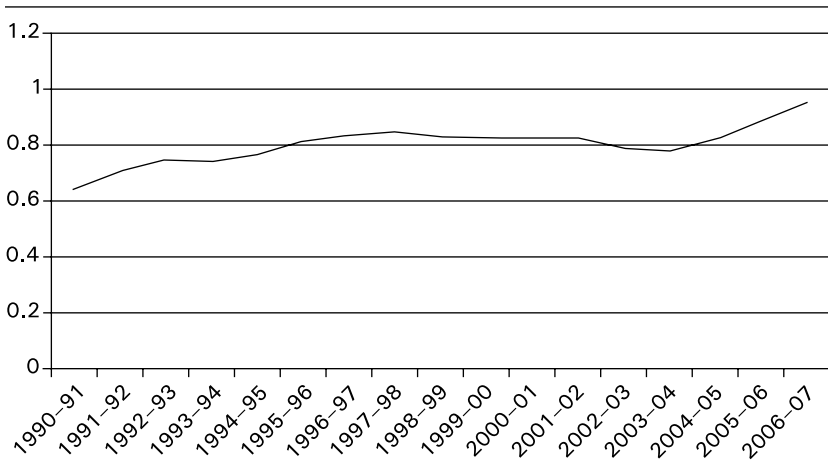
18. $k_m(1-\tau_d)$.

19. $k_u(1-\tau_c)(1-\tau_d)$.

The top line plots market value of equity and net debt as a multiple of NAGDP. The bottom line plots market value of equity as a multiple of NAGDP.

We observe that for the 1991–2004 period the ratio of total corporate value to NAGDP has been relatively constant with a mean value of 0.787. The predicted equilibrium value for the same time period is 1.09 (Table 11). If we use our model as a benchmark, the conclusion is that the Indian market was not overvalued during most of the 1991–2004 period—certainly not on average. In fact, tangible assets alone account for over 95 percent of the value²⁰ of the entire market—a point reinforced by Figure 4, which plots corporate capital as a multiple of NAGDP.

FIGURE 4. Corporate Capital / NAGDP



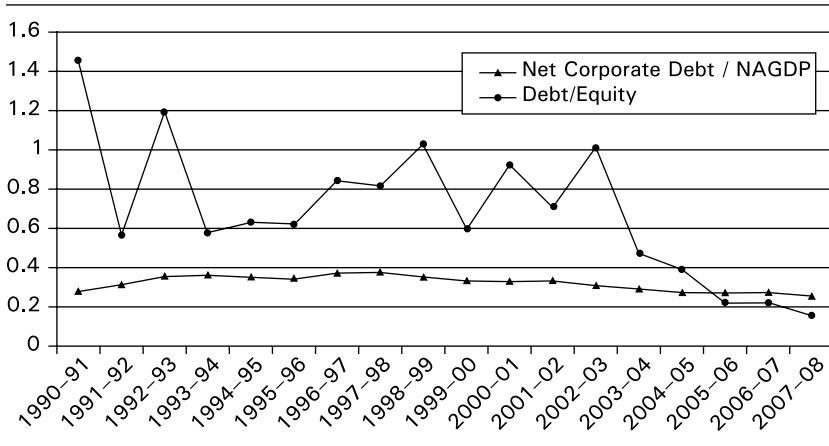
Source: National Accounts.

The Indian experience during 1991–2004, where both capital output and corporate valuations relative to GDP were constant, contrasts greatly with the U.S. experience, in which the capital output ratio is fairly constant but corporate valuations relative to GDP have moved considerably. McGrattan and Prescott (2005) attribute this to changes in the tax and regulatory framework.

20. The effective distribution tax rate over this period was 4.9 percent. Note that from equation 6 the contribution of tangible capital stock to corporate valuation is $k_m(1-\tau_d)$.

Next, we examine the 2005–2008 period. One explanation for the run up in equity values relative to GDP is that there was a change in the capital structure of firms. If there were debt equity swaps,²¹ equity values relative to GDP would increase. To see if this was the case in India, we examine the net corporate debt relative to GDP and the debt equity ratio (Figure 5).

FIGURE 5. Net Corporate Debt / NAGDP and Debt / Equity



Source: Net Corporate Debt is for all non-financial firms in CMIE BB. GDP data is from the Indian National Accounts.

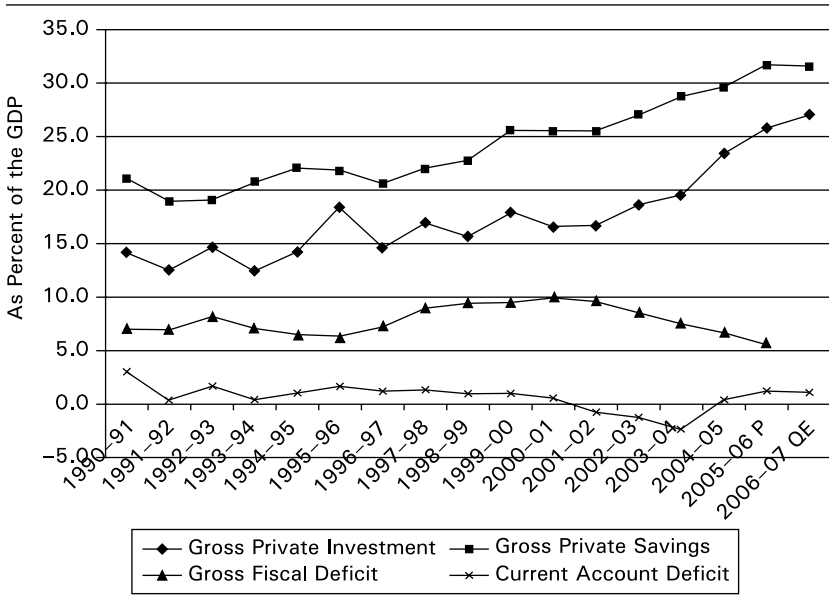
Looking at Figure 5, we see a gradual decline in debt financing starting in 1998 but nothing significant in the 2005–08 period. Hence, this is an unlikely explanation for the precipitous decline in the debt equity ratio in Figure 5, which seems to be the result of an increase in equity valuation.

Is this increase in corporate valuations consistent with changes in the underlying corporate capital stock? The average observed value over this period was 1.468, which is almost exactly equal to our high estimate of 1.471 but over 50 percent more than the low estimate for the fundamental value. The conclusion that market valuations should increase is apparent from Figure 4. We should have expected a 20–25 percent increase in valuations, based solely on the increase in tangible capital. This increase in the tangible capital stock is consistent with the increase in gross private investment over

21. With corporations buying back debt and issuing equity or changing the debt equity mix in financing new investments.

this period. This rate, which averaged 16.51 percent during 1991–2004, jumped to 25.5 percent during 2005–08. (Figure 6)

FIGURE 6.



However, this increase in the savings rate does not imply the valuations observed at the end of 2008. Our analysis suggests that an optimistic estimate of fundamental value of the current Indian equity market is about 1.2 (since debt is about 0.25). This is considerably lower than the 1.6 value observed in 2008. One effect that we have not accounted for is the demand from foreign institutional investors. In 2007, Foreign Institutional Investment was valued at 300 billion dollars (versus a low of 60 billion) and this fact may have important implications in valuing Indian stock markets.²² If the effect of this demand is to change the marginal investor, the relevant marginal rate of substitution will change, affecting market valuations as well. These are issues that we plan to peruse in subsequent research.

In closing, we revisit Figure 2, which suggests that intangible capital in India is still increasing in some sectors. This will lead to a future increase in the equilibrium value of the Indian equity markets relative to GDP. If cross

22. I thank Surjit Bhalla for this insight.

country data is any guide, we expect these markets to stabilize at around 1.5 GDP once intangible capital reaches steady state levels.

Valuation Ratios

In this section, we relate the price earnings ratio and Tobin's q , to quantities identified in the model developed in the second section. Both these ratios are widely used as measures of over and undervaluation of equity. James Tobin introduced q , defined as the ratio of the market value of equity and net debt to tangible capital at replacement cost:

$$q_t = \frac{p_t + b_t}{k_{m,t+1}}$$

In the absence of intangible capital, equation 1 implies that the equilibrium value of $q_t = 1$. Persistent departures from $q_t = 1$ ²³ are interpreted as an indication of the over or undervaluation of capital markets. Unfortunately, in an economy with changing tax rates and significant intangible capital the usefulness of q_t is limited. As was shown in the second section, in a setting with corporate taxes, distribution taxes (that is, taxes on dividends and capital gains), and subsidies to investment (for example, investment tax credits), the equilibrium relation specifying the price of corporate equity and capital stocks is:²⁴

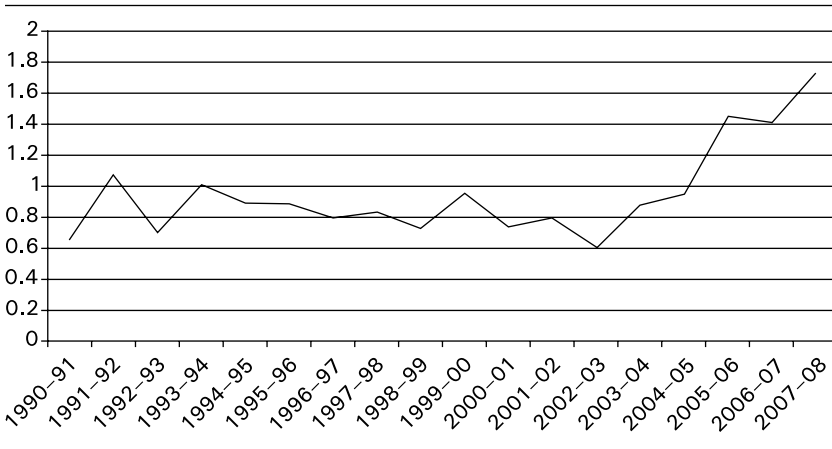
$$p_t = (1 - \tau_d)[(1 - \tau_s)k_{m,t+1} + (1 - \tau_c)k_{u,t+1}] \quad (6)$$

In this general setting if we define $q_t = p_t/k_{m,t+1}$ it is readily seen that not only is its equilibrium value not 1 but that it will change with changes in the tax code. In particular, it will change with changes in the tax rates on corporate distributions (dividends and buybacks) and these rates have varied considerably in India from year to year. Thus q_t may differ from 1 either because of over or undervaluation in capital markets, or simply as a result of changes in the tax rates; the ratio per se does not distinguish between the two effects. For the time period 1991–2008 q_t is plotted in Figure 7.

23. Sometimes the historical average value of q is used as an ad hoc benchmark instead of $q = 1$. See Smithers and Wright (2000).

24. We remind the reader that in deriving equation 5 we have abstracted from net corporate debt. Empirically this is a small relative to equity.

FIGURE 7. Tobin's q



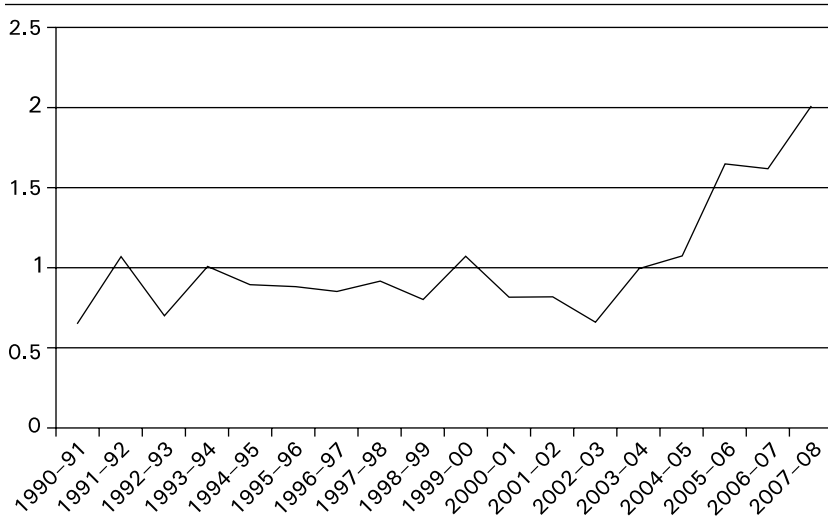
Source: Total value data is market value of CMIE COSPI firms and Net Corp debt of all non-financial firms. Total assets is for all non-financial firms from CMIE BB.

To eliminate the variations in q_t , due to changes in distribution taxes one can define a tax adjusted q_t^τ as

$$q_t^\tau = \frac{P_t}{(1 - \tau_d)k_{m,t+1}}$$

The advantage of this measure is that it abstracts from the high frequency variation in dividend taxation characteristic of India. If corporate tax rates and investment tax rates are relatively stable, then the historical average value of q_t^τ provides a benchmark for relative valuation. q_t^τ is plotted in Figure 8. In the presence of intangible capital and changing tax rates, it is apparent that changes q_t^τ do not necessarily represent periods of over or undervaluation of equity markets.

With these caveats in mind, we examine the behavior of q_t^τ . From 1991 to 2004, the value was fairly constant with a mean of 0.88. In the absence of intangible capital, theory predicts that this value should be $(1 - \tau_s)$. Since τ_s was negligible in India over this period, the average estimated value is slightly below the equilibrium value, leading one to conclude that over the period 1991–2004 the Indian equity market was not overvalued. Starting in 2005, q has increased at an average rate of 23 percent per year. Since there was no change in τ_s , one can only conclude that either the amount of intangible capital dramatically increased or that the market was overvalued relative to its fundamentals.

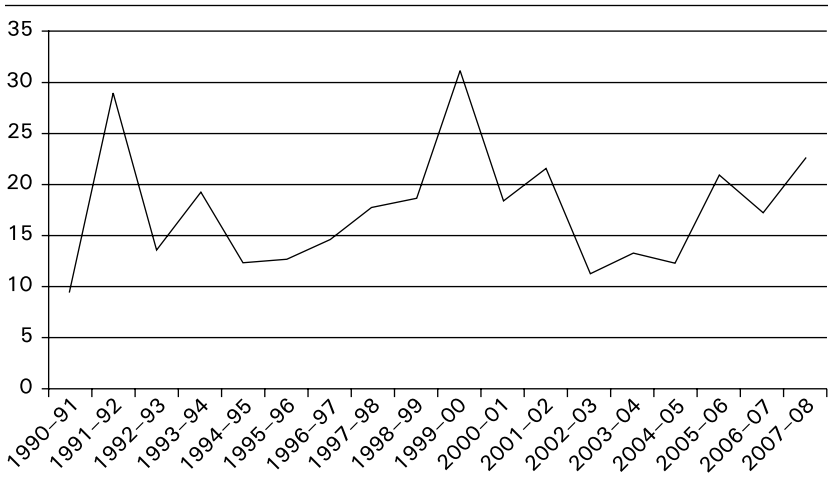
FIGURE 8. Tobin's q Adjusted for Distribution Taxes

Source: Total value data is market value of CMIE COSPI firms and Net Corp debt of all non-financial firms. Total assets is for all non-financial firms from CMIE BB.

A measure closely related to q is the price earnings (P/E) ratio.²⁵ It is the ratio of the stock price to earnings per share or, at the aggregate level, the value of equity normalized by after-tax corporate profits. It is widely used by financial analysts, and in recent years has been popularized by academics (Campbell and Shiller, 2001; Shiller, 2000). The P/E ratio for the Indian equity markets is plotted in Figure 9.

As expected, the P/E has fluctuated considerably over the period 1991–2008 with a low of 10, a high of 30 and a mean value of 17.6. The mean value of the P/E ratio in India is about that same as the historical average for the S&P 500, which is 18. Many practitioners consider the market overvalued when the actual value exceeds 24 or 27 (corresponding to a 33 percent or 50 percent increase over historical norms). Using this criterion, we conclude that except for a brief period in 1999–2000 the India market was fairly priced.

25. In a deterministic world an equilibrium relation is $P/E = q/r$, where r is the discount rate. Under uncertainty, variations in r will make P/E more variable than q . The reader is referred to Smithers and Wright (2000) for a detailed comparison of the relative merits of q and the P/E.

FIGURE 9. Price Earnings Ratio

Source: Price data is for the CMIE COSPI set. Earnings data is for all non-financial firms from CMIE BB.

In conclusion, we reiterate that q and P/E ratios, which implicitly abstract from both tax rates and intangible capital, offer inadequate measures of under and over valuation of capital markets. In particular, for economies that exhibit sizable secular growth in intangible capital, as has been observed in India over the last 15–20 years, these metrics offer limited analytical utility.

Concluding Comments

In this paper, we take a critical look at the relationship between the value of capital stock in the Indian corporate sector and the valuation of claims to this capital stock in capital markets. We address the question of whether Indian equity valuations over the period 1991–2008 are consistent with three key market fundamentals: corporate capital stock, after-tax corporate cash flows, and net corporate debt. Our analysis extends the neo-classical growth model to include intangible capital and key features of the tax code and uses national account statistics to estimate the equilibrium value of corporate equity relative to GDP. Our framework can provide policy makers with a benchmark to identify deviations in equity markets relative to those implied by economic fundamentals. In addition, it facilitates a quantitative assessment of policy changes such as, changes in dividend taxation on stock prices. We caution the reader that although our framework is well suited

to examining secular movements in the value of equity relative to GDP, it is not suitable to address high frequency price movements in the stock market. In fact, we know of no framework that can satisfactorily account for these movements in terms of the underlying fundamentals. High frequency volatility remains a puzzle.

Based on our analysis, we conclude that in a large measure, Indian equity markets were fairly priced over the 1991–2008 period.

APPENDIX

TABLE A - 1. Capital Stock of Innovative Property (GDP)

Year	<i>Depreciation rates (Half-life)</i>			
	<i>10%</i> <i>(6.9 years)</i>	<i>20%</i> <i>(3.5 years)</i>	<i>30%</i> <i>(2.3 years)</i>	<i>CHS (20%)</i> <i>(3.5 years)</i>
1991	0.00%	0.00%	0.00%	0.00%
1992	0.16%	0.16%	0.16%	0.16%
1993	0.46%	0.45%	0.43%	0.45%
1994	0.86%	0.80%	0.75%	0.80%
1995	1.17%	1.04%	0.94%	1.04%
1996	1.28%	1.09%	0.92%	1.09%
1997	1.43%	1.17%	0.95%	1.17%
1998	1.93%	1.60%	1.35%	1.60%
1999	2.29%	1.86%	1.55%	1.86%
2000	2.45%	1.92%	1.54%	1.92%
2001	2.69%	2.07%	1.64%	2.07%
2002	2.91%	2.20%	1.73%	2.20%
2003	3.32%	2.51%	2.01%	2.51%
2004	3.72%	2.80%	2.24%	2.80%
2005	4.11%	3.09%	2.46%	3.09%
2006	4.44%	3.29%	2.59%	3.29%
2007	4.76%	3.49%	2.74%	3.49%
2008	5.03%	3.65%	2.82%	3.65%

TABLE A - 2. Capital Stock of Brand Equity (GDP)

Year	<i>Depreciation rates (Half-life)</i>			
	<i>10%</i> <i>(6.9 years)</i>	<i>20%</i> <i>(3.5 years)</i>	<i>30%</i> <i>(2.3 years)</i>	<i>CHS (60%)</i> <i>(1.2 years)</i>
1991	0.00%	0.00%	0.00%	0.00%
1992	1.08%	1.08%	1.08%	1.08%
1993	2.25%	2.15%	2.05%	1.74%
1994	3.36%	3.08%	2.81%	2.13%

(Table A-2 continued)

(Table A-2 continued)

Year	Depreciation rates (Half-life)			
	10% (6.9 years)	20% (3.5 years)	30% (2.3 years)	CHS (60%) (1.2 years)
1995	4.39%	3.87%	3.41%	2.37%
1996	5.30%	4.50%	3.84%	2.51%
1997	5.83%	4.75%	3.90%	2.33%
1998	6.15%	4.80%	3.80%	2.13%
1999	5.99%	4.41%	3.32%	1.63%
2000	6.08%	4.35%	3.22%	1.67%
2001	5.87%	4.02%	2.88%	1.41%
2002	5.76%	3.84%	2.72%	1.37%
2003	5.71%	3.75%	2.66%	1.40%
2004	5.70%	3.70%	2.65%	1.44%
2005	5.75%	3.73%	2.70%	1.51%
2006	5.78%	3.75%	2.73%	1.54%
2007	5.79%	3.74%	2.73%	1.52%
2008	5.83%	3.76%	2.75%	1.54%

Comments and Discussion

Ajay Shah: The Question—A large part of the success of financial economics has been the simple idea that if there are two routes to the same risk, they should have the same price. This is about the *relative* pricing of two assets that have the same risk.

Finance has been much less effective in making *absolute* statements about the value of an asset. As an example, we know relatively little about what the P/E of Nifty 'ought' to be. The paper explores two difficult questions:

- Can we make some statements about the valuation of the stock market?
- Can we do this in the context of an optimizing model, grounded in fundamentals?

If this can be done well, it is important in three ways. First, it would give us a framework to think about an important question. Second, it gives us a model to help us think about the world—for example, we could talk about the impact on the market P/E when the taxation of dividends is changed. Third, a methodology which fares well at this daunting problem could potentially have other interesting applications. And of course, along the way, the journey might throw up some interesting surprises and unexpected insights even if the main quest is unsuccessful.

The model employed in the paper is a dynamic general equilibrium model drawing on growth theory. Nothing is random—which comes as a surprise when we think that finance is almost entirely about how human beings behave around randomness. In the RBC tradition, the DGE model is calibrated using Indian NAS and Centre for Monitoring Indian Economy (CMIE) data.

Intangible Capital

The paper emphasizes the problem of intangible capital. This is organizational capital, scientific knowledge, brand value, patents. It argues that intangible capital is of essence in thinking about the problem. I am quite sympathetic

to this idea. As an example, it is easy to buy 10,000 trucks. But it is very difficult to build a trucking company with pan-India operations. The fleet of 10,000 trucks is the hard, physical capital. But the breath of life that convert these into a working company is the incredibly complex combination of information and incentives which overcome principal-agent problems across the perhaps 25,000 workers across the country who would turn it into a trucking company. So I'm fully supportive of the idea that intangible capital is of first order importance in thinking about what is a firm.

Once we start thinking about intangible capital, it changes our views on notions of Tobin's q . If we see the stock market value a company with physical assets of 10,000 trucks at twice or thrice the accounting value of the trucks, then we should not be surprised. Similarly, the market value of a hospital company with 10,000 beds should be much bigger than the replacement cost—as measured by an accountant—of setting up the hardware of buildings and medical equipment. We could classify this as one of the unexpected insights obtained in the journey.

When I think of the complexity of firms in India, I expect intangible capital to play a big role. The numerical estimates that are in the paper are rather small and came as a surprise to me.

By and large, the model does fairly well at telling us something about the valuation of the equity market. It suggests that there is no first order mispricing in the stock market. It reminds us of the immense importance of tax treatment of capital, and underlines the 'modern macro consensus' about the desirability of low taxation of capital.

The paper would have been more interesting if it had first done a Mark 1 model without intangible capital, identified weaknesses in it, then introduced intangible capital, and we would have been able to see how this new feature of the model helped change matters.

Depreciation

A key concern is the choice of a depreciation rate. Should Hulten/Wyckoff depreciation rates be used? Or something different? It is, of course, best to do ground-up research on measuring the appropriate depreciation rate for large Indian companies. But in the absence of that, I have two perspectives on why higher depreciation rates are appropriate in India.

The first issue is about the impact of trade liberalization on capital stock. When a country opens up to international trade, a lot of existing physical capital and intangible capital gets destroyed. Companies in India who were producing things like computer hardware simply went bankrupt when India

opened up. A much bigger scale of capital destruction took place in places like the USSR, where the wedge between domestic prices and world prices was even bigger than that found in socialist India. Trade reforms destroy a lot of capital. Another way to say this is that depreciation rates are high when trade barriers are changing more.

This intuition has many interesting implications. As an example, the standard estimation strategies say that Total Factor Productivity (TFP) growth in India was not strong after the early 1990s. But if we think that a lot of K got destroyed from 1991 to 2001, then TFP growth was stronger than we think.

The second issue is about repeated obsolescence in a developing country with high rates of growth. At any point in time, the K/L ratio that an optimising firm would choose in India would be different from that at the world frontier, given low wages and expensive capital in India. And in a few years, rapid GDP growth would make these technological choices obsolete and necessitate capital destruction. Since we cannot jump to the frontier, we have to build many times and destroy the intermediate stages on our path to the frontier. This argument also suggests that depreciation rates in India should be high.

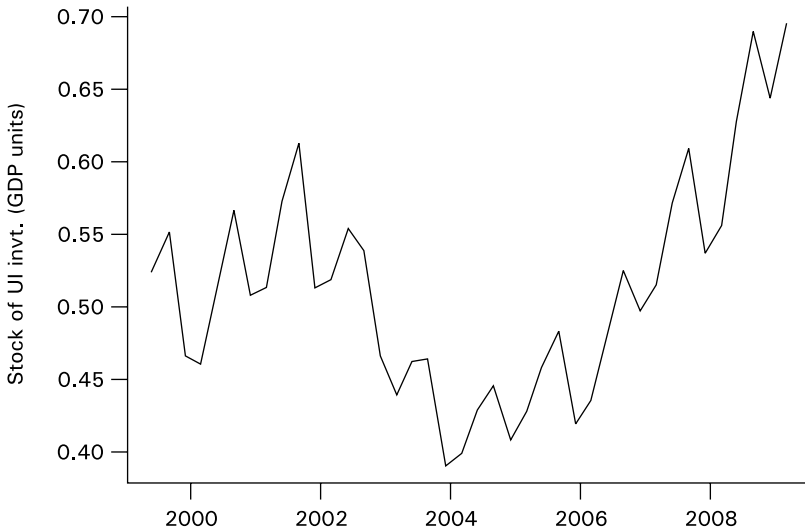
It should be noted that this argument requires a combination of (a) a very different ratio of prices of capital to labor and (b) high growth rates. In socialist India, the second condition did not obtain, so factories would have worked for a longer period of time without encountering obsolescence.

Interpreting the Post-2002 Events

A key figure in the paper suggests that after March 2002, q went up sharply, after adjusting for intangible capital and changes in taxation.

It would be interesting to ask: How does this prediction compare when faced with investment data? The CMIE Capex database is a quarterly inventory of all projects that are at hand. I focus on the projects classified as being ‘under implementation’ by CMIE.

This time-series (in the figure above) shows that the investment boom came a bit later, after the March 2002 turning point in the time-series of q . It is interesting to ask why there is such a disagreement between these two dates. One possibility could be a simple time-to-build explanation: of the time taken in India to carry an investment idea through to the point where it can be classified as “under implementation.” This would be a benign explanation, consistent with the story of the paper. There could be others.



Surjit Bhalla: Mehra's paper on the Indian stock market is timely, and informative. The question addressed by Mehra is whether the Indian stock market has been fairly valued over the post-reform period 1991–2008. There is a large interest in this question; a question raised by market participants and central bankers (is there a bubble?). For the record, the Indian stock market (at 16000) is up roughly 4 times from the average 1996 level and three times from the 2004 level.

The paper is in the best traditions of IPF. It provides a historic and comparative overview of the subject. Using straightforward models, Mehra reaches the controversial conclusion that over the long period 1991–2008, the Indian stock market has been fairly valued. I want to give a few reasons why Mehra's conclusion is likely to be correct.

A lot has happened over the last twenty years. But in the main, the following factors stand out: First, this was an economic reform period, with most of the reforms bunched in the early years, but nevertheless, continuing. Second, the savings rate has doubled to the mid-thirty's range. Third, the middle class, one of the prime buyers of stocks, has risen from about 8 percent of the population in the early 1990s to above 40 percent today. Fourth, and finally, foreign institutional investors (FIIs) have been a major source of demand.

All these factors suggest that the share of market capitalization as a fraction of GDP should rise, and therefore the rate of growth of stock prices

should outpace per capita income growth; however, overvaluation means an *excessive* rise. What is the evidence that the stock price increase in India has *not* been excessive? Most striking, perhaps, has been the behavior of one of the largest investors in the Indian stock market, the FIIs. During the great meltdown of 2008/9, when the stock market declined to nearly a third of the peak reached in January 2008, the FII holdings in Indian stocks dropped from \$ 300 billion to only \$ 60 billion. This was a decline of \$ 240 billion in assets. The total remittances or sales by FIIs were a paltry \$ 13 billion, or less than six percent of total pre-decline assets. The remainder was all valuation loss. In other words, the FIIs clearly did not feel that the decline had to do with overvaluation; if they did, they would have redeemed more.

The middle class and savings rate issue is related, but what it does mean is that there has been a structural increase in the demand for stocks—hence, a structural increase in the fair valuation price level. Mehra presents, in Table 3, an estimate of the increase in the (intangible) capital stock—it has risen from 0.45 percent of GDP (1991 to 2004) to almost double that level 0.88 (2005 to 2008). Investments in intangible capital stock during the recent five year period have been upwards of 3 percent; using this investment data, Mehra finds that the estimate of intangible capital stock is upwards of 3 percent (one estimation method yields an estimate close to 6 percent). As a comparator, in the US, intangible capital stock is a third of GDP, and investment in intangible stock about a tenth.

During 1991–2004, the average value of the Sensex was 3600; during 2005–2008, the average level was 12200. The price level (GDP deflator) in the latter period was 55 percent higher. So the simplest back of the envelope calculation suggests that a “fair” Sensex level during the 2005–2008 period would be three times higher than the 1991–2004 level: a doubling from the increase in the capital stock, and a 54 percent increase on the doubling because of the increase in the price level. This yields an average Sensex level around 11000—not very far from the observed value of 12220. Given that the estimate of capital stock is likely to be considerably higher than the 0.88 percent Table 3 estimate, it is likely that the Indian stock market is not only not overvalued, it very likely is undervalued, and by a not insignificant amount.

General Discussion

Most of the general discussion focused on the calibration of the model to India’s situation. Urjit Patel suggested that it might be useful to separate

the data between companies that are subject to normal corporate taxation and those that operate under the alternative minimum tax. The separation might provide a means of measuring the effect of taxes on corporate valuations. Poonam Gupta suggested a separation by economic sectors, such as manufacturing versus IT.

Kaushik Basu raised questions about the meaning of depreciation for intangibles capital. How can it be measured? It does not seem subject to the same wear and tear as tangible capital. Others emphasized the role of obsolescence as the primary meaning of depreciation in the context of intangibles, but Basu noted that workers often learn to use the intangible capital more efficiently over time, and that learning-by-doing could be interpreted as negative depreciation in the context of constructing a stock of intangibles.

Arvind Virmani also believed that there would be problems with measuring physical capital because the magnitude of the 1991 reforms would induce an initial surge of obsolescence of the existing capital stock. He believed that the reforms had induced a j-curve effect, initially inducing a decline in output that was followed by a growth acceleration.

Abhijit Banerjee raised concerns about the magnitudes of the real interest rate and total factor productivity growth that needed to be assumed to make the model consistent for the observed equity valuations. He did not believe that the rate of TFP growth could be as high as 8.8 percent and noted that a real interest rate of 14 percent was far from the value observed in the market. He thought they suggested problems with applying the model in the Indian context. In particular he pointed to all of the distortions and other constraints that made individuals' internal rates of return far higher than market interest rates. These aspects are not captured in the model. Similarly, Dilip Mookherjee wondered how the model would account for the sharp increases in rates of saving and investment that have occurred in recent years. They are far from the steady-state values and would be difficult to incorporate in the calibration of the model.

Guillermo Calvo pointed out that the cycles in equity markets are often highly correlated across a large number of emerging markets. He wondered how that correlation could be accounted for in models, such as that of the current paper, that are country-specific. He thought it could be useful to conduct some cross-country studies of the correlations on equity markets.

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