THE IMPLICATIONS OF INFORMATION PROCESSING EFFICIENCY ON DECISION MAKING

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The Implications of Information Processing Efficiency on Decision Making

by

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WORDS OF INSPIRATION

He who dwells in the secret place of the Most High

Shall abide under the shadow of the Almighty

I will say of the LORD, "He is my refuge and my fortress;

My God, in Him I will trust."

(Psalms 91: 1 – 2)

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DECLARATION OF AUTHORSHIP

I, **Eng Tuck CHEAH**, declare that this thesis and the work presented in it are my own and have been generated by me as the result of my own original research.

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I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;

2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;

3. Where I have consulted the published work of others, this is always clearly attributed;

4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;

5. I have acknowledged all main sources of help;

6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;

7. Either none of this work has been published before submission, or parts of this work have been published as [please refer to "**Publications from Research**" on page xii]:

This thesis is based on work done by myself jointly with others. The following table outlines the contribution(s) of the respective individuals with respect to my thesis:

Chapter	Co-Author(s)	Contribution(s)
Information Processing Efficiency and Related to the Role of the Individual Demography in Decision Making: An Empirical Examination of the Socially Responsible Investors and their Corporate Social Responsibility Attitudes	**Dr. Dima Jamali** Associate Professor of Management Suliman S. Olayan School of Business American University of Beirut	Providing feedback on drafts of the paper
	Professor Johnnie E. V. Johnson Professor of Risk and Decision Analysis School of Management University of Southampton	Supervisor - provided advice and suggestions based on earlier drafts of the paper
	Dr. Ming-Chien Sung Senior Lecturer in Management Science School of Management University of Southampton	Supervisor - provided advice and suggestions based on earlier drafts of the paper
Information Processing Efficiency related to the Role of Motivation in Decision Making: An Exploratory Study into the Demand for Horserace Wagering Across Sectors of the Pari-Mutuel Market in a Multi-Competitor Environment	**Dr. Richard Thalheimer** Thalheimer Research Associates Kentucky, US	Providing feedback on drafts of the paper
	Professor Johnnie E.V. Johnson Professor of Risk and Decision Analysis School of Management University of Southampton	Supervisor - provided advice and suggestions based on earlier drafts of the paper
	Dr. Ming-Chien Sung Senior Lecturer in Management Science School of Management University of Southampton	Supervisor - provided advice and suggestions based on earlier drafts of the paper
Information Processing Efficiency related to Speed of Adjustment in Decision Making: Equity Market Size and Financial Integration in the Asia Pacific Region	**Professor Hui-Boon Tan** Professor of Business Economics and Finance Nottingham University Business School University of Nottingham Malaysia Campus	Providing data and feedback on drafts of the paper
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and suggestions based on
earlier drafts of the paper

PUBLICATIONS FROM RESEARCH

Chapter	Output

1   *Information Processing Efficiency and Related to the Role of the Individual Demography in Decision Making: An Empirical Examination of the Socially Responsible Investors and their Corporate Social Responsibility Attitudes*

Journal:

"Drivers of Corporate Social Responsibility Attitudes: The Demography of Socially Responsible Investors" (with Dima Jamali, Johnnie E.V. Johnson and Ming-Chien Sung) **British Journal of Management (2010) –** *In Press.* 2009 Social Science Citation Impact Factor: 1.448. Listed in ABS Academic Journal Quality, UK(4)

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British Academy of Management Annual Conference (2010) (University of Sheffield, Sheffield, UK) "Drivers of Corporate Social Responsibility Attitudes: The Role of Demography of Socially Responsible Investors" (with Dima Jamali, Johnnie E.V. Johnson and Ming-Chien Sung)

3   *Information Processing Efficiency related to Speed of Adjustment in Decision Making: Equity Market Size and Financial Integration in the Asia Pacific Region*

Journal:

Earlier work on this chapter is published as:
"Stock Market Capitalization and Financial Integration in the Asia Pacific Region" (with Johnnie E.V. Johnson, Ming-Chien Sung and Chong-Hin Chuah) **Applied Economics (2009) –** *In Press.* 2009 Social Science Citation Impact Factor: 0.404. Listed in ABS Academic Journal Quality, UK(2)

Conferences:

European Financial Management Symposium on Asian Finance (2010) (Renmin University, Beijing, China) "The Dynamic Stock Market Capitalization Integration in the Asia Pacific Region" (with Hui-Boon Tan, Johnnie E.V. Johnson and Ming-Chien Sung)

18th European Financial Management Association Annual Conference (2009) (Bocconi University, Milan, Italy) "Does Size Really Matter Across Time? Financial Integration Dynamics and Stock Market Capitalization in the Asia Pacific Equity Markets" (with Hui-Boon Tan, Johnnie E.V. Johnson, Ming-Chien Sung and Chong-Hin Chuah)

Signed:...

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ABSTRACT

This thesis investigates the implications of information processing efficiency on decision making with respect to the ability of decision makers to process information in a rational and timely manner. In order to examine the different aspects of information efficiency with respect to decision making, three different settings were used. First, attitudes and perceptions held by individual decision makers play an important role in the information processing stage of a decision. Therefore, the first thrust of this thesis seeks to investigate the impact of demographic characteristics of decision makers (socially responsible investors (SRIs)) on their attitudes and perceptions (in relation to their corporate social responsibility (CSR) views). The results show that demographic characteristics are useful predictors of CSR views held by SRIs. This implies that companies can reduce their cost of capital by attracting the affluent members of SRIs community and increase their CSR rankings by creating diversity in their corporate boardrooms. These efforts, if undertaken by companies, can help increase share price of the respective companies. Government agencies can also encourage companies to implement CSR agendas by requiring companies to implement CSR agendas which will appeal to the specific members in the SRIs community (clientele effect). Second, the ability of decision makers to process information in a rational manner can be seriously undermined when decision makers are expected to match the different motivations underlying their own or others' objectives with the multiple choices which are available to them. In the second thrust of the thesis, a state contingent (UK horseracing pari-mutuel betting market) with multi-competitor choices is used to illustrate the discovery of the determinants of demand (day-of-the-week, weekend, public holiday, number of races in the same hour, field size, televised races, flat and jump races, race quality, timing of the race during the day, insider trading, track conditions, bookmakers' over-round and risk attitude of bettors) unique to different groups of decision makers (bettors). The results demonstrate that unique sets of determinants can be used to identify the different types of decision makers (that is, sophisticated and unsophisticated bettors). Clearly, the discovery of these unique determinants for demand can be used by the respective authorities (British Horseracing Board, Horseracing Betting Levy and Tote boards) in deciding which variables are important to influence the behavior of the respective decision makers (bettors and horseracing authorities). Third, decision makers ought to be able to arrive at a decision in a timely manner. The third thrust of this thesis attempts to investigate the speed of adjustment with respect to the arrival of new and unexpected information in understanding the financial integration process in the Asia Pacific region (APR). Using stock market capitalization as a measure of equity market size, it was also found that more advanced equity markets are more informationally efficient that those less advanced equity markets possibly due to the fact that the infrastructure which supports information flow enables information to be easily accessible by investors for decision making. The results suggest that a more integrated equity market in the APR can lead to a greater speed of adjustment with respect to information shocks. Therefore, domestic governments have a role to play in ensuring the necessary infrastructure to facilitate information flow is improved and better integrated with neighbouring equity markets. Finally, the thesis concludes that demographic characteristics play an important role in influencing the rational information processing involved in decision making by individuals. When confronted with choices, decision makers are affected by their various motivations and those who seek to capitalise on others' decisions need to be aware of these motivations. In addition, the infrastructure on which information flows is essential in influencing the speed at which information is processed.

INTRODUCTION

Aims of Thesis

This thesis investigates the implications of information processing efficiency on decision making. The efficient market hypothesis (EMH) which forms the bedrock in which many modern financial theories are based makes two important assumptions regarding information processing with respect to decision making. First, decision makers are able to process information in a rational fashion. Second, these decisions should be made in a timely manner. However, recent developments in financial economics especially in the area of behavioral finance have shown that decision makers can be irrational in their reaction to the arrival of new and unexpected information. In particular, decision makers themselves are not free from individual biases and these inherent biases impair their ability to process information rationally. Another source of information processing error can be introduced in the decision making process when decision makers are confronted with choices. The theory of individual choice and the theory of interactive behavior argue that decisions are subject to the motivations of the respective decision makers and how they react to information made available to them from the environment. However, the assumption of homogeneity of decision makers by the theory of individual choice and theory of interactive behavior under the EMH framework failed to account for heterogeneity in the motivations by individuals in decision making. Therefore, the overall objective of this thesis is to examine the implications of information processing efficiency on decision making. Therefore, in order to examine the different aspects of information processing efficiency with respect to decision making, three different settings were used:

First, attitudes and perceptions held by individual decision makers play an important role in the information processing stage of a decision. Their attitudes and perceptions, in turn, can be shaped fundamentally by their inherent demographic characteristics. Therefore, the first thrust of this thesis seeks to investigate the impact of demographic characteristics of decision makers on their attitudes and perceptions. In particular, using a worldwide questionnaire survey, I provide empirical evidence of demographic determinants to perceived social obligations on organizations held by socially responsible investors (SRIs). Organizational decision making by executives, incorporating corporate social responsibility (CSR) agendas which respond to

attitudes held by SRIs, can be an important factor in maximizing shareholder wealth. Consequently, it is important to examine the relationship between demographic characteristics of SRIs and their perceived social obligations on organizations.

Second, demographic characteristics only represent one 'internal' aspect of the decision making environment which affects decision makers. It is difficult to process information when decisions makers are expected to match the different motivations underlying their own or others' objectives with the multiple choices which are available to them. Using an example from a speculative market (horseracing), the second thrust of this thesis explores the demand determinants in a multi-competitor environment for the pari-mutuel horseracing market in the UK. In particular, we seek to identify unique or specific variables which matter to specific types of bettors when confronted with a range of choices to wager in a pari-mutuel horseracing market. We also explore the implications of these findings for owners of the pari-mutuel pool who attempt maximise shareholder value by accounting for the motivations of different bettor groups.

The ability of decision makers to make rational decisions, as discussed above, clearly impacts the efficiency of markets. In addition, the speed at which valuable and material information is incorporated in the price of a product is equally essential to a well-functioning efficient market. In order to facilitate the efficient functioning and processing of information, the underlying infrastructure which supports the flow of information is therefore important. Using an example from equity markets, the third thrust of this thesis aims to show that the infrastructure underlying the flow of information can influence the speed at which decisions are made. In particular, the study assesses the process of financial integration (which affects the infrastructure upon which information flows) and the speed of adjustment by which equity market participants in individual equity markets respond to information contained in temporary shocks. In particular, we examine these mechanisms in the Asia Pacific region. The novel idea behind Fama's efficient market proposition is based on the premise that stock prices in equity markets will move quickly to incorporate the arrival of new and unexpected information. Therefore, we expect that a better financially integrated equity markets in the Asia Pacific region can lead to a greater speed of adjustment to information shocks as a result of improved infrastructure to facilitate the flow of information.

In summary, there are two essential ingredients underlying the propositions in the EMH. First, decision makers make rational decisions and second, decision makers make timely decisions. The overall thrust of this thesis is two-fold. First, the thesis sets out to examine how rational decisions are influenced by factors influencing individual decisions makers such as demography and motivation, both of which may influence their decisions when confronted with choices. Second, the thesis illustrates how changes to infrastructure upon which information flows can affect the speed by which decisions are made.

Structure of Thesis

This thesis is structured as follows. In Chapter 1, we discuss the first thrust of the thesis concerning the empirical relationship between the demographic characteristics of SRIs and their CSR attitudes. In Chapter 2, we develop the second thrust of the thesis concerning the determinants of demand by horserace bettors confronted with a multi-competitor environment in a pari-mutuel wagering market. In Chapter 3, we develop the third thrust of the thesis concerning financial development and integration with respect to speed of information adjustment in the Asia Pacific region. In the last section, we consolidate the respective contributions within each chapter of the thesis and provide a conclusion.

CHAPTER 1

INFORMATION PROCESSING EFFICIENCY RELATED TO THE ROLE OF THE INDIVIDUAL IN DECISION MAKING:

AN EMPIRICAL EXAMINATION OF CORPORATE SOCIAL RESPONSIBILITY ATTITUDES AND THE DEMOGRAPHY OF SOCIALLY RESPONSIBLE INVESTORS[1]

At the heart of the efficient market hypothesis is the assumption that individual decision makers are able to and efficient in processing information rationally. Their ability to process information, in turn, is influenced by a range of demographic characteristics. This study reflects upon the previous literature drawn from interdisciplinary studies ranging from corporate responsibility to finance to identify possible demographic characteristics which are useful in explaining attitude formation by decision makers; which in turn influence their decisions. In particular, we identify demographic characteristics of socially responsible investors and explore the relationship of these demographic characteristics with their CSR attitudes. In this study, we analyse (using generalized ordered logistic regression) the questionnaire responses of 2,464 SRIs from 20 countries. The results demonstrate that younger and female SRIs are more likely to believe that a company's social and environmental performance is as important as its financial performance. Female SRIs and those with high incomes are the most likely to believe that companies should be as responsible to their shareholders as to the broader society. In addition, younger SRIs, those with high incomes and those who have attained higher education levels regard socially responsible companies as at least as profitable as other companies. The benefits which companies can derive from understanding the demographic profile of SRIs are examined, including a potentially lower cost of capital, improved CSR rankings and business policy formulation and communication consistent with CSR views held by specific groups of SRIs.

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[1] The original title for this chapter is "Drivers of Corporate Social Responsibility Attitudes: The Demography of Socially Responsible Investors". This chapter is currently in press with the ***British Journal of Management***.

1.1   Introduction

Since its introduction in the early 1990s, socially responsible (SR) investment has gained prominence (Robson and Wakefield, 2007) as both a rival and a complement to conventional investment (Sparkes, 1991). Broadly defined, SR investment is the philosophy and practice of making strategic investment decisions by integrating financial and non-financial considerations, including personal values, societal demands, environmental concerns and corporate governance issues (Lozano et al., 2006; Michelson et al., 2004; Scholtens, 2006). These non-financial factors are commonly linked with corporate social responsibility (CSR), defined as the philosophy and practice of voluntarily integrating social and environmental concerns into companies' operations (Jamali et al., 2008) and mobilizing companies' resources to benefit society beyond basic economic and legal concerns (Carroll, 1991). Conflicting views on CSR still exist but contemporary proponents argue that companies' objectives should include the pursuit of financial wellbeing *and* the satisfaction of stakeholders' non-financial aspirations, beyond mere compliance with legal requirements (Baron, 2001; Cheah et al., 2007; Donaldson and Preston, 1995; Freeman, 1984; Garriga and Mele, 2004; Hart, 1995; McWilliams and Siegel, 2001).

Socially responsible investors[2] (SRIs) are likely to invest in companies with CSR agendas (Sparkes and Cowton, 2004). The relationship between CSR and SR investment is captured by Sparkes (2002, p. 42): '…corporate social responsibility (CSR) and socially responsible investing are in essence mirror images of each other. Each concept basically asserts that business should generate wealth for society but within certain social and environmental frameworks. CSR looks at this from the viewpoint of companies, SR investment from the viewpoint of investors in those companies.' Therefore, a growth in SR investment is likely to lead to greater sensitization to responsible business practice and societal welfare. In other words, the link between CSR and SR investment suggests that the latter is one of the key drivers of CSR and can play a crucial role in influencing organizations to adopt more socially responsible business practices (Lozano et al., 2006; Waring and Edwards, 2008).

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[2] There is no universal definition for SRIs or a universal agreement on the characteristics of an SR investor. For the purpose of this study, we define SRIs as those who aim to achieve an acceptable rate of return within the boundaries of ethical corporate activities and those who seek to influence corporate behavior by pursuing greater social accountability and responsibility for companies (Hudson, 2005).

The growth in SR investment in the US has been linked to particular groups defined by demographic characteristics such as gender and education (Michelson et al., 2004). In addition, a number of studies have identified demographic characteristics as a potentially useful means of profiling SRIs (Hayes, 2001; Michelson et al., 2004; Rosen et al., 1991; Schueth, 2003; Tippet and Leung, 2001; Tippet, 2001). However erroneous conclusions may have been drawn from these studies, as most employed small samples. In addition, it could be argued that several of these studies used inappropriate methods to investigate the relationship between demographic characteristics of SRIs and their CSR attitudes. For example, Williams (2007) employed the binary logistic regression model, which could, as a result of the process of dichotomizing the responses, have led to a loss of statistical power; as information contained in the ordering of the responses was diluted (Long and Freese, 2001). In addition, it could be argued that, in some studies, statistical models to distinguish the investment decision-making styles of SR and conventional investors were inappropriate (e.g., McLachlan and Gardner, 2004).

The aim of this study is to fill the gap in our understanding of the demographic characteristics of SRIs, which can be used to distinguish their views on CSR-related issues. In particular, this study makes the following important contributions: First, we use existing literature to identify some demographic characteristics that maybe useful for segmenting the population of SRIs. We then use responses from a large, global questionnaire survey to identify 2,464 SRIs from 20 countries and investigate the manner in which their demographic characteristics are related to their CSR-related attitudes. This is achieved by employing a generalized ordered logistic regression (gologit) model, which enables us to capture the full richness of information contained in the SRIs' ordered questionnaire responses.

A closer examination of the demographic characteristics of SRIs is worthwhile, in itself, as this can help to identify the distinctive attributes of SRIs which may influence their investment decision-making styles. An understanding of SRIs' demographic characteristics also enables CSR focused companies[3] to prioritize their CSR agendas in order to attract specific groups of SRIs (clientele effect). In addition, an awareness of the demographic characteristics of SRIs enables SR investment fund managers to target their sales strategies towards specific groups of SRIs, while attending to internal issues relating to the selection and retention of

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[3] We define CSR focussed companies as those with explicit objectives in executing CSR-related agendas. These companies may or may not be owned exclusively by SRIs.

employees who share the same affinities and orientations (McLachlan and Gardner, 2004; Williams, 2007). Furthermore, understanding the demographic characteristics of SRIs (and the issues they consider important when making investment decisions) is critical for organizations; particularly because of the increasing importance of SRIs and their demands to become further engaged with the executives of publicly-listed companies (specifically to influence corporate decision-making).

The chapter proceeds as follows: In section 1.2, we first examine the role of SR investment with respect to specific salient themes in the CSR debate (namely, financial performance, company profitability, responsibility to broader society and trust in financial statements). The objective of this discussion is to establish issues related to these four themes on which different groups of SRIs may disagree. Second, we use the results of existing studies to identify some demographic characteristics that maybe useful for segmenting the population of SRIs. Third, we develop a series of hypotheses, based on the view that the demographic characteristics of SRIs are correlated with their CSR-related views. The methodology and data employed to test these hypotheses are explored in sections 1.3. The empirical results and related analyses are presented in section 1.4, together with a discussion of their important implications in section 1.5. In section 1.6, we draw conclusions, identify limitations of the study and suggest future avenues for research.

1.2   Literature review and hypotheses development

Four themes in the CSR literature

A number of studies have investigated the role of socio-demographic characteristics in explaining the demand for SR investment products (see Nilsson, 2009, for a review). In addition, clear links between SR investment and CSR have been established in previous studies (Anderson, 1986; Sparkes, 2002). However, no previous literature links the socio-demographic characteristics of SRIs to their CSR views (Nilsson, 2009)[4]. Roberts (1996) suggests that this is

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[4] A sample of more recent SR investment literature which features demographic characteristics as explanatory variables is provided in the Table 1.1. A more complete literature review is summarized in Nilsson (2009) and the literature exploring the role of socio-demographics in profiling green consumers is explored in Diamantopoulos (2003).

an important gap in our knowledge. Our aim, therefore, is to fill this gap. To achieve this, we begin this section by examining the role of SR investment with respect to key themes in the CSR debate; specifically, to establish issues on which particular SRIs may disagree. We, later in the chapter, explore to what extent particular groups of SRIs, defined by their demographic characteristics, differ in their views regarding these issues.

CSR and financial performance

Previous studies have shown that CSR and financial performance are linked (Cochran and Wood, 1984). According to the efficient market hypothesis, if CSR leads to improved financial performance, information regarding a change in a company's CSR ratings will instantaneously alter share prices once equity market participants become aware of the information. Consequently, for example, efforts to increase workforce diversity with respect to demographic characteristics (e.g., age and educational attainment diversity, increasing female representation on corporate boards), which are likely to improve CSR ratings, can potentially have a positive impact on shareholders' wealth (Erhardt et al., 2003; Nielsen and Huse, 2010). Similarly, the cost of ineffective CSR measures may have a detrimental effect on shareholders' wealth.

The growing literature on corporate boardroom diversity highlights the contributions of a diverse board of directors on organizational and financial performance of a firm (Erhardt et al., 2003). According to Erhardt et al. (2003), two emerging streams of research on the impact of corporate boardroom diversity on the financial performance of firms: observable (demographic) and non-observable (cognitive). For example, previous studies by Maznevski (1994), Milliken and Martins (1996), Watson et al. (1998) and Timmerman (2000) have used a wide range of observable (demographic) variables such as gender, age, race and ethnicity and non-observables (cognitive) variables such as knowledge, education, values, perception, affection and personal characteristics. Despite the fact that the evidence surrounding the impact of corporate boardroom diversity is mixed, there are generally two conflicting streams of empirical evidence regarding diversity and group performance. First, the development of competitive advantage arising from a greater pool of knowledge, creativity and innovation (Watson et al., 1993), Bantel (1993) and Simons and Pelled (1999) can lead to higher organizational financial performance. On the other hand, heterogeneity of decision making groups can lead to increased occurrences of disagreement which weakens team consensus

(Hambrick et al., 1996), increased time, effort and expenditure to reconcile or reach consensus resulting in team performance (Treichler, 1995, Knight et al., 1999). However, by and large, these previous studies point to the fact that corporate boardroom heterogeneity has an important impact on the financial performance of the firm.

Companies who are interested in improving their financial performance may, therefore, attempt to appeal to investors with views in line with their own CSR policies; because, provided these investors 'ethical' objectives are satisfied by the company's policies, they are likely to accept a lower rate of equity return. This, in turn, leads to a higher value of the company. This is akin to the clientele effect in corporate finance, where companies appeal to investors with specific cash flow needs that match their dividend payout policy (again lowering the cost of capital)[5]. Consequently, in order to improve the value of their companies, boards of directors may decide to tailor their CSR policies to the attitudes of particular groups of SRIs, perhaps defined by their demographics. For example, companies who wish to attract female shareholders can implement CSR decisions in line with the attitudes of this specific group of investors. Furthermore, in searching for potential funds, CSR companies may wish to appeal to the more affluent groups within the SRIs. This can again help to lower their cost of capital because the more affluent SRIs maybe willing to compromise their wealth maximization objective in order to support financially sustainable CSR-related agendas.

In seeking to align their CSR policies with the attitudes of particular groups of SRIs, companies must be aware that different groups of SRIs give higher or lower priority to maximising shareholder wealth than to the goals of promoting social and environmental concerns. Therefore, some SRIs maybe more tolerant of accepting some financial penalty, commonly known as the "ethical penalty" (McLachlan and Gardner, 2004; Williams, 2007). These SRIs would clearly disagree with the view that (which we term *CSR View 1*): 'A company's social and environmental performance is not as important as its financial performance'.

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[5] The proponents of the clientele effect in corporate finance argue that companies will appeal to investors with specific cash flow needs that match their dividend payout policy.

CSR and company profitability

Triple Bottom Line (TBL) is a systematic approach to managing the complete set of a company's responsibilities and for reconciling economic, social and environmental objectives to produce a more balanced view of corporate performance (Jamali, 2006). However, the more traditional and prevalent view in the CSR literature is that economic responsibility, measured by a company's profitability is indeed the foundation upon which all other responsibilities rest (Carroll, 1999; Carroll, 1991; Carroll, 1979), and that business organizations need to focus primarily on profitability and the economic bottom line to ensure their viability.

Given the agency relationship between company directors and their owners and the growing importance of SR investment, directors of publicly listed companies are increasingly required to take account of the views and perceptions of SRIs. Agency theory suggests that the contractual agency relationship between directors (agents) and shareholders (principals) ensures that directors are legally bound to act in the best interests of shareholders. They are, therefore, required to undertake business strategies aimed at satisfying shareholders' wealth maximization objectives (Jensen and Meckling, 1976). Researchers have explored whether engagement in CSR compromises this objective (Lindgreen and Swaen, 2010; Margolis and Walsh, 2001; Orlitzky et al., 2003) and, hence, the level of the profitability of SR investment funds (Bauer et al., 2005; Hamilton et al., 1993; Statman, 2000). Evidence in this respect is mixed (Baron, 2001; Cochran and Wood, 1984; McWilliam and Siegel, 2001; Waddock and Graves, 1997). However, Carroll and Shabana (2010) argue that companies that engage in CSR activities will see direct and clear links between CSR initiatives and superior financial profitability. Consequently, they argue that it is important for companies to pursue CSR initiatives, as this will also fulfil the obligations of managers to maximize shareholders' wealth in general and profitability in particular. We summarise this side of the argument as *CSR View 2*: 'Companies that are socially responsible are more profitable than socially irresponsible companies'.

There are also arguments against implementing CSR initiatives, since many of these initiatives could have negative effects on profitability; as suggested by the mixed research evidence indicated above. In addition, effective CSR initiatives are often unique to particular circumstances and may not yield the same level of financial profitability if they are replicated in

other situations. Consequently, it is plausible that certain groups of SRI investors, particularly those who give greater weight to profit, may not agree with *CSR View 2*.

CSR and responsibility to broader society

Friedman (1970) suggested that companies should only be accountable to their shareholders, maintaining that publicly-listed companies should focus on the shareholder wealth maximization objective[6]. Similarly, it has been argued that companies should pay little attention to ethical obligations, provided they operate profitably and within legal stipulations (Hill et al., 2003). More recent views on CSR fall into two camps: the classical view, with a narrow competitiveness focus and little tolerance for a social role for business, and the modern view, which envisages businesses' responsibility extending beyond profit-making to include a wider spectrum of stakeholders' and society's interests (Jamali et al., 2009; Quazi and O'Brien, 2000). In addition, the modern view argues that directors need to constantly realign the company to the perceptions and expectations of stakeholders, to ensure sustained legitimacy (Post, 1978). Nasi et al. (1997) and Panwar et al. (2010) underscore the importance of companies investigating the gap between societal expectations and societal perceptions regarding their current performance. A higher/lower expectation for companies to undertake CSR activities may result from an unfavourable/favourable perception by society concerning their efforts in promoting CSR activities. Consequently, according to agency theory, directors will need to pay close attention to perceptions held by stakeholders, defined in the broadest sense.

We summarise the classical view of CSR as 'Companies should be more responsible to their shareholders than to the broader society' (*CSR View 3*), and we suspect that some groups of SRIs are more likely to adhere to this view than the alternative, modern view.

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[6] For details on how wealth maximization (as a shareholder's objective), company value and the present value of tax shield are related, please refer to the seminal paper by Modigliani and Miller (1958) and to Brounen et al. (2006), Hovakimian et al. (2004), Miller (1988) and Rajan and Zingales (1995). Essentially, in the presence of tax, a lower cost of capital leads to a higher value of the company, implying an increase in shareholder wealth.

CSR and trust in financial statements

There are mixed views in the CSR literature concerning the extent to which the recent ascendancy of CSR can mitigate widely prevailing distrust in companies, and in the accuracy of their financial statements. Some argue that, following a string of corporate scandals, there is a global crisis of ethics (Ghillyer, 2008) and a fundamental distrust of companies and their reporting practices. For example, several prominent organizations (all formerly Wall Street stars, for example, Enron and WorldCom) have been found to have hidden the true state of their precarious finances. There is, on the other hand, an increased awareness of the importance of ethics, with CSR advancing steadily and moving into the mainstream (Ghillyer, 2008). However, with massive bankruptcies, accounting scandals, fraud and evidence of obstruction to justice by major corporations, the erosion of trust in companies and in their financial reports remains a major concern (Sagar and Singla, 2003). As a result, numerous companies have implemented programs to incorporate ethics into their organizations. These programs range from formulated codes of ethics to educating their employees towards ethical behavior (Schlegelmilch, 1997).

In summary, the growth of CSR may have gone some way to increase faith in the veracity of companies' financial statements, but it is likely that some groups of more sceptical SRIs may still adhere to *CSR View 4*, namely: 'The accuracy of financial statements of many companies cannot be trusted'.

SRI and socio-demographic characteristics: hypotheses development

CSR is a multi-faceted concept that potentially affects the entire spectrum of business decision-making. Nilsson (2009) argues that SR investment decisions, which integrate financial social, environmental and ethical considerations, share similar dimensions with pro-social variables associated with CSR. At one end of the spectrum, SRIs who predominantly focus on the wealth maximization objective (keeping socially responsible objectives to a minimum) can behave primarily like non-SRIs. However, some SRIs, who focus on socially responsible agendas, may behave very differently. Consequently, while SRIs are often treated as a homogenous group, they are likely to be heterogeneous in their investment preferences.

In order to be considered as a suitable investment vehicle by SR mutual funds, many companies take steps to adhere to certain standards of CSR, giving greater weight to ethical decision-making (Nilsson, 2008; Schlegelmilch, 1997). Many companies take such steps realising that there is heterogeneity in investment preferences among SRIs. However, they often have little knowledge of the CSR attitudes of different groups of SRIs. The decisions of companies wishing to attract SR investment are, therefore, likely to be improved if they are able to target their actions in line with the criteria considered most important by particular segments of the SRI community. In seeking to explore how different groups of SRIs vary in terms of their attitudes to CSR issues we explore the possibility of employing SRIs' demographic characteristics as a means of achieving this (Roberts, 1996).

Rest (1986) was one of the first to develop a theory of ethical decision-making[7], which used demographic characteristics to explain (and predict) how individuals think about, and react to, ethically charged situations. The theory argues that an individual's perception of moral intensity is moderated by individual and organizational characteristics and varies across different situations. In particular, McLachlan and Gardner (2004) found a statistically significant difference in the perception of moral intensity among SRIs and conventional investors. Harrison (1995) has also argued that demographic information is useful when segmenting markets on the basis of attitudes.

Three recent studies have directly associated demographic characteristics[3] with differences in the amount of SR investment (Nilsson, 2008), which investors are likely to report themselves as having made an SR investment (Junkus and Berry, 2010) and with differences in SRIs' attitudes (Nilsson, 2009). The data, methodology and major findings of these studies are summarised in the Table 1.1. Each of these studies has important limitations (see Table 1.1) but they all suggest that segmenting SRIs by demographic characteristics maybe possible. We, therefore, explore whether the views of SRIs, segmented according to the demographic characteristics explored in these studies (gender, age, education and income), differ with respect to the controversial themes emerging from the CSR literature, discussed above: (i) the relative importance of companies' social and environmental vs. financial performance, (ii) whether companies which pursue CSR policies are more profitable, (iii) whether company

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[7] For a comprehensive list of previous studies reviewing the literature on ethical decision-making, see O'Fallon and Butterfield (2005), Loe et al. (2000) and Ford and Richardson (1994).

responsibilities should be broad (e.g., to society at large) or narrow (e.g. to shareholders) and (iv) the degree to which the financial statements of companies can be trusted.

To achieve this objective we develop hypotheses related to the four demographic characteristics, education, age, income and gender.

Education levels: Lewellen et al. (1977) found that the level of education affects an investor's capital gains, dividend yield and overall return. In addition, socially responsible consumers have been shown to be better educated (Chan, 1999; Murphy et al., 1978; Schueth, 2003; Wall, 1995). These findings are supported by the work of Nilsson (2009) and Tippet and Leung (2001) which has shown that the education level of SRIs explains their demand for SR investment funds. Consequently, we believe that SRIs who are better educated are likely to be more aware of, and concerned about, the impact of companies' activities on society and the environment. Hence, we would expect that their perceptions regarding the conduct of companies are more likely to influence their investment behavior. Further, we expect SRIs who are better educated to be more sceptical of annual company reports, as ethics-related subjects increasingly feature in institutions of higher learning, especially in the business schools (Warren and Tweedale, 2003). Consequently, we expect an SRI's level of education to affect their views concerning the four important issues related to CSR identified above. To explore this view we test the following null hypothesis:

Hypothesis 1: The level of education amongst SRIs does not affect the degree to which they hold *CSR Views 1-4.*

Age: A number of studies have shown that SRIs tend to be younger (e.g., Diamantopoulos et al., 2003; Hayes, 2001; Laroche et al., 2001; Lewellen et al., 1977, Rosen et al., 1991; Schueth, 2003). This clearly suggests a link between age and attitudes to SR investment. In particular, we suspect that younger SRIs may represent a generation of investors who are more sensitive to the manner in which companies conduct their business and the impact they have on society and the environment. We suspect, therefore that a link may also exist between the age of SRIs and their CSR attitudes. To explore this view we test the following null hypothesis:

Hypothesis 2: The age of SRIs does not affect the degree to which they hold *CSR Views 1-4.*

Income levels: SRIs have been found to have lower incomes than their mutual fund counterparts (Rosen et al., 1991) but SRIs are generally wealthier (Tippet, 2001; Vinning and Ebreo, 1990). Even though the objective of maximizing expected return on investment remains an essential requirement for many investors (Matterson, 2000), SRIs are willing to trade off this objective with the goals of promoting the well-being of the planet. In other words, SRIs, particularly wealthier SRIs, maybe more willing to tolerate an 'ethical penalty' (McLachlan and Gardner, 2004; Williams, 2007). We, therefore, suspect that that the level of income of SRIs may influence their CSR attitudes. To explore this view we test the following null hypothesis:

Hypothesis 3: The level of SRIs' income does not affect the degree to which they hold *CSR Views 1-4.*

Gender: An important implication of the trend for women to be appointed as senior executives and directors is that this gives them access to power and the ability to invest. This is important since it has been shown that women make a larger proportion of SRIs from the overall investor population (Beal et al., 2005). This is supported by Tippet and Leung (2001) and Tippet (2001), who have shown that SRIs tend to be predominantly female (Lewellen et al., 1997; Schueth, 2003). Similarly Diamantopoulos et al. (2003) and Laroche et al. (2001) have shown that socially responsible consumers tend to be women. Previous studies have also shown that cognitive abilities, problem-solving, motivation, risk attitudes, confidence and decision styles differ between males and females, and these factors clearly help to shape their perceptions of moral intensity (Johnson and Bruce, 1993; Johnson and Powell, 1994). We expect, therefore, that a SRIs' gender may influence their CSR attitudes. To explore this view we test the following null hypothesis:

Hypothesis 4: An SRI's gender does not affect the degree to which they hold *CSR Views 1-4.*

Table 1.1: Key literature linking demographic characteristics and SR investment.

Three recent studies have directly associated demographic characteristics with differences in the amount of SR investment which investors are likely to report themselves as having made an SR investment and with differences in SRIs' attitudes. The data, methodology and major findings of these studies are summarised here. Each of these studies has important limitations but they all suggest that segmenting SRIs by demographic characteristics maybe possible.

Author(s) and Publication Year	Data and Methodology	Major Findings
Junkus and Berry (2010)	5,391 members of the American Association of Individual Investors (at the end of November 2008) were surveyed. SRIs were distinguished by their response to the question "Have you ever made an SR investment?" Analysis of Variance test of equality of population distribution and *t*-test were used to compare the demographic characteristics of the respondents	Female investors were more likely to be SRIs and SRIs tend to be younger and better educated. The paper argues that future research should examine if those predisposed to SR investments conform to a particular profile and if this profile is significantly different from that of other investors.

The limitation of this study is that it failed to take into account whether the higher risk aversion of women SRIs and their greater concern for environment (as reported in previous studies) is responsible for their results. The paper did not examine any statistical relationships between demographic characteristics of the SRIs (or non-SRIs) and their investment behavior or attitudes. |
| Nilsson (2009) | 563 respondents were classified (using a cluster analytic approach) into different segments based on their perception of the importance of financial return and social responsibility. Discriminant analysis and chi-square tests were used to further profile the respective segments. | Three segments of SRIs were identified: those who value financial return over social responsibility (primarily concerned about profit), those who value social responsibility over financial return (primarily concerned about social responsibility) and those who value both return and social responsibility (socially responsible and return driven).

SRIs who value social responsibility over financial return were found to be predominantly female and have a university degree. Those SRIs who value financial return over social responsibility were found to be predominantly male and have less formal education. The gender and level of education were useful in explaining those SRIs who value both return and social responsibility. |

Important limitations of this paper are that it only used respondents from one SR investment provider and the sample concentrated on older respondents.

| Nilsson (2008) | 528 Swedish investor respondents to a questionnaire survey. 439 respondents had at least one SR investment product in their portfolio; the remaining 89 respondents had no SR investment product in their portfolio.

An ordinal logistic regression was conducted to ascertain whether certain independent variables (pro-social attitudes, perceived consumer effectiveness, trust, perception of financial return and perception of financial risk) have an impact on investment behavior (measured by a six-point Likert scale: developed from respondents indicating the percentage of their portfolio held in SR investment) | Gender and education are statistically significant in determining the proportion of portfolio held in SR investment. Men and those who were not educated up to a university degree were found to have the tendency to invest a smaller proportion of their portfolio in SR investments. Income and age variables were not statistically significant.

Perceived consumer effectiveness (PCE) is the belief that consumers are more likely to act on a social issue if their behavior can help resolve the issue in question. Therefore, individuals will not invest in SR investments if they do not believe that these investments can help solve social, ethical and environmental problems. PCE and pro-social attitudes were significant in explaining investment behavior of investors.

There was no statistically significant relationship between trust and SR investment behavior.

Perception of financial return is statistically significant while perception on financial risk is not statistically significant in explaining investment behavior.

Two important limitations of the study: The authors indicated that the study included a higher proportion of older respondents and the results with respect age should be interpreted with caution. Second, as our current paper points out, applying ologit model without testing for the parallel line assumption can lead to invalid estimates. |

1.3   Data and methods

Data sample, measures and variables

We employed the *Environics* dataset supplied by GlobeScan Ltd. The survey on which the dataset was based involved a fully stratified representative sample. It contains responses concerning a wide range of individual attitudes toward CSR from 1,000 individuals (investors and non-investors) from each of 20 countries (20,000 in total). Non-SRIs' responses were filtered out, leaving 2,464 for analysis.

There is no universal agreement on how to identify SRIs. The study by McLachlan and Gardner (2004) accessed clients of several Australian service companies (including some companies that advertised only 'ethical' investment products). They identified SRIs as those participants who (a) were current customers of a designated ethical service provider, or (b) reported themselves as holding an investment portfolio, including designated ethical shares or designated ethical funds. However, being current customers of a designated ethical service provider and/or holding shares in ethical investment products does not necessarily imply that investors are SRIs. To overcome this problem we first identify active investors as those respondents who indicated that they own shares (i) directly; (ii) indirectly through a mutual fund, pension plan, or other retirement fund; or (iii) both directly and indirectly (see question 1 Appendix to Chapter 1). SRIs are then identified as a subset of these active investors if they report that they have either bought or sold their shares at least once because of a company's demonstrated social responsibility (see question 2 in Appendix to Chapter 1). This, we believe, provides a better means of identifying SRIs than that adopted by McLachlan and Gardner (2004), since the investors specifically indicated that their decisions were influenced by social considerations.

The survey was designed to reduce cultural bias in the use of response scales. For example, it is known that Latin cultures tend to use the extreme end of scales, whereas other cultures (e.g., Japanese) tend to float to the centre so as not to stand out from the crowd. In an attempt to minimize this effect the questions were designed such that their content displayed as little cultural bias as possible. In particular, the survey was designed such that the questions had

relevance in virtually every country. In addition, the questionnaires were pre-tested, in English, to ensure that questions were understandable. A total of 6 to 10 participants were selected in one developed country (usually Canada) and a similar number in a developing country (often Kenya). Whilst questions were not rotated in a pre-test to control for position of a question, the question sequencing was always taken into account and whenever possible the relative question sequence was held constant over multiple tracking waves. Finally, the fieldwork was conducted using the ESOMAR (www.esomar.org) guidelines for either telephone or face-to-face interview.

Montiel (2008) indicates that there is no universally accepted conceptualization or measurement of CSR attitudes. The scales employed in our study for measuring the strength of CSR attitudes involve the use of a four-point Likert scale, where 1= strongly agree and 4 = strongly disagree[5]. These CSR attitudes are employed as the dependent variables in our study. The four statements of CSR attitudes which respondents were asked their degree of agreement and the respective metrics employed to capture their responses are shown in Table 1.2.

Demographic details of the SRI respondents, including *Education* (metric: low, medium and high), *Income* (metric: low, medium-low, medium, medium-high and high), *Age* (metric: age) and *Gender* (metric: male and female), were assigned as independent variables.

Table 1.2: CSR views explored and metrics used to assess SRIs' attitudes.

The scales employed in our study for measuring the strength of CSR attitudes involve the use of a four-point Likert scale. These CSR attitudes are employed as the dependent variables in our study and represent the four statements of CSR attitudes which respondents were asked their degree of agreement. The respective metrics employed to capture their corresponding responses are provided.

CSR Views	Metrics
As an investor, a company's social and environmental performance is *not* as important to me as its financial performance.	1 – Strongly Agree 2 – Somewhat Agree 3 – Somewhat Disagree 4 – Strongly Disagree
Companies that are socially responsible are more profitable than socially irresponsible companies.	1 – Strongly Agree 2 – Somewhat Agree 3 – Somewhat Disagree 4 – Strongly Disagree
Companies should be more responsible to their shareholders than to the broader society.	1 – Strongly Agree 2 – Somewhat Agree

	3 – Somewhat Disagree
	4 – Strongly Disagree
I do not trust the accuracy of the financial statements of many companies.	1 – Strongly Agree
	2 – Somewhat Agree
	3 – Somewhat Disagree
	4 – Strongly Disagree

The descriptive statistics of the dependent and independent variables are presented in panels A to H of Table 1.3. Using the median as the measure of central tendency, the demographic description of a typical SR investor in our study would be a 45 year-old male, with a medium level of income and education. Our results suggest that SRIs are generally older (median age: 45) than the age range reported by Hayes (2001); i.e. between 18 and 24. In addition, our sample of SRIs contained a greater proportion (58 percent) of males, in contrast to the sample used by Tippet and Leung (2001).

Table 1.3: Descriptive statistics regarding the demographic characteristics of SR Investors.

The descriptive statistics of the dependent and independent variables are presented in panels A to D. Using median as the measure of central tendency, the demographic description of a typical SR investor in our study would be a 45 year-old male, with a medium level of income and education.

Panel A – *Education*

	Frequency	**Mean**	**Median**	**Max**	**Min**	**Standard Deviation**
Low (0)	252	1.34	1	2	0	0.65
Medium (1)	1114					
High (2)	1098					

Panel B – *Age*

	Frequency	**Mean**	**Median**	**Max**	**Min**	**Standard Deviation**
Age	2464	45.47	45	92	17	14.32

Panel C – *Income*

	Frequency	Mean	Median	Max	Min	Standard Deviation
Low (0)	207	2.42	3	4	0	1.27
Medium Low (1)	439					
Medium (2)	556					
Medium High (3)	647					
High (4)	615					

Panel D – *Gender*.

	Frequency	Mean	Median	Max	Min	Standard Deviation
Male (0)	1424	0.42	0	1	0	0.49
Female (1)	1040					

Panel E – Responses to the view that: 'as an investor, a company's social and environmental performance is not as important to me as its financial performance.'

	Frequency	Mean	Median	Max	Min	Standard Deviation
Strongly Agree	407	2.47	2	4	1	0.94
Somewhat Agree	889					
Somewhat Disagree	783					
Strongly Disagree	385					

Panel F – Responses to the view that: 'companies that are socially responsible are more profitable than socially irresponsible companies.'

	Frequency	Mean	Median	Max	Min	Standard Deviation
Strongly Agree	515	2.32	2	4	1	1.01
Somewhat Agree	930					
Somewhat Disagree	758					
Strongly Disagree	261					

Panel G – Responses to the view that: 'companies should be more responsible to their shareholders than to the broader society'

	Frequency	Mean	Median	Max	Min	Standard Deviation
Strongly Agree	642	2.32	2	4	1	1.01
Somewhat Agree	731					
Somewhat Disagree	742					
Strongly Disagree	349					

Panel H – Responses to the view that: 'I do not trust the accuracy of the financial statements of many companies'

	Frequency	Mean	Median	Max	Min	Standard Deviation
Strongly Agree	815	2.02	2	4	1	0.90
Somewhat Agree	950					
Somewhat Disagree	530					
Strongly Disagree	161					

Generalized ordered logistic regression model

The ordered logistic (ologit) regression model is usually used when the responses to the dependent variables are ordinal, regardless of whether the independent variables are categorical or continuous. In our study, each of the dependent variables is regressed against all the demographic characteristics. As a result, each of the CSR attitude statements generates separate regression results[8].

An assumption that underpins the ologit regression is the parallel line assumption. This requires that the effect of a change in the independent variables is the same for each level of the dependent variables. For example, if *Age* is the independent variable, then the impact on the dependent variable of a 10-year increase from, say 30 years or 40 years, should be identical. If this assumption is violated, the coefficients produced by the ologit model will be invalid. In

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[8] A simple linear regression model is not suitable because the ordered responses employed in this study would violate the model's assumptions (McKelvey and Zavonia, 1975; Winship and Mare, 1984). The linear regression model requires that the dependent variables are continuous. However, in our study, the dependent variables consist of several categorical variables.

practice, this assumption is overly restrictive and is often violated (Long and Freese, 2001). To overcome this limitation, we employ a model which corrects for problems arising from violation of this assumption: the generalized ordered logistic (gologit) regression model (Clogg and Shihadeh, 1994; Fahrmeir and Tutz, 1994; Fu, 1998; McCullagh and Nelder, 1989). Consequently, employing the gologit model ensures that the results we produce are unbiased (Long and Freese, 2001). Long and Freese (2001) and Williams (2006) provide an accessible treatment of the technical details of the gologit model.

After performing the gologit regressions, we interpret the results. This is not straightforward since there is no single approach that can fully describe the relationship between an independent variable and the outcome probabilities of the dependent variables of the gologit regression model. This arises because the outcome probability of the dependent variables is nonlinear, and substantively meaningful interpretations are based on predicted probabilities and functions of those probabilities (Long and Freese, 2001). To interpret the relationship between the independent variables and the outcome probability of the dependent variables, we compute the predicted probabilities of the dependent variables by including a set of central tendency measures (such as mean and median) values for the independent variables. We investigate the predicted probabilities in the dependent variables which have statistically significant independent variables in the respective gologit regression models.

1.4　Empirical results

Descriptive statistics, summarizing the degree of support shown by the 2,464 SRI respondents for the four CSR-related views discussed above, are presented in Table 1.3 (Panels E to H). Using the median response as a reflection of the SRIs' attitudes suggests that the 'typical' SRI agrees with all four CSR-related views. The results of the gologit regressions are shown in panels A-D of Table 1.4.

Table 1.4: Results of the Generalized Ordered Logistic Regression (Gamma Parameterization).

The results of the gologit regressions are shown in panels A – D. The log-likelihood ratios for all four models suggest that independent variables are jointly statistically significant. An SR investor's age and gender are significantly correlated with their support of the view that 'as an investor, a company's social and environmental performance is not as important to me as its financial performance' statement. An SR investor's education level, age and income level are significantly correlated with their support for the view that 'companies that are socially responsible are more profitable than socially irresponsible companies' statement. An SR investor's age, income level and gender are significantly correlated with their support for the view that 'companies should be more responsible to their shareholders than to the broader society'. However, none of the SRIs' demographic characteristics we examined are significantly correlated with their support for the view that 'I do not trust the accuracy of the financial statements of many companies' statement.

Panel A: Responses to the view that: 'as an investor, a company's social and environmental performance is not as important to me as its financial performance.'

Independent Variables	Coefficient (*p*-value)
Education	0.014
	(0.811)
Age	-0.014***
	(0.000)
Income	-0.043
	(0.154)
Gender	0.275***
	(0.000)
Gamma 1 (Age)	0.012***
	(0.001)
Gamma 2 (Age)	0.017***
	(0.000)
Constant 1	2.251***
	(0.000)
Constant 2	-0.032
	(0.857)
Constant 3	-1.873***
	(0.000)
Number of observations	2464
LR χ^2	33.48***
(*p*-value)	(0.000)
Pseudo-R^2	0.005
Log likelihood	-3234.753

***Significant at the 0.01 level

Panel B: Responses to the view that: 'companies that are socially responsible are more profitable than socially irresponsible companies.'

Independent Variables	Coefficient (*p*-value)
Education	0.206***
	(0.000)
Age	-0.006**
	(0.029)
Income	0.068**
	(0.025)
Gender	0.001
	(0.990)
Constant 1	1.162***
	(0.000)
Constant 2	-0.534***
	(0.002)
Constant 3	-2.331***
	(0.000)
Number of observations	2464
LR χ^2	31.20***
(*p*-value)	(0.000)
Pseudo-R²	0.005
Log likelihood	-3176.243

**Significant at the 0.05 level
***Significant at the 0.01 level

Panel C: Responses to the view that: 'companies should be more responsible to their shareholders than to the broader society.'

Independent Variables	Coefficient (*p*-value)
Education	0.051
	(0.378)
Age	-0.009***
	(0.000)
Income	0.080***
	(0.008)
Gender	0.175**
	(0.018)
Constant 1	1.140***
	(0.000)
Constant 2	-1.146
	(0.390)
Constant 3	-1.728***
	(0.000)

Number of observations	2464
LR χ^2	30.42***
(*p*-value)	(0.000)
Pseudo-R²	0.005
Log likelihood	-3309.16

***Significant at the 0.01 level

Panel D: Responses to the view that: 'I do not trust the accuracy of the financial statements of many companies.'

Independent Variables	Coefficient (*p*-value)
Education	-0.014
	(0.815)
Age	-0.003
	(0.351)
Income	0.028
	(0.362)
Gender	-0.010
	(0.892)
Gamma 1 (Age)	0.008**
	(0.029)
Gamma 2 (Age)	0.024***
	(0.000)
Constant 1	0.790***
	(0.000)
Constant 2	-1.182***
	(0.000)
Constant 3	-3.726***
	(0.000)

Number of observations	2464
LR χ^2	19.32***
(*p*-value)	(0.004)
Pseudo-R²	0.003
Log likelihood	-3050.694

** Significant at the 0.05 level
***Significant at the 0.01 level

The log-likelihood ratios for all four models (related, respectively, to CSR-related views 1-4), estimated on the basis of the responses of the 2,464 SRI respondents, suggest that the independent variables are jointly statistically significant. A positive (negative) coefficient

associated with Education, Age or Income variables implies that SRIs tend to disagree (agree) with the CSR statements. In addition, a male respondent would tend to be less (more) supportive of the CSR statement if the coefficient associated with Gender is positive (negative).

The results of the gologit regression analysis (shown in Table 1.4, panel A) suggest that an SR investor's *Age* (p-value < 0.01) and *Gender* (p-value < 0.01) are significantly correlated with their support for the view that 'as an investor, a company's social and environmental performance is not as important to me as its financial performance' statement. In addition, a SR investor's *Education* (p-value < 0.01), *Age* (p-value < 0.05) and *Income* (p-value < 0.05) are significantly correlated with their support for the view that 'companies that are socially responsible are more profitable than socially irresponsible companies' statement (see Table 1.4, panel B). Equally, an SR investor's *Age* (p-value < 0.01), *Income* (p-value < 0.01) and *Gender* (p-value < 0.05) are significantly correlated with their support for the view that 'companies should be more responsible to their shareholders than to the broader society' (see Table 1.4, panel C). However, none of the SRIs' demographic characteristics we examined are significantly correlated with their support for the view that 'I do not trust the accuracy of the financial statements of many companies' statement' (see Table 1.4, panel D).

The gamma parameterization of the gologit model, which is used to assist in testing the parallel lines assumption, shows that the Age variable violates the parallel-line assumption for all dependent variables. Consequently, extra caution must be placed when interpreting the results with respect to Age, as the coefficient associated to Age maybe biased. In all cases where Age is statistically significant, Age is negatively related to the respective dependent variables, and Education and Gender are positively related to the dependent variables.

To facilitate the interpretation of these results, post-estimation analyses were conducted for those gologit models where significant independent variables were found (see Table 1.5). We report the predicted probabilities of the dependent variables (strength of support for the four CSR views) given a set of values of independent variables (demographic characteristics of SRIs). In particular, we employ the mean and median values of the respective independent variables. It is noteworthy that more SRIs tend to 'somewhat agree' with the view that 'companies that are socially responsible are more profitable than socially irresponsible companies'. Despite the fact some SRIs maybe more tolerant of some financial penalty, also known as the "ethical penalty"

(McLachlan and Gardner, 2004; Williams, 2007), SRIs do not believe that pursuing CSR agendas would necessarily result in lower profitability. In fact, some SRIs argue that pursuing CSR agendas may lead to higher profitability. In particular, SRIs seem to believe that companies that in CSR activities will see direct and clear links between CSR initiatives and financial profitability. Therefore, it is unsurprising that, SRIs would 'somewhat agree' with the view that 'companies that are socially responsible are more profitable than socially irresponsible companies'. With the exception of the view that 'companies should be more responsible to their shareholders than to the broader society', the predicted probability of the outcome shows that SRIs tend to 'somewhat agree' with the CSR views we examine (Table 1.5, panel A). Specifically, we found that male (female) SRIs 'strongly agree' ('somewhat disagree') and older (younger) SRIs tend to be more (less) supportive of the view that 'as an investor, a company's social and environmental performance is not as important to me as its financial performance' (Table 1.5, panel B). SRIs who have high (low) levels of education and income tend to either 'somewhat disagree' (agree) or 'strongly disagree' with the view that 'companies that are socially responsible are more profitable than socially irresponsible companies' (Table 1.5, panel C). Male SRIs 'strongly agree' with the view that 'companies should be more responsible to their shareholders than to the broader society' and SRIs with high incomes tend to either 'somewhat disagree' or 'strongly disagree' with the view that 'companies should be more responsible to their shareholders than to the broader society'. Younger (older) SRIs tend to be less (more) supportive of the view that 'companies should be more responsible to their shareholders than to the broader society' statement (Table 1.5, panel D). Since none of the demographic characteristics were statistically significant in explaining the view that 'I do not trust the accuracy of the financial statements of many companies', no post-estimation analysis was conducted regarding this statement.

Table 1.5. Results for post-estimation analyses.

With the exception of the view that 'companies should be more responsible to their shareholders than to the broader society', the predicted probability of the outcome shows that SRIs tend to 'somewhat agree' with the CSR views we examine (Panel A). Specifically, we found that male (female) SRIs 'strongly agree' ('somewhat disagree') and older (younger) SRIs tend to be more (less) supportive of the view that 'as an investor, a company's social and environmental performance is not as important to me as its financial performance' (Panel B). SRIs who have high (low) levels of education and income tend to either 'somewhat disagree' (agree) or 'strongly disagree' with the view that 'companies that are socially responsible are more profitable than socially irresponsible companies' (Panel C). Male SRIs 'strongly agree' with the view that 'companies should be more responsible to their shareholders than to the broader society' and SRIs with high incomes tend to either 'somewhat disagree' or 'strongly disagree' with the view that 'companies should be more responsible to their shareholders than to the

broader society'. Younger (older) SRIs tend to be less (more) supportive of the view that 'companies should be more responsible to their shareholders than to the broader society' statement (Panel D). Since none of the demographic characteristics were statistically significant in explaining the view that 'I do not trust the accuracy of the financial statements of many companies', no post-estimation analysis was conducted regarding this statement.

Panel A: Predicted probability using mean and median.

Dependent Variables	Responses	Predicted Probability using	
		Mean	Median
As an investor, a company's social and environmental performance is not as important to me as its financial performance.	Strongly Agree	0.1630	0.1886
	Somewhat Agree	0.3636	0.3740
	Somewhat Disagree	0.3178	0.2938
	Strongly Agree	0.1556	0.1437
Companies that are socially responsible are more profitable than socially irresponsible companies.	Strongly Agree	0.2075	0.2169
	Somewhat Agree	0.3801	0.3746
	Somewhat Disagree	0.3084	0.3056
	Strongly Agree	0.1041	0.1029
Companies should be more responsible to their shareholders than to the broader society.	Strongly Agree	0.2581	0.2738
	Somewhat Agree	0.2998	0.2907
	Somewhat Disagree	0.3012	0.2945
	Strongly Agree	0.1409	0.1410
I do not trust the accuracy of the financial statements of many companies.	Strongly Agree	0.3307	0.3343
	Somewhat Agree	0.3893	0.3732
	Somewhat Disagree	0.2179	0.2203
	Strongly Agree	0.0622	0.0722

Panel B: Gender-based predicted probabilities for responses to the view that: 'As an investor, a company's social and environmental performance is not as important to me as its financial performance.'

Dependent Variables	Responses	Gender	Predicted Probability	Difference
As an investor, a company's social and environmental performance is not as important to me as its financial performance	Strongly Agree	Male	0.1886	0.0560
		Female	0.1326	
	Somewhat Agree	Male	0.3672	0.0133
		Female	0.3539	
	Somewhat Disagree	Male	0.2944	-0.0554
		Female	0.3498	
	Strongly Disagree	Male	0.1498	-0.0140
		Female	0.1638	

Panel C: Education- and income-based predicted probabilities for responses to the view that:
'Companies that are socially responsible are more profitable than socially irresponsible companies.'

Dependent Variables	Responses	Metric	Predicted Probability
		Education	
Companies that are socially responsible are more profitable than socially irresponsible companies	Strongly Agree	Low	0.2445
		Medium	0.2165
		High	0.1909
	Somewhat Agree	Low	0.4142
		Medium	0.3897
		High	0.3603
	Somewhat Disagree	Low	0.2651
		Medium	0.2976
		High	0.3281
	Strongly Disagree	Low	0.0762
		Medium	0.0962
		High	0.1207
		Income	
	Strongly Agree	Low	0.2334
		Medium Low	0.2224
		Medium	0.2118
		Medium High	0.2015
		High	0.1917
	Somewhat Agree	Low	0.3946
		Medium Low	0.3891
		Medium	0.3829
		Medium High	0.3761
		High	0.3687
	Somewhat Disagree	Low	0.2825
		Medium Low	0.2933
		Medium	0.3040
		Medium High	0.3145
		High	0.3249
	Strongly Disagree	Low	0.0895
		Medium Low	0.0953
		Medium	0.1014
		Medium High	0.1079
		High	0.1147

Panel D: Income- and gender-based predicted probabilities for responses to the view that 'companies should be more responsible to their shareholders than to the broader society.'

Dependent Variables	Responses	Metric	Predicted Probability	Difference
		Income		
Companies should be more responsible to their shareholders than to the broader society	Strongly Agree	Low	0.2911	
		Medium Low	0.2772	
		Medium	0.2636	
		Medium High	0.2505	
		High	0.2379	
	Somewhat Agree	Low	0.3186	
		Medium Low	0.3113	
		Medium	0.3033	
		Medium High	0.2946	
		High	0.2852	
	Somewhat Disagree	Low	0.2708	
		Medium Low	0.2835	
		Medium	0.2961	
		Medium High	0.3084	
		High	0.3203	
	Strongly Disagree	Low	0.1195	
		Medium Low	0.1280	
		Medium	0.1370	
		Medium High	0.1465	
		High	0.1566	
		Gender		
	Strongly Agree	Male	0.2780	0.0455
		Female	0.2325	
	Somewhat Agree	Male	0.2970	-0.0047
		Female	0.3017	
	Somewhat Disagree	Male	0.2881	-0.0311
		Female	0.3192	
	Strongly Disagree	Male	0.1368	-0.0098
		Female	0.1466	

1.5   Discussion and implications

Our findings demonstrate a link between the demographic characteristics of SRIs and the degree to which they agree with statements reflecting CSR-related views. Clearly, the findings should not be interpreted as suggesting that demographic characteristics of SRIs are necessarily the reason for their degree of support for particular CSR initiatives undertaken by companies. However, agency theory suggests that, in the light of our results, managers (agents) should carefully understand the demographic characteristics of their SRIs (principals) and consider taking action to ensure that their CSR agendas are aligned with their SRIs' perceived expectations. This is particularly important given that increasingly assertive and influential SRIs are engaging executives of publicly listed companies in the process of corporate decision-making (Galbreath, 2009).

Our results show that younger SRIs and female SRIs tend to 'somewhat disagree' or 'strongly disagree' (but male SRIs tend to 'strongly agree') with the view that 'as an investor, a company's social and environmental performance is not as important to me as its financial performance'. In particular, younger and female SRIs' views appear at variance with the arguments of Friedman and Miles (2001) and Friedman (1970) that companies should focus on profit maximization and not pursue interests beyond those which comply with the law and which avoid deception and fraudulent practices. This interesting finding is consistent with the literature, in the sense that it confirms the permeation of more progressive CSR views among the younger generation of SRIs. Our finding that female SRIs place at least as much weight, when investing, on a company's social and environmental performance as on its financial performance, is entirely novel. However, this finding accords with Schueth's (2003) conclusion that SRIs tend to be predominantly female (Schueth, 2003). Consequently, our results appear to suggest that younger and female SRIs share an appreciation of the intersection between business and society, where social consciousness and social action are seen as important determinants of a company's success (Hill et al., 2003).

We found that younger, better-educated and higher income SRIs are more likely to either 'somewhat disagree' or 'strongly disagree' with the view that 'companies that are socially responsible are more profitable than socially irresponsible companies'. One possible explanation

is that younger SRIs with better education and income are not particularly concerned about a company's wealth maximization, as they belong to a more affluent segment of society. Consequently, they prefer to see companies pursuing CSR related agendas, irrespective of the immediate implications for the bottom line. This finding is important because it not only provides support for the prevailing view that SRIs tend to be younger, better educated and wealthier (e.g., Tippet, 2001; Hayes, 2001) but it also suggests that those SRIs who are younger better educated and wealthier are those most likely to support socially responsible companies while cognizant of the likely negative implications for profits (i.e. they are prepared to accept the ethical penalty).

We find that younger SRIs, and those with higher incomes, tend to 'somewhat disagree' or 'strongly disagree' with the view that 'companies should be more responsible to their shareholders than to the broader society'. Consequently, younger and more affluent SRIs appear to hold a broader conception of CSR, entailing a sense of responsibility to a wider set of stakeholders and to society at large. However, male SRIs tend to 'strongly agree' with this statement. This is consistent with their greater support (than females) for the view that 'as an investor, a company's social and environmental performance is not as important to me as its financial performance'. Taken together, these results suggest a narrower classical CSR orientation among male SRIs. Consequently, these findings, coupled with the lack of support among male SRIs for the view that 'as an investor, a company's social and environmental performance is not as important to me as its financial performance', confirm that younger and those who are female SRIs, hold broader views of CSR and are inclined to invest in companies meeting a wider spectrum of expectations, balancing financial objectives and social and environmental concerns (Ethical Funds, 2002; Kennedy, 2001; Matterson, 2000; World Bank, 2002).

Implications of Study

There are several important implications of our findings. First, we find that gender is a salient variable in accounting for different CSR attitudes among SRIs. These findings help explain the increased predominance of females amongst those engaged in SR investment and the support of female SRIs for CSR, irrespective of the ethical penalty (reduced profit) they may incur. Consequently, our results support Schueth's (2003) findings concerning the part played by females in the SR investment growth in the US. Our results suggest that attracting female SRIs (who hold positive views on CSR) to invest in a company can help push the CSR agenda, both

internally and externally; leading to, perhaps, increased female representation at different levels in the company, good management of diversity and more awareness and sensitivity to issues relating to discrimination. Our results also suggest that companies intending to attract female SRIs should focus their efforts on improving social and environmental performance as well as taking proactive steps to positively impact broader society.

The second important implication of our findings is that well educated and affluent SRIs are increasingly aware of the triple bottom line integration imperative and the need to balance multiple impacts and bottom lines. In other words, they are aware of a need for a systematic approach to managing the complete set of a company's responsibilities and for reconciling economic, social and environmental objectives to produce a more balanced view of corporate performance (Jamali, 2006). This implies that companies pursuing CSR agendas are able to secure equity financing from SRIs who are prepared to accept a relatively low expected return from such companies (this will lower the overall cost of capital for these companies). The current view in the literature is that SRIs tend to be (cf. non-SRIs) younger, better educated and more affluent individuals (e.g. Tippett, 2001; Hayes, 2001) and our results show that it is the younger, better educated and more affluent SRIs who are most likely to support socially responsible policies. The willingness of some SRIs to accept an ethical penalty is well documented (McLachlan and Gardner, 2004; Williams, 2007) and our results show that this group is most likely to consist of the younger, better-educated and more affluent SRIs. According to agency theory, top management (agents) is duty-bound to allocate resources to CSR-related agendas consistent with views held by SRIs (principals). Therefore, this underscores the importance for executives to align their resources targeted at CSR efforts to meet expectations of younger, better-educated and more affluent SRIs.

The third important implication of our findings is that they provide the knowledge needed for developing appropriate sales and financial consulting strategies for investment fund companies when targeting particular groups of SRIs (Williams, 2007). In particular we demonstrate that these policies should be targeted at customers with particular demographic profiles. For example, our findings suggest that they should tailor their sales and financial consulting to younger, better educated and wealthier investors and, particularly female investors. These are the investors that are likely to be most amenable to companies taking a rounded view of

responsibility and, hence, those most likely to embrace the tenets of socially responsible investment.

1.6 Conclusion

The societal impacts of corporate behavior are at the heart of CSR (Lindgreen and Swaen, 2010). The increasing pressure on executives to make socially acceptable decisions reflects the growing importance of SR investment. Despite numerous research projects exploring CSR and related areas, there has been relatively little research which links the SR investment literature to the CSR literature. Consequently, we have attempted to fill this gap by demonstrating that specific demographic characteristics of SRIs are correlated with certain CSR views. For example, younger female SRIs tend to hold a broader conception of CSR and disagree with the view that a company's social and environmental performance is not as important as its financial performance. In addition, younger SRIs, those who are better educated and those who are more affluent seem to support a broad range of objectives, of which profit is only one, and not necessarily the primary one. However, we find that none of the demographic characteristics examined here are correlated with SRIs' distrust of the accuracy of many companies' financial statements.

Our findings, that demographic characteristics can be used to predict SRIs views concerning a number of CSR-related issues, lead to a number of important insights: First, more affluent SRIs are willing to accept a lower rate of return in order to facilitate the pursuit of CSR-related agendas. This can lead to a lower cost of capital and, in turn, will increase the company's value; which is consistent with the shareholders' wealth maximization objective. Second, investment fund companies can use these findings to develop more relevant financial consultation and targeted sales strategies, by targeting these on groups of SRIs defined by their demographic characteristics. Third, attracting female SRIs is likely to help promote the CSR agenda, given that we find they are particularly interested in companies focusing their efforts in improving social and environmental performance, as well as taking proactive steps to positively impact broader society. In order to attract female SRIs companies will need to align themselves with the views held by this group. This in turn is likely to lead to increased female representation at different levels in the company, good management of diversity and more awareness and

sensitivity to issues relating to discrimination. Finally, as SR investment is growing, agency theory predicts that senior management (agents) will be placed under increasing pressure and scrutiny to undertake CSR-related initiatives demanded by SRIs (principal). Consequently, our results indicate that it is important for senior management to be aware of the CSR views held by groups of SRIs defined by their demographic characteristics when formulating their strategic plans.

Whilst this study has advanced our knowledge regarding the correlation between demographic characteristics of SRIs and their CSR attitudes, some limitations of the study should be noted, which could be addressed in future research: First, the addition of a number of control variables would have ensured that the results were more robust. For example, cultural differences among the respondents could play an important role in mediating or moderating the correlation between the demographic characteristics of SRIs and their CSR-related views. Consequently, future research should examine the degree to which culture moderates this relationship. Second, risk, which is an important factor affecting investment decisions, was not accounted for in this study. Future research should therefore endeavor to capture the risk profile of SRIs (Nilsson, 2009, 2008) and to explore if this affects the correlation between SRIs' demographic characteristics and their CSR attitudes. Third, legal provisions, especially relating to corporate governance issues, may influence CSR attitudes held by SRIs. One example is the protection afforded by legal institutions and the government with respect to an investor's legal rights. An investor's legal rights are dependent upon differences in legal traditions, which, in turn, can have a significant impact on the provision of effective private and societal property rights. Consequently, future research is needed to examine the impact of legal traditions on the relationship between SRIs' demographic profile and their CSR attitudes.

In summary, despite this study's limitations, the results demonstrate an important connection between SRI's demographic characteristics and their views related to CSR. These findings are likely to be of value to companies wishing to attract SR investment, to investment fund companies when developing financial consulting strategies targeted at particular groups of SRIs, and to governments and other regulatory authorities who may wish to encourage a greater move towards CSR.

CHAPTER 2

INFORMATION PROCESSING EFFICIENCY RELATED TO THE ROLE OF MOTIVATION IN DECISION MAKING:

AN EXPLORATORY STUDY INTO THE DEMAND FOR HORSERACE WAGERING ACROSS SECTORS OF THE PARI-MUTUEL MARKET IN A MULTI-COMPETITOR ENVIRONMENT

Under the expected utility and the efficient market hypothesis frameworks, rational economic agents are assumed to be homogenous when making decision under uncertainty. However, in reality, economic agents are heterogenous with different motivations in making decisions. Different groups of economic agents would process information in conjunction with their motivations, thereby, arriving at different decisions. Using horseracing pari-mutuel market in the UK as an example, we intend to show possible links between the types of bettors and their unique determinants in demand for horserace wagering in a multi-competitor environment. There has been little research identifying and estimating the determinants of pari-mutuel wagering, particularly across the different sectors. This paper aims to fill this gap by exploring the determinants of demand for horserace pari-mutuel betting in the UK, using unique dataset for all 8,193 races run in the UK during 2004. This exploratory paper contributes to the existing literature in three significant ways: This is the first paper to explore the determinants of pari-mutuel demand across important sectors *('home-track'* (on races run at that track), 'away-track' (on-track but on races run elsewhere), via telephone, internet and through betting shops). Second, this paper is the first to estimate the demand for pari-mutuel wagering in the context of a market where bookmakers, betting exchanges and the pari-mutuel markets compete for customers, as they do in the UK. Third, we attempt to fill an important gap in the literature addressing horserace wagering demand by incorporating risk preferences of bettors in our demand estimation. Finally, we attempt to draw some possible links between the motivations which underpin the betting behavior of various groups of bettors and their demand for horserace wagering Our results show that the day of the week, the number of runners in a race, whether the race is televised, the type of race (flat or jumps), race quality (as measured by race class and winners' prize money), when the race takes place (specifically, first and last race of the day), a measure of the degree of insider trading (Shin-Z), the track ground conditions and bookmaker's over-round all influence the demand for pari-mutuel wagering to a different degree in the various sub-markets. We also find that individuals who place their bets on-track, via the internet and through betting shops, tend to be risk averse, whereas those wagering on-track, but on races run elsewhere, and those who bet via the telephone appear to be risk preferring. We also find that classifying bettors to sophisticated and unsophisticated based on their motivations for betting is helpful in identifying unique determinants of demand in explaining their betting behavior.

2.1   Introduction

How rational economic agents make decisions under uncertainty (Hausch et al., 2008) within the expected utility theory framework (see studies by Griffith, 1949; McGlothlin, 1956; Weitzman, 1965 and Ali, 1979 in which the horse track betting behaviors were explained using the expected utility theory) dominated the research agenda regarding demand for horserace betting post 1944 (after the publication of *Theory of Games and Economic Behavior* by von Neumann and Morgenstern). However, the assumption of homogeneity of decision makers under the utility theory framework failed to account for heterogeneity in the motivations which drive bettors to wager. Clearly, different motivations for betting among the respective bettors will induce sets of determinants of demand which will be unique to each respective group of bettors. This study attempts to offer possible links between the motivations underlying betting behaviors with the unique determinants of demand for horserace betting in a multi-competitor environment.

Standard consumer preference theory postulates that demand for any product is a function of its own price, price of related products, consumers' income, tastes or preferences and expectations about future prices and income. Similarly, the demand for wagering on horseraces can be treated as an economic good (Ali and Thalheimer, 1997; Gruen, 1976) and is subject to a range of determinants. The objective of this study is to explore the nature of the factors affecting the total demand for wagering on horseraces across sectors of a pari-mutuel market (known as handle[9]) which competes for customers with a range of other horserace wagering markets (e.g.,

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[9] According to Gruen (1976), the total amount wagered is known as handle. There are three parallel systems of betting offered to horserace bettors in the UK: First, there are many independent bookmakers, located on-track, in high street betting offices and on the internet who offer (competing) 'fixed-odds' to bettors. These odds may change as the race time approaches as a result of a range of factors, including betting patterns, but, generally, the odds at the time the bet is made will be applied in calculating returns to a winning bet. Second, bettors may wager with betting exchanges via the internet. The odds in these markets operate in the same way as in bookmaker markets, except for the fact that the odds are offered by other bettors. The exchange serves as means by which bettors who wish to wager on a given horse and those who wish to offer odds on a given horse can agree a price. Third, the pari-mutuel system provides a means of pooling bets on horses in a given race. The pari-mutuel operator removes a fixed percentage from the total wagered on a given race (to cover administration costs and profit) and, the remainder is redistributed to the holders of bets on the winning horse. Consequently, the odds to be applied to winning wagers cannot be accurately determined until after betting ceases (at the time the race starts). On racetracks, the odds are constantly recalculated and displayed on a Totalizator ("tote") board (at roughly 45-second intervals) to reflect the amount wagered up to that point in time (McGlothlin, 1956).

betting exchanges and off-track bookmakers).

Our study extends previous research in a number of important ways: First, to the best of our knowledge, this is the first study to explore the determinants of demand for wagering across important sectors of the pari-mutuel market (on-track (on races run at that track: 'home-track' betting), on-track but on races run elsewhere ('away-track' betting), via telephone, internet and through betting shops) in the UK. Second, this represents the first attempt to estimate the demand for pari-mutuel wagering in the context of a market where the pari-mutuel operator competes with bookmakers and betting exchanges, as they do in the UK. Third, we fill an important gap in the literature addressing horserace wagering demand by incorporating risk preferences of bettors in our demand estimation. Finally, this study attempts to draw some possible links between the motivations which underpin the betting behavior of various groups of bettors to their unique determinants in demand for horserace wagering. The UK pari-mutuel market is an important horseracing betting market and is suitable for investigation for the purpose of this study as it is representative of most other pari-mutuel horseracing betting markets around the world. In the UK, the pari-mutuel and betting exchanges systems run in parallel with the fixed-odds system (organized by the bookmakers). In the US, the pari-mutuel betting system (with electronic tote boards) is the most dominant horse wagering form. In addition, the tote system in Singapore and Malaysia operates in such a way that it closely resembles the pari-mutuel system in the US (Hausch et al., 2008; Leong and Lim, 1994).

We apply the seemingly unrelated regression (SUR) model to investigate the determinants of pari-mutuel wagering, using race-by-race factors across the five sectors of the pari-mutuel market in the UK, throughout 2004. We employ 8,193 individual race observations spread across 60 racetracks. Our results show that the day of the week, the number of runners in a race, field size, whether a race is televised, the type of race (flat or jumps), race quality (as measured by race class and prize money[10]), when the race takes place (specifically, first and last race of the day), a measure of the degree of insider trading (Shin-Z[11]), the track ground conditions and

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[10] The prize money or purse on offer is made up of stakes put up by the owners of the entered horses and additional money from other sources, including sponsors, the race track and the Levy Board in the UK (Magee, 1990).

[11] Shin-Z is a measure of insider trading which can be calculated from bookmaker odds. The measure is based on a theoretical model which is used to explain the bias prices in bookmaker markets which result from insider trading (Shin, 1993, 1992, 1991).

bookmakers' over-round[12] all influence the demand for pari-mutuel wagering differentially in the five sectors of the market. In addition, we find that pari-mutuel bettors seem to be risk-averse when wagering on home tracks, via the internet and in betting shops but appear to be risk-preferring when wagering on away tracks and when betting via the telephone.

The chapter is structured as follows: In Section 2.2, we explore the literature addressing the determinants of demand for wagering on horserace betting and we employ this to develop the relevant hypotheses. In Section 2.3 we describe the data and the methodology employed to test the hypotheses. We present and discuss the results in Section 2.4. In Section 2.5, we draw some conclusions, examine some limitations and identify possible directions for future research.

2.2   Literature review: Determinants of demand for pari-mutuel wagering

We provide an overview of the previous literature on the demand for wagering in Table 2.1 (see Appendix to Chapter 2), and this is discussed below. Next, we will discuss the individual motivations underlying the decision to bet. Subsequently, based on the literature, we develop our hypotheses concerning the relationship between each of the explanatory variables and the pari-mutuel handle in each of the market sectors.

Individual Motivations for Horserace Betting

Bruce and Johnson (1992) identified, using various branches of social sciences, several individual motivations underlying betting behavior. In general, they examined two groups of bettors: sophisticated and unsophisticated. For sophisticated bettors, they argued that there are essentially two motivations for placing bet on horseracing events, namely financial gains and intellectual challenge. For unsophisticated bettors, they argue that there essentially are two motivations which underlie their gambling behavior, namely, excitement and social interaction.

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[12] Bookmaker over-round is the theoretical profit bookmakers make from a £1 bet on a given race. This can be calculated by summing the odds implied probabilities of all the runners in a given race. The over-round is the amount by which this figure exceeds 1.

For sophisticated bettors, the first motivation we examine for betting in horseracing is financial gain. Sophisticated bettors are characterized by their professional approach to betting: They follow strict disciplines and systematic rules with the intention of maximizing their financial gains (Bruce and Johnson, 1992). Cornish (1978) reported that, of those who were surveyed, 70 percent identified financial gain as their primary objective for betting. However, Filby and Harvey (1988) have shown that only 25 percent of all bets yielded positive return. A second motivation underlying the betting intention for sophisticated bettors is to derive satisfaction from intellectual challenge, as horserace betting is perceived as a source for problem-solving similar to crossword puzzles and chess (Downes et al., 1976). Bruce and Johnson (1992) argue that these sophisticated bettors who apply their intellectual or analytical skills in choosing their bets are likely to use technology (telephone and internet) more frequently than other bettors to place their bets.

Bruce and Johnson (1992) suggest that the primary motivations for wagering on horseraces for unsophisticated bettors are social interaction and excitement. Bruce and Johnson (1992) opine that these bettors share a common enthusiasm regarding the prospects and performance of racehorses and as a result, enjoy the social aspects of discussing and witnessing their success or loss in placing bets. Therefore, their primary motive for betting stems from social satisfaction arising from the company and interaction with other bettors. Some of these unsophisticated bettors also place their bets on horseracing events for the sake of excitement arising from the uncertainty that surrounds the outcome of each race, the build-up to a race and the drama of the race itself. Actual financial gain is not seen as important as the thrills and pleasures of anticipating a win; the excitement being generated by the process of gambling behavior and environmental changes (Dickerson, 1979; Downes et al., 1976). Therefore, we would expect that these bettors frequent betting shops and racetracks where they meet and mingle with other bettors.

Public Holiday, Weekend and Day of the Week Effects

Given that most bettors are employed during week days, they are likely to treat betting and attendance at the racetrack as a leisure pursuit. This activity is, therefore, more likely to occur during weekends and on public holidays (Saunders and Turner, 1987; McGlothlin, 1956). Therefore, we would expect a positive relationship between dummy variables representing races

run at weekends and on public holidays and the amount of pari-mutuel wagering at the home-track, the away-track and in betting shops. However, since there is less need for bettors in weekday employment to bet via the internet and the telephone at weekends and during public holidays (as they can go to the track or to high street betting offices), we expect such dummy variables to be negatively related to the amount of pari-mutuel wagering with telephone and internet sector handles. Kopelman and Minkin (1991) argue that bettors who attend racetracks on weekday are likely to be sophisticated bettors who are most likely to spend considerable time, effort and money analyzing the past performances of horses and jockeys and treating betting as a means of increasing their wealth. These bettors choose to go to the track, as it is here where most valuable betting information, including information concerning a horse's condition prior to a race, can be found). However, as the week progresses, we expect increasing number of unsophisticated bettors (Bruce and Johnson, 1992) participating in racetrack wagering. Therefore, we would expect a positive relationship between dummy variables representing races run on weekdays have a greater home-track handle with respect to Monday. In general, the day of the week is postulated to have a positive effect on handles across all sectors of the pari-mutuel market (Coate and Ross, 1974).

Number of Races in the Same Hour and Field Size

We expect the number of races run during the same hour on the same day to be negatively related to the handles of all the sectors of the pari-mutuel market (Gramm et al., 2007). In particular, as the number of races increases, we would expect bettors to diversify their bets across different races as a result of the greater choice available. Consequently, they are likely to reduce their bets per race. The field size is also likely to be positively related to the demand for wagering across all sectors of the pari-mutuel market. Larger field sizes, in general, are associated with more competitive races, with longer odds available. We would expect this to attract unsophisticated bettors (in particular leisure bettors) who enjoy watching competitive events. This can be attributed to the fact that bettors are given more options to bet and this increases the opportunity for random events (and, thus, generate leisure betting interest) affecting the outcome of the race (Gramm et al., 2007).

Televised Races

Forrest et al. (2010) found a positive relationship between the number of televised races and real daily turnover on horserace betting. We would expect unsophisticated bettors (who gain excitement from watching the race) to wager more in betting shops if these races are televised in betting shops. Therefore, we would expect a positive relationship between a dummy variable representing televised races and pari-mutuel handle in all sectors of the market.

Flat and Jump Races

Races in the UK are run either entirely on a level surface ('flat' races) or horses must also jump obstacles ('fences': 'jumps races'). Flat racing is generally associated with better known jockeys and higher valued horses and, as a result, attracts greater media interest. Consequently, we would expect pari-mutuel handle in most sectors of the market to be positively related to a dummy variable representing flat races. This would be a particularly important determinant for sophisticated bettors as they would analyze the previous performances of horses in predicting the outcome of the current races.

Race Quality

We capture race quality by two measures, namely, race class and prize money. Higher quality races attract greater media interest. Consequently, we expect that the higher quality races to attract a relatively larger pari-mutuel betting handles. The class of different races in the UK is determined by racing administrators, the British Horserace Board, and they distinguish 8 different class levels (see Table 2.2 for the relevant classifications in the Appendix to Chapter 2). We would expect dummy variables representing *Class_A*, *Class_B* and *Class_C* (see Table 2.3 for reclassification of these races into four categories in Appendix to Chapter 2) races (these represent the three highest levels of quality) to be positively related to handle across all sectors of the pari-mutuel market (see, Ali and Thalheimer, 1997). However, since a disproportionate degree of media interest focuses on the highest class races, we would expect the positive relationship to weaken from *Class_A* to *Class_B* and from *Class_B* to *Class_C*. The higher class races usually offer the higher prizes to winning owners, but this is not always the case and races with the largest prizes also attract media interest. Consequently, we would expect the quality of a

race, as measured by the winning prize money, to have a positive effect on the betting pool (Forrest et al. 2010). As race quality is an important input in helping sophisticated bettors in choosing their type of race, we would expect that sophisticated bettors to bet more in higher class races as the performance of horses are more predictable than in lower class races.

Timing of Race during the Day

The first race on any given day at most racetracks is often a low quality event, not necessarily just in terms of prize money or class, but also related to the type of jockey competing (e.g., these races are often confined to apprentice jockeys) and to horses with particular characteristics (e.g., horses which have never won a race). Therefore, we would expect fewer bets placed by both sophisticated and unsophisticated bettors. In addition, this race being scheduled early in the afternoon means that some bettors are still traveling to the track or are engaged in other activities (e.g., finishing lunch) when this race takes place. Consequently, we would expect a dummy variable capturing the first race at a particular track on a given day to be negatively related to pari-mutuel handle across all sectors of the market. In particular, we suspect that this effect is likely to be the most significant for the home-track handle.

Kopelman and Minkin (1991) find that home-track pari-mutuel bettors wager more money on the last race of the day, in an effort to recoup their losses. They argue that this behavior results from a form of mental accounting, whereby individuals gain significantly greater utility from breaking-even rather than from finishing a betting day making a loss. Johnson and Bruce (1993) confirm this finding amongst bettors in the UK betting offices. In fact, they find that bettors tend to wager on short odds horses (favorites) in the last race of the day. Whilst this strategy reduces the risk of the wager, it also requires that they invest significantly higher stakes in order to recoup earlier losses. We argue that sophisticated bettors who are likely to be more rational and therefore, avoid betting on last races. However, unsophisticated bettors who are likely to suffer from mental accounting bias would be likely to raise their stakes to recoup their losses particularly in last races. We would, therefore, expect that a dummy variable capturing the last race of the day will be positively related to handle in all sectors of the pari-mutuel market.

Insider Trading

The Shin-Z variable measures the degree to which those with access to privileged, private information (insider information) are betting on a given race (Shin, 1993; 1992; 1991); a higher Shin-Z value reflecting a greater degree of insider information. The use of Shin-Z value is not only restricted to horse wagering but also is used in equity market studies. The benefit of using Shin-Z includes being mathematically tractable and independent of the level and fluctuations in wagering odds. The underlying assumption in the use of Shin-Z is the belief that bettors with insider information have an advantage which results in the exposure of risk of adverse selection to bookmakers. As a result, bookmakers will adjust the risk they offer to account for the potential for large payouts from wins by low probability (long odds) and protection against losses to insiders (Coleman, 2007). Despite the fact that the approach used in calculating Shin-Z only represents the demand side of the wagering market and not the supply side as assumed (classic depiction of the joint hypothesis problem posed by Fama (1991) in testing the efficient market hypothesis), the findings by Coleman (2007) imply that conclusions drawn from a mis-specified market model are likely to be invalid. We hypothesize that in races where sophisticated bettors believe insiders are likely to operate they are more likely to bet with bookmakers, thus securing the odds at which their bet will be settled (Tuckwell, 1994). Some unsophisticated bettors may not be concerned at all with insider trading activities while others might abstain from wagering on these races. Regardless, the betting pattern by unsophisticated bettors is not easily discernable for races where there is a high level of insider trading. The danger of betting in the pari-mutuel pool on such races is that price moves on a particular horse in the market (as a result of insider activity) is likely to lead to herding behavior. This is likely to mean that the final pari-mutuel odds will over-estimate the horse's chance of winning (i.e., the odds represent bad value). Consequently, we expect Shin-Z to be negatively related to pari-mutuel handle.

Track Conditions

The track conditions (or 'going'), that is the degree of firmness of the running surface, can have a large influence on the outcome of a race. Some horses much prefer running on a sound surface, whilst others perform better on a rain softened surface or even in waterlogged conditions. These effects can also vary from track to track. In particular, wet conditions (i.e., the track surface is

'soft' or 'heavy') may have an uncertain impact on individual horse's performances (Gramm et al., 2007). Consequently, we would expect bettors to be wary under such conditions. As a result, handle across all sectors of the pari-mutuel market is likely to be negatively correlated with a variable measuring the degree to which ground conditions are affected by waterlogging. This will be exceptionally relevant for sophisticated bettors who take into account track conditions as an important input before placing their bets.

Bookmaker's Over-round

A bookmaker's over-round represents the amount withheld from each pound wagered to cover the bookmaker's costs and profit (Thalheimer and Ali, 1995b), and is the price of wagering in a fixed-odds betting market. Clearly, fixed-odds betting represent a substitute product to pari-mutuel betting. In the UK, throughout the period of analysis, track take[13] (i.e., the amount deducted from the pool of bets on a given race by the pari-mutuel operator) was constant across all races. However, the bookmaker's over-round varied from race to race. We use the final declared odds in the bookmaker market to estimate the average bookmakers' over-round on a given race (although in practice this may have varied between bookmakers at different times throughout the active betting market). Since the bookmakers' over-round is the price of a substitute product, we expect that this will have a positive relationship with the demand for pari-mutuel wager (i.e., a higher (lower) bookmaker over-round would lead to lower (higher) quantity demand for wagering with bookmakers and an increase (decrease) in demand for pari-mutuel wagering). Sophisticated bettors would view pricing to be an important element to consider especially if their motive is to maximize financial gain. Therefore, sophisticated bettors would be particularly sensitive towards bookmakers' over-round.

Note that in studies exploring the demand for pari-mutuel wagering, the pari-mutuel takeout rate has attracted much attention (Thalheimer and Ali, 1995b). The takeout rate is a key variable in demand analysis as it represents the price of the pari-mutuel wagering. The pari-mutuel takeout rate in the UK has declined over several years, but throughout the period of the

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[13] In the pari-mutuel betting market, the takeout rate is composed of two parts: the standard deduction made by the pari-mutuel operator to cover expenses and profit (sometimes known as 'track-take') and breakage (Ritter, 1994). Breakage is the practice of rounding published odds down to the nearest ten pence or ten cents on a £1 or $1 bet (Hausch et al., 2008).

study this remained at 13.5 percent across all races. Consequently, the takeout rate for the pari-mutuel wagering is not included in the analysis of our SUR model.

Risk Measure

An important variable in our study is the risk associated with pari-mutuel wagering on a given race. We measure this risk by the coefficient of variation based on the final pari-mutuel odds. In particular, this variable is computed by taking the natural logarithm of normalized odds-implied probability of each horse winning the race (see Table 2.4 for the formula in the Appendix to Chapter 2). As it is assumed that most individuals are risk averse, we would expect that the greater the risk relative to return, the lower the demand for wagering. This can be achieved by measuring the risk attitude of bettors by using the coefficient of variation by taking the natural logarithm of normalized odds-implied probability of horse winning the race. Therefore, it is expected that a negative relationship may exist between the coefficient of variation based on pari-mutuel odds in a given race and the handles of all sectors of the pari-mutuel market.

2.3   Data and methodology

Data Employed

The data employed here is unique in that it involves the amount bet on each horse in each of the five sectors of the pari-mutuel market ('*home-track*', '*away-track*', *telephone*, *internet* and *betting shops*) across all races run at the sixty racetracks operating in the UK throughout 2004. This data was supplied by the Totalizator Board. To this was added the final declared odds in the parallel bookmaker betting market for each race, supplied by Raceform Interactive.

The dependent variables employed in this study are the handles for the five sectors of the pari-mutuel market. These handles were adjusted for inflation throughout 2004, using the UK Retail Index (base year 13 January 1987). The dependent variables were transformed into the natural logarithm form after adjusting for inflation. The explanatory variables employed were the day of the week, the number of runners in a race (i.e., field size), whether a race is televised, the type of race ('flat' or 'jumps'), race quality (as measured by race class and prize money for

the winning horse), when the race takes place (specifically, the first and the last race of the day respectively), a measure of the degree of insider trading (Shin-Z), the track ground conditions, bookmakers' over-round and coefficient of variation of the natural logarithm of the normalized odds-implied probability of a horse winning the race as a measure of risk.

When dummy variables were employed as explanatory variables, we chose one of the categories as a control and defined a dummy variable for each of the remaining categories (Ramanathan, 1993). The controls adopted for the day of the week, track condition and race class dummy variables were *Monday*, standard going (encompassing good and standard track conditions), and the lowest race classes (*Class G and H*), respectively. The definitions of the respective variables are given in Table 2.3 (see Appendix to Chapter 2) and the formulas used to compute the relevant variables are provided in Table 2.4 (see Appendix to Chapter 2).

Estimation Procedure

The estimation of the system of equations (*home-track, away-track, telephone, internet, and betting shops*) was carried out jointly using the SUR method proposed by Zellner (1962). The SUR approach allows for the possibility of contemporaneous correlation between the disturbance terms from different equations at a given time. This is an appropriate technique for our data as bettors have the choice to wager in the respective sectors, thus yielding nonzero correlation between the disturbance terms across the different sectors (Forrest et al., 2010; Thalheimer and Ali, 1995b). When contemporaneous correlation exists, estimating all equations jointly is more efficient than estimating each equation separately using the ordinary least squares (Thalheimer and Ali, 1995b; Judge et al., 1988; Srivastava and Giles, 1987; Fomby et al., 1984). In general, the specification of m SUR equations for the i-th equation is given in the matrix form as follows:

$$\mathbf{y}_i = \mathbf{X}_i\boldsymbol{\beta}_i + \mathbf{u}_i \qquad\qquad (2.1)$$

where $i = 1, 2, ..., m$ and $t = 1, 2, .., n$. $\mathbf{y}_i$ is a $(n \times 1)$ vector of observations on the dependent variable y_{it} and $\mathbf{u}_i$ is a $(n \times 1)$ vector of disturbance terms for $i = 1, 2, ..., m$. $\mathbf{X}_i$ is a $(n \times k_i)$ matrix

of observations on the k_i vector or explanatory variables explaining y_{it} and $\boldsymbol{\beta}_i$ is a $(k_i \times 1)$ vector of unknown coefficients.

To benefit from estimating $\boldsymbol{\beta}_i$ as a system of equations using feasible generalized least square, it is important that the assumption that contemporaneous correlations are zero is not violated and the assumption that the explanatory variables in each equation in the SUR are not identical (Judge et al., 1988)(see Appendix to Chapter 2 for a brief note on testing the contemporaneous correlation of SUR). The contemporaneous correlation assumption implies that that one or more of the off-diagonal elements of the covariance matrix of the joint disturbance vector are zero. In order to test for this assumption, the log-likelihood ratio (Wang and Dunne, 2003; Judge et al., 1988) and the Breusch-Pagan tests[14] (Breusch and Pagan, 1980) are utilized.

2.4   Results and discussion

The descriptive statistics for the variables employed in this study are displayed in Table 2.5. The estimated SUR system covariance matrix of the disturbance terms, used to calculate the log-likelihood ratio and the Breusch-Pagan tests for contemporaneous correlation in the disturbance terms, are shown in Table 2.6. One of the pre-requisites for using SUR is that there are efficiency gains in estimating all equations jointly. We confirm this by ensuring that the contemporaneous correlation assumption is not violated. The results presented in Table 2.7 show that we reject the null hypothesis that the error covariance matrix of the five equations is diagonal. The log-likelihood ratio test result supports the use of SUR. This conclusion is supported by the Breusch-Pagan test, given that the contemporaneous correlations between the disturbance terms in the

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[14] The Lagrange multiplier statistic which follows a χ^2 distribution was developed by Breusch and Pagan (1980). This test statistic is given as

$$\gamma = n \sum_{m=1}^{M} \sum_{n=1}^{m-1} r_{mn}^2$$

where r_{mn} is the estimated correlation between the disturbances of the M equations and n is the number of races. The test statistic follows a χ^2 distribution with $\dfrac{M(M-1)}{2}$ degrees of freedom.

sectors are jointly not equal to zero.

Table 2.5: Descriptive statistics for the dependent and independent variables.

The descriptive statistics for the variables employed in this study is provided. The first five variables are dependent variables while the remaining variables are independent variables used in the SUR modelling.

Variable	Mean	Median	Maximum	Minimum	Standard Deviation	Skewness	Kurtosis
Home-Track	8.8191	8.6865	13.4818	5.5222	1.0727	0.6745	4.0386
Away-track	7.2811	7.2858	11.1609	1.2980	0.9512	-0.1911	3.5736
Telephone	6.0560	5.9584	10.2348	0.0000	1.1504	-0.0081	3.0791
Internet	6.0821	6.1039	9.0277	1.9993	0.8565	-0.1937	3.7163
Shop	7.5151	7.5155	10.3865	1.7267	0.7275	-0.1066	4.8432
Public	0.0266	0.0000	1.0000	0.0000	0.1609	5.8830	35.6099
Tue	0.1261	0.0000	1.0000	0.0000	0.3320	2.2529	6.0755
Wed	0.1456	0.0000	1.0000	0.0000	0.3527	2.0095	5.0380
Thu	0.1439	0.0000	1.0000	0.0000	0.3510	2.0291	5.1172

Fri	0.1435	0.0000	1.0000	0.0000	0.3506	2.0333	5.1344
Sat	0.1965	0.0000	1.0000	0.0000	0.3974	1.5275	3.3334
Sun	0.1059	0.0000	1.0000	0.0000	0.3078	2.5608	7.5574
Same_Hour	5.0627	5.0000	14.0000	1.0000	1.6359	0.2588	5.0203
LHorse	2.3072	2.3026	3.4012	0.6931	0.3872	-0.4297	2.9841
TV	0.0802	0.0000	1.0000	0.0000	0.2716	3.0915	10.5575
Flat	0.5970	1.0000	1.0000	0.0000	0.4905	-0.3954	1.1563
Class_A	0.0865	0.0000	1.0000	0.0000	0.2812	2.9412	9.6504
Class_B	0.3588	0.0000	1.0000	0.0000	0.4797	0.5886	1.3464
Class_C	0.4290	0.0000	1.0000	0.0000	0.4950	0.2868	1.0823
FirstRace	0.0430	0.0000	1.0000	0.0000	0.2028	4.5078	21.3205

LastRace	0.0430	0.0000	1.0000	0.0000	0.2028	4.5078	21.3205
Shin	0.0204	0.0196	0.0837	0.0000	0.0056	1.4307	8.4012
Going_Hard	0.2616	0.0000	1.0000	0.0000	0.4395	1.0851	2.1774
Going_Offtrack	0.3178	0.0000	1.0000	0.0000	0.4657	0.7825	1.6122
Over-round	0.1716	0.1618	0.5941	0.0024	0.0688	0.6776	3.5170
CV_Tote	0.3558	0.3471	1.0698	0.0710	0.0902	0.6729	4.0797
Prize_1	7115.3010	4124.2500	788220.0000	0.0000	16082.4700	20.8872	788.7415

***denotes significance at 1 percent level

Table 2.6: The estimated system covariance matrix of disturbance terms.

The results show the calculation for the the estimated SUR system covariance matrix of the disturbance terms.

	Home-Track	Away-track	Telephone	Internet	Betting shops
Home-Track	0.6114				
Away-track	0.1305	0.6152			
Telephone	-0.0346	0.0016	0.9814		
Internet	0.1548	0.1154	0.0098	0.5209	
Betting shops	0.1727	0.1131	0.1025	0.1409	0.26933

Table 2.7: Result of testing the contemporaneous correlation in disturbance terms assumption.

One of the pre-requisites for using SUR is that there are efficiency gains in estimating all equations jointly by ensuring that the contemporaneous correlation assumption is not violated. The results show the log-likelihood ratio and the Breusch-Pagan tests for contemporaneous correlation in the disturbance terms.

	Likelihood Ratio Statistic (Critical Value)	Breusch-Pagan (*p*-value)
Disturbance Term	4416.6*** (18.31)	4948.863*** (0.0000)

*** denotes significance at 1 percent level

    The results of estimating the SUR model are reported in Table 2.8. The adjusted R^2 ranges from 26 percent to 49 percent. This suggests that the specified models do not fully account for the variations in the dependent variables (the handles in the respective sectors of the pari-mutuel market). However, most of the coefficients are significant and have the signs we expected.

Public Holiday, Weekend and Day of the Week Effects

From the results in Table 2.8, the coefficients with respect to day of the week dummy variables are contrast estimates. These coefficients are contrast estimates with respect to *Monday*. Similarly, the coefficients of the weekend variables are also contrast estimates with respect to *Monday*. With the

exception of *betting shops* and the *telephone* handles on *Sunday* (negative and statistically significant), all other coefficients are positive and statistically significant. This is consistent with our conjecture that positive relationships are to be expected for *home-track* and *away-track* handles as betting and attendance at the race tracks is increased later in the week (with more bettors who are generally employed taking time off for racetrack attendance later in the week, particularly on *Fridays* and *Saturdays*). Our results confirm Forrest et al.'s (2010) and DeGennaro's (1989) findings that a positive relationship exists between *Saturday* and the handles in most sectors of the pari-mutuel market (except *betting shops* and *telephone* handles). Clearly, unsophisticated bettors who treat betting as a leisure pursuit (c.f. sophisticated bettors), they would contribute more significantly towards the *home-track* and *away-track* pari-mutuel handles (Saunders and Turner, 1987; McGlothlin, 1956). One possible explanation is that betting shops usually attract more persistent bettors and during weekends unsophisticated bettors who are motivated by excitement might wish to attend racetracks with other bettors. Alternatively, these unsophisticated bettors who do not wish to go to racetracks might also prefer to bet via the telephone or internet from their respective home during weekends, taking a break from employment during weekdays. Another possible explanation for the unexpected sign associated with *betting shops* handle could be attributed to model mis-specification for *betting shops*. Surprisingly, the *telephone* betting handle is also negative and statistically significant with respect to *Sunday*. This may arise from model mis-specification, perhaps resulting from some features of the racing offered on Sunday (not captured by our models) deterring those who normally bet on the telephone. As might be expected, we observe a similar pattern of results associated with betting during public holidays to that observed on Saturdays. In particular, a significant, positive relationship exists between the *Public* dummy variable and the handles in most sectors of the pari-mutuel market (except *betting shops* handle - see above).

Table 2.8: Result of unrestricted SUR.

The results of estimating the SUR model is provided. The adjusted R^2 ranges from 26 percent to 49 percent. With the exception of *betting shops* and *telephone* handles on *Sunday* (negative and statistically significant), all other coefficients are positive and statistically significant. A significant positive relationship exists between the *Public* dummy variable and the handles in most sectors of the pari-mutuel market (except *betting shops* handle). As for day of the week dummy variables, we find that most coefficients are positive and statistically significant with respect to the *Monday* variable. It is interesting to note that *Tuesday* is not statistically different from *Monday* with respect to all the handle equations despite the fact that these coefficients are positive (except *away-track*) with respect to all the handle equations suggesting that there is no statistical difference in the pari-mutuel handle on *Monday* and *Tuesday*. We find that as the number of races within the same hour in a race day increases, the amount wagered in each sector of the pari-mutuel market per race decreases. In addition, handles in all sectors of the pari-mutuel market (other than the *away-track*) are negatively and significantly related to the number of races in any particular day. We also find that *field size* is positively related to the handles across all market sectors (albeit statistically insignificant for *telephone, internet* and *betting shops* handles). We find that handles across all sectors increase significantly for televised races. Our results suggest that flat racing is generally more popular with pari-mutuel bettors than jumps racing. Our results also show that more is wagered on higher quality races and higher prize money races. We also find that handle across all sectors of the pari-mutuel market is significantly lower in the first race of a given meeting. Our results also show that across all sectors, the handle increases significantly in late races. We find a negative and statistically relationship between the *Shin-Z* variable and the handle in all sectors of the pari-mutuel market. Further, the degree of firmness of the racing surface for most handles are significantly higher when the ground conditions are firmer although this relationship is statistically insignificant with respect to the *internet* handle. Our results demonstrate that bookmakers' over-round is positively and significantly related to handle across all sectors of the pari-mutuel market. Finally, we find that our measure of risk associated with a given race is negatively and significantly related to the handle in *home-track, internet* and *betting shops* handles. Surprisingly, the risk variable is positively related to the *away-track* and *telephone* handles.

Variables	Home-Track (*p*-value)	Away-track (*p*-value)	Telephone (*p*-value)	Internet (*p*-value)	Betting shops (*p*-value)
Constant	8.4728*** (0.0000)	5.4044*** (0.0000)	4.6098*** (0.0000)	4.4078*** (0.0000)	5.8405*** (0.0000)
Public	0.7968*** (0.0000)	0.4604*** (0.0000)	0.1588** (0.0286)	0.1982*** (0.0002)	-0.1401*** (0.0000)
Tue	0.0204 (0.5504)	-0.0130 (0.7035)	0.0009 (0.9830)	0.0324 (0.3037)	0.0326 (0.1506)
Wed	0.3104*** (0.0000)	0.2341*** (0.0000)	-0.0603 (0.1513)	0.1445*** (0.0000)	0.0319 (0.1477)
Thu	0.3759*** (0.0000)	0.3930** (0.0000)	0.0068 (0.8726)	0.2179*** (0.0000)	0.0593*** (0.0000)
Fri	0.5035*** (0.0000)	0.4694** (0.0000)	0.0539 (0.2022)	0.2385*** (0.0000)	0.1576*** (0.0021)

Sat	0.8852***	0.8032***	0.0686	0.2632***	-0.0678***
	(0.0000)	(0.0000)	(0.1036)	(0.0000)	(0.0000)
Sun	0.5130***	0.3841***	-0.1550***	0.1205***	-0.1281***
	(0.0000)	(0.0000)	(0.0009)	(0.0004)	(0.0000)
Same_Hour	-0.0511***	0.0713***	-0.0330***	-0.0167***	-0.0471***
	(0.0000)	(0.0000)	(0.0000)	(0.0021)	(0.0000)
LHorse	0.0201	0.1262	0.5383***	0.4697***	0.7177***
	(0.8016)	(0.1154)	(0.0000)	(0.0000)	(0.0000)
TV	0.3604***	0.3560***	0.8431***	0.3598***	0.2688***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Flat	-0.0234	0.1595***	-0.1279***	0.1982***	0.1465***
	(0.2196)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Class_A	1.4683***	0.7514***	0.2896***	0.7408***	0.6140***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Class_B	0.7399***	0.4512***	-0.1188***	0.4168***	0.2727***
	(0.0000)	(0.0000)	(0.0015)	(0.0000)	(0.0000)
Class_C	0.2554***	0.1835***	-0.2786***	0.2098***	0.0629***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0007)
FirstRace	-0.0746*	-0.3213***	-0.1743***	-0.1258***	-0.2184***
	(0.0856)	(0.0000)	(0.0015)	(0.0000)	(0.0000)
LastRace	0.1286***	0.2731***	0.1948***	0.2129***	0.1452***
	(0.0033)	(0.0000)	(0.0005)	(0.0000)	(0.0000)
Shin	-22.7806***	-5.4362	-16.8097***	-3.8111	-2.3500
	(0.0000)	(0.1517)	(0.0004)	(0.2747)	(0.3490)
Going_Hard	0.4482***	0.0479**	-0.3945***	0.0244	0.0888***
	(0.0000)	(0.0298)	(0.0000)	(0.2288)	(0.0000)
Going_Off	0.1308***	-0.0429**	0.0417	0.0336*	0.0186
	(0.000)	(0.0392)	(0.1124)	(0.0790)	(0.1774)
Over-round	1.1576***	1.8013***	3.3234***	1.3248***	1.3321***
	(0.0095)	(0.0001)	(0.0000)	(0.0013)	(0.0000)
CV_Tote	-0.9522***	0.5636***	0.9783***	-0.3992***	-0.7950***
	(0.0000)	(0.0000)	(0.0000)	(0.0004)	(0.0000)
Prize_1	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Observations	8193	8193	8193	8193	8193
R-Squared	0.4701	0.3219	0.2604	0.2918	0.4925
Adjusted R-Squared	0.4687	0.3200	0.2584	0.2899	0.4911

* denotes significance at 10 percent level
**denotes significance at 5 percent level
***denotes significance at 1 percent level

As for day of the week dummy variables, we find that most coefficients are positive and statistically significant with respect to the *Monday* variable. It is interesting to note that *Tuesday* is not statistically different from *Monday* with respect to all the handle equations despite the fact that these coefficients are positive (except *away-track*) with respect to all the handle equations; suggesting that there is no statistical difference in the pari-mutuel handle on *Monday* and *Tuesday*. This could be attributed to the fact that Mondays and Tuesdays are the first two working days of the week, and it is unlikely that most employed unsophisticated bettors will attend racetracks or engage in betting activity during these days. It is also interesting to note that there is no statistical difference in the amount wagered in pari-mutuel markets on the telephone or in betting shops on Wednesday (c.f. *Monday*). In fact, there is no statistical difference between the amounts wagered on any of the working days with *Monday* with respect to the *telephone* handle. This suggests that those who bet via the telephone are not constrained by work commitments. This could arise because those in employment still find it relatively easy to make phone calls during working hours or sophisticated bettors who bet via the telephone is not constrained by work commitments. Despite these anomalies, our results generally confirm the findings of Coate and Ross (1974), who found a positive relationship between day of week and pari-mutuel handle.

Number of Races in the Same Hour and Field Size

We find that as the number of races within the same hour in a race day increases, the amount wagered in each sector of the pari-mutuel market per race decreases (see Table 2.8). This probably arises, as we suggested when establishing our hypotheses, that bettors have a relatively fixed betting budget and these bettors simply spread their bets over the races available with the exception of the *away-track* handle. In addition, handles in all sectors of the pari-mutuel market (other than the *away-track*) are negatively and significantly related to the number of races in any particular day, suggesting once again that bettors operate a fixed budget across a betting day, and increasing the

number of races results in a reduction in wagering on individual races. However, the handle in the away-track sector is positively and significantly related to the number of races in any particular day. Since the number of races run at a particular track rarely varies significantly, this result suggests that those who attend racetracks and bet on races run elsewhere increase the amount they bet per race as the opportunities presented elsewhere increase (perhaps decreasing their spend at the track they are attending). This result is consistent with Gramm et al.'s (2010) findings.

We also find that field size is positively related to the handles across all market sectors (see Table 2.8). As the number of horses in a particular race increases, we find that the *telephone*, *internet* and *betting shops* handles increase significantly. The field size variable is also positively related to *home-track* and *away-track* handles (albeit, insignificantly). These findings confirm those of Gramm et al. (2007) and Forrest et al. (2010).

Televised Races

We, as expected, find that handles across all sectors increase significantly for televised races, suggesting that media interest and the opportunity to engage with the betting event stimulates demand from the unsophisticated bettors (see Table 2.8); confirming the findings of Forrest et al. (2010).

Jump and Flat Races

Our results suggest that flat racing is generally more popular with pari-mutuel bettors than jumps racing, the handle in most sectors increasing significantly for flat (c.f. jumps) races. This may result from the greater media attention given to flat racing in the UK and/or to the greater perceived predictability of flat races (jump races involve the added uncertainty of whether a horse will complete the race). However, the *home-track* handle, once race quality, field size, whether the race is televised etc. are controlled for, is not influenced by whether the race is run on the flat or over jumps; suggesting that unsophisticated bettors who attend racetracks to observe the spectacle of racing are equally attracted to bet on flat and jumps races. Finally, handle for pari-mutuel bets placed over the telephone decreases significantly for flat (c.f. jumps) races. This may arise from an omitted variable in the model, or it maybe that those who bet via telephone realize that there are more mis-priced horses running in jumps races. This may arise because the greater media attention

given to flat races means that more information is available to bettors, enabling them to more accurately judge the chances of horses running in flat races.

Race Quality

We explored two measures of race quality, race class and the winners' prize money. For most sectors of the pari-mutuel market, our results confirm our hypothesis that more is wagered on higher quality races. However, this is not the case for wagers placed via the telephone (see Table 2.8). In fact, the coefficients for *Class_B* and *Class_C* races show a negative relationship with the *telephone* handle. We suspect that this could be attributed to model mis-specification, or it may result from sophisticated bettors who generally bet by telephone identifying more mis-priced horses in the lower quality races. In fact, previous research has suggested that those with access to privileged information *are* more likely to exploit this in lower quality races (Johnson et al., 2010). In all sectors of the pari-mutuel market we find a descending pattern in the size of the differences in handles between the higher and the lowest quality races. We conclude, therefore, that race quality, as measured by the race class, is an important determinant of wagering across all sectors of the UK pari-mutuel market.

We also explored the influence of race quality, as measured by *prize money* offered to the winning horse, on pari-mutuel handle. These results confirm the importance of race quality to sophisticated bettors in determining pari-mutuel handle in the UK. In particular, there was a statistically significant positive relationship between the size of race winning prize money and the handle across all sectors of the pari-mutuel market.

Timing of Race during the Day

We find, as expected, that handle across all sectors of the pari-mutuel market is significantly lower in the first race of a given race meeting (see Table 2.8). As indicated above, we suspect this arises because the early timing of the race prevents some bettors from placing bets (see above) and/or the characteristics of the first race on any given day at most racetracks are often not conducive to readily assessing the chances of runners (e.g., because these races are often confined to particular types of horses or jockeys, whose relative quality it is difficult to assess; horses which have never won a race

or apprentice jockeys), which deters bettors. We also explore pari-mutuel handle in races run at the end of a particular race meeting. Our results indicate that across all sectors the handle increases significantly in these late races (see Table 2.8). As indicated above, this confirms our hypothesis that unsophisticated bettors may engage in a form of mental accounting, whereby the prospect of 'breaking-even' provides considerable utility. When comparing the coefficients across all the sectoral handles, we find that for the *home-track* handle, the coefficient with respect to the last race of the day is the lowest. This signifies that unsophisticated bettors who attend racetracks have limited amount of cash. This is in contrast to those who place their bets on telephone and internet. These bettors usually can replenish their supply of cash relatively easily via bank machines or online banking transactions. The average unsophisticated bettor is likely to lose, on average, throughout a day's racing, and the last race gives them the opportunity to re-coup earlier losses. However, this is likely to require the unsophisticated bettors to place larger bets on the final race.

Insider Trading

We find a negative and statistically relationship between the *Shin-Z* variable and the handle in all sectors of the pari-mutuel market (see Table 2.8). A higher *Shin-Z* value implies a greater degree of insider information available to some bettors. We argued above that bettors who possess inside information are likely to wager in the parallel bookmaker market, where they can secure the odds at which their bet will be settled. As the insider information is revealed in the odds in the bookmaker market, pari-mutuel bettors may engage in herding behavior, driving the pari-mutuel odds on the horse in question to unrealistically low levels (see Law and Peel, 2002). The potential for such herding behavior in races where inside information is likely to be present (where Shin-Z is high) is likely to act as a deterrent to pari-mutuel sophisticated bettors, and our results confirm this.

Track Conditions

The degree of firmness of the racing surface (track conditions) is well known to have a significant bearing on the results of horseraces. We had expected that track conditions which enable the results of races to be better forecast (i.e., when the racing surface is firmer), to stimulate demand for pari-mutuel betting. Our results bear this out to some extent (see Table 2.8). The handles for most sectors of the pari-mutuel market are significantly higher when the ground conditions are firmer (i.e., going hard variable c.f. the going standard variable), although this relationship is statistically

insignificant with respect to *internet* handle. The *telephone* sector differs from the other sectors in that this relationship between firmer ground conditions and handle is negative and significant. This may arise from model mis-specification or, as we have seen from the results presented above, those who place bets via telephone appear to act in a counter-intuitive fashion. These sophisticated bettors, who we have speculated to be more knowledgeable bettors, may expect other less knowledgeable bettors to under-estimate the degree of predictability of race results on standard going. Consequently, they may perceive standard going to offer the prospect of under-priced bets and this may stimulate their demand for betting under such conditions.

We had speculated that sophisticated bettors may perceive races run under more waterlogged conditions to be less predictable and that this may lead to decreased demand. However, the results in relation to the going-off variable (which consists of the following more waterlogged underfoot conditions: good-to-soft, yielding, good-to-yielding, soft-to-yielding, standard-to-soft, soft, very soft, slow, heavy, sloppy), suggest that pari-mutuel handle in the different sectors of the market react differently under these conditions. There is, as expected, a significant fall in pari-mutuel handle in the *away-track* pool under softer ground conditions, but a significant increase in pari-mutuel handle in the *home-track* and *telephone* sectors and no significant relationship in the internet and betting shops sectors. The relationship in the *telephone* sector is again explainable by the argument that the more knowledgeable sophisticated bettors (who we speculate bet by telephone), may expect other less knowledgeable bettors (possibly unsophisticated bettors) to under-estimate the degree of predictability of race results on softer going. Consequently, they may perceive softer going may offer the prospect of under-priced bets and this may stimulate their demand for betting under such conditions. The significant increase in pari-mutuel handle in the *home-track* sector under more waterlogged conditions may result from model specification, and certainly requires further investigation.

Bookmaker's Over-round

Our results demonstrate that bookmakers' over-round is positively and significantly related to handle across all sectors of the pari-mutuel market (see Table 2.8). This confirms our expectation and underscores the important role that the price of a competitive product plays in determining the demand for pari-mutuel wagering in the UK.

Risk Measure

Finally, we find that our measure of risk associated with a given race, the coefficient of variation for totalizator, is negatively (and significantly) related to the handle in *home-track*, *internet* and *betting shops* handles. Surprisingly, it is positively related to the *away-track* and *telephone* handles. The latter results suggest that *away-track* and *telephone* bettors tend to be risk preferring, being attracted by the races where risk appears at its greatest. However, we have argued that telephone bettors maybe more knowledgeable bettors (sophisticated bettors) and often appear to act counter-intuitively. In this case, they may perceive that the average bettor who chooses to bet in these higher risk events may distort the odds (e.g., over-betting the 'safer' choices (e.g., the favorites) in these races), thus providing telephone bettors with opportunities for exploitation.

Overall, whilst we have identified and discussed a number of important anomalies in our results, it is important to note that our results are generally in line with standard consumer preference theory. We also find that classifying bettors into sophisticated and unsophisticated bettors based on their respective motives for betting are useful in identifying unique determinants to demand with respect to their gambling behavior in a multi-competitor environment.

2.5   Conclusion

The objective of this study was to explore the nature of determinants of demand for betting across various sectors of a pari-mutuel market which directly competes with both the bookmaking and betting exchange markets. The contributions of this study are four-fold: This is the first study to explore the determinants of demand for wagering across important sectors of the pari-mutuel market. Second, this represents the first attempt to estimate the demand for pari-mutuel wagering in the context of a market where the pari-mutuel operator competes directly with bookmakers and betting exchanges, as they do in the UK. Third, we fill an important gap in the literature addressing horserace wagering demand by incorporating risk preferences of bettors in our demand estimation. Finally, our study offers some possible links between the motivations which underpin the betting behavior of various groups of bettors to their unique determinants of demand for horserace wagering.

In this study, we found that the day of the week, number of runners in a race, field size, whether a race is televised, the type of race (flat v. jumps), race quality (as measured by race class and prize money) , timing of a race (first race and last race of the day), a measure of insider trading (Shin-Z), track conditions and bookmakers' over-round are important determinants of the demand for pari-mutuel wagering across all sectors of the market. In addition, those pari-mutuel bettors who wager home-track, via the internet and through betting shops appear to be risk-averse whereas those who wagering in the away-track and via the telephone appear to be risk preferring. We find that categorizing bettors into sophisticated and unsophisticated bettors based on their respective motives for betting are useful in identifying unique determinants of demand with respect to their gambling behavior in a multi-competitor environment.

There are significant implications of this study to the relevant authorities for policy decision making. Clearly, the discovery of these determinants will help reveal variables which helpful in decision making by the relevant authorities, such as the British Horseracing Board, Horseracing Betting Levy and Tote boards in deciding on variables which matters to the decision makers. Institutions offering betting opportunities can also benefit from making decisions which will be tailored to the needs of their customers, based on the determinants of demand for their product. Also, regulators can implement measures to harmonise the efficiency between the various sectors in the pari-mutuel horseracing market. For example, a bookmaker's over-round is the price of a competitive product to the pari-mutuel betting. We find that a bookmaker's over-round is an important determinant to pari-mutuel betting behavior. Therefore, we would expect bookmakers to adjust their respective over-rounds in order to attract bettors to switch from betting with the tote. In addition, Thalheimer and Ali (1995b) argue that track takeout rate by the government is a form of distortion to the efficient function of the wagering markets. As a result of removing the pari-mutuel takeout rate by the UK government, the competition and efficiency between bookmaker and pari-mutuel wagering markets are greatly enhanced.

The implications from the results of this study are constrained by the following caveats: Economic theory is useful in postulating relationships between economic variables but only rarely does economic theory help in specifying the functional form by which explanatory variables should enter into the regression models (Thalheimer and Ali, 1995b). For example, omitted nonlinear variables could lead to a model being poorly specified. In the single equation model case, model mis-specification can cause estimators to be biased and inconsistent (Ramanathan, 1993) but for a

system of equations, the mis-specification in any equation can contaminate all the estimates in the system (Johnston and DiNardo, 1997). Consequently, omitted variable bias is a common problem for researchers as a result of poorly specified model. Model mis-specification is likely to cause some of the signs in the coefficients with respect to the explanatory variables to be statistically insignificant across some of the handle equations. This phenomenon could also explain the lack of consistency in the relationship we observe between some of the explanatory variables and the handles of various sectors of the pari-mutuel markets.

The exclusion of important variables can also lead to model mis-specification. For example, race track participants will pay some or all of a variety of attendance -related costs such as parking, admissions to the race track facility, programs and/or racing forms and concessions (Thalheimer and Ali, 1995b). These extraneous costs may have a negative relationship with respect to the home-track equation handle. However, information with respect to these costs is not available from published sources over the period of this study. Consequently, the impact of these extraneous costs as determinants of home-track demand cannot be evaluated. Further, we were also unable to test the assumption that the explanatory variables in each equation are not identical (Judge et al., 1988) as a result of model mis-specification. This arises because it is meaningless to test for the assumption that the explanatory variables with respect to each equation in the SUR are not identical if the coefficients are either having incorrect sign or not statistically significant.

A number of avenues for further research are highlighted by our findings. In particular, given that our observations are based on race-by-race data rather than via time series data, all standard econometric tests based on time series using SUR methodology are not valid. Consequently, future research might involve arranging the data in a time series manner, allowing econometric time series tools to be applied to examine the dynamic nature of determinants of demand for pari-mutuel wagering in the UK. Also, future studies may adopt a panel data analysis approach (Baltagi, 2008). This would enable us to examine the dynamics of cross-sectional populations and to control the unobserved time-invariant heterogeneity in cross-sectional models (Arellano, 2003) when examining the determinants of demand for pari-mutuel wagering.

CHAPTER 3

INFORMATION PROCESSING EFFICIENCY RELATED TO THE SPEED OF ADJUSTMENT IN DECISION MAKING:

EQUITY MARKET SIZE AND FINANCIAL INTEGRATION IN THE ASIA PACIFIC REGION[15]

One of the important assumptions underlying the efficient market hypothesis (EMH) is that decision makers would react instantaneously to the arrival of new and unexpected information. This implies that the speed of adjustment with respect to new and unexpected information would be high. We argue in this chapter that equity markets which are highly integrated would imply that the speed of adjustment would be high as well. Therefore, we argue that efforts undertaken by member governments within a regional grouping to improve the existing information infrastructure to facilitate access to information will increase the speed of information transmission. By using equity market size as a measure of financial development, especially in term of financial deepening and widening, we argue that financial development improves the existing information infrastructure, thus increasing the speed of adjustment to information transmission within a unified equity market. This study investigates the current financial integration dynamics in the Asia Pacific region (APR) using equity market size to examine the two-tier integration proposal by Moshirian (2009). Our findings confirm Moshirian's proposal that the first tier involves all constituent countries promoting security and free trade while the second tier involves a smaller group of more advanced countries initiating financial integration process in the APR. We find little evidence for financial integration due to the lack of financial integration among smaller equity markets in the APR. We find support for the geographical proximity hypothesis as larger equity markets seem to dominate smaller equity market within the same geographical proximity and identify Australia as being a potential equity market leader to spur the next level of financial integration in the APR. This is unsurprising given that Australia is the first major equity market in the APR to mirror changes in the US equity market. Larger equity markets in the APR tend to be more informationally efficient and as equity markets become larger, these equity markets become more endogenous. We also show that equity markets in the Asia Pacific region can be categorized into advanced, where information flows is least restricted and easily accessible to investors for decision making and less advanced, where the existing information structure can be improved upon to support access to information. Finally, important implications for financial policy decision making by government institutions and agencies with respect to financial contagion in the APR are discussed.

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3.1   Introduction

Moshirian (2009) argues that before any regional capital market (particularly the Asia Pacific region (APR)) can become part of a wider global financial market, a two-tiered system is required to enable the emergence of a unified regional capital market. The first tier involves all constituent countries focusing on promoting regional security and free trade while the second tier involves a smaller group of the more advanced countries initiating the regional financial integration process. Moshirian (2009) also suggests that, through time, less developed countries in the region should be invited to merge their capital markets with the well-integrated capital market formed earlier by their advanced counterparts. However, in order for the two-tier system to succeed in the APR, there are two specific issues which require further analysis. First, to identify which equity market within the APR can be entrusted with the important leadership role, associated with bringing the advanced countries together to form a unified financial market. Second, we intend to examine the information processing efficiency in response to temporary shocks in the equity markets in the APR.

The purpose of this study is to explore these issues, after first undertaking an examination of the current financial integration dynamics in the APR, from an equity size market perspective. Most financial integration research has employed equity rates of return for examining equity market linkages but numerous studies point out that this approach is not robust and is susceptible to bias (e.g., Yeh and Lee (2000), Janakiramanan and Lamba (1998) and Koch and Koch (1991). Equity market size has been used in a few studies to explore the extent to which stock markets have widened and deepened (Torre et al., 2006; Rajan and Zingales, 1998; Bekaert and Harvey, 1997), but it has never been employed to identify a potential financial integration process leader in the APR. To fill this research gap, this study utilizes stock market capitalization (SMC), as measured by the sum of market-value weighted equity index multiplied by the number of shares outstanding of a country, as an indicator of equity market size to adequately account for the degree of mobility of capital between equity markets within the APR. In particular, we intend to study the information transmission mechanisms and information processing efficiency of equity markets within the APR. This, in turn, allows us to investigate the degree of financial integration in the APR and possibility of

speculative attacks. Such an analysis is expected to help inform international policy makers when formulating and designing a unified financial architecture for the APR.

We find weak evidence in support of financial integration in the APR, based on existing financial arrangements of constituent equity markets. This could be due to the fact that there are varying degrees of financial integration in the geographical sub-regions. This implies that equity traders can relatively easily exploit arbitrage opportunities between equity markets in these sub-regions. Our analysis identifies the Australian equity market as the most likely candidate for providing the leadership required for unifying equity markets in the region via the two-tiered system proposed by Moshirian (2009). This finding is expected given that Australia is the first major equity market in the APR to reflect changes in the US equity market. We also find a higher degree of information efficiency amongst the six largest equity markets in the APR (Australia, China, Hong Kong SAR, Japan, South Korea and Taiwan), confirming that equity market size does appear to be related to information efficiency. Finally, we show that the larger equity markets in the region are more endogenous.

Overall, this study provides contributions across the topics of international investment, equity market linkages and equity market integration by extending our knowledge of the role equity market size plays in explaining the different degrees of financial integration across geographical sub-regions and the different levels of information efficiency. This is due to the fact that larger equity markets are presumed to have the appropriately developed infrastructures to facilitate equity trading and the necessary regulations to protect investors' rights (La Porta et al., 2000). Our findings help to bridge the gap between the existing literature on financial market development and financial market integration (Panchenko and Wu, 2009).

The chapter is structured as follows. In Section 3.2, we discuss the literature concerning how financial development and information processing efficiency are related to financial market integration and use this to develop hypotheses. In Sections 3.3 and 3.4, we describe, respectively, the data and methodology employed to test the hypotheses. We present results in Section 3.5 and draw conclusions in Section 3.6.

3.2 Relating financial market integration and financial development and information processing efficiency

Our study provides a link between the existing literatures on the relationship between financial market integration and (a) financial development and (b) information processing efficiency. We review these in turn in relation to the APR:

Financial market integration and financial development in the APR

The financial development literature suggests that there is considerable agreement among investors that SMC should be used to value an equity market (Rajan and Zingales, 1998) and to measure public confidence in the equity market (Dornbusch et al., 2000). The economic growth of a country can also be used to indicate the anticipated future growth in its equity market when the present value of future growth opportunities is capitalized (Rajan and Zingales, 1998); the economic growth of a country is, thus, linked to the growth in its SMC (Demirguc-Kunt and Levine, 1996). Consequently, for a region like the APR, this implies that forging stronger economic ties through free trade should provide a direct benefit of a higher SMC growth rate across member countries (Moshirian, 2009).

Considering the large number of countries in the APR, the different levels of economic growth rates across constituent countries, the overlap between economic groupings and cultural and racial barriers, Moshirian (2009, 2008) proposed that the more advanced equity markets in the region should be entrusted with the leadership role necessary for spurring the financial integration process. He argues that this is necessary because a leader is required to initiate the process of sub-groups integrating among themselves rather than directly engaging with wider global equity markets. Therefore, the identification of a potential equity market should be conducted among equity markets located within a relatively close geographical distance. The geographical proximity hypothesis expounded by Click and Plummer (2005), Dekker et al. (2001), Ng (2000) and Janakiramanan and Lamba (1998) postulates that amongst equity markets within the same geographical vicinity, which share a common group of investors, the more dominant or leading equity market is likely to exert a greater influence over smaller equity

markets. This hypothesis can also be applied to sub-regions in the APR. Therefore, testing the geographical proximity hypothesis is similar to testing Moshirian's (2009) proposition that equity markets within close geographical proximity would have a higher likelihood of integrating among themselves. Dekker et al. (2001) and Janakiramanan and Lamba (1998) have used the vector autoregression (VAR) analysis to test the geographical proximity hypothesis. Therefore, we test the following *'Geographical Proximity Hypothesis'* relating to the APR: *Larger equity markets, such as Australia, China and Singapore, dominate their neighboring countries in the Australia-New Zealand (ANZ), Greater China (which consists of China, Hong Kong SAR and Taiwan) and Malaysia-Singapore-Thailand (MST) sub-regions, respectively.*

Moshirian (2009) argues that the more advanced countries in the APR should consider coming together to first remove financial barriers, thereby allowing for financial integration. This would eventually lead to a true union in a two-tier system. Consequently, to facilitate this process, it may be useful to identify a potential equity market leader in the APR to spur the financial integration process. Previous studies have either explicitly assumed or shown that the US equity market has been the de facto leader in influencing the financial integration process in the APR (Moshirian, 2009). However, it is important to identify a potential equity market leader within the APR after controlling for the role played by the US equity market. This view is supported by the diminishing role played by the US equity market in the APR (Ng, 2000). In addition, the recent developments in the sub-prime credit crisis have undermined the role that the US equity market plays in influencing financial globalization, with specific reference to the APR. Therefore, there is a pressing need to identify a potential leader among the constituent members in the APR to spur the next phase of the financial integration process, without over-reliance on the US equity market's leadership. Consequently, we test the following, *'Leading Equity Market Hypothesis': Advanced equity markets with larger SMC (for example, Japan, Hong Kong SAR or Australia) exert greater influence on the relatively smaller equity markets in the APR and could be regarded as a potential equity market leader in the APR financial integration process.*

Speed of adjustment to temporary shocks and financial market integration in the APR

Abrupt changes in capital flows or contagion can reverse the benefits of financial integration, especially for fragile financial systems and those with weak regulatory and supervision structures (Agenor, 2001). In larger equity markets, where technological advances in information flows allows investors to become more responsive to new information, the negative effects of massive cross-border capital movements are instantaneously reflected in their respective equity market size. This is especially true with regard to information that has a direct bearing on the differences in the size of the expected rates of return on their financial asset portfolios (Agenor, 2001; Bekaert and Harvey, 1997). In order to trace such information propagation mechanisms between equity markets in the APR, it is useful to employ SMC because it can be used to gauge the level of investors' confidence (i.e. amount of investment) in their choice of equity market.

In the international finance sphere, financial integration is increasingly seen as important, since financially integrated equity markets reap the benefits of a lower cost of capital (Kim et al., 2005; Foerster and Karolyi, 1999; Moshirian, 1998), greater competition and allocative efficiency (Folkerts and Mathieson, 1989). Financial integration can bring many benefits arising from unabated capital flows, in terms of expanding the investor's opportunity set, higher risk-adjusted rates of return and greater portfolio diversification potential (Obstfeld, 1994). However, financial integration can also lead to financial instability (Chang and Velasco, 2000) due to the volatile nature of these capital flows. Therefore, as a result of financial integration which allows for free flow in cross-border capital and information flows, we would expect a higher degree of speed of adjustment in market equity size to temporary shocks in the short run. The speed in which equity market size changes as a result of cross-border capital flows should be higher for larger equity markets than smaller equity markets.

Greater financial openness not only can help countries borrow in order to smooth out their uneven consumption especially during adverse economic and financial shocks but also enjoy the benefits of welfare gains and potential growth as a result of risk-sharing (Obstfeld, 1994; Liu and Pan, 1997). Therefore, there are incentives for government authorities to simultaneously remove financial barriers and

synchronize trading mechanisms; thereby facilitating a more efficient flow of capital between equity markets, creating a financially integrated market. In order to assist government authorities to measure the removal of investment barriers, Ng (2000) and Bekaert and Harvey (1997) have suggested the use of SMC. As a result, we would expect that higher efficiency in cross-border in capital flows would increase the speed of adjustment in market equity size for equity markets with fewer financial barriers.

A financially integrated equity market will not be able to contain a financial contagion when speculators and arbitrageurs alike are able to move their capital freely (Jeon and Chiang, 1991). One benefit of using SMC is to examine how equity markets are linked, and, thus, their vulnerability to speculative attacks is that SMC is likely to be positively correlated with the ability to mobilize capital and diversify risk (Demirguc-Kunt and Levine, 1996). This vulnerability can be inferred from the pattern of short-run SMC movements across markets in the APR. A short run reduction in SMC outside of normal limits may indicate a capital withdrawal, which could signal an impending speculative attack. SMC may, therefore, act as a useful early warning indicator of the onset of a financial contagion. In this regard, it is important to note that while capital mobility plays a crucial role in accelerating the process of financial integration, insufficiently regulated capital mobility can also harm national equity markets.

There is a clear need to understand not only the scale but the speed of these destructive movements in speculative capital flows are propagated through international capital flow channels in the longer run but also in the short run as well (Masih and Masih, 1997). In particular, changes in short-term portfolio capital are known to be sensitive to herding among investors and to contagion (Agenor, 2001). Consequently, such sudden cross-border flow of capitals can result in a loss of confidence in a country's economic prospects (Dornbusch et al., 2000). In fact, risk premiums in segmented capital markets maybe directly linked to the volatility of equity markets, higher volatility leading to higher cost of capital (Bekaert and Harvey, 1997).

History serves as a reminder of the dangers of financial integration. In the battle of Chibi in 208 AD in China, the defeat of a mighty armada by the northern warlord Cao Cao was attributed, in part, to Cao Cao's ships being moored from stem to stern to prevent seasickness in his army. In the prevailing wind conditions, the chaining of the battleships allowed fire to spread easily and quickly when attacked by fire ships from

the southern navy (de Crespigny, 1990). Linking equity markets in a financially integrated capital market is similar to such a stem to stern chaining of battleships and dismantling the financial barriers to speculative trading runs the risk of allowing financial contagion to spread among constituent equity markets in the APR (Dornbusch et al., 2000). Consequently, we test the following *'Speed of Adjustment Hypothesis':* *The larger the equity market is, the higher the speed of adjustment in market equity size to temporary shocks with regard to capital mobility in information processing efficiency.*

3.3   Data

For our empirical analyses, we obtained, from Bloomberg, a panel dataset of daily US currency denominated SMCs for ten countries in the APR, namely, Australia, China, Hong Kong SAR, Japan, South Korea, Malaysia, New Zealand, Singapore, Taiwan and Thailand and US for the period between 22 September 2003 and 29 October 2007. We computed the continuously compounded daily growth rate of the SMC (sum of market-value weighted equity index multiplied by the number of shares outstanding) for these markets by taking the first difference in the natural logarithm of the daily SMC of the respective equity markets. Our purpose is not only to explore the dynamics of the equity markets in the APR as a whole but also to examine the dynamics within the sub-regions. Consequently, we also employ data from the sub-regions, defined in previous studies; namely, 'Australia-New Zealand' (ANZ) (Dekker et al., 2001; Janakiramanan and Lamba, 1998), 'Greater China' which consists of China-Hong Kong SAR-Taiwan (Huang et al., 2000; Yeh and Lee, 2000) and 'Malaysia-Singapore-Thailand' (MST) (Dekker et al., 2001; Janakiramanan and Lamba, 1998).

3.4   Methodology

We employ multiple time series analysis for examining the dynamics of financial integration in the APR (Lutkepohl, 2007). We first discuss our cointegration approach and then the variance decomposition (VD) and impulse response (IR) framework used for the empirical analyses.

Measuring financial integration using cointegration

We first adopt the well-established cointegration procedure introduced by Johansen (1988) and Johansen and Juselius (1990). We test for stationarity by using the standard Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and the Kwiatkowski-Phillips-Schmidt-Shim (KPSS) unit root tests on the natural logarithm of the daily SMCs and SMC growth rate. The vector autoregression-based (VAR) cointegration procedure, which is provided in the form of a vector error correction model (VECM), is given as follows (Pesaran et al., 1996; Pesaran and Shin, 1996):

$$\Delta Y_i = \mu + \gamma \delta_t - \pi Y_{t-1} + \sum_{i=1}^{p-1} \theta_i \Delta Y_{t-i} + \psi_t \tag{3.1}$$

where Y_i is a vector of jointly determined endogenous and exogenous stationary variables, $\theta_i = \sum_{j=i+1}^{p} A_j$ are the short run adjustments to changes in the variables (which suggests the presence of p - r common trends)(Gonzalo and Granger, 1995), A_j are n x n coefficient matrices, $\pi = \sum_{j=1}^{p} A_j - I = \alpha\beta'$ is the long run multiplier matrix (given that α and β' are the n x r matrices where r is the number of cointegrating vectors, p is the number of lags and I is a unit matrix), μ is a vector of constants, δ_t is a vector of trends, γ is the associated coefficients of the vector of trends, Ψ_t is the vector of innovations (allowed to be contemporaneously correlated with its own lags but assumed to be uncorrelated with the right-hand side variables, and has white noise properties).

In order to remove the autocorrelation in the residuals, a number of lags (p) is needed. However, the minimum number of lags to include in the VECM is p-1 to avoid misspecifications within the cointegration framework, as suggested by Engle and Granger (1987). α measures the speed at which each variable adjusts to the disturbances in the long-run equilibrium and the β' is a matrix of long-run coefficients (Bley, 2009). Therefore, to test the null hypothesis of at most r cointegrating vectors, the conventional λ- trace and λ- max statistics are used.

An interesting feature of a single common stochastic trend among a group of equity markets is that it suggests a perfect correlation in the long run among these

equity markets. The behavior of any constituent market will serve to represent the behavior of the group (Phylaktis and Ravazzolo, 2005) and this implies that an integrated equity market occurs when constituent equity markets share a single common trend with only transitory deviations. It should be noted that capital mobility in a financially integrated region is generally associated with the lack of entry and exit barriers on capital flows erected by regulatory bodies and a lack of legislative controls over deposit rates. Therefore, a single common stochastic trend among a group of equity implies an unrestricted flow in capital in a financially integrated region (Jeon and Chiang, 1991).

Variance decomposition, endogeneity and geographical proximity

To test the *Geographical Proximity Hypothesis*, the VD approach (Stock and Watson, 2001) is used to empirically assess whether the interaction in the SMC growth follows a mutual and symmetric or a unidirectional and leader-follower (dominating versus dominated) pattern (Elyasiani et al., 2007). This approach allows us to determine the relative importance of shocks by partitioning the forecast errors' variances (FEV) in an equity market into proportions, which can be attributed to each equity market in the system, including its own (Masih and Masih, 1997).

Once the VECM is estimated, the VD and IR analysis is undertaken. Lutkepohl and Reimers (1992) and Mellander et al. (1992) have argued that innovation accounting can be used to summarize the structure of the equity market linkages by observing their short-run dynamic interactions. We have employed the ordering-invariant generalized VD to overcome the sensitivity to the ordering of the VD under Cholesky factorization (Pesaran and Shin, 1998).

The criteria employed to identify a potential equity market leader for the APR was suggested by Elyasiani et al. (2007) and Friedman and Shachmurove (1997). If the shocks from an equity market explain a large percentage of the FEV in other equity markets, and its own FEV cannot be explained by shocks from other equity markets at all horizons, it is regarded as a pure leading equity market. If the shocks from an equity market explain very little of the FEV of other equity markets and its own FEV can be explained by shocks from other equity markets, then this equity market is regarded as pure follower (Friedman and Shachmurove, 1997). An exogenous equity market is one

where the shocks originating from other equity markets cannot explain all of the FEV in the equity market. Likewise, if the shocks in other equity markets can explain all of the FEV in an equity market, then that equity market is regarded as an endogenous equity market.

The degree of asymmetry between the share of VD for the various pairs of equity markets is measured by subtracting the share of equity market *(m)* in VD of equity market *(n)* from the share of equity market *(n)* in VD of equity market *(m)*. Elyasiani et al. (2007) argue that a positive asymmetry value suggests that equity market *(m)* leads equity market *(n)* and a negative asymmetry value suggests that equity market *(n)* leads equity market *(m)*. The magnitude of the difference measures the degree of asymmetry, with zero being symmetrical.

Dynamic impulse responses and speed of adjustment in the equity market size to temporary shocks

We conduct an IR analysis to trace the magnitude of responses of current and future values of SMC growth rates to unanticipated shocks due to a one standard deviation change in the current value of one of the VAR errors (assuming that this error returns to zero in subsequent periods while holding other errors equal to zero) (Stock and Watson, 2001). This analysis will reveal an equity market's degree of sensitivity and speed of adjustment (with respect to information processing and vulnerability) to a temporary shock, given its degree of interdependence on other equity markets. A higher degree of interdependence implies a higher degree of sensitivity, and vulnerability to unanticipated shocks originating from other equity markets.

We employed the generalized impulse response (GIR) function, particularly because this approach facilitates the search for a potential equity market leader, despite the fact that it uses extreme identifying assumptions (Kim, 2009). This is due to the fact that GIR provides a realistic description of equity market linkages (Elyasiani et al., 2007) and is more accurate than other approaches such as directed acyclic graphs (DAG) technique (Yang et al., 2006).

3.5   Empirical results

Descriptive statistics

Descriptive statistics for the daily SMC growth rates in the APR are presented in Table 3.1. During the sample period, the mean SMG growth rates for all equity markets are positive. Measured by the average daily SMC, the largest equity market in the APR is Japan, followed by Hong Kong SAR, China, Australia, South Korea, Taiwan, Singapore, Malaysia, Thailand, and New Zealand.

Financial integration in APR

In Table 3.2, we report the findings of the ADF, PP and KPSS unit root tests. The test results lead to a rejection of the null hypothesis of stationarity for the daily natural logarithm of the SMC at the 1 percent level for all the equity markets, except that in the USA, Interestingly, the daily SMC for the US equity market is stationary at the level. For the remaining equity markets, the daily SMC growth rate series (produced by first differencing) are stationary.

Table 3.1: Descriptive statistics for SMC growth rates for the countries in the APR.

The mean, median, maximum, minimum and standard deviation variables for SMC growth rates of the individual equity markets are in percentages. The Size column is given as the average daily SMC values of the individual equity markets in US thousand dollars.

Equity Market	Observations	Size (Ranking)	Mean	Median	Maximum	Minimum	Standard Deviation	Skewness	Kurtosis	Jacque-Bera
Australia	804	739,516 (4)	0.128607	0.153209	6.091474	-6.985456	1.231713	-0.661688	7.083151	617.1854 (0.000000)
China	804	872,365 (3)	0.252712	0.148682	14.74330	-13.33755	2.108571	1.054343	13.84873	4,091.739 (0.000000)
Hong Kong SAR	804	1,175,232 (2)	0.197815	0.196401	7.344550	-4.858187	1.231599	-0.030482	6.588313	431.4702 (0.000000)
Japan	804	4,151,712 (1)	0.059106	0.065170	8.217246	-11.45942	1.482886	-0.624344	10.28117	1,828.253 (0.000000)
South Korea	804	603,410 (5)	0.178092	0.227295	9.047688	-10.20539	1.716930	-0.379022	8.027944	866.1375 (0.000000)
Malaysia	804	202,169 (8)	0.089398	0.085619	22.53604	-18.90583	1.417832	1.748985	120.1315	460,022.9 (0.000000)
New Zealand	804	37,649 (10)	0.062486	0.114082	5.128684	-5.450827	1.142369	-0.560684	6.503264	453.2657 (0.000000)
Singapore	804	272,480 (7)	0.159678	0.185507	7.727672	-5.310166	1.158874	0.131213	9.197445	1,288.986 (0.000000)
Taiwan	804	525,615 (6)	0.087780	0.076779	6.552638	-9.631353	1.406584	-0.634823	8.214600	964.9358 (0.000000)
Thailand	804	125,441 (9)	0.126796	0.090324	8.387183	-18.09835	1.806624	-1.160238	17.47232	7,196.892 (0.000000)
US	804	15,500,716	0.048935	0.079916	2.817191	-3.641058	0.808624	-0.337000	4.878916	133.4842 (0.000000)

Table 3.2: Results for unit root tests on the level and first difference of the SMCs in the APR.

The ADF, PP and KPSS denote the Augmented Dickey Fuller, Phillips-Perron and Kwiatkowski, Phillips, Schmidt and Shin tests for unit roots respectively. The optimal number of lags was chosen based on Schwarz Information Criterion (SIC).

Equity Market	ADF		PP		KPSS	
	Level	First Difference (*p*-value)	Level	First Difference (*p*-value)	Level	First Difference (*p*-value)
Australia	-2.242185 (0.4649)	-25.84193*** (0.0000)	-2.232086 (0.4705)	-25.78425*** (0.0000)	0.544973***	0.032151
China	0.469374 (0.9992)	-29.81759*** (0.0000)	0.600821 (0.9995)	-29.88150*** (0.0000)	0.812606***	0.198810
Hong Kong SAR	-0.269791 (0.9914)	-28.26337*** (0.0000)	-0.278466 (0.9912)	-28.26284*** (0.0000)	0.730495***	0.066522
Japan	-2.416508 (0.3706)	-32.68983*** (0.0000)	-2.611104 (0.2754)	-32.69831*** (0.0000)	0.369078***	0.031763
South Korea	-2.728390 (0.2253)	-29.77294*** (0.0000)	-2.666407 (0.2510)	-29.80621*** (0.0000)	0.191257**	0.040454
Malaysia	-1.592228 (0.7956)	-33.90998*** (0.000)	-1.691526 (0.7544)	-33.92986*** (0.0000)	0.576219***	0.070640
New Zealand	-2.231059 (0.4711)	-25.68229*** (0.0000)	-2.146914 (0.5182)	-25.61229*** (0.0000)	0.344397***	0.096314
Singapore	-1.456686 (0.8434)	-30.18433*** (0.0000)	-1.390064 (0.8634)	-30.13564*** (0.0000)	0.613243***	0.045183
Taiwan	-2.308498	-26.90513***	-2.557013	-26.94272***	0.441196***	0.028794

	(0.4283)	(0.0000)	(0.3005)	(0.0000)		
Thailand	-2.498841	-30.21654***	-2.591914	-30.15659***	0.283833***	0.068527
	(0.3287)	(0.0000)	(0.2842)	(0.0000)		
US	-4.176078***		-4.142209***			0.092231
	(0.0050)		(0.0057)			

*Denotes statistical significance at the 10 percent level.
**Denotes statistical significance at the 5 percent level.
***Denotes statistical significance at the 1 percent level.

Most studies exploring financial integration in the APR have included the US equity market as an endogenous variable in the VAR analysis (notably in studies by Bessler et al., 2003; Dekker et al., 2001; Janakiramanan and Lamba, 1998). This approach makes it difficult to identify a potential equity market leader amongst the countries that make up the APR. However, failing to include the US equity market could lead to a misleading picture of the financial integration dynamics in the APR (Dekker et al., 2001). Consequently, we treat the natural logarithm of the daily US SMC as an exogenous variable in the VAR system. We have included the contemporaneous, lag 1 and 2 of the daily SMC of US in the error correction model for the purpose of controlling for the US effect. The benefits of including the US equity market in our analysis are not only to control for the effects the US equity has on the financial integration process in APR but also to help reveal the nature of the underlying dynamic linkages between equity markets in the region. Thus, we are able to identify a potential equity market leader within the APR (Masih and Masih, 2001; Sheng and Tu, 2000).

The results of the multivariate cointegration analysis (reported in Table 3.3) indicate that the null hypothesis of at most two cointegrating vectors is not rejected at the 5 percent level, using the critical values by Osterwald-Lenum (1992). These findings are in agreement with several previous studies which have explored cointegration in the APR using price indices (Click and Plummer, 2005; Phylaktis and Ravazzolo, 2005; Sander and Kleimeier, 2003) and suggest that there appears to be two, albeit weak, common stochastic trends among the constituent equity markets in the APR. Consequently, since asset prices exhibit co-movements, investors cannot reduce their overall risk by holding a diversified portfolio of equities from markets across the APR.

Table 3.3: Results for multivariate cointegration of SMC in the APR.

The number of cointegration vectors *r* is shown as well as the critical values for trace (λ-trace) and maximum eigenvalue (λ-max) statistics. The critical values are taken from Osterwald-Lenum (1992).

Null Hypotheses	Eigenvalues	λ-trace	λ-max
$r = 0$	0.1116	341.8444** (255.0700)	95.0566** (66.1700)
$r \leq 1$	0.0925	2467878** (213.4000)	77.9368** (60.4800)
$r \leq 2$	0.0524	168.8510 (174.8800)	43.2468 (54.1700)
$r \leq 3$	0.0496	125.6042 (140.0200)	40.8433 (48.5700)

**Denotes statistical significance at the 5 percent level
The values in parentheses are the 95 percent critical values

Endogeneity and geographical proximity hypothesis

The weak cointegration results discussed above can be attributed to the lack of financial integration at the geographical sub-region level in the APR. This can be seen from the results presented in Table 3.4 relating to the decomposition of FEV in the daily SMC growth rates in response to a unit standard deviation shock in the respective equity markets, derived using the generalized VD (see Pesaran and Shin, 1998). The sum of the FEV decomposition in the generalized VD is unlikely to sum up to 100 percent and all the FEV have been standardized to sum to 100 percent for each of the individual equity markets (see Wang, 2002). This is due to the fact that unless the variance-covariance matrix of the forecast error is orthogonal (as for orthogonalized VD), the sum of the FEV decomposition will not sum to 100 percent. Table 3.4 also reports the 5-, 10- and 15-day FEV of each equity market accounted for by shocks in each of the ten equity markets in our VECM system (see Table 3.4).

Table 3.4: Results of generalized forecast error variance decomposition.

Each entry denotes the total percentage of forecast error variance of the individual equity market in the first column explained by the market in the first row. Error variance decomposition has been standardized for each of the explained equity market such that the sum is 100 percent. Entries in the "All Foreign" denote the total percentage forecast error variance of the market in the first column explained by all foreign markets.

Equity Market Explained	Days after shock	By innovations in										
		Australia	China	Hong Kong SAR	Japan	South Korea	Malaysia	New Zealand	Singapore	Taiwan	Thailand	All Foreign
Australia	5	54.2474	0.1992	5.0752	4.6257	7.1318	4.4411	17.5812	0.9355	3.7499	2.0131	45.7526
	10	54.6123	0.1891	4.8583	4.3245	6.9789	4.4581	17.9975	0.9510	3.6189	2.0115	45.3877
	15	54.5773	0.1847	4.7636	4.2002	6.9009	4.4521	18.0952	0.9561	3.5599	2.0065	45.4227
China	5	2.6252	83.6894	5.3441	0.5044	0.4634	4.1089	1.2080	0.9993	0.5004	0.5570	16.3106
	10	2.8925	83.3270	5.2639	0.4739	0.4580	4.1971	1.3559	0.9691	0.4943	0.5682	16.6730
	15	3.0079	83.2046	5.2276	0.4596	0.4556	4.2254	1.4191	0.9436	0.4904	0.5663	16.7954
Hong Kong SAR	5	13.5603	2.8638	45.5782	4.1255	10.2700	6.1205	4.2607	0.9863	9.4028	2.8320	54.4218
	10	16.2403	2.9118	44.5106	3.4137	10.1273	5.8277	5.4680	0.5853	8.8263	2.0889	55.4894
	15	17.9049	2.9462	43.6600	3.0138	10.0173	5.5882	6.2150	0.5476	8.4547	1.6523	56.3400
Japan	5	12.3788	0.3366	8.2830	50.1150	13.0531	1.9458	3.2794	0.4438	9.0687	1.0958	49.8850
	10	14.1270	0.3428	7.9445	48.7545	13.1626	1.8107	3.9997	0.3468	8.7719	0.7395	51.2455
	15	15.2611	0.3507	7.7008	47.8074	13.1709	1.7104	4.4646	0.4322	8.5525	0.5494	52.1926
South Korea	5	10.9764	0.3310	11.0266	9.2816	44.6434	3.5293	3.5140	0.9224	13.5668	2.2086	55.3566
	10	11.4018	0.3351	10.9415	9.1198	44.3931	3.5486	3.7338	0.8385	13.5616	2.1262	55.6069
	15	11.6163	0.3375	10.8976	9.0405	44.3086	3.5488	3.8395	0.7855	13.5495	2.0760	55.6914
Malaysia	5	11.7214	2.1279	8.5913	1.3456	5.0539	60.5854	3.6215	0.6178	4.4948	1.8403	39.4146
	10	14.0725	2.1814	8.1978	1.0499	5.0533	58.8591	4.6067	0.4346	4.2216	1.3230	41.1409
	15	15.5249	2.2142	7.8881	0.8773	5.0169	57.6923	5.2264	0.5202	4.0209	1.0188	42.3077
New Zealand	5	21.3553	0.0217	0.7092	0.9859	2.1798	0.8776	72.7293	0.1839	0.8158	0.1416	27.2707

	10	21.7752	0.0209	0.6411	0.8609	2.0729	0.8244	72.8684	0.1162	0.6995	0.1205	27.1316
	15	21.9763	0.0208	0.6107	0.8063	2.0287	0.7986	72.9138	0.0858	0.6518	0.1073	27.0862
Singapore	5	12.5451	1.6897	7.5554	5.5266	5.6950	5.1847	4.8684	48.4418	7.6165	0.8767	51.5582
	10	20.1470	2.0571	7.3680	4.7873	6.3333	5.0021	8.2716	37.7012	7.6425	0.6899	62.2988
	15	25.6844	2.2784	6.9913	4.1557	6.5710	4.6948	10.8177	30.4776	7.3871	0.9421	69.5224
Taiwan	5	8.6016	0.4169	11.4730	6.2311	13.9118	3.8298	3.6985	1.9302	48.9894	0.9177	51.0106
	10	9.6408	0.4434	11.2414	5.8390	13.9466	3.7727	4.2697	1.4774	48.6557	0.7132	51.3443
	15	10.2681	0.4581	11.0966	5.6222	13.9665	3.7161	4.6012	1.2022	48.4743	0.5948	51.5257
Thailand	5	10.2121	0.1256	7.3344	2.4052	6.5780	3.2294	2.0110	0.5464	5.1361	62.4218	37.5782
	10	12.7274	0.1368	7.1674	2.1125	6.8808	3.1518	2.8025	0.3466	5.1821	59.4922	40.5078
	15	14.3506	0.1466	7.0146	1.9181	7.0120	3.0600	3.3336	0.3832	5.1322	57.6490	42.3510

Supporting Dekker et al. (2001) and Friedman and Shachmurove's (1997) results, at the 15-day horizon, the Singaporean equity market appears to be the most endogenous equity market in the APR. Furthermore, our results indicate that the equity markets which are most influenced (in descending order of endogeneity) by other equity market are Singapore, Hong Kong SAR, Japan, Taiwan, South Korea, Australia, Thailand, Malaysia, New Zealand and China. This ordering is at odds with those of Dekker et al. (2001) and Janakiramanan and Lamba (1998). The difference, in terms of ranking of equity markets based on the degree of endogeneity, is expected given that our use of SMC provides a more comprehensive picture of the financial integration processes in the APR. It is interesting to note that emerging equity markets with high growth phases, such as Thailand, Malaysia and Taiwan, tend to isolate themselves from the developments in the advanced equity markets.

We investigate whether more advanced equity markets within the same geographical vicinity (which share a similar group of investors) exert more influence on smaller equity markets. Consequently, we test the *Geographical Proximity Hypothesis* in three sub-regions, namely, ANZ, Greater China and MST.

Within the ANZ sub-region, we find that the shocks in the Australian equity market explain a larger percentage of the FEV in the New Zealand equity market than the shocks in the New Zealand equity market explain the FEV of the Australian equity market (see Table 3.4). These results are contrary to those of Dekker et al. (2001) who, despite applying the generalized VD to overcome the problem arising from using the Cholesky decomposition by Janakiramanan and Lamba (1998), found no support for the *Geographical Proximity Hypothesis* for the ANZ sub-region. By employing SMC as a measure of equity size, we have avoided the potential bias arising from ignoring market equity size and, as a result, revealed the true degree to which equity markets within the ANZ sub-region influence each other. Our findings provide full support for the *Geographical Proximity Hypothesis* in the ANZ sub-region.

The results presented in Table 3.4 also suggest that shocks in the Hong Kong SAR equity market appear to have the largest explanatory power on FEV in the Chinese equity market (compared to any other equity market in the APR). This could be attributed to the success in the continuous realignment of financial institutions, political systems and legal frameworks within the Hong Kong SAR after the return of the former British colony to

mainland China in 1997. This change was widely heralded as a healthy development towards a closer financial integration between these two equity markets (Yeh and Lee, 2000). It is interesting to note that political issues have kept the Chinese and Taiwanese equity markets apart and this explains the inability of shocks in either of these equity markets to explain the FEV of the other equity market. However, it appears that the Hong Kong SAR equity market is better linked to the Taiwanese equity market. Taken together, these results provide support for the *Geographical Proximity Hypothesis* within the Greater China sub-region.

Our results for the MST region show that the Singaporean equity market is more integrated towards more advanced equity markets and has decoupled herself from her neighbors within the sub-region. However, it can be seen from Table 3.4 that the Singaporean and Thai equity markets are weakly led by the Malaysian equity market. Thus, we find partial empirical support for the *Geographical Proximity Hypothesis* for this sub-region.

Potential leading equity market

Table 3.5 shows the symmetry between constituent equity markets on Day 15. The results in Table 3.5 indicate that the Australian equity market is the most likely candidate for the 'leading equity market' in the APR. In particular, we observe that the Australian market exerts the largest influence on all remaining equity markets in the APR, since the magnitudes in the difference in VD shares in the Australian equity market against all the remaining equity markets are positive and relatively large. This result supports our *Leading Equity Market Hypothesis*, that one of the advanced equity markets in the APR should provide the leadership required to unify the region's equity markets.

Table3. 5: Symmetry results for Day 15.

The degree of asymmetry between the share of vector decomposition for the various pairs of equity markets is measured by subtracting the share of the equity market (m) in VD of equity market (n) from the share of equity market (n) in VD of equity market (m). Positive asymmetry value suggests that equity market (m) leads equity market (n) and a negative asymmetry value suggests that equity market (n) leads equity market (m). The magnitude of difference measures the degree of asymmetry, with zero being symmetrical.

Equity Market Explained	Differences in the VAR shares (in percentages) in								
	Australia	**China**	**Hong Kong SAR**	**Japan**	**South Korea**	**Malaysia**	**New Zealand**	**Singapore**	**Taiwan**
Australia									
China	2.8232								
Hong Kong SAR	13.1413	-2.2814							
Japan	11.0609	-0.1089	4.6869						
South Korea	4.7154	-0.1182	0.8803	-4.1304					
Malaysia	11.0728	-2.0112	2.2999	-0.8332	1.4681				
New Zealand	3.8810	-1.3983	-5.6043	-3.6583	-1.8108	-4.4278			
Singapore	24.7282	1.3348	6.4437	3.7235	5.7855	4.1746	10.7318		
Taiwan	6.7082	-0.0323	2.6419	-2.9303	0.4169	-0.3048	3.9495	-6.1849	
Thailand	12.3441	-0.4197	5.3623	1.3688	4.9360	2.0412	3.2263	-0.5589	4.5374
Absolute Minimum	6.18489								
Absolute Maximum	24.72822								

Our results are consistent with the important role that the Australian government has been playing in the APR. For example, the call by the Australian Prime Minister Kevin Rudd to create a new Asia-Pacific bloc, similar to the European Union by 2020, which will focus on economic, security and political co-operation. In addition, the Australian government played a pivotal role in setting up of the Asia-Pacific Economic Cooperation (APEC) to increase cooperation on regional trade and investment liberalization and facilitation, with the aim of enhancing economic growth and prosperity in the region.

It is also interesting to note that our results suggest that the Chinese equity market remains isolated from the other equity markets in the APR. This might be due to the fact that China has kept its nationalistic view of the region or the world. For example, Moshirian (2009) notes that the Chinese equity market is still sensitive to national sovereignty and culture despite financial liberalization reforms. The results presented in Table 3.5 show that the magnitude of difference in the VD shares between the Chinese equity market and the remaining equity markets in the APR is less than 2 percent and the negative sign shows that the Chinese equity market is led by the Hong Kong SAR equity market. However, we expect that, given the robust efforts of the Chinese government to facilitate its equity market's growth, this market will overtake the Hong Kong SAR equity market. Also, it is clear that capital controls, the limited convertibility of its currency and a requirement for Shanghai and Shenzhen only list mainland-incorporated issuers have hampered the role that China can potentially play in influencing other equity markets. In particular, assessing market capitalization values in China has been problematic in the past due to mainland-incorporated issuers' stock being segmented into tradable and no-tradable shares. As more and more companies have transformed their non-tradable (state-held) equity into tradable listed form reflecting the effects of the sweeping 'Split Share Reforms' of 2005-7 as invoked by the CSRC, these reforms will undoubtedly increase China's influence and integration with other equity markets. Therefore, it would appear that the role to fall on Australia. It would be interesting to see how these reforms will propel China's role as a leading financial and economic powerhouse in the APR. Our results also indicate that the Hong Kong SAR equity market leads the Taiwanese equity market.

It is important to note the diminished role of Japan as a leading equity market in the APR[16]. With the exception of the Chinese, Singaporean and Thai equity markets, the Japanese equity market is led by the remaining equity markets in the APR. These results are contrary to earlier findings by Ghosh et al. (1999) and Masih and Masih (2001). However, our results support findings in later studies by Bessler and Yang (2003), Yang et al. (2003) and Dekker et al. (2003), which conclude that the Japanese equity market behaves more like an isolated equity market under normal conditions. In order for the Japanese equity market to act as a potential leader in the APR, it needs to play a more assertive role in the region, by intensifying efforts regarding mutual learning, which could break down differences and emphasize common values and principles in creating a more financially integrated region (Moshirian, 2009).

Dynamic impulse responses and speed of adjustment in the equity market size to temporary shocks

To complement the VD analysis and to determine the pattern of information transmission among equity markets in the APR, an IR analysis is performed. The results of this IR analysis of the daily SMC growth rate in the APR to a unit standard deviation of shock in each of the individual equity markets and its dynamic effects throughout the system up to 15 trading days are presented in Table 3.6. The more responsive an equity market is with respect to information transmission, the more interactive it is, and the greater the speed with which a shock in a particular equity market is transmitted to the remaining equity markets within the APR.

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[16] A number of previous studies have argued that the role of the Japanese equity market has slowly diminished and efforts to play the role as the leader in the APC has met resistance (see Kenen and Meade, 2007; Park, 2004 and references therein).

Table 3.6: Results of impulse response analysis of the SMC in the APR to a unit standard deviation shock in the individual equity markets.

Each entry denotes the impulse response coefficient of the individual equity market in the first column due to a unit standard deviation shock by the market in the first row.

Equity Market Responding	Days after shock	To one S.D. impulse in									
		Australia	China	Hong Kong SAR	Japan	South Korea	Malaysia	New Zealand	Singapore	Taiwan	Thailand
Australia	0	0.0108	0.0009	0.0042	0.0044	0.0045	0.0031	0.0054	0.0014	0.0035	0.0023
	5	0.0111	0.0006	0.0032	0.0030	0.0039	0.0032	0.0064	0.0015	0.0028	0.0021
	10	0.0111	0.0006	0.0032	0.0030	0.0039	0.0032	0.0064	0.0015	0.0028	0.0021
	15	0.0111	0.0006	0.0032	0.0030	0.0039	0.0032	0.0064	0.0015	0.0028	0.0021
China	0	0.0017	0.0208	0.0054	0.0019	0.0017	0.0037	0.0004	0.0021	0.0016	0.0011
	5	0.0038	0.0196	0.0049	0.0014	0.0014	0.0045	0.0026	0.0021	0.0015	0.0017
	10	0.0039	0.0196	0.0049	0.0014	0.0014	0.0045	0.0027	0.0020	0.0015	0.0016
	15	0.0039	0.0196	0.0049	0.0014	0.0014	0.0044	0.0027	0.0020	0.0015	0.0016
Hong Kong SAR	0	0.0042	0.0028	0.0108	0.0043	0.0053	0.0036	0.0014	0.0023	0.0053	0.0032
	5	0.0059	0.0024	0.0095	0.0024	0.0045	0.0034	0.0035	0.0003	0.0042	0.0019
	10	0.0065	0.0025	0.0093	0.0022	0.0045	0.0033	0.0039	-0.0007	0.0040	0.0013
	15	0.0067	0.0025	0.0092	0.0020	0.0044	0.0032	0.0041	-0.0011	0.0039	0.0011
Japan	0	0.0056	0.0013	0.0055	0.0138	0.0064	0.0024	0.0024	0.0023	0.0056	0.0026
	5	0.0060	0.0009	0.0044	0.0108	0.0057	0.0021	0.0032	-0.0002	0.0046	0.0011
	10	0.0064	0.0009	0.0042	0.0106	0.0057	0.0019	0.0036	-0.0010	0.0044	0.0007
	15	0.0066	0.0009	0.0041	0.0105	0.0056	0.0019	0.0037	-0.0014	0.0044	0.0004
South Korea	0	0.0066	0.0013	0.0077	0.0073	0.0157	0.0039	0.0033	0.0024	0.0082	0.0036
	5	0.0071	0.0012	0.0068	0.0062	0.0136	0.0039	0.0041	0.0018	0.0076	0.0030
	10	0.0071	0.0012	0.0068	0.0061	0.0136	0.0039	0.0041	0.0017	0.0076	0.0029
	15	0.0072	0.0012	0.0067	0.0061	0.0136	0.0039	0.0042	0.0017	0.0075	0.0029
Malaysia	0	0.0038	0.0024	0.0045	0.0023	0.0033	0.0133	0.0018	0.0021	0.0034	0.0023
	5	0.0055	0.0021	0.0040	0.0013	0.0032	0.0106	0.0031	0.0000	0.0029	0.0015

	10	0.0059	0.0021	0.0038	0.0011	0.0031	0.0105	0.0035	-0.0009	0.0027	0.0010
	15	0.0062	0.0021	0.0037	0.0009	0.0031	0.0104	0.0037	-0.0013	0.0026	0.0007
New Zealand	0	0.0055	0.0002	0.0014	0.0019	0.0023	0.0015	0.0110	0.0011	0.0018	0.0005
	5	0.0065	0.0002	0.0011	0.0012	0.0019	0.0012	0.0118	0.0003	0.0011	0.0005
	10	0.0066	0.0002	0.0010	0.0012	0.0019	0.0012	0.0119	0.0002	0.0010	0.0004
	15	0.0066	0.0002	0.0010	0.0012	0.0019	0.0012	0.0119	0.0002	0.0010	0.0004
Singapore	0	0.0013	0.0010	0.0023	0.0017	0.0016	0.0016	0.0010	0.0104	0.0021	0.0009
	5	0.0051	0.0016	0.0030	0.0023	0.0028	0.0024	0.0033	0.0060	0.0030	0.0001
	10	0.0061	0.0017	0.0026	0.0018	0.0027	0.0021	0.0040	0.0041	0.0027	-0.0009
	15	0.0066	0.0017	0.0024	0.0015	0.0027	0.0020	0.0043	0.0032	0.0026	-0.0014
Taiwan	0	0.0043	0.0010	0.0064	0.0054	0.0068	0.0033	0.0022	0.0026	0.0131	0.0023
	5	0.0058	0.0012	0.0060	0.0043	0.0068	0.0035	0.0039	0.0021	0.0126	0.0014
	10	0.0061	0.0013	0.0059	0.0041	0.0067	0.0034	0.0041	0.0015	0.0125	0.0011
	15	0.0062	0.0013	0.0059	0.0041	0.0067	0.0034	0.0042	0.0013	0.0124	0.0010
Thailand	0	0.0037	0.0009	0.0051	0.0033	0.0040	0.0030	0.0008	0.0016	0.0031	0.0174
	5	0.0072	0.0007	0.0052	0.0027	0.0052	0.0035	0.0034	0.0003	0.0045	0.0147
	10	0.0078	0.0008	0.0049	0.0024	0.0051	0.0032	0.0039	-0.0009	0.0043	0.0140
	15	0.0081	0.0008	0.0048	0.0022	0.0051	0.0031	0.0041	-0.0015	0.0042	0.0137

Following Yang et al. (2003) and Dekker et al. (2001), we have taken 0.5 percent as the threshold value above which the impact of a shock is considered significant. In general, for non-stationary variables, almost all initial shocks would have long lasting and significant permanent effects (Wang and Dunne, 2003). Figure 3.1 shows the transmission of information propagation mechanism, derived from the impulse coefficients of the SMC in the APR to a unit standard deviation shock in the individual equity markets (shown in Table 3.6), taking 0.5 percent as the threshold value.

Figure 3.1: The transmission of information propagation mechanism and impulse response in the SMC in the APR.

These lines show the efficiency of information transmission from one equity market to another. The solid arrows show the instantaneous effect and the dotted line arrows show the lagged effect.
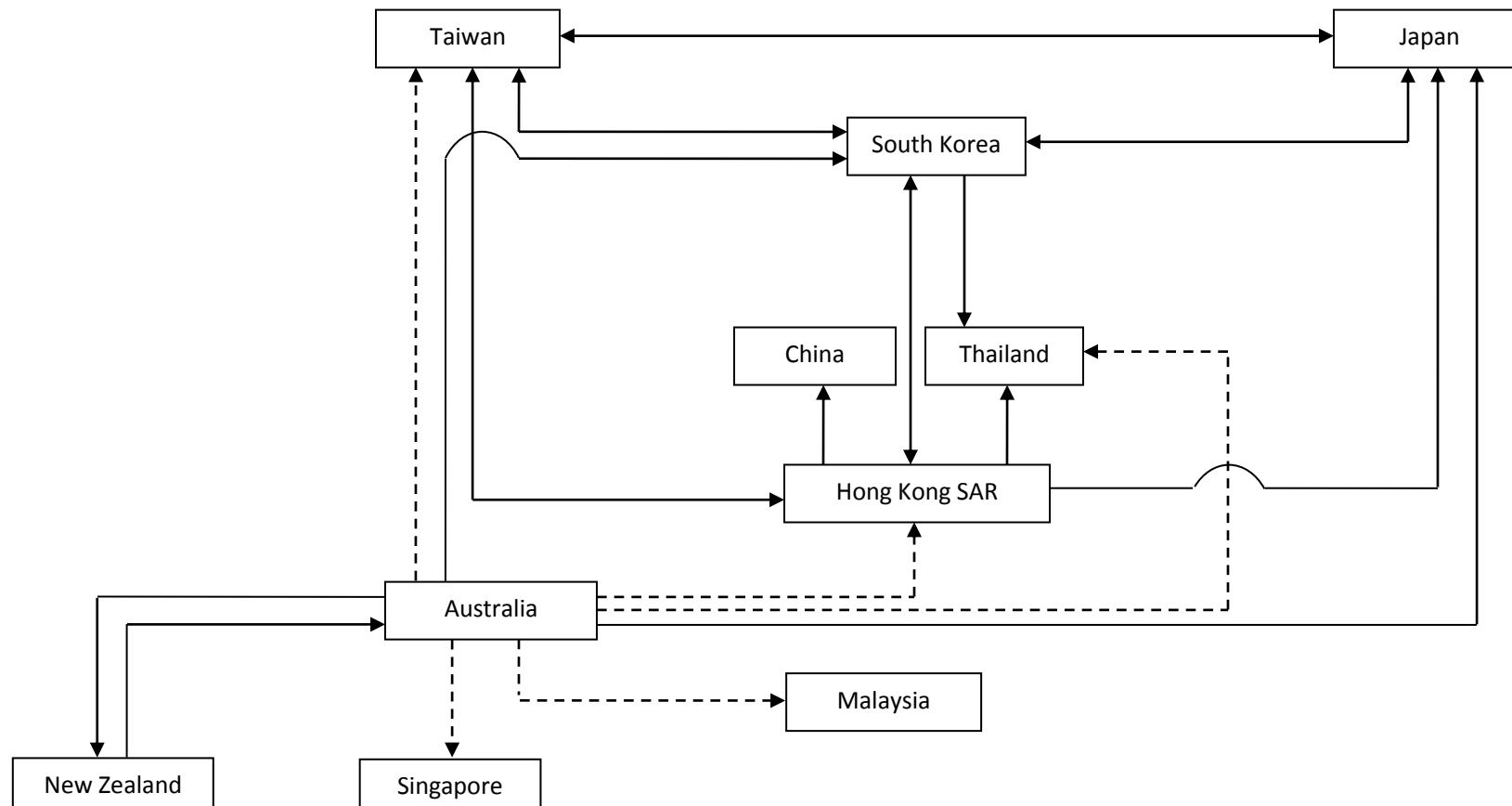
The results show that the speed of information transmission between the six largest equity markets in the APR (Australia, China, Hong Kong SAR, Japan, South Korea and Taiwan) is instantaneous with respect to an initial shock from New Zealand (via Australia, with the exception of Hong Kong SAR which receives the initial shock from New Zealand via Taiwan and South Korea). However, smaller equity markets do not feel the effect of the initial shock from New Zealand until day 3 (see Figure 3.1). These findings support Moshirian's (2009) view that the advanced equity markets (the six largest equity markets) can be nominated to form the initial core members to spearhead the reforms necessary for a true equity market union before inviting equity markets from the wider APR.

However, our results reveal a higher degree of interactivity between the South Korean and Japanese equity markets, after controlling for the US equity market as an exogenous variable in our VECM system of equations. These results differ from those of Park and Fatemi (1993), who report a lower level of interactivity between the South Korean and Japanese equity markets. It is important to note that the South Korean and Taiwanese economies are heavily dependent on trade with the US and Japan, but the results in the study by Park and Fatemi (1993) did not show a strong linkage between the Japanese and US equity markets and the South Korean and Taiwanese equity markets. In our study, the results clearly reveal that the South Korean and Japanese equity markets are linked and are significantly affected by the US and/or the Japanese equity markets.

It is clear from Figure 3.1 that the most efficient information transmission occurs between the six largest equity markets in the APR. The larger equity markets in the APR exhibit a higher degree of information efficiency and this contributes to a higher level of financial integration. Smaller equity markets, on the other hand, appear to be less informationally efficient and less financially integrated. Our results imply that less profitable opportunities exist for equity traders in the larger equity markets in the APR. However, arguably, an arbitrageur could exploit the profitable opportunities arising from the lack of financial integration in the smaller equity markets (Jeon and Chiang, 1991). This painful lesson was learnt during the 1997 Asian financial crisis, where several equity markets, including the Malaysian equity market, were adversely affected by such arbitrage. This led the Malaysian government to impose capital control measures and a ban on short selling activities; subsequently, these measures were replaced by a restricted short selling scheme (Yang et al.,

2003). While these measures were able to prevent further damages to the financial sector and the Malaysian economy, the Malaysian experience also showed that intervention by governments can mitigate against a higher degree of financial integration in the APR (Park and Fatemi, 1993).

Implications of Study

It is interesting to note that the Australian equity market can be seen as a proxy for changes in equity markets in the US. Despite the fact that the effects from the US equity market are captured in the error correction model (see Table 3.4) as an exogenous variable, the strong economic link between US and Australia exists. The US remains a major trading partner of Australia (2nd largest importer of US goods and 5th largest exporter of Australian goods). Also, stronger cultural and political links between Australia and the US than Australia with the remaining APR countries (except New Zealand) could possibly imply that changes in the Australian equity market will mirror the effects in the US markets. Therefore, despite the fact that the Chinese economy is one of the largest in the region, Australia remains a potential contender to lead the APR given its strong political and trade links with the US.

In our sub-region analysis, we find that the reaction of the Australian equity market to a one unit standard deviation shock originating from New Zealand is very similar to the reaction of the New Zealand equity market to a one unit standard deviation shock emanating from the Australian equity market. This symmetric response may reflect a higher degree of economic and financial integration and the free flow of information between these two countries (Eun and Shin, 1989). The IR analysis for the Greater China sub-region shows that the Chinese and Taiwanese equity markets react to a one unit standard deviation shock from the Hong Kong SAR equity market. It is noteworthy that the Hong Kong SAR equity market responds to a one unit of standard deviation shock from the Taiwanese equity market but both the Chinese and Taiwanese equity markets fail to react to a unit standard deviation of shock emanating from one another. This result is consistent with the argument that political issues have kept the Chinese and Taiwanese equity markets apart.

Equity markets in the MST sub-region have weak responses to a unit standard deviation shock originating from the other equity markets within the sub-region. This result was expected because of the actions taken by the Malaysian and Singaporean governments since 1989 to disengage their respective equity markets from each other. In particular, both governments decided to delist companies registered in the other country from their respective stock exchanges in 1989 in response to the 1985 financial crisis in Singapore (which spilled over into Malaysia). In addition, capital control measures were imposed to restrict capital mobility into and out of the Malaysian equity market (Click and Plummer, 2005; Sun et al., 2002). From Figure 3.1, it can also be shown that an important link between Singapore and Australia exists. The Singaporean equity market appears to react only to information transmitted from the Australian equity market. The strong links in the equity markets between Singapore and Australia can be seen from attempts by the Singapore stock exchange to acquire the Australian Securities Exchange to form the first major consolidation of exchanges in the APR. Further, close political and economic links between Singapore with the US and Australia with US, suggest that the Singaporean equity market could also reflect, to some extent, the effect of changes in equity markets in the US. By and large, the results in Table 3.4 clearly seem to suggest that the increasing FEV in the Singaporean equity market from Day 5 to Day 15 is accounted by shocks from the Australian equity market. This result is further reinforced by the IR analysis which implies that information transmission to the Singaporean equity market is solely as a result of initial shocks from the Australian equity market. Therefore, while links between Singapore and the other remaining equity markets in the MST have weakened, stronger links is formed between the Singaporean equity market with the Australian equity market.

Correlation between equity market size and financial integration

In our discussion so far, we have examined the financial integration dynamics in the APR by taking into account equity market size. One question remains: Is equity market size correlated with the degree of endogeneity of the respective equity market?

To address this issue, we use the Spearman's ρ to measure the strength of association between the rankings provided by Janakiramanan and Lamba (1998) and Dekker et al. (2001) against the rankings based on endogeneity derived from our findings. The results are presented

in Table 3.7. The positive correlation in the rankings between the degree of endogeneity and equity market size provided by Janakiramanan and Lamba (1998) suggests that as an equity market becomes larger, the equity market tends to be more exogenous. We also find a similar, albeit weaker, positive relationship between the degree of endogeneity and equity market size using the list derived from the study by Dekker et al. (2001). We find that in our list the relationship between the degree of endogeneity and equity market size is negative. The overall negative albeit insignificant relationship can be attributed to the inclusion of China which is relatively a large equity market but also highly endogenous. However, it is important to note that none of the rankings are statistically significant. However, it is important to note that none of the rankings are statistically significant.

Table 3.7: Spearman's ρ used to compare the rankings derived from previous studies and current study based on endogeneity (from most endogenous to most exogenous).

The results of Spearman's ρ which measure the strength of association between the rankings provided by Janakiramanan and Lamba (1998) and Dekker et al. (2001) against the rankings based on endogeneity derived from the current study.

Janakiramanan and Lamba (1998)	Dekker et al. (2001)	Present Study
Malaysia	Singapore	Singapore
Australia	Malaysia	Hong Kong SAR
Singapore	Australia	Japan
Thailand	Hong Kong	Taiwan
Hong Kong	New Zealand	South Korea
New Zealand	Thailand	Australia
Japan	Japan	Thailand
	Taiwan	Malaysia
	US	New Zealand
		China
ρ = 0.214	ρ = 0.167	ρ = - 0.345
(*p*-value = 0.645)	(*p*-value = 0.693)	(*p*-value = 0.328)

3.6 Conclusion

The aim of this study was to investigate the two-tier system proposed by Moshirian (2009) with respect to the dynamics of financial integration in the APR by taking into account equity market size. As a result, new insights are provided regarding the current financial integration processes at work within sub-regions in the APR. In addition, we identify a potential equity market leader

for the region after accounting for equity market size, namely, Australia, which may spearhead the next phase of the financial integration process. Larger equity markets are more informationally efficient than those less advanced equity markets. We have shown that equity markets in the Asia Pacific region can be categorized into advanced, where information is easily accessible by investors for decision making and less advanced, where the existing information infrastructure can be improved upon to support access to information and to promote greater speed in transmitting information by removing financial barriers. Larger equity markets in the APR tend to be more informationally efficient and as equity markets become larger, these equity markets become more endogenous.

By taking SMC as a measure of equity market size, our results show that the weak and slow financial integration process associated with the APR can be attributed to the lack of financial integration in several geographical sub-regions (Moshirian, 2009). Further, our results confirm Moshirian's proposition (2009) regarding the need to develop the layered Asia Pacific Community framework with some advanced countries acting as the founding members of a unified equity market. Our results also demonstrate that the speed of information transmission amongst equity markets in the APR is related to the equity market size of the respective equity markets. The larger equity markets tend to have higher level of information efficiency and the smaller equity markets are potentially vulnerable to speculative financial attacks due to their lower level of information efficiency. Smaller equity markets in the APR are shown to have lower levels of financial integration and the financial liberalization of these equity markets have exposed investors to the risk of greater volatility of capital flows.

In sum, our results verify the importance of considering equity market size when studying financial integration in the APR. Investors can tap into the differences in the size of the expected rates of return on their financial asset portfolios as a result of international financial asset diversification in the fragmented equity markets in the APR, especially among the smaller equity markets. However, these potential gains from international financial asset diversification run the risk of being wiped out by speculative attacks given the existing financial arrangements within the APR.

CONCLUSION

The following discussion outlines the major findings, implications and contributions (see Table at the end of this section) of the three broad thrusts of the thesis and the link between these chapters and the overall research objective.

The overall research objective of this thesis is to investigate the implications of information processing efficiency on rational and effective decision making. Information processing efficiency is pivotal to effective decision making within economic systems and therefore, this thesis sets out to explore these underlying pre-requisites to the EMH in the following settings.

The first thrust of the thesis focuses on examining the extent to which demographic characteristics of SRIs influence their perceived social obligations of organizations. Using a worldwide questionnaire survey and the generalized order logistic regression, the findings suggest that younger, male SR investors are strong believers that a company's social and environmental performance is as important as its financial performance. Further, younger SR investors with high income and education levels view companies that are SR as at least as profitable as socially irresponsible companies. Finally, male SR investors with high incomes are the most likely to believe that companies should be responsible to their shareholders as to the broader society. The implications of this thrust of the thesis indicate that demographic characteristics of SRIs play an important role in influencing their perceived social obligations in three important ways. First, CSR companies can attempt to reduce their cost of capital by attracting the affluent members from the SRIs community. Second, CSR companies can improve their CSR rankings by creating diversity in their corporate boardrooms. This will help increase their share price and, in turn, maximize shareholder wealth. Third, there is a role of government agencies and institutions to play in encouraging CSR companies to implement CSR agendas by appealing to the specific members in the SRIs community (clientele effect). Consequently, these important findings and implications demonstrate that information processing efficiency of decision makers can be influenced by their inherent demographic characteristics.

The second thrust of the thesis focuses on the discovery of the demand determinants for a state contingent asset with multi-competitor choices. Using a unique dataset for all 8,193 races run in the UK during 2004, we find that the day of the week, the number of runners in a race, field size, whether a race is televised, the type of race, race quality, when the race takes place, a measure of the degree of insider trading, track conditions and bookmakers' over-round influence the demand for pari-mutuel wagering in five different sectors (i.e., home-track, away-track, via telephone, internet and through betting shops) of the market. In particular, we find that different types of bettors (sophisticated and unsophisticated bettors) have different preferences towards their betting choice with respect to the sectors of the horseracing pari-mutuel market. The influence of the factors therefore varies across these sectors Clearly, the discovery of these determinants will help reveal variables which helpful in decision making by the relevant authorities, such as the British Horseracing Board, Horseracing Betting Levy and Tote boards in deciding on variables which matters to the decision makers. Institutions offering betting opportunities can also benefit from making decisions which will be tailored to the needs of their customers, based on the determinants of demand for their product. Also, regulators can implement measures to harmonise the efficiency between the various sectors in the pari-mutuel horseracing market. The findings in this chapter show that in processing information, bettors are affected by their underlying motivations for wagering; these influence their choices or channels they employ for betting in a multi-competitor environment.

The third thrust of this thesis focuses on the speed of adjustment to the arrival of new and unexpected information. Using an example from the equity markets, the study explores the degree of financial integration and the speed of adjustment as a result of a temporary shock in the Asia Pacific region, using equity market size. Based on this measure of financial integration, the results single out Australia as the most likely potential equity market leader in the region and that larger equity markets seem to dominate smaller equity markets within the same geographical proximity. Finally, the findings of this thrust of research seem to reveal that advanced equity markets are more informationally efficient than those less advanced equity markets. In summary, the research has shown that equity markets in the Asia Pacific region can be categorized into 'advanced', where information is easily accessible by investors for decision making and 'less advanced', where the existing information infrastructure can be improved to support access to and flow of information.

In conclusion, this thesis has examined the two essential ingredients underlying the propositions in the EMH. First, decision makers make rational decisions and second, decision makers make timely decisions. Using three different decision-making settings, this thesis has shown that demographic characteristics play an important role in influencing the rational information processing involved in decision making. In addition, when confronted with choices, in processing information decision makers are affected by their various motivations, and those who seek to capitalise on others' decisions need to be aware of these motivations. Finally, the infrastructure on which information flows is essential in influencing the speed at which information is processed and integrated.

Table: Summary of the contributions of the three research thrusts with respect to information processing efficiency and decision making.

		Decision Making		
		Demography of Individuals (Chapter 1)	**Individual Motivations (Chapter 2)**	**Speed of Adjustment (Chapter 3)**
Information Processing Efficiency	**Contribution 1**	CSR companies can lower their cost of capital by attracting affluent SRIs (clientele effect)	Regulators can implement rules to harmonise efficiency between sectors in the pari-mutuel horseracing market.	A need to setup regional government to coordinate efforts in financial integration in the Asia Pacific region
	Contribution 2	CSR companies should be able to improve their share price via improvements in CSR rankings by creating diversity in their corporate boardrooms	Horseracing Betting Levy and Tote boards to manage horseracing in a multi-competitor pari-mutuel market	Effective and efficient international institutions are needed to regulate short run capital flows
	Contribution 3	Government agencies and institutions can implement policies to encourage CSR agenda in companies	Informed betting institutions can tailor the betting opportunities the offer based on the needs of their customers	Domestic governments can introduce measures to improve the infrastructure – financial deepening and widening

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APPENDICES

Appendix for Chapter 1

Questions employed to determine whether a participant was an SRI

Question 1

Do you currently own shares in a company listed on a stock exchange, either directly or indirectly through a mutual fund, pension plan, or other retirement fund?

1.   I own shares directly
2.   I own shares indirectly through a mutual fund, pension plan, or other retirement fund
3.   I do not own any shares
4.   I own shares both directly and indirectly

Question 2

Has a company's demonstrated social responsibility ever had an influence on your investment decisions? Have you either bought or sold its shares as a result?

1.   It had an influence at least once
2.   I considered it, but didn't buy or sell shares as a result
3.   It had no effect on my share purchases or sales

Appendix for Chapter 2

Table 2.1: Overview of previous literature exploring demand for pari-mutuel wagering.

Author(s) and Publication Year	Research Method(s)	Variable(s)	Findings
Coate and Ross (1974)	Multiple regression analysis	Dependent Variables: 1. Daily attendance at the thoroughbred tracks 2. Daily attendance at the harness tracks 3. Daily pari-mutuel handle at the thoroughbred tracks 4. Daily pari-mutuel handle at the harness tracks Independent Variables: 1. Day of week 2. Temperature (daily high for the flat regressions and daily average for the harness regression) 3. Precipitation (inches) 4. Season 5. Dummy variables for off-track betting activity 6. Economic prosperity (average weekly earnings in manufacturing industries; total employment; unemployment rate; average number of hours worked per week in manufacturing industries per employee; average hourly earnings in manufacturing industries)	1. Off-track dummy variables for all the regression models are statistically significant 2. Day of the week, precipitation, off-track betting dummy, trend, fall season and unemployment are statistically significant for daily attendance at the thoroughbred tracks 3. Day of the week, precipitation, off-track betting dummy, fall season and total unemployment variables are statistically significant for daily attendance at the harness tracks. 4. Day of the week, temperature, precipitation, off-track betting dummy, trend, fall season and professional team sports are variables which are statistically significant for daily pari-mutuel handle at the thoroughbred tracks 5. Day of the week, temperature, precipitation, off-track betting dummy, fall season and professional team sports are statistically significant for daily pari-mutuel handle at the harness tracks.

		7. Professional team sports 8. Trend 9. Dummy variable for alleged scandal at Yonkers Raceway on June 7, 1971.	
Gruen (1976)	Multiple regression analysis	Dependent Variable: Number of bets per race per capita Independent Variables: 1. Percentage of the handle which is not returned to the bettors 2. Income per capita 3. Dummy variable for depression or optimism 4. Dummy variable for optimism or prosperity	1. Income effect is positive – bets are a normal good. 2. Price variable is negative – track take is elastic. 3. Optimism and pessimism dummy variables have the correct sign.
Suits (1979)	Multiple regression analysis	Dependent Variable: Real handle at all thoroughbred tracks in the respective states divided by population of the state Independent Variables: 1. Real per capita personal income in the respective states 2. Number of days on the racing schedule 3. Pari-mutuel take-out rates in force in the respective states.	1. Income elasticity of demand is at or slightly below unity. 2. Elasticity with respect to number of racing days is uniformly low. 3. Price elasticities uniformly indicate that demand for thoroughbred racing is relatively elastic.
Morgan and Vasche (1979)	Multiple regression analysis	Dependent Variables:	Pari-mutuel Attendance:

1. Number of standardized wagers per attendee (AW) – average dollar amount wagered per attendee.
2. Pari-mutuel track attendee per capita (AC).

Independent Variables:

1. Real disposable income per capita
2. Unemployment rate
3. Number of calendar racing days for an individual Southern California thoroughbred meet
4. Real price of wagering – equal to the percent of each dollar wagered per meet which is not returned to bettors but rather is retained for the state, the racing associations or horseracing purses (takeout)
5. Amount of harness and quarter horseracing days scheduled in Southern California
6. Dummy variable for years 1968 and threreafter, representing the conversion to "night" as opposed to "day" harness and quarter horseracing.
7. Dummy variable for the Hollywood Turf Club meet
8. Dummy variable for Del Mar Thoroughbred Club meet
9. Dummy variable for the Oak Tree Racing Association meet
10. Dummy variable for 1970 major labor strike which interrupted racing activity at the Los Angeles Turf club

1. AC is positively related the unemployment race and negatively related to per capita real disposable income.
2. Additional negative influences on attendance include the real price of wagering, the presence of real price of wagering (takeout), major strike activity at Santa Anita in 1970 and the appearance of night time racing for quarter horses and harness horses
3. There also exists evidence of certain intermeet structural differences involving the effects on racing attendance of income, unemployment and thoroughbred racing days, as indicated by the performance of selected dummy variables for the Del Mar and Oak Tree locations.

Pari-mutuel Wagering:

1. AW is positively related to real per capita disposable income.
2. AW is negatively related to AW but insignificant.
3. AW is negatively related to the presence of night time racing for non-thoroughbreds
4. AW is positively related to the number of thoroughbred days, Santa Anita strike in 1970 and the number of scheduled harness and quarter horseracing days.

meet at Santa Anita

11. Dummy variable for the unique supplementary effect on the 1970 Santa Anita strike on the Del Mar meet

12. Dummy variable for the unique supplementary effect of real income for the Del Mar and Oak Tree meets, respectively

13. Dummy variable for the unique supplementary effect of unemployment on the Del Mar meet

14. Dummy variable for the unique supplementary effect of additional number of racing days for the Del Mar and Oak Tree racing meetings

Simmons and Sharp (1987)	Multiple Regression analysis	Three regression models were run – one for meets held in states with lotteries (45 meets), one for those in states without lotteries (44 meets) and one for studying the impact of lotteries on the daily average handle. Dependent Variable: Average daily handle – total amount wagered at a meet divided by the number of days in the meet Independent Variables: 1. Takeout rate 2. Length 3. Seating capacity 4. Number of stakes races 5. Population	1. All variables with the exception of competition from professional sports and other forms of gambling and poverty were statistically significant. The coefficients had the correct signs. 2. Competition from professional sports and other forms of gambling and poverty were significant in one of the two regressions. 3. States with lotteries have higher price elasticity. 4. Meets held in states without lotteries have daily handle approximately similar to daily handle in lottery states in 1982.

6. Per capita income
7. Poverty level
8. Unemployment rate
9. Competition from professional sports and other forms of gambling such as casinos and lotteries
10. Lotteries

DeGennaro (1989)	Multiple Regression Analysis and Simultaneous Equation System	Two sets of regression models were run. The first equation uses the multiple regression models. The second set of equations employ the simultaneous system of equations. Dependent Variable: Ordinary Least Squares Total pari-mutuel handle on a particular day Dependent Variables: Simultaneous Equation System 1. Total number of individuals attending the races on a particular day 2. Total purse of all races on a particular day 3. Total mutual handle for all races on a particular day Independent Variables: 1. Total Purse – total amount (in dollars) distributed to the horsemen during all races contested during each day's racing program 2. Total number of individuals attending the races 3. Dummy variable for new totalizator	Single Equation Models: Total Mutuel Handle on a Particular Day is Dependent Variable a. Purse is significant. b. Attendance is significant. c. The negative sign on the new totalizator system dummy variable is surprising. d. The sign for the Tuesday and Wednesday (day of the week) dummy variable is negative e. The dummy variable for subsidy provided by the state is not significant. Systems of Equations Methods: Before Adjusting for Multicollinearity 1. The variables total purse distributed to the owners of the competing horses on a particular day and day of the week (Wednesday) are insignificant with respect to total number of individuals attending the races on a given day. 2. The equation for purse has only three variables that are statistically significant: dummy variable for subsidy provided by the state, day of the week (Friday) and dummy variable for days when many people need not work (Saturday or national

system

4. Dummy variable for on-track conditions on a particular day.
5. Dummy variable for subsidy provided by the state – sum of the state's racetrack's and owners' contribution to purses of subsidized races on a particular day
6. Four dummy variables for days of the week
7. Dummy variable for days when many people need not work (Saturday or national holiday)

holiday).

3. Both the total number of individuals attending the races on a particular day and the total purse distributed to the owners of the competing horses on a particular day are highly significant.

Systems of Equations Methods: After Adjusting for Multicollinearity

1. Dummy variable for on-track conditions on a particular day with respect to the total number of individuals attending the races equation is insignificant.
2. Dummy variable for day of the week (Tuesday) is statistically significant.
3. The independent variables are as expected and significant for the equation for purse.
4. Purses are positively related to dummy variables for day of the week (Fridays and holidays).
5. The dummy variable for subsidy is clearly significant but it point estimate is less than one with respect to purses.
6. The purse variable is significant with respect to the handle equation.
7. The predicted attendance is a significant determinant of the handle equation.
8. The coefficients for dummy variable for day of the week (Tuesday and Wednesday) and dummy variable that controlling for the installation of new tote machines with respect to the handle equation are negative.

| Thalheimer and Ali (1992) | Seemingly Unrelated | Two sets of demand equations were specified and are jointly estimated. | 1. Durbin-Watson statistic in each case indicates the absence of serial correlation – |

Regression

Dependent Variables:

1. Real total handle per capita
2. Real on-track handle per capita – difference between real total handle and CALL-A-BET handle divided by market area population

Independent Variables:

1. Own price takeout rate
2. Own price admissions and parking – constructed as arithmetic average of simple individual price indices for admission and parking (PINDEX). The simple price index is the ratio of price in the current price to that in a base period. In this case the first half of 1983. The real price index is deflated by CPI-U value of PINDEX
3. Competition – CALL-A-BET
4. Dummy variable for Competition from Churchill Downs – a second pari-mutuel horserace track (Churchill Downs)
5. Competition – professional sports
6. Racing quality – number of quality races per racing day at the meet
7. Income
8. Number of racing days at Louisville Downs and Kentucky Harness Racing Commission.

no specification errors such as omitted variables or incorrect functional form.
2. As expected, the introduction of a substitute wagering opportunity in the form of CALL-A-BET wagering has a detrimental impact on on-track handle.
3. Surprisingly, the CALL-A-BET wagering system is shown to have a negative impact on total handle as well.
4. Handle demand is elastic with respect to takeout rate.
5. Handle demand is found to be inelastic. with respect to the increase in the price of admissions and parking in 1987.
6. The impact of income on on-track and total handle is found to be significant, increasing up to a real per capita income level of approximately $ 11,900 and decreasing thereafter.
7. Competition from Churchill Downs Thoroughbred racetrack and the Redbirds professional baseball teams is detrimental to handle.
8. Offering quality races is found to have a significant positive impact on both on-track and total handle.
9. Racing days is found to have a significant positive impact on both on-track and total handle.

Church and Bohara (1992)	Multiple regression analysis	A multiple regression model to estimate the revenue function. Simulations for revenue	1. Declining marginal revenue from additional race days at each racetrack and a

and profit maximizing with respect to total number of race days were also carried out.

Dependent Variable:

Season handle

Independent Variables:

1. Dummy variable for season race day
2. Dummy variable for total season race days at all tracks
3. Total season purses paid to horse runners
4. Population in each concentric ring from the respective race tracks
5. Per capita income within each concentric ring from the respective track

downward shift in its marginal revenue for additional days at other racetracks.

2. Marginal revenue coefficients for seven race tracks are positive as expected and statistically significant.
3. Six revenue coefficients for intertrack competition are negative as expected (three are statistically significant) and the positive coefficient for the Downs at Albuquerque is not statistically different from zero.
4. As expected, the coefficient for the purse is positive and statistically significant.
5. Five of the population and income coefficients are unexpectedly negative but are insignificant.
6. Per capita income within 70 miles from each track is positive and significant (as anticipated).
7. The simulated revenue maximizing (370 days) and profit maximizing (326 days) total number of race days are considerably less than the actual 1988 season days (423 days).

Thalheimer and Ali (1995a)	Seemingly Unrelated Regression	Dependent Variables:	

Thalheimer and Ali (1995a) — Seemingly Unrelated Regression

Dependent Variables:

Two sets of SUR equations were constructed - total handle equations and on-track handle equations:

1. Total handle equation – Natural logarithm of total handle
2. On-track handle equation – Natural logarithm of on-track handle per capita

1. Total handle is negatively related to distown for all racetrack. On-track handle is not significantly related to distown for 4 thoroughbred racetracks but is positively related to it for the remaining 2 harness racetracks.
2. For four thoroughbred racetracks, competition from cross-bred(harness) intertrack wage is insignificant on total handle and on-track handle equations. However, cross-thoroughbred intertrack wage is significant and will decrease total

Independent Variables for both equations:

1. Average travelling distance to the nearest wagering sites to wager on races conducted by racetrack (distown).
2. Average travelling distance to the nearest intertrack site providing opportunity to wager on cross-breed races (ditwcross)
3. Dummy variable for day of the week
4. Dummy variable for major holiday
5. Dummy variable for lottery
6. Average value of purse offered on stakes races on the day
7. Number of stakes offered on the day
8. Dummy variable for race simulcast out-of-state on that day
9. Carryover pool for pick-6 wage from prior day
10. Average temperature on the day
11. Squared value of temperature
12. Average precipitation on the day
13. Dummy variables for various respective racetracks
14. Dummy variable if telephone wagering system as in existence
15. Takeout rate
16. Dummy variable of other games on the day
17. Dummy variable for post time if different from one of the first day of sample period

and on-track handles for 2 harness racetracks.
3. With respect to other demand factors, "head-on" competition from other racetracks will result in significant decline in total and on-track handle in 4 of the 5 racetracks where it occurred.
4. Introduction of a state lottery has a statistically significant adverse effect on total and on-track handles in all racetracks.

| Thalheimer and Ali (1995b) | Seemingly Unrelated | Dependent Variables: | 1. For the attendance equations, all the coefficients except for the number of racing |

	Regression	Dependent Variables: 1. Per capita attendance 2. Real per capita handle Independent Variables: 1. Own price takeout rate 2. Racing quality 3. Per capita income squared 4. Substitute product lottery 5. Substitute product- professional sports 6. Number of racing days	days and per capita income squared for the Lebanon Raceway are significant. 2. Attendance and handle are found to be elastic with respect to the takeout rate. 3. Attendance and handle are found to increase as income increases and then fall when income exceeds a certain level. 4. Income effect is positive at low levels of income and negative at higher levels of income. 5. The average impact of the lottery on handle is greater than its impact on attendance. 6. Professional sports have a large negative impact on attendance and handle demands. 7. The number of racing days has a positive impact on both attendance and handle at Turfway Park and River downs and on handle at Lebanon.
Thalheimer and Ali (1995c)	Seemingly Unrelated Regression	Dependent Variables: Two sets of SUR equations were constructed for the three racetracks – based on straight and exotic wagering demand equations: 1. Per capita annual exotic wagers at the respective race tracks 2. Per capita annual straight wagers at the respective race tracks Independent Variables: 1. Weighted average take-out rates 2. Number of horse exotic wagering opportunities per performance at the respective race tracks	1. Both straight and exotic wagering demands are price elastic. 2. Straight and exotic wagering demands are found to be equally responsive to changes in their own prices across the two thoroughbred racetracks. 3. Own-price elasticities are found to be higher than the corresponding than the corresponding cross-price elasticities. 4. For thoroughbred horseracing, the net effect of increasing the number of two-horse exotic wagering opportunities is to increase total wagering. 5. For exotic and straight wagering demands were found to decrease as the number of horses increases. 6. For harness horseracing, it is found that, as

3. Annual number of performances at the respective race tracks
4. Annual number of performances simulcast from one racetrack to the remaining racetracks for intertrack wagering
5. Annual per capita income in the market area of the respective racetracks
6. Square of annual per capita income in the respective market areas
7. Annual number of casinos operating in Atlantic City
8. Annual number of performances at MP track overlapped with those at AC; FR overlapped with those at AC; CD overlapped with those at LD
9. Per capita annual exotic and straight wagers at MP
10. Take out rate for exotic and straight wagers for the respective race tracks
11. Price index of admission and parking at LD
12. Price index for using telephone betting system to place wagers on racing at LD
13. Quality index for racing at LD
14. Number of home-track baseball games conducted by Louisville Redbirds baseball team in Louisville.

the total number of exotic wagering opportunities increases, the demand for exotic wagering increases while that for straight wagering decreases.
7. For thoroughbred or harness horseracing it also found that lowering both the exotic and straight take-out rates could increase total revenue.

Ali and Thalheimer (1997)	Seemingly Unrelated Regression	Dependent Variables: 1. Annual on-track and ITW wagers on harness horseracing 2. Annual on-track wagers on harness	1. All the estimated coefficients, which are statistically significant, have the signs as predicted by theory. 2. Effects of own price and price of the associated good (costs per visit to wagering

horseracing
3. Annual on-track and ITW wagers on thoroughbred horseracing
4. Annual on-track wagers on thoroughbred horseracing

Independent Variables:

1. Takeout rate for harness horse-race wagering
2. Takeout rate for thoroughbred horse-race wagering
3. Costs per visit to on-track wagering sites for thoroughbred horse-race wagering in New Jersey
4. Costs per visit to on-track wagering sites for harness horse-race wagering outside New Jersey
5. Costs per visit to on-track wagering sites for thoroughbred horse-race wagering outside New Jersey
6. Costs per visit to ITW sites for harness horse-race wagering in New Jersey
7. Costs per visit to ITW sites for thoroughbred horse-race wagering in New Jersey
8. Costs per visit to on-track wagering sites for harness horse-race wagering in the entire market area
9. Costs per visit to on-track wagering sites for thoroughbred horse-race wagering in the entire market area
10. Quality of harness horse-racing in New Jersey
11. Quality of thoroughbred racing in New Jersey

sites) are negative and those of prices of alternative goods are positive.
3. The effect of casino gambling is negative and that of racing quality is positive. The income effect is positive at low levels and is negative at high levels of income.
4. Racing quality is a significant positive determinant for horserace wagering.
5. Competition from own-breed on-track wagering outside New Jersey and from casino gambling at Atlantic City, New Jersey has a significant and negative influence on horserace wagering in New Jersey. Competition from cross-breed, on-track wagering has no significant influence on thoroughbred horserace wagering but it has a significant negative influence on harness horse-race wagering.
6. Casino gambling at Atlantic City, New Jersey is estimated to have resulted in a decline in wagering on harness or thoroughbred horseracing.
7. A decrease in the costs to visit thoroughbred on-track wagering sites from its 1988 level is estimated to decrease harness horserace wagering
8. Own-price (takeout rate) has a highly significant and negative effect on horserace wagering.
9. The costs per visit to both own-breed on-track wagering and ITW sites are also significant determinants of harness or thoroughbred horse-race wagering.
10. A decrease in the per cost visit to on-track own-breed horserace wagering sites from its 1988 level is estimated to result in an

		12. Annual number of casinos at the Atlantic City 13. Per capita annual income (real USD) in the entire market area 14. Square value of per capita annual income in the entire market area 15. Dummy variable which assumes the value of 1 for the years 1976 through 1988 and 0, for all other years 16. Dummy variable which assumes the value of 1 for the year 1976 through 1988 and 0, for all other years	increase in harness and thoroughbred horserace wagering. 11. Similarly, a decrease in the cost per visit to own-breed ITW sites from its 1988 level is estimated to result in an increase in harness and thoroughbred horserace wagering.
Thalheimer (1998)	Multiple regression analysis	The demands for live, full card and VLT wagering were estimated. Dependent Variables: 1. Live and full-card simulcast wagering 2. VLT wagering measured as credits played Independent Variables: 1. Average daily temperature 2. Average daily precipitation 3. Dummy variable for holidays 4. Dummy variable for day of the week 5. Number of VLTs 6. Live race simulcast of Kentucky Derby, Preakness Stakes, Bermont Stakes on live race day 7. Number of stakes races 8. Value of highest-stakes race on a stakes race day 9. Number of exotic wagers – two-horse	Live Race Wagering: 1. 17 of the 29 variables in the live race-wagering model were significant. Number of VLTs is statistically significant and negative as expected. 2. All but one of the significant live race variables were positively related to live race wagering. 3. The trifecta wager was negatively related to live race wagering. 4. There were no significant full-card simulcasting variables. 5. The only full card simulcast variable that was found to be significant was Hawthorne racetrack – negative relationship with live wagering demand. Full-card simulcast wagering: 1. Nine of the 28 variables in the full-card wagering model were significant. Number of VLT is significant statistically and

(doubles, exactas)
10. Number of exotic wagers – trifecta
11. Trifecta – superfecta exotic wager carryover pool from prior day
12. Twin trifecta exotic wager carryover pool from prior day
13. Number of stakes races
14. Value of highest stakes races on a stakes race day
15. Number of exotic wagers – two-horse except quinella (doubles, exactas)
16. Number of exotic wagers – two-horse (quinellas)
17. Number of exotic wagers – three horse (trifectas)
18. Trifecta – superfecta exotic wager carryover pool from prior day
19. Number of exotic wagers – pick six
20. Pick 6 plus pick 9 exotic wager carryover pool from prior day
21. Dummy variable for day when full-card simulcast is taken from Hawthorne racetrack

negative as expected.
2. Each of the significant full-card simulcast variables was positively related to full-card wagering.
3. With the exception of the tri-superfecta carryover pool, none of the live race variables were significant with respect to full-card simulcast wagering.
4. On days where there was a live race tri-superfecta carryover pool, wagering on full-card racing increased.

VLT wagering:

1. Ten of the 27 variables in VLT wagering model were significant. Number of VLTs was significant and positively related to its own wagering demand as expected.
2. None of the live race variables was found to have a statistically significant relationship to VLT.
3. With respect to the full-card simulcast variables, the number of two-horse exotic wagers and the pick-6 wager were found to be significant and positively related to VLT wagering.
4. Day when full-card simulcast is taken from Hawthorne racetrack was found to be significant and negative, as it was for live race wagering.

Gramm et al. (2007)	Seemingly Unrelated Regression	Two sets of SUR equations were constructed – the total amount wagered in various pools and the overall race handle: Dependent Variables for the first set of SUR	1. Increased race quality has a positive impact on wager dollars. 2. With allowance races, stake races increases betting volume. 3. Starter allowance and high-claiming races

equations:

Natural logarithm of total amount wagered into the win, place, show, exacta and trifecta pools

Independent Variables for the first set of SUR equations:

1. Race purse size
2. Race classifications
3. Race types – allowance races
4. Number of betting interests
5. Number of betting interests squared – optimal field size
6. Competitiveness of race on betting
7. Track conditions
8. Race participants
9. Distance
10. Track take
11. Dummy variable for Big carryovers
12. Number of other races concurrently for the bettor to handicap
13. Dummy variable for the order of races at a track
14. Dummy variable for the day of the week
15. Dummy variable for holidays
16. Dummy variable for place, show, exacta and trifecta wagers

Dependent Variables for the second set of SUR equations:

Natural logarithm of overall race handle

no effect from allowance races.
4. Races restricted to fillies and mares slightly reduce volume for win, place and exacta wagers in the purse regressions Maiden races reduce betting volume for all wagers in the race classification regressions and for exactas in the purse size regressions.
5. Number of betting interests has positive but diminishing effect on betting volume.
6. A divergence in betting volume as a result in the competitiveness of a particular race.
7. Demand for a wager across tracks is price elastic with respect to track takes for straight wagers and exactas and price inelastic for trifectas.
8. A large six-pick carryover has a significant impact on all betting pools.
9. Turf races attract additional volume for straight wagers but there are no significant differences in trifectas and possibly a negative effect for exactas.
10. Suboptimal track conditions reduce the amount wagered across all pools. The distance of the race reduces volume for win, place and exacta wagers.
11. For competing races or similar wagers, quinellas and exactas are substitutes as are trifectas and superfectas.
12. The days of the week and the order of the races did impact wagering. Saturdays are the most popular followed by Fridays and Wednesdays. Wagering increases throughout the day.
13. Multirace wager increase betting volume.
14. Additional betting interest increases

Independent Variables for the second set of SUR equations:

1. Cover race competitiveness
2. Track conditions
3. Track takeout
4. Surface
5. Race participants
6. Race restrictions
7. Dummy variable for day of the week
8. Dummy variable for holidays
9. Race number
10. Dummy variables for availability of daily double, pick threes, quinella and superfecta wagers.

15. Bettors prefer quality racing.
16. Race competitiveness does not impact total race handle.
17. Off track conditions and races restricted to maiden and fillies and mares reduce total race handle.
18. Grass races are found to be more popular.
19. The elasticity of demand across tracks is estimated to be price elastic for straight wagers and exactas and price inelastic for trifectas.

Thalheimer (2008)	Multiple regression analysis	Dependent Variables:

Dependent Variables:

Handle per unit of market area population for VLT wagering and for on-track pari-mutuel wagering.

Independent Variables:

The independent variables were grouped into three: general market environment and the VLT-specific and pari-mutuel-specific determinants.

The General Market Determinants:

1. Trend
2. Seasonality captured by binary month variables
3. Holiday captured by the binary national holiday variable

1. Trend is positively related to VLT.
2. VLT handle is increasing at a decreasing rate with the number of VLTs.
3. VLT handle is positively related to each of the machine type variables.
4. VLT is found to be positively related to VLT lodge-to-track ratio.
5. VLT handle is positively related to maximum bet limit.
6. Number of wagering day is increasing at a decreasing rate with VLT handle.
7. Number of full-card simulcasts per wagering increases at a decreasing rate with VLT handle.
8. VLT wagering is positively related to number of live race days.

4. Market area per capita captured by per capita income
5. Extreme weather conditions captured by binary variable
6. Competition

VLT-Specific Determinants:

1. Number of VLTs
2. VLT type
3. VLT location
4. VLT maximum bet per day
5. VLT wagering days
6. LVT price

Pari-mutuel-Specific Determinants:

1. Pari-mutuel wagering days
2. Number of on-track full-card simulcast programs per pari-mutuel wagering day
3. Live race days per pari-mutuel wagering day
4. Average daily purse
5. Presence of stakes race
6. Price of pari-mutuel wagering

Forrest et al. (2010)	Seemingly Unrelated Regression	Dependent Variables: 1. Real horserace turnover 2. Dog race turnover 3. Soccer turnover 4. Numbers turnover Independent Variables:	The following findings are in relation to the horseracing dependent variable: 1. Saturday was the most popular day for betting and the Spring and mid-Summer months were busier than the Autumn and Winter months. 2. Strong displacement of horse betting by

1. Lagged turnovers
2. National Lottery variables:

    (a) Wednesday Bonus
    (b) Saturday Bonus

3. Prize money
4. Total runners
5. Total runners squared
6. Dummy variable for Grand National
7. Dummy variable for Big meeting
8. Number of UK horseraces broadcast on terrestrial television on that day
9. Number of UK horseraces broadcast solely to bookmaker shops by satellite television
10. Number of foreign (including Irish) horseraces relayed to bookmaker shops by satellite television
11. Dummy variable for foreign races
12. Dummy variable for 1st favorite won
13. Dummy variable for 2nd favorite won
14. Dummy variable for lagged 1st favorite won
15. Dummy variable for lagged 2nd favorite won

Control Variables:

1. Number of betting shops open on a given day
2. Weekly time trend
3. Dummy variables for month and day of week
4. Dummy variable for morning dog

football betting in June of an even numbered year.

3. Shop opening is positively related to horseracing betting.
4. Weekly time trend variable was negatively related to horse betting turnover.
5. Total number of runners (and its square), number of British televised races and the number of British, Irish and foreign races broadcast by satellite television bookmakers are significant.
6. Total purse money offered to owners of win and place horses in that day's British races have positive coefficient.
7. Current day and lagged values for the proportions of favourites and second favourites that won in British horseraces were positive.
8. Various special football events impacted negatively on horse betting.
9. Lottery variables are negative.
10. Number of British dog races is negatively related to horse betting.

races
5. Dummy variable for afternoon dog races
6. Dummy variable for Bank holiday soccer
7. Dummy variable for Scotland in Euro 1996
8. Dummy variable for FA Cup Final

Table 2.2: Races by category used by the British Horseracing Board.

Category	Races
Category 1	Pattern and Listed Races
Category 2	Heritage Handicaps and un-Listed handicaps rated 96 – 110 Conditions Stakes Nursery Handicaps of £ 20,000+
Category 3	Handicaps of 86-100 Classified Stakes 0-85/90/95 Conditions Stakes Nursery Handicaps 0-95
Category 4	Handicaps of 71-85 Classified Stakes 0-75/80 Conditions Stakes Open Maidens/Novices 'Premier' Claimers
Category 5	Handicaps 56-70 Classified Stakes 0-65/70 Nursery Handicaps 0-75 Maiden Auctions/Median Auction Maidens Novice Auctions/Novice Median Auctions Claimers and Sellers
Category 6	Handicaps 46-55 Classified 0-55/60 Selling Nursery handicaps 0-65 Maiden Auctions/Median Auction Maidens Novice Auctions/Novice Median Auctions Claimers and Sellers
Category 7	Classified 0-50 Claimers and Sellers
Category 8	All races at a Regional Fixture

Adapted from *The British Horseracing Board*, July 2004

Table 2.3: Definition of variables.

Variables	Definition
Dependent Variables:	
Home-Track	Natural logarithm of amount bet on win bets (i.e. bets which will produce a return if the horse wins the race) on this horse in the pari-mutuel market at the track where the race takes place; the home-track pool(adjusted for retail price index)
Away-track	Natural logarithm of amount bet on win bets on this horse in the pari-mutuel market at tracks other than where the race takes place; the away-track pool (adjusted for retail price index)
Telephone	Natural logarithm of amount bet on win bets on this horse in the pari-mutuel market on the telephone (adjusted for retail price index)
Internet	Natural logarithm of amount bet on win bets on this horse in the pari-mutuel market on the internet (adjusted for retail price index)
Betting shops	Natural logarithm of amount bet on win bets on this horse in the pari-mutuel market in the betting shops (adjusted for retail price index)
Independent Variables:	
Public	Dummy variable for Bank holidays 1 = Bank holiday, 0 = others
Tue – Sun	Dummy variables for the respective days of the week 1 = Day of the week , 0 = others
Same_Hour	Number of races in the same hour within the same race meeting day
LHorse	Natural logarithm of the total number of runners in each respective race meeting on the day
TV	Dummy variable for a televised race 1 = Race televised, 0 = Otherwise
Flat	Dummy variable for flat races 1 = Flat, 0 = Jump
Going_Hard	Dummy variable for race track going conditions 1 = Hard, Firm, Fast and Good to Firm; 0 = Others
Going_Off	Dummy variable for race track going conditions 1 = Good to Soft, Yielding, Good to Yielding, Soft to Yielding, Standard to Slow, Soft, Very Soft, Slow, Heavy, Sloppy; 0= Others

Class_A	Race quality 1 = Class 1 and 2, 0 = others
Class_B	Race quality 1 = Class 3 and 4, 0 = others
Class_C	Race quality 1 = Class 5 and 6, 0 = others
Firstrace	Dummy variable for the first race of the day 1 = First race, 0 = Otherwise
Lastrace	Dummy variable for the last race of the day 1 = Last race, 0 = Otherwise
Shin	Shin-Z for the race, as a measure of insider activity
Prize_1	Prize money for the horse which wins the race
Over-round	Bookmaker over-round
CV_Tote	Coefficient of variation for totalizator of the natural logarithm of normalized odds-implied probability of horse winning the race

Table 2.4: Formula for computing variables.

Variables	Variable Construction
Odds-implied probability of horse winning based on totalizator (pari-mutuel) odds (TP_i)	$$TP_i = \frac{1}{WP_i}$$ where WP_i is defined as the return declared on horse-*i* on totalizator for the respective race meeting and *i* is the number of horse in each respective race meeting.
Natural logarithm of normalized odds-implied probability of horse winning the race based on totalizator (pari-mutuel) odds (TLP_i)	$$TLP_i = ln\left(\frac{TP_i}{\sum\limits_{i=1}^{n} TP_i}\right)$$ where $i = 1, 2, .., n$ and ln is the natural logarithm operator.
Over-round for bookmakers' odds	$$1 - \left(\sum\limits_{i=1}^{n} \frac{1}{1+SP_i}\right)$$ where SP_i is the final declared odds in the bookmaker market for horse-*i*
Coefficient of variation for the natural logarithm of normalized (pari-mutuel) odds –implied probability of horse winning the race (CV_T)	$$CV_T = \frac{s_T}{\overline{TLP_i}}$$ where $s_T = \sqrt{\dfrac{\sum\limits_{i=1}^{n}(TLP_i - \overline{TLP_i})^2}{n-1}}$ and $\overline{TLP_i}$ is the average of TLP_i

A brief note on testing the contemporaneous correlation of SUR.

In order to test the contemporaneous correlation, the likelihood ratio statistic is used to test the null hypothesis:

$$H_O : u_{12} = u_{13} = ... = u_{1m} = 0$$

$$u_{23} = ... = u_{2m} = 0$$

$$u_{mn} = 0$$

against the alternative hypothesis that one or more of the off-diagonal elements of the variance-covariance matrix of the joint estimation of the seemingly unrelated regression model are non-zero. This is given as follows:

$$H_A : u_{12} \neq u_{13} \neq ... \neq u_{1m} \neq 0$$

$$u_{23} \neq ... \neq u_{2m} \neq 0$$

$$u_{mn} \neq 0$$

where u_{ij} represents the contemporaneous covariance between each of the two equations. The likelihood ratio statistic is given as:

$$LR = (H_O / H_1) = 2(LL_U - LL_R)$$

where LL_U stands for the maximized values of log-likelihood function of the unrestricted model under null hypothesis and LL_R stands for the maximized values of the log-likelihood function of the restricted model under the alternative hypothesis. Under H_O, the log-likelihood ratio is asymptotically distributed with $\frac{n(n-1)}{2}$ degrees of freedom.