DIFFERENTIAL ESTIMATION RISK AND FIRM VALUE: A COMMENTARY

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ABSTRACT

This paper discusses the differential estimation risk model and its two risk components: information risk and stochastic parameter risk. If estimation risk is being systematically priced by investors in the financial markets, investors would require a risk premium to compensate themselves for bearing estimation risk. Assets are therefore traded at a discount off their true values that would be realised if all price-sensitive information is made available. Initial public offerings are one such example of high information risk assets that offer successful subscribers significant risk premium on the first trading day. The differential estimation risk model has significant implications for disclosure requirements in the regulation of Asian financial markets as well as the production of information in these economies.

INTRODUCTION

When price-sensitive information about firm value is not disclosed or inadequately disclosed, investors have to formulate their expectations of the asset's return based on non-objective bases or intuition. Investors are therefore likened to use bayesian inference in their formulation of expectations of assets' returns. In this paper, I define the estimation risk of an asset to be the incremental variation of its predictive return distribution that is due to investors' ignorance of the parameters of its true return distribution. This definition of estimation risk is more precise than the alternative definition of parameter uncertainty. It also distinguishes the effect of the use of estimators from the availability or quantity of information. If estimation risk is being systematically priced by investors in the stock market, investors would require a risk premium to compensate themselves for bearing estimation risk. Assets are therefore traded at a discount off their true values that would be realised if all price-sensitive information is made available.

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This paper proposes a model for estimation risk. It analyses estimation risk in terms of two component risks: information risk and stochastic parameter risk. Information risk arises from the non-availability or inadequacy of price information that is used by investors to formulate their expectations of assets returns. Stochastic parameter risk exists if the asset has a return distribution that has stochastic parameters or random parameters that vary over time.

Estimation risk is most significant in an initial public offering (IPO) of common stock by virtue of the fact that the stock has had no prior market price. We discuss the empirical findings of the initial performance of IPOs as well as the firm size effect that are consistent with the implications of the differential estimation risk model. This model has further implications for the regulation of Asian financial markets. Specifically, the quality and the frequency of information releases in easily understandable form to investors is critical for the maximisation of firm values in these markets. Therefore, this discussion is relevant for issuers, regulators, the research community, information agencies, fund managers as well as the investing public.

This issue of firm value maximisation is especially pertinent for investors in the developing Asian economies who would consider taking their companies public to realise their returns to investment. Oftentimes, the regulatory conditions in these developing financial economies do not favour or require disclosures of price-sensitive information. Moreover, business and trade statistics are often lacking and the legal and financial systems in these countries may not be transparent. The differential estimation risk model predicts that firm values in such financial economies would be discounted because the business environment systematically carries high estimation risk.

THE DIFFERENTIAL ESTIMATION RISK MODEL

Estimation risk of an asset has been vaguely defined in the literature as parameter uncertainty (Bawa, Brown and Klein 1979:2). This paper gives a formal definition to estimation risk. I propose that estimation risk exists when the joint distribution of asset returns, f, is not completely known. This includes the situation in which the functional form of f is unknown which is a non-parametric case. It also includes the more common case in which the functional form of f is presumed known, but the value of the parameter vector θ (of finite dimension) is unknown. For example, if f belongs to the family of multivariate normal distributions, then θ consists of the elements in a mean vector and a variance-covariance matrix.

It has been shown that when f is unknown, and when investors have minimal prior information about f, the capital market equilibrium accounting fully for estimation risk is observationally equivalent to that when estimates are assumed to represent the true values (Bawa 1977, 1979).

The discussion on estimation risk is generally restricted to the parametric case in which the functional form of f is known, but the value of θ is unknown. One measure of estimation risk of an asset has been the quantity of information. For example, information on an asset has been defined as the time series observations of its returns (Barry and Brown 1985). The quantity of information is then measured by the available sample size of prices or returns.

Various studies argue that when assets in a portfolio have different quantities of information (or differential information), estimation risk is non-diversifiable (Bawa and Brown 1979; Klein and Bawa 1977; Barry and Brown 1985; Clarkson et al 1996). Specifically, these studies show that a high information asset has a smaller beta, given differential information across assets, than it would have, given equal information across assets.

Again, it is argued that an investor who maximises expected utility of terminal wealth will use the predictive return distribution to formulate expectations of asset returns and recognise estimation risk (Zellner and Chetty 1965). When the parameters of an asset's return distribution are known, investors condition the return distribution on them to formulate their predictions of its returns (Lam 1992). In this paper, I assume the more common case when the parameters are unknown. Here, investors uncondition the return distribution on the posterior distributions of the mean parameter values and derive their predictive return distribution of the asset. In the course of estimating the posterior distribution of each parameter, investors recognise that the posterior distributions are estimated with mean square errors. This estimation process results in the predictive return distributions having larger variance-covariance matrices than if parameters were known. I therefore define estimation risk more precisely as the incremental variation of an asset's predictive return distribution that is due to investor's ignorance of the parameters of its true return distribution.

In this analysis, I assume that asset return distributions are jointly normal with unknown means but known variance-covariance matrix. Moreover asset return distributions have random parameters that vary both across assets and over time. I also assume that investors behave as if they use bayesian inference to estimate parameters when the true parameters are unknown. This means that investors incorporate both sample information and their subjective beliefs in a posterior distribution of the mean parameter value.

It is then postulated that the information and predictability characteristics of an asset affect its estimation risk through the mean square error of this posterior distribution. In the discussion on information risk, the mean square error of the posterior distribution of a mean parameter value decreases as information increases (Lam 1992). The information risk of an asset is then defined to be that incremental variation of its predictive return distribution relative to the limiting case when the asset has infinite sample information.

This paper proposes a new dimension to estimation risk that arises from stochastic parameter risk. I define a high predictability asset as one whose true return distribution has parameters with lower intertemporal variation than those of a low predictability asset. Investor's posterior distributions of the mean parameter values of a low predictability asset have mean square errors that persist even though sample information goes to infinity. The predictability risk of an asset is then defined as that component of the variance of its predictive return distribution that is attributable to the intertemporal variation of parameters of its true return distribution.

Figure 1: The Differential Estimation Risk Model

The differential estimation risk model illustrates the association between the information and predictability characteristics of an asset and the estimation risk that arises when the parameters of the asset's return distribution are unknown. For example, assets with low variance parameters and high information have low estimation risk; those with high variance parameters and high information have high estimation risk, but assets with high variance parameters and low information have the highest estimation risk.

	Assets with low variance parameters	Assets with high variance parameters
Assets with high information	**Low estimation risk (1)**	**High estimation risk (2)**
Assets with low information	**High estimation risk (3)**	**Highest estimation risk (4)**

Figure 1 models differential estimation risk in terms of the two components of estimation risk: information risk and predictability risk. It illustrates the association between the information and predictability characteristics of an asset and its estimation risk.

Assets in cell (1) of Figure 1 have high information and low variance parameters. Both the statistical estimators and investors' subjective beliefs about the parameters converge to the true parameter values. The posterior distributions of the parameters have small mean square errors. Such assets therefore have low estimation risk. Assets in cell (2) have high information but also high variance parameters. According to the definition of predictability risk, these assets have higher estimation risk than those assets in cell (1); and this estimation risk is permanent. Similarly, the low information assets in cell (3) have higher estimation risk than the high information assets in cell (1). However, this estimation risk is essentially information risk that dissipates as sample information goes to infinity.

When sample information is absent, investors rely on their subjective beliefs as estimators of the mean parameter values. These investors first identify reference assets, i.e. high information assets whose returns are correlated with those of the low information asset. They then derive the posterior distributions of the mean parameter values of these reference assets. Investors formulate their subjective beliefs about the mean parameter values of the low information asset based on their expectations of the correlation of its parameters with those of the reference assets. The posterior distributions of the mean parameter values of a low information asset therefore have mean square errors that tend to increase with the mean square errors of the posterior distributions of parameters of its reference assets.

If the low information assets in cell (4) have reference assets that are also low predictability assets in cell (2), then these cell (4) assets will have the highest estimation risk relative to those in cell (1) through cell (3). This is attributable to the compounding effect of both information and predictability risks. Furthermore, this analysis implies that part of this estimation risk is permanent and is never resolved even when sample information goes to infinity.

EVIDENCE FOR ESTIMATION RISK IN THE INITIAL PUBLIC OFFERINGS MARKET

This section discusses the implications of the differential estimation risk model for the initial public offerings (IPOs) market. This is to illustrate how the model may be applied to valuation of going concerns in financial markets in cases where firm values are dependent on uncertain future cash flows, rather than market values of firm assets. IPOs of such common stock are good examples of low information assets since they have yet to be traded on any capital market.

In the absence of signalling, investors have an adverse selection problem over the differential estimation risk of IPOs. Investors perceive all issues as having the same estimation risk. It is postulated that a continuum of varying quality could result in the low quality assets driving out the high quality assets such that no market exists at all (Akerlof 1970). Akerlof calls this the 'lemons' problem or a problem that is created because quality cannot be differentiated or ascertained.

This study analyses why a failure of the IPO market is not observed. In competitive IPO markets like the US, we observe IPOs being sold either as firm commitment or best efforts IPOs. To explain the economic role of an investment banker in identifying and pricing IPOs, the interaction of the issuer, investment banker and investors is examined in a simplified four-period model.

In period one the issuer approaches an investment banker to underwrite the issue. He underwrites the IPO only if he can price the issue with some confidence. Otherwise, he offers the IPO on a best efforts contract. In period two the issuer decides whether to proceed with the issue conditional on the investment banker's offer. In period three investors bid for the IPO at the public offering price, which is a fixed price. If a firm commitment IPO is undersubscribed, the investment banker takes the unsubscribed portion into his inventory as underwritten. In the case of a best efforts offering, the issue would be withdrawn if the subscription falls below a specified minimum subscription level. The investment banker takes no risk and acts as a selling agent for the issue. In period four the IPO seasons in the aftermarket.

In the context of the US practice and the differential estimation risk model, it is hypothesised that a firm commitment IPO signals for a high predictability asset. The investment banker is assumed to have a larger information set on reference assets than an issuer or the investor. However, his comparative advantage over the issuer and the investor is in pricing high predictability IPOs. When the issuer approaches the investment banker to price the issue, the investment banker ranks the expected firm value (before accounting for estimation risk) relative to those of its reference assets. He then determines the public offering price by discounting the expected per share firm value by the expected return on estimation risk.

Based on the investment banking practice in the US, the investment banker sets the public offering price after the market closes the day prior to offering. In the context of our discussion on estimation risk, we can say that this pricing policy allows him to isolate the estimation risk of an issue from its market risk [1].

In the US financial markets, the firm commitment contract has three properties of a signal: visibility, credibility and independence. Firstly, the terms of the contract are visible to investors. For example, the public offering price, underwriting discount, issue size and the underwriting syndicate are disclosed in the prospectus. The issuer is also required to file a preliminary underwriting agreement with the registration statement to the Securities and Exchange Commission.

Moreover, an investment banker's investment in information is visible and lends credibility to his pricing. The size and staffing of the market research department and the number of branch offices and senior investment bankers that provide feedback for this information can be observed. The investment banker's wealth stake in the underwriting also provides good collateral for his pricing.

Consider an investment banker's incentives to accept side-payments from an issuer to underwrite an offering after he has offered the issuer a best efforts contract. In competitive markets, an investment banker thrives on repeat business from his clientele of both issuers and investors. He builds up reputation capital and a good track record by pricing new issues right. Presumably, a value maximising investment banker will find it unprofitable to underprice an issue (relative to its equilibrium value at issue) at the expense of the issuer or to overprice it at the expense of investors. We therefore argue that investors can rely on the firm commitment contract as an independent, arm's length transaction between the investment banker and the issuer.

This differential estimation risk model implies that new issues of seasoned stock that have more information would offer lower information risk than IPOs. Further if investment bankers act independently to maximise their firm values they will be observed to underwrite new issues of seasoned stock more frequently than IPOs.

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[1] *British Petroleum Inc. is a case to illustrate that it* ***does*** *pay an investment banker to adhere to this pricing policy. British Petroleum Inc. went public with a $ 12.33 billion offering on 30 October 1987. The investment bankers for the US tranche agreed to the issuer's request to set the public offering price two weeks earlier on 15 October. On 19 October 1987, the Dow Jones Industrial Index fell 508 points from 2247 to 1739. And on 29 October, British Petroleum shares (actually American depository receipts equivalent to 12 shares) closed at $55.75 againts the public offering price of $65. The four US underwriters: Goldman, Sachs & Co (lead underwriter), Morgan Stanley & Co., Solomon Inc. and Shearson Lehman Brothers Inc. estimated that pre-issue book losses from the market crash amounted to $600 million.*

Statistics on initial offerings for the period 1977 through 1982 are consistent with this implication of the model (Booth and Smith 1986: 262). In a sample of 866 *IPOs of common stock,* there are 396 (46%) firm commitment and 470 (54%) best efforts IPOs. In the sample of 1035 *new issues of seasoned stock,* however, there are 1008 (97%) firm commitment and 27 (3%) best efforts offerings. In this six-year period investment bankers underwrite new issues of seasoned stock more readily (97% of the time) than IPOs (46% of the time).

In the absence of signalling, investors apply the same expected return on the mean estimation risk on all IPOs. We have shown in the above analysis how a firm commitment offering can signal for a high predictability asset. Its signalling effect is to lower investors' expected return on its estimation risk. Therefore the issuer of a high predictability offering, when offered a firm commitment contract by an investment banker, will not choose a best efforts contract. This analysis shows that there is a signalling equilibrium in the IPO market with firm commitment and best efforts contracts. For this reason, there is no failure of the IPO market even though information risk is at its highest.

In summary, the differential estimation risk model implies that low information assets like IPOs will be priced for their differential information and predictability risks. It predicts that low predictability IPOs will tend to offer larger returns on estimation risk than high predictability IPOs. In a signalling equilibrium, the model predicts that best efforts IPOs will offer a larger average initial return than firm commitment IPOs. Another predictive hypothesis of the model would be that younger firms that are lesser known would offer a larger average initial return than older and better known firms. Moreover, these older and better known firms would tend to use a firm commitment offering rather than a best efforts offering to signal for quality.

In one study, 2,466 US offerings from 1975 through 1984 were categorised by the firm age and the contractual mechanism used in the public offer (Loughran, Ritter and Rydvist 1994). It is observed that there is a tendency for the more established companies to have lower initial returns than young companies (with age less than 10 years). Moreover, initial returns tend to be lower if more information about the state of demand is acquired prior to determining the offering price. Out of the sample of 2,466 offerings, only 20 old firms use the best efforts contract. While firm commitment offerings offer average initial returns ranging from 10% to 20%, best efforts offerings offer average initial returns that range from 40% to 50%. All of these observations are consistent with the implications of the differential estimation risk model for the IPO market.

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[2] *Chalk and Peavy (1987) report that the average initial returns on best efforts and firm commitment IPOs are 36.1% and 19.6% respectively. Ritter (1987) documents average initial returns of 47.8% and 14.8% for best efforts and firm commitment IPOs respectively.*

These findings are also consistent with those in earlier studies (Chalk and Peavy 1987 and Ritter 1987)[2]. The more conclusive evidence that supports the differential estimation risk model is the finding that abnormal returns on both best efforts and firm commitment IPOs are transitory and are dissipated by the third trading day (Clarkson and Thompson 1990; Lam, 1992). Specifically, this finding supports the postulate that differential information risk is dominant in IPOs and that such risk is transitory and can be quickly dissipated in the aftermarket as more information is produced.

The model of a signalling equilibrium in an IPO market with the choice of an investment banking contract may not be applicable in instances where the large and positive average initial returns on IPOs may not be derived under competitive pricing conditions[3]. There may exist financial economies where IPOs are *deliberately* underpriced (below their equilibrium fair value after accounting for the estimation risk at issue), either to extract oligopolistic profits for investment bankers or in compliance with regulatory or institutional requirements, at the expense of the issuers yet without losing goodwill and reputation capital. For example, in an economy like Malaysia where IPOs tend to be "underpriced" in compliance with social and institutional requirements, a competitive investment banking industry could possibly result in the best efforts contract being the optimal contract in equilibrium[4]. In the latter instance, the large and positive average initial returns on IPOs would be explained *largely* by the "underpricing" hypothesis (that effectively re-distributes wealth from issuers to investors) rather than the estimation risk hypothesis (that compensates investors for the non-diversifiable component of estimation risk in IPOs). The investment banker is compensated for his selling efforts in a best efforts contract rather than his underwriting skills in distinguishing IPOs with acceptable estimation risk. Since there is a continuum of competitive conditions in IPO markets around the world, it is posited therefore that the initial return on an IPO may be explained by the estimation risk and the "underpricing" hypotheses to varying extent.

In a summary of the empirical studies about the IPO markets in various financial economies, it is observed that IPOs generally offer large and positive (market-adjusted) average initial returns (Loughran, Ritter and Rydqvist 1994). For example, it is documented that the average initial return on IPOs in the United States is 15.3% for the period 1960 through 1992 (Ibbotson et al 1994). On the other hand, Malaysia offers an average initial return of 80.3% given a sample of 132 underwritten IPOs over the 11-year period, 1980 through 1991 (Isa 1993).[5] Singapore

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[3] *The author thanks a referee for suggesting that the choice of the contract need not be the investment banker's only means of regulating the risk of a new issue. He suggests that the risk of a new issue is a function of both the contract type as well as the degree of "underpricing". This is observed to be the case for countries like Malaysia, where " underpricing" is being used as a re-distribution mechanism to pursue social and national objectives.*

companies also traditionally have their IPOs underwritten and these offer an average initial return of 27.0% over the period, 1973 through 1987 (Koh and Walter 1989). Australian IPOs offer an average initial return of 11.9% over the period 1976 through 1989 (Lee et al 1993). In this study of 25 financial economies, Malaysia offers the highest average initial return of 80.3% while France offers the lowest return of 4.2% over the comparable period, 1983 through 1992 (Loughran, Ritter and Rydqvist 1994).

A more recent study tests the implications of the estimation risk hypothesis for the price behaviour of fixed price and tender price IPOs on the Stock Exchange of Singapore (SES). The IPO market in Singapore offers a unique showcase for the price discovery process of risky securities (Lam 1996). Even before the incorporation of the SES in May 1973, IPOs have been offered in the primary market under the fixed price system. In July 1991, the SES introduced an option to issuers for IPOs to be offered on two-tier pricing basis. This allows issuers to incorporate a tender tranche in the public offer.

The estimation risk hypothesis implies that informed (institutional) investors who invest in information and tend to hold sizeable share holdings in any particular firm that has been selected for inclusion in their portfolio will tend to participate in the tender tranche of the IPO under the two-tier pricing system (Lam 1996). Uninformed (retail) investors who are less able to price the IPO tend to participate in the fixed price tranche of the IPO. Retail (institutional) investors bear greater (less) estimation risk and expect a higher (lower but positive) expected return on the IPO.

Consistent with the implications of the estimation risk hypothesis, the empirical findings suggest that the pricing system does preselect the typical shareholder in the public offer. A fixed price system tends to attract retail investors who tend to punt in the early aftermaket. A tender priced IPO tends to attract institutional investors who tend to have a longer investment horizon than the retail investors. Lam (1996) also concludes that shareholder and share holding compositions do

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[4] *In October 1993, Singapore Telecommunications Ltd went public with three tranches of shares. Group A shares were sold at 45% discount (at a fixed price of S$1.90) to every Singaporean who was a Central Provident Fund member aged 21 and above in order to promote share ownership among Singaporeans. Group B shares were sold at a fixed price but with no discount, also to Singaporeans. Group C shares were sold by tender to Singaporeans and foreigners. Singapore, like Malaysia, traditionally have all IPOs sold on an underwritten or firm commitment basis. To date, this public offer is the only IPO on the Stock Exchange of Singapore that is not underwritten. The IPO (at least the local portion) was effectively managed on a best efforts basis.*

affect the trading and price behaviour in the aftermarket. Specifically, the average market-adjusted initial return on fixed price IPOs on the SES before and after July 1991 is 36% and 27% respectively. These returns are found to be insignificantly different at the 5% significance level.

On the other hand, the tender price IPOs after July 1991 offer a market-adjusted average initial return of 0.36% which is insignificantly different from zero at the 10% significance level. This last finding, however, is inconsistent with the prediction of the estimation risk hypothesis that given that both informed (institutional) and uninformed (retail) investors estimate firm values with varying degrees of estimation error, the average market-adjusted initial return on IPOs offered under the tender tranche is expected to be positive.

However, it is observed that there were no IPOs that were listed under the two-tier pricing system since 1994. The "single strike price" tender system for IPOs has seen a short two-year history on the SES. In contrast, the primary market under the fixed price system has remained healthy to date. After careful consideration of the IPO market conditions before and after July 1991, the empirical evidence may in fact be consistent with the estimation risk hypothesis. What is observed could probably be a temporary disequilibrium in the tender market that arises because the successful tenderers are not being compensated for the estimation risk they bear in the primary market.

The findings suggest that estimation risk is probably priced in the IPO primary market. This study provides support for the estimation risk hypothesis as an explanation for the IPO phenomenon that is documented in most competitive financial economies, and, suggests that the typical investor in the primary market is risk averse and not risk neutral. More specifically, the findings suggest that at least a part of the estimation risk in IPOs is systematic and risk averse investors will require compensation for their participation in the IPO market.

In the context of the differential estimation risk model, it is the Securities and Exchange Commission, or its equivalent, that regulates the level of "acceptable" estimation risk of new issues in the primary markets through its listing requirements. Regulation of the secondary markets for firm value maximisation should then focus on the dissipation of information risk and the resolution of stochastic parameter risk. The issues include the amount and quality of information to be disclosed as well as the contracting options in the IPO market. If regulators would also allow for a range of contracting options to be driven by market forces, a signalling equilibrium could be maintained to

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[5] *M. Shamsher et al (1993) report an average initial return of 135% for a sample of 65 IPOs that were listed on the KLSE between 1975 and 1990.*

differentiate the low estimation risk IPOs from the high estimation risk IPOs.

IMPLICATIONS OF ESTIMATION RISK AND DISCLOSURE FOR FIRM VALUE MAXIMISATION

Regulators in the Asian economies should be focused on the motivations or the mission statement for regulation so that rules and bye-laws may be reviewed from time to time in the light of changing market structure and conditions. The traditional motivation for regulation has been the protection of the 'small' investors. This has been so in the regulation of disclosure requirements for original and continuing listings on stock exchanges.

I propose that a more positive motivation is the maximisation of firm values in the economy. The discussion of the differential estimation model and various empirical evidence suggests that firm values tend to be increased when estimation risk is dissipated or resolved with the production and dissemination of price-sensitive information in an economy.

From the perspective of the differential estimation risk model, a change in a firm's financial and investment policies shifts the mean parameter values of its return distribution. For expository purposes we suggest that given a set of financial and investment policies of a firm, it is the interaction of competitors' strategic actions, e.g. product and market innovation, or market entrants and firm failures, that causes the intertemporal variation of these parameters. I further suggest that this variation of the parameters is smaller for firms in a mature industry or market than in a new or growing one. This leads to the association of high predictability assets with firms in mature industries or markets and low predictability assets with firms in new or growing industries or markets. Given risk-averse investors and an economy with non-diversifiable estimation risk, the differential estimation risk model implies that low predictability assets will offer positive expected returns on estimation risk.

The firm size effect documents that small capitalisation firms tend to offer higher average returns than large capitalisation firms of the same risk class (Banz 1981 and Reinganum 1981). This phenomenon would be consistent with the implication of the model if such small capitalisation firms may just be these low predictability assets with high stochastic parameter risk that will offer positive returns on estimation risk.

The economic role of the investment banker in the IPO market is an excellent example of how good quality firms can increase firm value through a signalling equilibrium even though information

risk is at its highest at issue. The same principle can be applied in the seasoned stock market. Given a track record of trading in the aftermarket, the differential estimation risk model implies that, ceteris paribus, the estimation risk of an asset would be lower in the seasoned stock market than in the IPO market. The signalling problem in the seasoned stock market is therefore a lesser one than in the IPO market.

Notwithstanding, the 'lemons' problem of uncertain quality persists in the seasoned stock market. Given a continuum of estimation risk, it does pay the high predictability (quality) firms to signal for its quality to increase their firm values. One credible signal is dividend payments. In a signalling equilibrium in the seasoned stock market, low predictability (quality) firms will not be able to bear the costs to signal. Their high estimation risk will therefore persist. The firm size effect may be explained in this light since small firms generally have funding constraints and are not able to signal consistently with cash dividends.

In the context of the differential estimation risk model, regulation of continuing listings of seasoned stocks should therefore focus on the resolution of stochastic parameter risk. Regulatory disclosures determine the minimum level of information that is available to investors. Such expenses are usually borne by firms. Information that is generated in readily assimilated format using generally accepted accounting principles reduces the information costs of investors. To the extent that regulatory disclosures reduce estimation risk and investors' uncertainty over firm value, market values of publicly listed firms in the economy are increased over those in the absence of regulation.

The listing requirements cover both original listing requirements and continuing listing requirements. The continuing listing requirements regulate the announcements that have to be made to the stock exchange for release to investors. Such announcements could include those of takeovers and mergers, corporate restructure, dividends, bonus and rights, new issues and private placements, etc. Regulation also covers periodic reports and annual reports, their regularity as well as reporting format and disclosures. Regulators also reserve the right to inquire or investigate the affairs or transactions of the listed companies.

Information that discloses how the firm value would have changed with each new investment or a review of existing investments in the light of changing economic conditions and parameters, or information about corporate restructure and the decision making process would be considered as price-sensitive information. A mature financial market is characterised by the presence of public accountants, professional investment and fund managers, financial analysts and information agencies. International stockbroking houses inevitably have strong research departments in each

of their regional offices. Information agencies like Dun and Bradstreet, Dow Jones Inc., Bloomberg and Telerate generate price-sensitive information for investors and complement regulatory disclosures. Their presence increases the efficiency of information production in that economy. Regulators of financial markets should therefore look upon these international stockbroking houses and information agencies with favour.

Since the production of information is costly, there ought to be a balance between regulatory disclosures and the encouragement of independent information agencies for the efficient production of information in an economy. The fact that investors in 'small' firms earn abnormal returns is consistent with the implication of the differential estimation risk model. This phenomenon also suggests that not all estimation risk is dissipated and resolved in market equilibrium. Perhaps it is optimal for investors to bear some level of estimation risk because the production of information is costly.

CONCLUSION

This paper proposes the differential estimation risk model as a framework for the analysis of asset valuation in cases where price-sensitive information may not be readily available for agents to formulate their expectations of asset returns.

I discuss the implications of the differential estimation risk model for the regulation of original and continual listings on Asian stock exchanges in particular and the regulation of financial markets in general. The discussion suggests that the dissipation or resolution of estimation risk increases firm value. This issue is more critical in those Asian economies whose legal and financial systems are not yet developed or transparent.

I suggest that regulators may want to convince publicly listed firms that regulatory disclosures add value. Regulators would have succeeded in their mission of firm value maximisation if firms begin to *voluntarily* disclose price-sensitive information that is beyond what is required in compliance with regulation.

I also highlight the complementary role of public accountants, international stockbroking houses, financial analysts, investment and fund managers and information agencies in the production of information. I propose that it may be optimal for investors to bear some minimal level of estimation risk in the economy because information production is costly.

What regulators in Asian economies have to decide is the optimal level of disclosure vis-a-vis the amount of price-sensitive information that may be generated by information agents and agencies in the private sector. Regulators should be focused on the motivations or the mission statement for regulation so that rules and bye-laws may be reviewed from time to time in the light of changing market structure and conditions.

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