

THE EMERGENCE OF THE KNOWLEDGE ECONOMY IN THE FINANCIAL MARKETS AND ITS REFORM IMPLICATIONS*

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1. Introduction

The emerging knowledge economy is a new phenomenon in the financial markets and poses new issues in various aspects of financial decision-making. The financial sector plays an important role in macroeconomic management but many studies on financial issues relate to the microeconomic level, where the study of markets under asymmetric information has provided insights into the significance of financial factors for corporate investment decision-making. There is relatively less research done on the role of financial intermediation at the macroeconomic level in the knowledge economy. Therefore, this paper makes contribution to the literature in this area by providing a systematic integration and investigation of the financial issues in the emerging knowledge economy through an empirical investigation of the e-commerce sector in relation to economic reform vis-à-vis public policy formulation. This paper provides an empirical analysis of the important financial issues in the e-commerce financial market and draws on the Australian findings of various economic variables that influence Australian e-commerce equity value. From the empirical findings of the Australian study we are able to extrapolate and hypothesise the inferences on both regulatory and monetary policy formulation for the regional countries. The issues and their implications for creating an intellectual-asset value chain to advance the recovery and reform process are also discussed.

The objectives of this paper are: firstly to highlight the emerging issues pertaining to the development of e-commerce as a market, secondly to identify and explain the macro-economic determinants of valuation for e-commerce stocks, and thirdly to develop a new theoretical framework, using the Australian e-commerce financial data, for determining the equity value of e-commerce firms and the public policy implications thereof. The impetus driving the valuation of e-commerce firms is the fact that firms are taking strategic positions in the post-industrial economy, which is the source of future economic growth¹. This paper also provides an empirical analysis of some other important issues in the e-commerce financial market such as market efficiency, volatility and predictability.

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¹ Stefan Rover, Chief Executive Officer – Banking, BROKAT Infosystems AG, 1999.

The paper is structured as follows: Section 2 provides a review of the issues of the e-commerce sector and their relationship to economic activity and reform. Section 3 reviews the role of macroeconomic or real variables in the valuation process for equity and more specifically for e-commerce equity. Section 4 presents the empirical evidence of the tests developed in this study in relation to volatility, predictability and efficient market hypothesis, including contemporary theories of valuation of financial assets and the issues related to volatility and predictability. The implications of the Australian study are given in Section 5. Section 6 contains the conclusions of this study.

2. E-Commerce and Economic Activity

The relationships between the financial markets and real economic activity in the knowledge economy are not yet well explored. The relationship between financial markets in the knowledge economy has been studied using endogenous growth model, although the application of this approach has not been fully explored (see Agenor and Montiel 1996 for a survey). In this literature, the role of finance in economic growth via productivity growth is stressed and the adoption of some public policy to manage financial market is also implied by the general propositions of endogenous growth theory. It may be noted in this connection that one appropriate framework for specifying the elements of the knowledge economy is endogenous growth model (see Islam 2001 for a full discussion of this point). From this point, this paper studies the relations between finance, endogenous growth, and the knowledge economy in the e-commerce sector.

2.1 Emergence of the Global Knowledge Economy and the Financial Issues in the E-Commerce Sector

The factors of economic growth also include in capital stock, knowledge, science and technology, population, innovation, the supply of resources, better management practices, improved productivity, and other related economic factors. However, the accelerated rate of economic growth has modified the traditional structure and institutional basis of the economy. This has been accompanied by by-products of fundamental consequences such as globalisation, the emergence of the knowledge eco-

nomies, and regional convergences and divergences of economic growth of different countries (Islam 2001; Oh and Islam 2001; Sheehan and Tegart 1998). The important characteristics of a knowledge economy may be summarised as the following: the increasing knowledge intensity of the economy, the rise of the online economy, the rising value of knowledge and market failures, and integrated international markets and globalisation (Sheehan and Tegart 1998). With the emergence of the knowledge economy and the changes in the growth rate and structure of the economy, several issues about its analysis and management, *especially the relations between finance and real economic activities in the knowledge economy*, have originated. Some of the relevant issues of e-commerce finance in the knowledge economy are summarised in the following sections.

Most industrial economies have registered remarkable economic performance experiencing a rise in trend growth (GDP per capita) in recent years (OECD 2000). A rapidly changing economy in which information and communications technology (ICT) plays an increasingly important role in restructuring economic activities resulting in strong non-inflationary growth, high stock market valuations, low unemployment are evidence of economic progress. The pervasive role of ICT applications span across a wide range of sectors in the economy has heralded in the era of the New Economy. This development has contributed to the recent global volatility in technology stocks and raised questions about the underlying value of market capitalisations that appear to defy all conventional financial evaluations and economic fundamentals². The present market scenario for e-commerce stock valuation is unclear and at best is an inconsistent measurement of e-commerce equity investment according to traditional measures. The movements of stock prices since World War II were closely connected to the rate of economic growth and economists had no trouble in explaining the resulting stock returns by standard valuation models according to which stock prices are determined by market fundamentals. But the recent volatility of the technology stock prices are more troublesome and the question has been asked whether these stock prices can still be explained by fundamentals, or whether speculative bubbles and fads govern these prices.

The global market euphoria in e-commerce stocks raises the question of the underlying value and raises questions as to whether technology stocks are really

² Alan Greenspan's speech at the Economic Club of New York, January 2000.

worth their market value or are the brokers 'noise-trading' (Black 1986) and over-hyping these shares to euphoric investors? An argument for the current valuation of technology related stocks is that information technology, which provides the impetus for the role of macroeconomic or real variables current market boom on a global scale, is a fundamental factor transforming the economy (De Long 1996). The stock market reflects this future growth of the economy as economic growth in the post-industrial era is expected to occur at a faster rate and earnings growth would also be faster than before and this fundamentally justifies the current stock prices. Therefore, it follows that e-commerce stocks are currently valued based on the potential outcomes and economic impacts of e-commerce, the forces underlying its development. This paper predominantly considers non-standard balance sheet or income statement information as inputs to develop a valuation model that overcomes the limitations of traditional valuation methods.

2.2 Issues of the E-Commerce Stock Market

In most developing countries, the financial sector assumes a major role in mobilising domestic resources and allocating them to investment projects. A recent development in developing countries has been the larger role to private initiative in the development process such as the privatisation of major public utilities in these countries. In developed countries like United States of America and Australia, the funding for innovations in the e-commerce sector is largely by private initiative and this implies that if the developing countries are to follow this path, a larger proportion of investment is to be undertaken by the private sector. As e-commerce is an important sector of the new economy that provides a platform for economic growth, it is crucial that the financial sector, vis-à-vis e-commerce equity market, is efficient to mobilise domestic resources effectively to finance e-commerce based economic activities. The important issues in the e-commerce equity market relate to the principles of valuation of e-commerce stocks, efficiency and volatility of the market and predictability of stock prices and returns (for a review of these issues and their empirical evidence relating to the general stock market see Cuthbertson 1997). These issues are addressed below.

2.3 Real Economic Activity and Financial Markets in the Knowledge Economy

The study of the relationship between financial intermediation and real economic

activity is important to assess the potential role of improved financial intermediation in the process of economic development (Islam, Billington and Oh 2001). The analysis of this relationship commenced with pre-Keynesian monetary economics, and emphasised the relationship between financial markets and fluctuations in prices and output. Economists like Hawtrey (1919, 1928), Wicksell (1935) and Fisher (1933) accepted the loanable funds theory of interest rate that credit markets perform a key role in coordinating the inter-temporal saving decisions of households and the investment decisions of firms. Keynes' theory of investment behaviour was less definitive on the role of finance and financial intermediation on aggregate economic activity and it did not elaborate on this area other than to observe that a collapse in confidence could have a recessionary impact on the economy. The liquidity preference theory (Hicks 1937; Modigliani 1944) postulates that in a world with only money and securities, the interest rate is determined by the demand and supply of money. Post Keynesian developments in the study of financial intermediation in the economy were by Gurley and Shaw (1955, 1960) and Brainard and Tobin (1963). Gurley and Shaw suggested that financial intermediation weakens the relationship between money and economic activity and makes the economy more dependent on the complex interaction between debts and assets in the economy. Brainard and Tobin postulated that monetary policy had important real effects as it affects return on real capital. Recent studies by Goldsmith (1960), Shaw (1973) and McKinnon (1973) further advanced the relationship between financial structure and real economic activity to specify a causal role for a country's financial system in the process of economic growth. Kindleberger (1978) and Minsky (1982) also found a relationship between the state of the financial system and economic performance.

2.4 E-Commerce Stock Valuation

The conventional theory of the firm stresses that business corporations provide the specialised institutional structure that comes into being to reduce the transaction costs. With the advent and proliferation of ICT in global economies since the early 1990s, the strategic use of ICT within the firm will no doubt revive interests in its role of promoting cost efficiency and giving birth to that cyber market structure called the Internet. The theory of the firm expounds contractual relationships as a pervasive feature of economic life. New research into the tantalising effects of modern age information technology on the rules that govern exchange, vis-à-vis information exchange

(Internet), would provide the catalyst to illuminate the impact of this phenomenon on the value of a firm.

The demographics of the Internet cannot be solely addressed by conventional physical sales and marketing that are subject to geographic constraint for the number of consumers. The Internet is constrained only by the people who have access to it and make active use of it. The era of increasing returns is upon us, where diminishing returns hold sway in the traditional part of the economy – the processing industries, increasing returns reign in the newer part – the knowledge-based industries (Arthur 1996).

3. Literature on the Traditional Asset Pricing Models and Their Limitations

The idea of the rational investor and the efficient markets hypothesis (discussed below) underpin stock prices and they reflect the true value of economic fundamentals, and market efficiencies prevent attempts by investors to make excess profits. In such a market the share price will be an unbiased estimate of its intrinsic value, where investment value is the present value of the share's future cash flows as estimated by well-informed and capable investors. Various asset pricing models exist for valuing stocks and they are briefly discussed below.

3.1 Discounted Cash Flow Approach

The use of the DCF model for estimating the expected returns for e-commerce stocks poses a challenge because it is hard to find reliable estimates for key inputs, such as dividends, beta and growth rate. The higher volatility of e-commerce stock prices is likely to cause the parameters needed to estimate expected returns to fluctuate and produce wide swings in the estimated expected returns. Empirical studies starting with Shiller (1981) has shown evidence that the variability of stock price indices cannot be accounted for by information regarding dividend alone since dividends do not vary enough to justify the price movement – the excess volatility problem.

3.2 Capital Asset Pricing Model (CAPM)

The CAPM is an economic model that predicts a trade-off between systematic

risk, known as beta (β), and expected return under specific conditions. It proves that the relationship between prices of assets in a general equilibrium, where the investors select assets to maximise the mean-variance utility, is linear. Although the CAPM is widely used there are many criticisms (Roll 1977) against it. The evolving nature of the e-commerce sector creates a situation where information is dynamic with the constant introduction of unanticipated operating conditions in the industry, creating information surprises that cause e-commerce stocks to move in a magnitude or direction not predicted by CAPM.

3.3 Factor Models

Sharpe (1965) described factor models as 'return-generating' statistical models that assume that the return on a stock is sensitive to the movements of various factors or indices. The two main factor models are the one-factor market model and the multiple-factor models. Depending on the number of predicted variables, the techniques of simple or multiple regression analyses are used to define the return-generating process.

The market model is a well-known single-factor model in finance that assumes that the monthly rate of return on a stock (R_{it}) is linearly related to the monthly rate of return on the overall stock market (R_{mt}). In contrast to the CAPM Model, the Market Model (MM) is a statistical model linking *ex post* returns on a stock to those on the market. The MM can be used to determine the level of stock return that is unrelated to the return on the market. The variable of interest would hence be the stock return unrelated to general market return, represented by the regression residual from estimating the regression line and referred to as an abnormal return. By removing the portion of the return that is related to variation in the market's return, the variance of the abnormal return is reduced. The advantage from using the MM will rely on the *R*-squared of the MM regression. The higher the *R*-squared, the greater is the variance reduction of the abnormal return, and the larger the benefit.

The multiple-factor model is a 'return-generating process' statistical model that describes how the return on a stock is produced by identifying major economic factors (variables) that systematically move the prices of all stocks. The factors are the characteristics being measured and could be anything that can be objectively identified and scored.

Factor models potentially provide the benefit of reducing the variance of the abnormal return by explaining more of the variation in the normal return. This variance reduction is typically the greatest in cases where the sample firms have a common characteristic, in this case of e-commerce firms, when they are all members of one market sector or industry (considered as such) and are grouped into sectors under one market capitalisation group (Campbell, Lo and MacKinlay 1997).

3.4 Asset Pricing Implications for E-Commerce Equity

The value of e-commerce stocks is influenced by the level and rate of development of intellectual property in the economy. In spite of its growing importance, there is no absolute valuation method for intellectual property (Dabek 1999). The limitations of conventional approaches compel the use of real economic activities, in an integrated and analytical manner, to visualise the economic logic behind e-commerce development. Fama (1970, 1990) conducted extensive study of the relation between stock market returns and fundamental economic activities in the United States. Huang and Kracaw (1984) and Chen (1991) have modelled the relation between asset prices and real economic activities using factors such as productivity, growth rate of gross national product, production rates, yield spread, inflation, unemployment and other real activity indicators.

3.5 Limitations of Current Models

The discounted cash flow models for stock valuation where future dividend are discounted at a constant rate poses two problems, the absence of earnings in the vast majority of e-commerce firms and the argument that stock prices are too volatile to be rational forecasts of future dividends discounted at a constant rate (Shiller 1981). The absence of the earnings data required by and the limitations of traditional valuation models makes it imperative that proxies and alternative models be used to determine the value of stocks of many e-commerce firms.

3.6 Volatility and Predictability of the E-Commerce Sector

The implications of the EMH in e-commerce stocks relate to the efficient allocation of capital in the sense that under the EMH market financing conditions and the firm's

cost of capital are optimal. It follows that if markets are efficient there is no need to defer projects or for government intervention. The measure of volatility of the e-commerce stocks vis-à-vis other market benchmarks and statistical analysis is crucial as a further test of market efficiency for the allocation of financial resources. If the e-commerce prices do not reflect market fundamentals then resources will be misallocated and hence volatility tests are joint test for informational efficiency. The predictability of e-commerce stock returns depends on the statistical analysis of the random walk hypothesis of the stock prices. If e-commerce stock prices were unpredictable, such test would support the rational expectation element of the EMH that forecast errors should be zero on average and uncorrelated with any information available at the time the forecast was made. The EMH emphasises that it is impossible for investors to persistently make supernormal profits.

It is also argued in the mainstream financial economics discipline that it is possible to develop stock market models based on the EMH to assess the predictability and volatility path of stock prices and returns (Cuthbertson 1997).

3.7 Efficiency of the Stock Market

The mainstream concepts, issues and methods in financial economics are based on the theory of efficient market (see Cuthbertson 1997 for a review). The EMH predicts that share prices fairly reflect all information that has been fully revealed to the market. Then the stock price only moves in response to new information that, by definition, is unpredictable. Information technology, which underpins e-commerce, is interpreted as a fundamental factor transforming the real economy to high profit growth in the future (De Long 1996). In the context of EMH, this implies that the stock market reflects the future growth of the real economy because investors have incorporated this high growth expectation into their investment decisions and therefore fundamentally justify the stock prices.

4. Methodology and the Approach of This Study

The approach adopted in this paper is based on the postulate that there exists a fundamental relationship between the financial markets and real economic activity. The positive market valuation of e-commerce firms, even when they have yet to earn

a profit, suggests investors clearly expect the increasing economic importance of the e-commerce sector in generating revenue for these firms. The Australian Government estimated the economic impact on the level of national output through increased use and development of the Internet to be an annual 2.7% increase (OECD 2000). The traditional approach of stock valuation is generally based on the recent earnings trend of the firm plus forecasts reflecting the economic prospects for the economy, industry and the firm. The valuation of e-commerce stocks based on current and likely future earnings performance poses a problem in that no past earnings or limited financial performance records are available for meaningful valuation and the process must therefore piece together information on forecasts of the overall economy and the conditions of the capital markets, to estimate or extrapolate a fair price. The absence of earnings time series data for e-commerce firms made it imperative that surrogates are used for estimating a firm's potential earnings. This situation has resulted in e-commerce consultants and researchers using such indicators as web-based metrics (Hagel and Armstrong 1997; Bontis and Mill 2000; Demer and Lev 2000; Trueman, Wong and Zhang 2000), 'cash burn' rate (Demer and Lev 2000), research and development expenditure (Hand 2000; Amir and Lev 1999), revenue and expenses (Amir and Lev 1999; Bontis 2000; Demer and Lev 2000; Hand 1999; Trueman *et al.* 2000). These 'value drivers' are fundamentally firm-specific indicators used to estimate and extrapolate its growth potential. This method of factor portfolios based on e-commerce sector-specific characteristics is consistent with the theoretical approach for factor selection mentioned in this paper. While real activity variables provide the indicators and underpinnings for economic performance of the general market, the variables that would signify potential growth impetus for the e-commerce sector are more specific and overt.

4.1 Methodology and Econometric Methods

Due to the nascent development of e-commerce, we hypothesise that new economic issues regarding e-commerce are emerging that have wide macroeconomics and e-commerce stock valuation implications and therefore public policy and hence reform relevance. The broad methodology adopted in this paper is as follows:

- (i) analyse and put the recent e-commerce stock price volatility and return into perspective to gauge its volatility in relation to return against the general market and between sectors;

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- (ii) develop an econometric multifactor model for e-commerce stock returns to identify and estimate the factors that are most likely to pervade e-commerce stock value;
 - (iii) test the predictability of stock returns using the combined explanatory power of the factors and analyse the ramifications of these factors for e-commerce investments and economic reforms;
 - (iv) make inferences from the perspective of the implications for public policy decision making.

4.2 A New Valuation Approach for the E-Commerce Equity Market

Macroeconomic analysis generally focuses on changes in macroeconomic conditions as a result of changes in government policies, market structure, technology, culture and other reasons. As these factors change, expectations about the performance of a particular firm, industry and economy will change and affect the investment weighting given to a particular sector. There is commonality in the view that the variations in expected returns are rational variations in response to market conditions (Chen 1991; Schwert 1990; Fama 1989, 1990). This research adopts the fundamental factor approach to estimate return for e-commerce equity from an ex post perspective. The advent of the Internet has been both pervasive and significant, affecting all market aspects including government policies, competition, lifestyle, costs and growth perception.

Unlike the traditional approach of stock valuation, the valuation of e-commerce stocks based on current and likely future earnings performance poses a problem in that past earnings financial performance records are limited for meaningful economic projections and the process must therefore piece together information on forecasts of the overall economy and the conditions of the capital markets to estimate and extrapolate a fair price. To address this situation a new model (the AEMM model) is developed in this study, specifying macroeconomic factors, for the estimation of e-commerce stock value. The model consists of several local and international factors that influence a particular financial market, namely, the Australian financial market. The factor identification process in this study seeks to ensure that equity investments in the e-commerce sector will maximise financial returns when these variables are included in the risk analysis. This paper adopts an important and recent approach to econometric specification, estimation and testing in relation to e-commerce stock valua-

tion. The AEMM model along with some other quantitative methods is used to address other financial issues in the e-commerce sector. Econometric analyses including stationarity tests, cointegration modelling, volatility and predictability analyses and efficient market hypothesis checks are performed. The empirical findings of this Australian study and their implications for reform of public policies in Asia are stated.

For many e-commerce firms, the emphasis is on long-term growth as opposed to current profitability. Traditional asset pricing methodologies, such as those of Sharpe (1964), Lintner (1965b), Black (1986), Merton (1973), and show that the expected return on a financial asset is a linear function of its betas or covariances with some systematic risk factors or market factors. This paper adopts the theoretical approach to specifying factors and the variable factors to be analysed are classified into two categories of economic and capital markets factors, and the purpose is to identify the causality relation of these variables to e-commerce stock returns. The selected macroeconomic and financial markets state variables closely related to e-commerce development and empirical financial studies of the stock market.

The technique of factor analysis is used to analyse data within the broader multivariate linear model developed in this paper. Traditional asset pricing methodologies, such as those of Sharpe (1964), Lintner (1965), Merton (1973) and Ross (1976) show that the expected return on a financial asset is a linear function of its betas or covariances with some systematic risk factors. The multi-beta models generalise the concept of risk under the traditional CAPM that market risk, risk that cannot be diversified away, underpins the pricing of assets. Market risk is measured using a series of risk factors that determine the behaviour of asset returns, whilst the CAPM measures risk only relative to market return.

The situation facing e-commerce stocks, as a reflection of the Internet as a business medium, is that it is still in a relatively early stage of development, complex and not fully understood. The CAPM, with all its controversies, can afford a simple model that is easier to understand, test and use to abstract from the noisy complexity of the e-commerce stock scenario. It will be used to describe what is occurring in regard to e-commerce stock volatility through analysis of the variability of past returns; also the findings will serve as the foundation for the forecast of the expected returns and as a basis for constructing a more effective model. A general representation of the multiple-factor model can be written as:

$$stockret_{it} = \alpha_i + (\beta_1)_i(F_1)_t + (\beta_2)_i(F_2)_t + \dots + (\beta_k)_i(F_k)_t + \varepsilon_{it}$$

where: $stockret_{it}$ = the return of stock i in period t ;

α_i = the expected value if each factor has a value of zero;

$(F_1)_t$ & $(F_k)_t$ = the values of factors 1 ... k with pervasive influence in period t ;

$(\beta_1)_i$ & $(\beta_2)_i$ = sensitivities of stock i to the factors;

$(\beta_k)_i$ = the change in the return on stock i per change in factor k ; and

ε_{it} = random error term.

The specific model developed in this study is presented in Section 5.3.1 below.

4.3 Financial Econometric Methods

The objective in multiple regressions is to identify the relationship between an exogenous variable and multiple endogenous factors and that the factors capture economy-wide systematic risks. The cointegration analysis is in two stages: the unit-root test to determine their non-stationarity and, when the results indicate that the first-differenced series of each variable are stationary, a subsequent test to determine whether these two variables are cointegrated. Stationarity is a state of statistical equilibrium when a series of observations have the same distribution over time (an invariant distribution function). Stationarity is used in time series econometrics to test for stability of the relationship between two or more variables over time. This enables a better understanding of the relationship when there is stationarity in the time series and the β does not change arbitrarily over time. This study also conducts cointegration tests to investigate the relation between stock underlying macro-variables. If economic variables are significant and consistently priced in e-commerce stock returns, they should be cointegrated. This co-integration relation between e-commerce stock returns and the underlying factors is a necessary condition of the equilibrium model of stock market returns. The test for unit root is first done using the autoregressive process of order one AR(1) model. The model assumes no hierarchical structure for the factors, hence no orthogonalisation is done.

5. Empirical Analysis – Data and Results

5.1 Data

The e-commerce firms in this study are selected from the population of pure-play e-commerce companies from a variety of sectors listed on the Australian Stock Exchange. The definition of pure-play e-commerce firms are those firms whose business activities are exclusively e-commerce based, including those with a few embryonic e-commerce businesses, and rely on their e-commerce/Internet expertise to provide the impetus for future growth. The proxy for market return for the study period is calculated from the closing *SP/ASX 200* index on the last trading day of the month in the period from July 1999 to June 2000. The stock prices are the closing prices of the e-commerce firms on the last trading day in each month obtained from the Australian Stock Exchange. The twenty-four macroeconomic variables (see Islam and Oh 2000) used are monthly data for the corresponding period as the stock market data, selected from various sources such as the Australian Bureau of Statistics, financial web sites and the Reserve Bank of Australia.

5.2 Econometric Study and Results

5.2.1 E-Commerce Stock Valuation and Volatility

The tendency of a stock to move up or down with the market is reflected in its beta coefficient, β . The total risk associated with the e-commerce stocks is decomposed from the analysis of variance (ANOVA) of the stock return to market return regression by dissecting it into systematic and unsystematic risks. The systematic and unsystematic risk profile, as measured by the market index, indicates that the e-commerce stocks were to a large degree subject to unsystematic risk (82%) rather than systematic risk (18%) in the study period (Islam and Oh 2000). This means that there was less of a tendency for the e-commerce stock prices to move together with the general market variability and unsystematic or firm-specific risk explains 82% of their variance. This situation can be explained by the higher return variability of the e-commerce stock portfolio; where monthly σ equals 49.82%, compared to the general market monthly σ of 3.13%.

From Table 1 below, volatility measured against the market, represented by beta, is generally higher for most sectors and implies that the majority of e-commerce stock returns were more volatile than the market return in the study period. From the perspective of risk-return relationship, the risk and return trade-off appears not to hold in the sample stocks in the study period.

Table 1: Relative Market Volatility of Sectors and Trade-off Between Risk* and Return

Sector	Beta	Return	SD
Health & Medical Services	19.86	0.39%	1105.33%
Miscellaneous Services	6.39	5.41%	47.04%
Retail/Retail Investment	5.22	4.20%	29.74%
Diversified Media	5.00	0.67%	28.99%
Computer & Office Services	4.93	0.07%	30.32%
Equipment & Services	4.25	26.97%	140.37%
Other Telecommunications	3.74	2.67%	21.38%
Miscellaneous Financial Services	0.57	0.44%	30.69%
Casino & Gaming	0.03	24.06%	56.33%
High Technology	-0.26	-1.26%	27.45%

*ranked in order of beta
Source: Islam and Oh (2000).

Though e-commerce firms have a number of advantages over traditional firms such as lower operating costs, the recent market consolidation³ of e-commerce stocks indicates a reaction to market risks and conditions faced by this sector and investors are constantly studying to see how changing technology will end up transforming the market. This confirms the general systematic risk level of the e-commerce stocks and that they move predominantly in a volatility sphere of their own, and relatively independent of the market.

5.3 The Multivariate Regression Model – Results

The following sections present the results of the tests done in estimating the multi-beta models for e-commerce stock valuation.

³ April 2000, when the market index dipped predominantly due to the fall of stocks in the e-commerce sector.

5.3.1 Stationarity Tests and Cointegration

The tests of stationarity or unit root tests are conducted on the factors that have been tested to be statistically significant at the 20% level in the estimated regression equations. The factors to be tested are *MRP*, *IP*, *NAS*, *CC* and *FE* as they all have been tested to be statistically significant at the 20% level, at least once, in the sectors analysed. *IP* was tested to be an explosive series and was excluded from the regression equation, the *R*-squared of the estimated regression equation increased to 64.82% as opposed to 48.12% after the exclusion. *MRP* had a *t*-statistic of 0.3749 and was insufficient to reject the null hypothesis. The rejection of the *MRP* factor may be construed that the CAPM as being less inappropriate for pricing e-commerce stock return, where the beta is the coefficient with the *MRP* factor.

From an e-commerce portfolio perspective these three explanatory variables have the strongest influence on e-commerce stock return across all the stocks and sectors evaluated in this study. They remain statistically significant even when we use a more stringent significance level of 10% ($c = 1.943$). Of the three pervasive factors, *NAS* and *CC* have a positive correlation and *FE* has a negative correlation with the return of the portfolio of e-commerce stocks.

On the basis of the criterion of goodness of fit, the following equation best explains Australian e-commerce stock returns in the study period:

$$\text{stockret}(\Delta \text{PR})_t = -0.1900 + 0.0013\Delta \text{NAS}_t + 0.0692\Delta \text{CC}_t - 0.3287\Delta \text{FE}_t$$

$$\quad \quad \quad (-1.2772) \quad (3.7657) \quad (1.9345) \quad (-2.1045)$$

$$R^2 = .6421$$

All three factors in the estimated equation are statistically significant at the 10% significance level (*t*-statistics in parentheses) and this validates the present model and confirms the evidence of their pervasiveness on the portfolio return of the e-commerce stocks. While systematic risk measured by the *NAS*, *CC* and *FE* factors explain more than half of the variance (56.62%) of the e-commerce portfolio return *PR*, in the equation. Such systematic risk level is consistent with empirical study done by Drummen, Martin, Zimmermann and Heinz (1992) where systematic risk explains almost half of the variance of European stocks. The estimated model therefore provi-

des a better measure of e-commerce portfolio return compared to the average 17% systematic risk level by the market model using the S&P/ASX 200 as the market index in this study.

A regression for testing cointegration involving the first differences, Δy_t and Δx_t , for each of the following equations (1) to (3), on the dependent variable *stockret*, with each of the three pervasive factors of NAS, CC and FE using the Dickey-Fuller test is conducted as follows:

$$\text{stockret}(\Delta PR)_t = \hat{\alpha} + \hat{\beta} \Delta NAS_t; \quad (1)$$

$$\text{stockret}(\Delta PR)_t = \hat{\alpha} + \hat{\beta} \Delta CC_t; \quad (2)$$

$$\text{stockret}(\Delta PR)_t = \hat{\alpha} + \hat{\beta} \Delta FE_t; \quad (3)$$

The results are presented in Table 2 below.

Table 2: Cointegration Statistics of Series with First Differences

Cointegration Series	Critical Value*	t-statistic ($\hat{\mu}_{t-1}$)	p-value	
Equation 1 (ΔNAS)	-3.04	-5.3614	0.0003	Cointegration
Equation 2 (ΔCC)	-3.04	-3.7237	0.0040	Cointegration
Equation 3 (ΔFE)	-3.04	-3.7076	0.0041	Cointegration

*Asymptotic Critical Values from Davidson and MacKinnon (1993), at the 10% significance level and no time trend.
Source: Islam and Oh (2000).

From Table 2, the t -statistic of ($\hat{\mu}_{t-1}$) for all the explanatory variables *NAS*, *CC* and *FE* are all below the asymptotic critical value of -3.04 at the 10% significance level. This is evidence that the variables are cointegrated for variables running a regression involving the first difference of their time series.

5.3.2 Efficient Markets Hypothesis Implications

In this study, the EMH is tested using the regression based method; using the three significant and pervasive factors that contain such information about e-commerce, equity investment opportunities are reflected in the *NAS*, *CC* and *FE*.

Following the practice for testing market efficiency in the literature, asymptotic analysis is used to test the weak-form EMH that information observable to the market prior to month t should not help to predict the return during the month t for the e-commerce sector return. The estimates for the EMH tests by sector are presented in Table 3 below.

Table 3: Summary of Results for Efficient Market Hypothesis Tests

Sector/return _{t}	α	return _{$t-1$} β	p^2
Casino & gaming	0.3080	-0.2154	0.0466
t -statistic	1.5486	-0.6992	
Computer & office services	0.0180	0.2540	0.0643
t -statistic	0.2358	0.8293	
Diversified media	0.0071	0.0832	0.0068
t -statistic	0.1055	0.2625	
Equipment & services	0.3048	-0.1128	0.0126
t -statistic	0.6745	-0.3579	
Health & medical services	2.5156	-0.1135	0.0129
t -statistic	1.0342	-0.3614	
High Technology	-0.0842	-0.1091	0.0121
t -statistic	-1.3801	-0.3505	
Miscellaneous financial services	-0.1039	-0.3255	0.1079
t -statistic	-1.7035	-1.0998	
Miscellaneous services	0.1416	0.2634	0.0621
t -statistic	1.1165	0.8137	
Other Telecommunications	0.0257	0.0573	0.0032
t -statistic	0.3802	0.1800	
Retail/retail investments	0.0599	0.1551	0.0169
t -statistic	0.7788	0.4149	
Portfolio	0.1658	0.1578	0.025
t -statistic	1.0487	0.5061	

Source: Islam and Oh (2000).

From Table 3, the results of the hypothesis testing imply that for all sectors the informationally efficient markets hypothesis prevails at the 10% significance level (critical value = 1.812). This suggests that e-commerce stock prices reflect all historical information regarding the underlying firm and the market responds immediately to new information regarding the firm. This characteristic can be reconciled with the dynamic nature of Internet development that is constantly changing as the virtual market evolves to incorporate new technologies, ideas and business models. Any piece

of past information would be rendered irrelevant or obsolete, whilst new information is rapidly factored into the stock price by investors.

5.3.3 Predictability

The weak-form EMH tests using the autocorrelation of returns data suggest the validity of the EMH for the returns of the e-commerce stocks in this study. The low R-squared of these tests supports the EMH (Table 3). This indicates the tests based on (*ex-post*) real returns cannot be used to predict excess returns. De Bondt and Thaler (1985) finds stocks with extreme price movements appear to have strong negative serial correlation of returns and are thus mean reverting. This would be contrary to the EMH in that it would be possible to make supernormal profits from predictability in stock prices. For the constructed e-commerce portfolio, there is no evidence of negative serial correlation except for some industry groups at the sector level. A longer time series data would be necessary to conduct a meaningful study of this volatility issue for the e-commerce stocks.

6. The Reform Implications from This Study

The Internet, which spawns e-commerce, is a new market infrastructure in a nascent stage of development and with its potential to pervade all facets of the economy is probably too important to be left entirely to market forces. The results of this study that the e-commerce stocks have a high unsystematic risk profile imply that the appropriate government actions for enhancing equity market efficiency in the e-commerce market as a means to minimise investment risk would be more definitive public regulations and/or more adept and literal information dissemination about the e-commerce market development. Romer (1992) and Soete (1997) find the need for government intervention to sustain investment in knowledge and Lehman (1996) suggest that US economic growth in the next century will be determined by the government creating incentives for private sector investment in R & D and fostering and promoting intellectual property.

The following conclusion can be made from this study into the financial issues of Australian e-commerce stocks on the basis of the empirical evidence generated to provide a theoretical foundation for formulating policies in the Asia region pertaining

to e-commerce equity market development:

The market model analyses highlight the excessive volatility of the e-commerce stock returns against market return, which can be explained by the high level of unsystematic risk element (low R^2) in these stocks. This implies a low correlation of e-commerce returns to the market return in terms of their prices reflecting similar economic fundamentals. This is interpreted as a strong presence of event effects in e-commerce stock prices in the market.

Australian e-commerce stocks are subject to higher unsystematic risk (82%) level than systematic risk (18%), measured by the *S&P/ASX* 200 market index.

The fact that e-commerce firms are subject to a relatively high level of unsystematic risk suggests that e-commerce sector return may react more aggressively to idiosyncratic economic factors than the traditional factors identified in other empirical studies.

From the covariance and correlation studies, the e-commerce stocks do covary and reflect the fact that e-commerce firms tend to have similar characteristics or properties being subject to the same market conditions of Internet development.

In general, these findings imply that the NASDAQ composite index, consumer confidence and foreign exchange rate between the Australian dollar and US dollar are significant factors in predicting changes in e-commerce stock return and it can be claimed that e-commerce stock returns variability is fundamentally linked to these variables.

The systematic risk measured by the NAS, CC and FE factors using the estimated model explains more than half of the variance (56.62%) of the e-commerce portfolio return, PR. This indicates that 56.62% of Australian e-commerce stock variance is specified but individual stock may vary from this benchmark.

The proof of EMH shown by tests done does not rule out the possibility of positive feedback traders or noise traders in the markets for e-commerce stocks. Visual analysis of the return spread, betas and standard deviations for the e-commerce stocks appears to indicate excessive volatility, which is a characteristic of the e-commerce financial market as discussed in Section 2, than would be suggested by the change in fundamentals (or pervasive factors NAS, CC and FE) under the EMH.

In the midst of the Internet market euphoria, e-commerce stocks are perceived as growth stocks whose value is driven partly by the NASDAQ composite index, consumer confidence and strength of the Australian currency (AEMM). The AEMM only explains part of the e-commerce value ($R^2 = 64\%$) due to these systematic factors and fund managers who ignore the noise would do so at the peril of missing the boat of higher returns while knowing that the risk associated with these firms may be high by traditional standards and their earnings doubtful. The trading approach may be to adopt an active tactical asset allocation (TAA) strategy for risk management. Lakonishok, Shleifer and Vishny (1994) suggest the return of growth stocks may be better explained by characteristics rather than risk and propose an agency rationale, that, fund managers are aware of the expected returns of value stocks but may prefer growth stocks because they are easier to justify to investors. This explanation can equally apply to e-commerce stocks.

The above results have relevance for Asia in the form of their implications suggesting intertwined, however complex and apparently fragile, relationships between financial activities and real economic performance and therefore the need for proactive government strategic intervention in e-commerce sector for effective and efficient financial management and development in the sector.

It may be noted that the case of Australia is used in this paper for comparing e-commerce development between Australia and Asian countries for the following reasons:

- Australia and Asian countries are in the same region considered to enjoy high Internet growth and are also at the same stage of e-commerce development;
 - Like Australia, e-commerce market development in Asian countries relies on leads from the US e-commerce sector;
 - Australia's well-developed education system provides the impetus for intellectual property development, which is crucial for the growth of e-commerce infrastructure;
 - Australia's e-commerce development policies within the context of an industrialised and a free market economy in the development of the sector provides an ideal contrast to the proactive and strategic interventionist role of Asian governments; and
 - Using Australia as a benchmark study avoids the incident of survivorship bias associated with a US study.
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7. Conclusions

The following conclusion can be made from this study into the financial issues of Australian e-commerce stocks on the basis of the empirical evidence generated to provide a theoretical foundation for formulating policies in the Asia region including the Indian sub-continent pertaining to e-commerce equity market development. From the recent global experience on the volatility of e-commerce equity market, there is a need for public policy to cultivate involvement in the e-commerce sector, so that the sector operates efficiently in an economically and socially desirable manner. This is consistent with studies of financial intermediation in the economy by Gurley and Shaw (1955, 1960) and Fry (1988), and endogenous growth theory where it is implied that financial intermediation may weaken the relationship between money and economic activity and may make the economy more dependent on the complex interaction between debts and assets in the economy and that the adoption of public policy is justified for proper financial management for economic development. The accomplishment of social and economic objectives in relation to e-commerce development must therefore require government intervention. Brainard and Tobin (1963) postulated that monetary policy had important real effects as it affects return on real capital and it is also through such policy that government can influence the allocation of capital to the development of e-commerce. The focus of public policy should be directed at minimising the problems of moral hazard and adverse selection in the e-commerce equity market. These problems are more evident due to the nascent and evolving nature of e-commerce development creating a situation of asymmetric information.

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Abstract

The knowledge economy as a new market system for intellectual assets has created an ever-broadening spectrum of industries crucial for economic growth and the continuing economic recovery and reform of the regional economies. This contributes to economic development and competitiveness of the regional economies. The transformation of traditional markets to an intellectual-asset value chain is largely encouraged and facilitated by the development of e-commerce. The advance of e-commerce has been hastened by the interest in e-commerce equity investment and is a new phenomenon in the financial markets. In this paper, we conduct a review of the equity capital market as a primary source of funding for e-commerce business venture in terms of market efficiency, equity returns, volatility and predictability, and their implications for economic reforms and development in the region. The factors contributing to e-commerce equity value in the financial markets are identified, analysed and explained using a recent approach to econometric specification, including stationarity tests and cointegration modelling.