THE FINANCE OF CLIMATE CHANGE: TRANSITIONING TO A LOW CARBON ECONOMY

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For my parents, with love and gratitude

Abstract

Financial markets play a vital role in the allocation of the world's resources. Yet financial markets are also prone to booms and busts as financial intermediaries imperfectly respond to the world around them. This thesis examines the role of financial markets in the context of climate change. It examines how financial markets are slowly, though imperfectly, moving towards addressing one of the greatest economic and scientific challenges of our century. I examine in-depth a number of areas where financial markets are operating effectively to address the challenges of climate change. I also identify those areas where market failures signal the need for further government intervention.

This thesis proceeds in four substantive chapters. My approach is empirical and employs both quantitative and qualitative techniques. I first address financial market theory on the role of information in efficient market operation (Chapter 3). I then examine behaviourally how financial markets are integrating new climate-related information in investment decisions (Chapter 4). This thesis then examines the two financial markets in depth. The first is an empirical examination of how carbon markets have influenced publicly listed markets in energy stocks within Europe (Chapter 5). The second is an empirical examination of direct investment (venture capital and private equity) in clean technologies in Europe and North America (Chapter 6).

Four findings emerge from this thesis:

Firstly, financial market reform must begin with greater information disclosure to the market on the physical and carbon-related risks facing corporations and the community.

Secondly, large asset owners (such as pension funds) should demand greater integration of long-term systemic risk considerations in their asset allocation decisions if they are to adequately respond to climate change.

Thirdly, market structure appears to materially influence the operation of a carbon price signal within an energy market. This indicates further empirical research is needed by governments to examine whether carbon markets achieve their intended aims.

Fourthly, the flow of direct investment (private equity) in emerging clean technologies is highly contingent on geography. The size and direction of capital flows is influenced by regulation, capital market structures, and physical environmental variables. Government must bear this in mind when formulating appropriate technology and industry policy to spur clean technology investment.

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Chapter 1 | Introduction

1.1 Introduction to research

The research towards this thesis has coincided with one of the most severe global financial crisis in recent decades. In 2007, sharp falls in the United States housing market set off mortgage defaults in major states including Arizona, Florida, and California. While this event was not remarkable in itself, the derivative instruments underlying these sub-prime mortgages were being traded by investment banks around the world at many multiples above their underlying value. This stark chasm between the real value and the traded value sparked a crisis of confidence which set off a selling spree across the world's capital markets. With confidence shot, investors in other assets followed the bear run, significantly deflating the returns of global pension funds and provoking the world's politicians to act. In the time since this thesis was started in 2007, numerous investment houses around the world have gone bankrupt including the world's fourth largest investment bank, Lehman Brothers. Other financial institutions have been bought out by governments because of the economic havoc they would cause if they were left to fail (Sorkin 2009). Many in the community have been left high and dry: their jobs insecure, their assets deflated in value, their confidence diminished.

Why was the global financial crisis of 2007 not foreseen? For some, blame has been pinned at the door of the City's investment bankers. "Banker bonuses", far beyond the average salary, appear to some commentators as footsteps to the crime scene.[1] Yet

[1] There have been numerous articles in the popular press on the perverse incentives created by large financial bonuses. These reward the "upside" of risk-taking activities without penalizing the "downside". This has encouraged governments to introduce targeted taxation of bonuses. *See* Philip Stephens, *How the big banks rigged the market*, Financial Times, Jan. 18, 2010. Available online at www.ft.com.

the sub-prime crisis, like other financial crises before it, suggests a far deeper malaise with the world's financial markets. In a world where capital flows across the globe at the click of a button, the gap between the world's asset owners and the underlying real economy has never been starker. It is this gap, which is set to widen in a world afflicted by climate change, where the central inquiry of this doctoral research is situated.

This thesis does not seek to diagnose the cause of the recent global financial crisis. Rather it seeks to explore the kind of tensions within financial markets which the recent crisis unveiled. That tension is conceptualized in this thesis as the tension between the global and local in financial markets. This manifests itself in many ways. For example, there is a gap between the knowledge of globally located investors and the local issues facing listed companies. There is a gap between the notion of investment capital flowing smoothly across national borders and the pooling of capital in some corners of the globe due to regulation or institutional factors. And there is a gap between the efficient market hypothesis where information flows freely to all players in the market and the efforts of investment managers to derive alpha returns from specialized knowledge.

The global/local tension can be explored in many ways in economic geography. In this thesis, this tension is especially explored in the context of climate change as an exceptional challenge facing the world's future financial markets. This thesis is structured across four chapters which have been individually researched and drafted but which all relate to the theme of mobilizing financial markets to address climate change.

The logic of these chapters will move from analysing the economic geography of financial information which greases the wheels of global finance (Chapter 3), through to the relational financial landscape which applies this information in investment

decisions (Chapter 4). It will then take a more detailed view on the role geography plays into two financial markets closely linked to climate change. Chapter 5 examines the listed capital markets of Europe which have been impacted by the introduction of the world's first regional carbon emissions trading scheme. Chapter 6 examines the unlisted private equity markets of North America and the United Kingdom where investments are being made in the emerging clean technology sector. Through a detailed analysis of these issues, this thesis seeks to contribute to a more sophisticated understanding of the operation, both present and future, of the world's financial markets in the context of climate change.

1.2 Background and theoretical framework

In the Middle Ages, Europe witnessed the invention of the world's first merchant banks. Located in Italy and known as Lombardy bankers, grain merchants would provide credit to farmers ploughing the Lombard plains to enable the production and harvest of cereal crops. Loans to Lombardy farmers would not be a certainty in all cases. Whether a Lombardy banker would lend to a particular farmer would depend on the credit worthiness of their investment. Where a particular farmer had a strong personal reputation, a skilful knowledge of the land, and there was reasonable certainty that the next year would be blessed with fine weather, then Lombardy bankers would agree to provide credit to a farmer. The Lombardy banker and the Lombardy farmer were close: they knew each other and there was a relationship of trust and intimate knowledge.

The reason for this reference back to financial history is to emphasise a remarkable characteristic of modern financial markets: the growing gap between the *local* factors shaping investments and the decision making processes of *global*

investors. Unlike the Lombardy bankers of the Middle Ages who were locally proximate and intimately connected to their investments, the advent of securitization in the 1970s and the rapid development of electronic trading technology across the world's stock markets has enabled capital to access the furthest reaches of the globe. Pension fund managers in Sydney, Australia are able to buy shares in a biotechnology company in Boston, Massachusetts in an instant. In other words, the global reach of financial markets is now greater and faster than past epochs in human history.

The global scale of modern financial markets of course has enormous benefits in terms of access to capital for the world's emerging businesses. But as Wójcik (2009) astutely points out, the connectivity of global financial markets involves a trade off: proximity between investor and investee is traded for the immense liquidity which comes from opening capital markets to billions of investors around the world simultaneously.

This trade off has profound implications for the operation and stable management of financial markets. As investors become distant from their underlying investments, there is more room for information asymmetry to emerge. They lose their direct connection to the local drivers and concerns facing their investments – a proximity which the Lombardy bankers enjoyed. This tension between the global and the local is a theme behind many speculative asset bubbles which have afflicted economies in financial history (Reinhart and Rogoff 2009; Clark 2010). The global/local tension also provides the theoretical background for grounding this thesis in economic geography. In the first substantive chapter of this thesis (Chapter 3), the role of financial information is closely examined given that information is an important tool

is bridging the divide between investors and the risks and opportunities facing investee companies.

The precise examination of the global/local tensions in financial markets explored in this thesis is a new contribution to the economic geography literature. This is in part due to the fact that the economic geography literature on finance is itself a relatively recent phenomenon (Clark and Wójcik 2007). The economic geography literature over the last several decades has always been characterised by dynamism and adaptability. This is a response to the extraordinary changes in economic and social life which have been afoot since the end of World War II. Notwithstanding this adaptability, the theoretical focus of economic geographers has been remarkably consistent. It has always been grounded in the spatial, locational and relational preoccupations of modern economic life.

The theoretical framework of economic geography has emerged in response to the post-war period. Modern society has witnessed economic change on an unprecedented pace and scale with the technological revolution bringing about the means of mass-production and the emergence of the modern consumer society (Scott 2000). Early study of the spatial dimensions of the real economy with the growth of transportation hubs, major infrastructure projects, and the rise of the modern city (Clark, Feldman, and Gertler 2000) gave way to the work of David Harvey who reinterpreted geographical questions applying a Marxian political economy lens (Harvey 1973). This gave way to a more empirical treatment of economics under Massey and Sayer who stressed the role of localities in economic processes (Massey 1979; Sayer 1982). More recently, in the context of economic globalisation, the importance of regional development in competitive economic development was emphasised with the work of

Porter and Krugman (Porter 1990; Krugman 1991). Indeed, the award of the Nobel Prize in Economics to Professor Krugman during the course of this doctoral research suggests the continued importance of economic geography to understanding the complexities facing modern economic life.

The economic geography of financial markets draws on the theoretical perspectives of each of the above literatures and applies it to the modern growth of financial markets as the organizers of global access to capital. This thesis conceptualizes the spatial dimensions of financial markets across three broad dimensions.

The first dimension is how geography influences the flow of capital across borders. Although there is a view that the advent of information technology has made geography irrelevant in the flow of global capital across markets (O'Brien 1992), economic geographers prefer to argue a more nuanced view. Whether the contours of spatial dimension are shaped by regulation (La Porta et al. 1997), corporate governance regimes (Wójcik 2002), or some other unit of analysis, the theoretical perspective of financial geography is one of a variegated financial landscape. This perspective is closely relied upon in the chapters in this thesis (Chapters 5 and 6) which empirically examine the flow of capital across borders.

The second theoretical dimension to financial markets is time. Although this perspective is less developed in this thesis, the nature of judgement in financial decision-making means that investors are required to make repeat decisions. Because global financial markets are highly liquid, investors are able to trade stocks over time as they learn from their mistakes or respond to new information. This temporal dimension is another factor which shapes and changes the flow of capital in modern markets and is also considered in the empirical analysis in Chapters 5 and 6.

The third dimension in which financial markets are impacted by geography is relational: that is, the way in which institutions or people acting as financial intermediaries shape the flow of investment capital. Contrary to popular imagination, finance is not the activity of excel monkeys or high-powered computers. Rather finance is the profession of highly trained practitioners who are called upon to exercise judgment and make decisions with vast volumes of capital on a daily basis. Financial markets therefore have a personality which is informed by the institutions which constitute the market. The interaction and relationships between the various chains of command make for another way in which space and place influence the direction of capital movements, rather than capital moving according to a predictable pattern based on mathematical calculations and triggers. These relationships are closely explored in Chapter 4 where the role of investment consultants in the allocation of pension fund capital is empirically considered.

In summary, the economic geography of financial markets draws and extends upon the axiomatic insights of geography with respect to the dynamic importance of space, relationships, and time. By focusing on financial markets and specifically the tension between the global investor and locally conditioned investment, the thesis continues the tradition of economic geography at a time when financial markets are under intense scrutiny.

In order to give specific form to this inquiry, this thesis particularly focuses on how financial markets are responding to one of the greatest exogenous variables of our time: climate change. Climate change is not only a challenging environmental problem facing the international community; it is also a serious economic and financial problem. Indeed, the economic cost of climate change on the global economy is only beginning to

be understood with the publication of the Stern Review on the Economics of Climate Change (Stern 2007). However, Stern's work applies macroeconomic modelling to examine the intersection between economics and climate change in the future. While this has merit, it also leaves gaps: it is a top-down approach which skates over the bottom-up issues facing local economic sectors. Also, it is theoretical and forward-looking in nature rather than empirically-focussed.

The theoretical approach in this thesis is in contrast to the approach of the Stern Review. True to the perspective of the economic geographer, we identify areas where the macro modelling and micro empirics diverge. The last two substantive chapters of this thesis (Chapters 5 and 6) therefore focus on two financial markets influenced by climate change in particular: publicly listed energy utilities subjected to a carbon market in Europe (Chapter 5), and the unlisted private equity markets in the United States and the United Kingdom commercializing technological solutions to climate change (Chapter 6).

By focusing on climate change as a cross-cutting issue in financial markets it is important to note that climate change in many ways represents a perfect storm for modern financial markets. Climate change is a classic example of a problem at the nexus of the global/local divide. On the one hand, the carbon emissions for which climate change is attributed are emitted locally by businesses and individuals carrying out productive activity; yet on the other hand the ramifications of these local actions are global in the form of the growing frequency of extreme weather events. On the one hand, limiting carbon emissions requires disciplined action on the part of individuals and companies in reducing the carbon intensity of their production processes; yet on the other hand the activity of one person or company will be meaningless without the

collective action of everyone. One the one hand, climate change demands fiscal investment and regulatory restraints by domestic governments to transition the domestic economy towards a low carbon trajectory; yet on the other hand the international negotiations under the United Nations Framework Convention on Climate Change have shown domestic governments to be reluctant to act without multilateral assurances from foreign governments. The local/global tension is therefore at the heart of the collective action problem around climate change.

But what does this mean for financial markets? It might be possible to argue that climate change has absolutely nothing to do with the operation and functioning of the world's capital markets. The need for a reliable and liquid supply of capital will continue regardless or perhaps even independently of political consensus on mitigating and adapting to climate change. But this doctoral thesis is committed to the view that such thinking is short-sighted. To the extent that climate change will signal the structural adjustment or demise of certain markets for goods and services and the emergence of new markets, then the contours of capital will be directly influenced by climate change. To the extent that the economic growth of companies is profoundly affected by the emergence of new industries around resource productivity, then the world's shareholders will also be profoundly affected by climate change.

Understanding these dynamics is vitally important because the health and growth of global financial markets is vitally important. Their importance do not lie in the accretion of bankers' bonuses, but rather in underwriting the organic growth of real assets and companies and, by extension, the creation of jobs, the growth of salaries, the alleviation of poverty, and the opportunity for individuals to support their own well being and the well being of others.

In Chapter 7 of this thesis, the conclusions and broader implications from this doctoral research will be brought together. Through the theoretical perspective of economic geography, we will try to understand the challenges at the convergence of climate change and financial markets and the role of geography in this interaction. The remainder of this chapter will set out the objectives and methodologies pursued in this research, as well as the initial findings and limitations to the research.

1.3 Research objectives and significance

This thesis closely examines the operation of modern financial markets using the lens of economic geography. In particular it is concerned with how a macroeconomic issue which threatens to be highly disruptive to the global economy – climate change – might impact the flow of investment capital in the world's listed and unlisted market.

Extending on the theoretical framework provided above, the aims of this thesis are set out below and coincide with the four substantive chapters (Chapters 3-6) of this thesis.

Chapter 3 objectives

How have financial markets within Europe and the UK responded to the demand for greater disclosure of financially relevant information?

a. What is the market for information disclosure in the UK compared to continental Europe?
b. What substantive information is growing in prominence because of its financial materiality?
c. Does this have any broader significance or is it a short-lived trend?

Chapter 4 objectives

How do financial intermediaries responsible for the day-to-day investment of capital respond to emerging themes in investment research around environmental, social and corporate governance risks (hereafter ESG) facing their investments?

a. What is the landscape for investment decision-making on behalf of the world's largest institutional investors, pension funds?
b. How do they regard risks and opportunities around ESG themes in their investment processes?
c. What are the institutional or structural barriers to change?

Chapter 5 objectives

How does carbon pricing impact the publicly traded price of energy companies in Europe operating under a carbon emissions trading scheme?

a. How does the price of carbon impact the financial performance of an energy utility?
b. How do geographical contours impact the flow of capital in and out of these companies?
c. What implications does this have for the operation of and investment around regional or global carbon trading schemes?

Chapter 6 objectives

How are unlisted private equity markets impacted by investment trends in the context of the demand for new climate-related technologies?

a. How is investment capital flowing into clean tech private equity?
b. What explains the size and flow of this investment?
c. What implications does this have for the financing of technologies which will respond to climate change?

By addressing these four objectives, it is intended that this thesis will offer a better understanding of the operation and drivers of financial markets in the context of climate change. In addition, where markets fail or financial markets are restricted in their operation, this thesis hopes to point the way for the greater role of government in helping drive economic growth and improve social well being.

1.4 Methodological approach

This thesis adopts a multi-method approach to examine the operation of financial markets. Each of the substantive chapters in this thesis deploys a different methodological approach: from discursive analysis (Chapter 3), to questionnaires and case studies (Chapter 4), to data driven financial econometrics (Chapter 5), to statistical data and close dialogue interviews (Chapter 6).

Multi-method approaches to social science research and economic geography research in particular are increasingly common, and the geography of financial markets is no exception (Bryman 2001, 2006). The advantage of using both qualitative and quantitative methodologies in the study of financial markets is to initiate and expand new approaches to examining the subject area (Greene, Caracelli, and Graham 1989).

Traditionally, the study of financial markets within the disciplines of economics and finance has involved the use of quantitative methodologies alone. These involve

mathematical models and theorems which historically examine as well as forecast the flow of capital. However, in practice, financial markets are more complex entities. Although quantitative approaches are important (as used in Chapters 5 and 7), a more nuanced view on market operations must also take into account the personal judgements involved in each investment decision being made. These personal judgements are best studied using qualitative approaches such as discursive analysis (Chapter 3), questionnaires (Chapter 4), and close dialogue interviews (Chapter 7).

By pursuing a multi-method approach, this thesis attempts to engage in a variety of inter-connecting issues related to financial markets and climate change. Our intention is not simply to triangulate our findings by applying different methodological approaches to the same questions. Rather, as the objectives described above reveal, we examine a number of loosely-connected questions which cover a broad range of issues in financial market operation including information disclosure, institutional investment decisions, carbon markets, and clean tech private equity. The multi-method approach enables us to do justice to this broad sweep of issues while maintaining an overarching focus on the financial markets and climate change.

1.4.1 Discursive analysis and primary texts (Chapter 3)

Chapter 3 of this thesis employs a discursive social science methodology drawing on close dialogue interviews, reference to primary source (legal) texts, and theory. Although the parameters for a discursive methodology are not clearly defined, they are an important approach to social science research because they allow reflexive engagement with subject matter. This means triangulating the findings from a variety of sources and identifying the overarching themes and points of analysis.

The focus for this substantive chapter is the formulation and passage of the UK Companies Act 2006. Hansard is referred to in order to analyse the original public debates which were had in the lead up to passage of this legislation in the House of Lords. By combining an analysis of these primary materials with discussions with a number of the legislative players, we are able to examine the intentions of the legislators in this instance. These insights are then paired with theory on Anglo-American versus continental European business approaches in order to provide a comparative analysis of information disclosure regimes across geographies.

1.4.2 Questionnaires and case studies (Chapter 4)

Another methodology deployed in this thesis in Chapter 4 is written responses to open-ended survey questions. During the course of 2008, I approached a number of the world's leading investment consultants with the support of the United Nations Environment Programme Finance Initiative (UNEP FI). By partnering with the UNEP FI I was able to gain access into the offices of the world's largest investment consulting firms in offices as diverse as London, New York, and Tokyo. The partnership with the UNEP FI certainly aided the seriousness with which consultants approached the request for responses. Their responses were given by senior consultants and cross-checked for accuracy and consistency with top level management. However, the association with the UNEP FI may have had a trade off as some respondents may have been more conservative or wary in their responses than had the research been conducted exclusively through close dialogue interviews (Clark 1998). We tried to mitigate this risk by promising anonymity in the discussion or attribution of any opinions made. In spite of this, the partnership with the UNEP FI acted as a double-edged sword by giving access to the biggest and most influential players in the market (who would otherwise

have been inaccessible) while also possibly leading respondents to "tone down" their remarks.

The final survey which was sent out was carefully formulated with 19 open-ended questions (see Chapter 4 Appendix 1). Pilot questions were tested on investment consultants for clarity and precision beforehand. The essential purpose behind these questions was to discern the extent to which investment consultants were turning their mind to environment, social and corporate governance (ESG) considerations when advising institutional investors about their investment decisions. Questions ranged from asking their opinion about whether ESG considerations were financial material through to the institutional infrastructure they had in place to research these considerations. Respondents were also asked to give examples of how they helped their clients respond to these issues. In some cases, respondents gave long and detailed responses to the questions and there was no need for clarification. However, where responses were short or unclear, follow up questions were asked to clarify their position.

Twenty consultants were approached in total. Consultants who were approached had world-leading reputations in the market and were spread across geography and size of assets under advisement (see Chapter 4 for further details). Although the number of consultants approach appears small, it reflects the oligopolistic nature of the investment consulting market worldwide where a small number of firms control the vast majority of the consulting market. Our final response rate was low with only six consultants replying. However, taken globally, these consultants still represented US$ 8 trillion of assets under advisement which was approximately 30% of global pension funds under advisement at the time the survey took place (30 June 2008). Nevertheless, this does impact the weight we are able to place on the findings. Rather than being a reflection of

the investment consulting market as a whole, these survey responses serve as six in-depth case studies on how ESG considerations are viewed in the investment consulting market by a variety of key players.

The surveys represent a unique and interesting dataset in the sense that they are the first empirical study we are aware of on the views of investment consulting companies on ESG issues. The paucity of research indicates that investment consulting companies are under-considered in the investment management chain. This may be because traditionally they are quite hard to access. However, like any opinion survey, the methodology used in this chapter has drawbacks because the comments provided might poorly reflect reality or experience (Useem 1995). There are a number of reasons why this might be the case, including misunderstanding of the questions, the desire to protect public relations, or political motivations. Nevertheless, expert opinions remain an important contribution to the social science research methodology (Castles and Mair 1984). What helps these responses in our study is the fact that they are given by expert professionals who are highly educated and experienced in the subject area. This helps improve the reliability of these responses as a reflection of the reality within these firms, compared to outsiders or members of adjacent professions who are more observers than participants (Alwin and Krosnick 1991). In addition, I entered into close dialogue with many of the respondents and their colleagues after the surveys were completed in order to cross-check and elaborate on the findings and make sure that the opinions made were representative and well-understood.

1.4.3 Econometrics (Chapter 5)

In order to study the flow of capital in Europe into energy stocks in the presence of a carbon market, a financial econometric approach was adopted in Chapter 5. In finance,

investor behaviour is reflected in their 'buy' and 'sell' decisions. Although the reasons for their decisions are not transparent in the financial data, the use of regression modelling with various explanatory variables is an attempt (albeit imperfect) to explain the motivations behind their decisions.

In this study, I rely on publicly available financial data on the traded stock price of energy utilities, carbon prices, and a number of explanatory variables to build an expanded capital asset pricing model (CAPM) (Sharpe 1964). A CAPM model is a time series model which tries to explain movements in a company's stock price over time with reference to a number of explanatory variables. Although cross sectional panel analysis is a relatively familiar methodology applied in the economic geography literature on corporate governance (Gompers, Ishii, and Metrick 2003; Bauer, Braun, and Clark 2008), the use of time series methodologies is relatively novel.

By using a time series methodology, I am able to examine interesting trends which evolve across time in the European energy utility market. This is fine-tuned by using structural breaks at a time point set as 24 April 2006 to break the data into two parts. The 24th of April 2006 is used as a time point because it represented an event in the carbon market history when it became clear the carbon spot market had been over-allocated with free allowances thereby leading to a sudden fall in demand.

1.4.4 Close dialogue interview (Chapter 6)

A purely quantitative econometric approach arguably provides a limited understanding of the market in the absence of qualitative research to delve more deeply into the trends. However, given that unlisted markets have even less reported publicly available data, a qualitative approach becomes even more essential. In the final substantive chapter (Chapter 6) I rely on close dialogue interviews with a number of leading venture capital

and private equity investment managers in the UK and US to understand the flow of capital in the clean tech private equity market.

Semi-structured close dialogue interviews involve an element of planned questions and an element of inductive discovery (Clark 1998). Going into the interviews, I had closely examined the quantitative statistics on clean tech capital flows globally over the last 5 years which were provided by New Energy Finance. This was complemented with recent professional experience I had in the clean tech private equity industry. However, as Strauss and Corbin (1998) argue from the perspective of grounded theory, it is necessary to constantly reflect on the relationships between different sets of data and respondents' experiences. Rather than trying to describe a "pre-existing reality", Strauss and Corbin (1998) encourage the researcher to discern their understanding from the stories of the participants. At times, I was required to follow the respondents' chain of thought and narrative rather than pursuing a singular line of inquiry.

The respondents for my semi-structured interviews were found through a combination of methods. The most successful were personal introductions from private equity colleagues I knew while working at Oxford Capital Partners private equity firm in the summer of 2009 as well as through an academic colleague, Dr Terry Babcock-Lumish. I also directly approached numerous investment managers who were widely recognized in the clean tech private equity community as leaders in their field. Once I had a number of initial contacts, snowballing allowed me to reach out to additional members (Gilbert 2001).

In total, thirty-four respondents were approached for interview. The respondents were based across the United Kingdom, the west coast of the United States (mainly San

Francisco and Palo Alto), and New York. In most cases, they were senior investment managers at private equity or venture capital firms with responsibility for the deals done by the firm (also known as the "buy-side") (See Chapter 6 Appendix 1). There were also some entrepreneurs at the management level of clean tech start-up companies. Interviews averaged between 45 minutes and 1.5 hours in duration and I travelled to where the interviewee was located to meet in person. In four cases it was necessary to conduct the interviews over the phone due to availability. All interviews took place over a 3 month period between September and November 2009.

Interviews were conducted with an introduction to my research project and a series of short questions to allow for open-ended responses. Hand-written notes were taken at each interview and transcribed immediately after the interview to ensure accuracy. To meet the requirements of the Oxford University ethics committee, interviews were not tape recorded. This improved the informality of the interviews and set up trust between myself and the interviewees which is important for improving reliability (Clark 1998). The lack of tape recording did not impede the accuracy of the recollections from the interviews.

Upon analysing the responses from my semi-structured interviews there was a large amount of consistency between the responses given. Many of the respondents also noted that the issues discussed were cutting edge and are only being gradually resolved by their firms as they gain more experience in this emerging investment area. Consistency across responses supports the reliability of the views provided. But given that the area of study is still emerging, future research will need to re-examine whether the opinions held continue to resonate.

1.5 Thesis structure and initial findings

This thesis is structured in accordance with the four paper approach to submission of the D.Phil. Specifically, it is made up of an introduction (Chapter 1), literature review (Chapter 2), four separate research papers (Chapters 3 through 6), and a conclusion (Chapter 7). The structure and initial findings of the literature review (Chapter 2) and research papers (Chapters 3 through 6) are set out below.

Chapter 2 links together the literatures guiding the progression of the substantive chapters in this thesis. The overarching theme is the tension between the global and local in global financial markets. We examine how financial markets adapt and respond to the challenges presented by the local/global tension, paying particular attention to this issue in the context of climate change.

Chapter 3 is titled *Implications of the UK Companies Act 2006 for Institutional Investors and the Market for Corporate Social Responsibility.* It examines to what extent financial markets in the UK and Europe are opening up to greater information disclosure on financially material information relating to corporate environmental and social responsibility. Examining recent amendments to corporate law in the UK, we argue that climate change amongst other emerging environmental and social issues have become financially material (as opposed to ethical) issues for businesses. This has led the UK government to regulate greater information disclosure by companies under the UK Companies Act 2006. These regulatory amendments, we argue, signal the increasing importance placed by governments on the rationalizing force of markets to efficiently evaluate the underlying value of corporations. This paper was co-authored with Professor Gordon Clark and was published in the *University of Pennsylvania Journal of Business Law* (Volume 11:2, 2009).

Chapter 4 is titled *The role of investment consulting in transforming investment decision-making: the integration of environmental, social and governance considerations into corporate valuation.* It examines how financial analysis based on ESG information is fed to institutional investors by the world's investment consulting companies. The location of investment consultants in the investment decision process of institutional capital is examined in detail. We argue that they play a pivotal role in shaping the flow of capital through their close relationship in connecting asset owners to asset managers. We then rely on our empirical qualitative research to argue that the ability of investment consulting companies to give advice on financially-material ESG issues is highly differentiated. Those firms with the deepest knowledge of ESG issues are able to lead their clients in a proactive way to incorporate ESG into their investment decisions. By contrast, relatively inexperienced firms were more likely to be client-led in their advice and conceive of ESG issues as ethical rather than financial issues. The broader implications of these findings in terms of addressing the impediments to long term decision making the investment industry are also considered. It was co-authored with Dr Adam Dixon and has been accepted for publication after peer review in an edited volume: Hawley, J. and Williams, A. (eds.) (forthcoming) *Institutional Investors, Risk/Return and Corporate Governance Failures: Practical Lessons from the Global Financial Crisis*, University of Pennsylvania Press.

Chapter 5 is titled *The Economic Geography of European Carbon Market Trading.* In this paper a time series econometric model is developed to examine empirically the impact of carbon trading on the stock price of European electricity utilities traded during Phase I (2005-2007) of the EU ETS. In particular, this paper examines how geographical borders impact the financial implications of carbon pricing

for stock returns. The key theoretical proposition examined in the paper is whether market structure as defined by national borders provides a better explanation for the differentiated effect of carbon on stock performance than company-level characteristics. The results in this paper suggest that market structure is in fact a more important factor in explaining the financial implications of carbon market trading, and the broader implications of this for linking up inter-national markets for carbon trading is discussed. A broader policy implication also discussed is the potential limitation of carbon trading as an effective economic solution to addressing climate change. This paper is currently under peer review at *Journal of Economic Geography*.

Finally, Chapter 6 is titled *The Geography of Clean Tech Private Equity.* Relying on semi-structured close dialogue with private equity managers in California, New York and the United Kingdom, I examine how the flow of clean tech venture capital is closely tied to geography. Far from being a flat market in which capital investment flows smoothly across regions, clean tech venture capital is very closely tied to the location-based characteristics of particular regions. The importance of location can be observed at three levels. Firstly it affects access to capital. The scale and structure of venture capital for clean tech start-up firms is very different in the US compared to the UK. This affects the type of businesses which are able to be successful. Secondly, physical geography affects the operation of the businesses. The yield for various technologies is highly dependent on the amount of sunshine, wind, or some other geographical variable, thereby impacting the landscape for which businesses succeed in which regions. Thirdly, venture capitalists need to be close to the management teams of their companies. This impacts the extent to which venture capital firms can enter dispersed global markets. This is considered in light of numerous firms

seeking to capitalize on opportunities in emerging markets like China and India. This paper is currently under peer review at *Economic Geography*.

1.6 Limitations of research

This thesis takes the opportunity of the 'four paper approach' to explore four aspects in which financial markets are moving towards a greater apprehension of the economic factors previously under-recognized, such as climate change. However, for what this thesis achieves in breadth it must inevitably trade off in terms of depth. In particular, this thesis takes a relatively narrow geographical focus primarily on Europe and the United States. In some chapters (such as Chapter 5 on carbon markets) it is only able to examine one jurisdiction in depth. While references to comparative regional policies are made where possible, to the extent it falls short then this is a limitation to this research.

Secondly, this thesis only begins to get under the surface of the geographical influences on listed and unlisted markets exposed to climate change effects. The examination of energy utility stocks in Europe and the clean tech private equity market are more like two case studies where geography matters rather than an overview of how economic geography influences climate-related financial markets. By taking two areas for particular focus I try to elaborate on the larger themes at play. However, to the extent that I am not able to verify the trends I discuss across new sectors or time frames then my research is limited. Furthermore, by building an econometric model in Chapter 5 which uses various proxies to measure market and firm level effects, I am limited by the assumptions I make in my model.

Finally as mentioned above, qualitative research drawing on expert opinion is never the final word on a matter. The subject matter of this thesis is contemporary and

many of the issues examined do not have long tracts of quantitative data underlying the analysis. Even where data is available, such as chapters 5 and 6, the number of years available is limited and the observation of long-standing trends is impossible to make. This makes qualitative research an important contribution to addressing these questions. However, the novelty of this work means that it is often difficult to identify large sample sizes of knowledgeable experts. Even when experts are identified, the issues in question are often difficult to discern clearly and the answers remain unresolved. This is a natural limitation of new research and must be addressed in future research.

In the concluding chapter of this thesis (Chapter 7), these limitations will be addressed more fully in terms of future research themes. Chapter 7 will present the significance and main findings of this doctoral research in full, linking the academic, policy, and investment implications together into an over-arching view of financial markets and climate change. At the same time, Chapter 7 will address areas where this research can be elaborated upon in the future. This will help address the limitations of the current research as well as further investigating the conclusions arrived at in this thesis.

Chapter 2 | Literature Review

2.1 Introduction

Economic geography lies at the intersection of geography and economics. Both disciplines share a common objective to better understand the challenges facing modern economic life. However, in the presence of globalisation, the growth and decline of economic and social regions, and the restructuring of innovative technology-led economies by governments around the world, it has become increasingly clear that the combined insights of both disciplines are necessary to gain a textured understanding of economic systems.

This thesis is grounded in the academic perspective and literature of economic geography. The broad, theoretical drive behind the economic geography literature is well-articulated in *The Oxford Handbook of Economic Geography* (2000). In that work, Clark, Feldman and Gertler (2000) identify three themes which they describe as "the basic building blocks or intellectual pillars" of economic geography. The first is an understanding of the *geographical and institutional organization of economic activity.* They point out that past theories of location in economic geography tended to characterise economic agents (whether firms, individuals, or communities) as mono-cultural entities which behaved according to neat theories and paradigms (Clark, Feldman, and Gertler 2000). This view of the world discounted the importance of context and institutional variety in shaping the behaviour of economic actors and the interaction between various actors and institutions. By attending to institutional and

contextual factors, economic geographers share a common concern from the dynamism of economic decision-making.

A second pillar they identify is the commitment to understanding *the processes of change in and across the economic landscape* (Clark, Feldman, and Gertler 2000). This pillar challenges the view of economic systems as stable and predictable over time. Of concern for economic geographers here is the rate and pace of economic change within and across regions. For example, the economic landscape of London in the 18th century or indeed the first half of the twentieth century is a very different beast to the economic geography of London today. This pillar of economic geography is attuned to *time* as a spatial dimension.

The final and overarching pillar described by Clark, Feldman and Gertler (2000) is economic geographers' commitment to *the diversity of economic life*. This commitment challenges a view of economic systems which searches for universalizing principles at the expense of heterogeneity across place and people. In many ways, it is the ambition of academic research to pay attention to diversity over generality which distinguishes mainstream economics from economic geography (Clark 1998). Clark (1998) argues that the methodological approach of economists based on stylized facts and macroeconomic modelling necessarily assumes generalized equilibrium positions in a particular economic system (Krugman 1991). While this approach is certainly valuable, the ability to model human interactions mathematically is invariability limited in many cases (Clark 1998). This limitation arises because of the tension between macro modelling and micro variability, between global trends and local activities, and between stylized facts and close dialogue or case studies.

This thesis draws on the academic insights of all three pillars of economic geography to examine financial markets in the context of climate change. However, most particularly, it relies on the insight of the third pillar and its commitment to diversity in the operation of financial markets. This thesis is able to examine the impact of climate change on financial markets only because markets are not perfectly efficient in being able to capture the effect of climate change in their day-to-day operation and market equilibrium models. If climate change effects were already endogenously incorporated into financial market equilibrium models, then the greater disclosure of information about climate change would not impact the flow of capital significantly. However, because climate change is dynamic – not only in terms of physical variability but also because of the host of regulatory, technological, and business challenges it presents – financial actors and by extension financial markets are necessarily responsive to its stimuli. As an economic geographer, my objective in this thesis is therefore closer to understanding how an extraordinary new variable like climate change impacts the flow of capital around the world rather than coming up with a new mathematical theorem which pretends to model a new market equilibrium position.

There is an underlying assumption in this thesis which must be disclosed upfront. This assumption is that there is a gap between the global and local in the operation of the world's global financial markets. More specifically, there is a gap between the mathematical sophistry of high finance used by global financial institutions and the opportunities and challenges in the real economy facing local businesses and other real assets. This insight is not new but it has profound implications. It is a point which is also made in the following excerpt from Clark, Feldman and Gertler (2000):

> "[T]he evidence suggests that not only is there competition between global financial markets for the flow of transactions, there is increasing competition between national legal systems of corporate finance for dominance (La Porta et al 1998). The combination, then, puts in play the spatial allocation of economic activity. At this level, national systems may be important ingredients in the allocation of activity. But the fact that a gap has opened up between national financial institutions tied to corporate interests and global financial institutions tied to market intermediation questions the long-term significance of national systems of finance" (p13).

The final words of this quote suggest that *national* systems of finance might be the "losers" in the tension between local and global in global financial markets. Yet the recent financial crisis suggests that the "losers" of this disconnect may be far more diverse. Where there is a large gap between the local and global in financial markets, all asset owners, including the retirement savings of a large portion of the world's population, are exposed to severe and prolonged volatility.

This exposure to volatility compels the economic geographer, businessman and politician alike to go forth and examine how markets are beginning to adapt and respond to these geographical challenges generally, and the emerging challenge of climate change in particular. As is examined in Chapter 3, this starts with the landscape for information disclosure. This is a public policy response to narrow the gap between the real economy and the traded economy through more publicly available information. The subsequent chapters develop thoughts which are natural extensions on the challenges thrown up in that chapter. They are tied together by a broader focus on the way in which financial markets are responding to global climate change.

In the subsequent sections of this literature review, I will argue that the tension between global and local in global financial markets represents one of the most complex challenges in the response to climate change. I will link this discussion to the traditions

in the economic geography literature which I believe are best placed to grapple with this problem. This literature review seeks to tie the thread between the literatures relied upon in the substantive chapters to this thesis (Chapters 3-6). As such, more detailed literature reviews can be found within each of the respective chapters of this thesis.

2.2 The geography of finance

Today's global financial markets exhibit a level of complexity and expansiveness unseen in previous epochs of financial history. Over the past four decades, the innovation of asset securitization and structured finance has opened the doors of the modern corporation to vast volumes of liquid capital. The sun never sets on the world's capital markets as money is moved almost instantaneously across borders with the invention of online financial brokerage.

The rise of modern financial markets is accompanied with the consolidation of a common language of finance (Clark, Hebb, and Wojcik 2007). Investment analysts around the world are trained to understand the capital asset pricing model, the Black-Scholes option-pricing theorem, and the principles of modern portfolio theory. In this unifying theory of market operation, asset prices efficiently reflect all publicly available information relevant to the financial performance of a particular company or asset (Wilhelm and Downing 2001). Markets are assumed to be efficient and investors trade on the belief that they are able to accurately discern the true value of a particular asset (Fama 1970).

Such a rosy picture of financial markets operating like clockwork to the step of economic globalisation betrays the severe booms and busts which have afflicted financial markets for centuries since the tulip bubble of 1620s during the Dutch Golden Age. At that time, as during other bubbles in financial market history, the traded price

of the product excessively exceeded its real, underlying value. Speculative asset bubbles by their very nature represent a disconnection between the real value of an asset and the financially engineered price traded by players in the market. This has characterised all asset bubbles in financial history, not least the recent sub-prime mortgage crisis which plunged the world into a global financial crisis in late 2007. In that instance, the crisis was provoked by the securitization of house mortgages taken out by credit-unworthy debtors in the outer suburbs of American cities. As the local housing market began to unravel, the underlying valuation of these properties was significantly less than the price traded in capital markets around the world. This led to a major global financial crisis which has depressed credit activity in financial markets for several years.

The disconnection between financial market theory and the real economy is an area of study at the heart of economic geography. As the sub-prime mortgage crisis shows, modern global financial markets face a complex tension between the understanding of global investors and the local complexities which drive underlying investments (Clark, Dixon, and Monk 2009). Notwithstanding the global impulses of financial markets, local knowledge and relationships still matter in finance. There is an established literature showing that investors have a bias in favour of proximate investments (Coval and Moskowitz 2001). Coval and Moskowitz (2001), for example, examine the role of proximity in mutual fund investments. They show that when mutual fund investments are made in the equities of companies which are head-quartered close to where the fund manager is based, these investments outperform more distant investments. The reason for this, Wójcik (2009) has argued, lies in the importance of locality in overcoming information asymmetry. Through close relationships, knowledge of the local market or familiarity with a particular economy, proximity helps narrow the

gap between the world of high finance and the real, operational risks and opportunities facing investee companies; in other words, it narrows the gap between the global and the local.

The importance of locality in financial market operation has led Clark (2005) to draw an analogy between financial markets and mercury. Like mercury, financial markets pool capital in local nodes, favouring certain hubs and certain clusters (Clark 2005). The clustering of financial activity around particular financial centers has been quantitatively shown in the financial geography literature by Wójcik (2009). However, also like mercury, global financial markets remain relatively porous in the sense of facilitating the flow of capital across borders. Financial markets conceived in this sense do not take the form imagined by pure neo-classical economy theory where arbitrage will lead to increasing spatial convergence across institutional landscapes and political economies. Rather, financial markets take some of the fluidity which comes from trading technologies and asset securitization while retaining some of the viscosity of local effects.

2.3 Financial information and the role of 'ESG'

The gap between the local and global in financial markets is bridged by financial information. Financial information feeds financial markets by connecting investors located anywhere in the world to the local knowledge of their prospective investment. Through this medium, investors connect with the day-to-day nuances of business on the ground. The role of information in the operation of financial markets is a central observation exploited in this thesis (Wilhelm and Downing 2001).

Given the central importance of information in finance, regulation pursuing the full and proper disclosure of financially material information by corporate managers has

attracted increasing attention in financial circles. The variegated landscape for corporate governance regulation has spawned an extensive literature in the field of economic geography. La Porta et al. (1997, 2002) have mapped the landscape for national systems of corporate governance around the world showing stronger shareholder protections in Anglo-American countries with their common law heritage compared to civil law countries such as continental Europe (La Porta et al. 1997; La Porta et al. 2002). Given the importance of information in financial market operation, the landscape for corporate governance has important implications for the geography of financial markets. Gompers, Ishii, and Metrick (2003), for example, provide empirical evidence that, cross-sectionally, publicly quoted firm value is higher when shareholder rights are stronger (Gompers, Ishii, and Metrick 2003). This relationship holds not only for capital expenditure and acquisitions, but also the firm's cost of debt (Klock, Mansi, and Maxwell 2005). More recently, Bauer, Braun and Clark (2008) have suggested that as markets have become more transparent in their corporate governance codes, there has been some convergence towards Anglo-American practices amongst European companies (Bauer, Braun, and Clark 2008).

The economic geography literature around corporate governance is an important contribution to our understanding of global capital markets. It has adjacencies with many other literatures, such as comparative research on financial accounting standards. Alexander (2007), for example, discusses how accounting principles around financial disclosure vary across the Atlantic. In the United States rule-based accounting standards have prevailed in contrast to principle-based standards in the United Kingdom (Alexander 2007).

An adjacent literature consulted closely in this thesis is the emerging literature around extra-financial reporting and the disclosure of environment, social and corporate governance considerations (hereafter, ESG) in annual corporate reporting. As discussed above, neoclassical economic assumptions that asset prices fully reflect all information in the market are contestable (Clark, Hebb, and Wojcik 2007). Although asset prices aim to reflect all the financial information relevant in modern accounting, many of the local and regional effects on businesses and corporate performance remain undetected and poorly understood by the market. Investors remain ignorant of the implications of significant macro-economic factors on the performance of their investments. This persists notwithstanding the best efforts of financial modellers to capture all explanatory variables in the market.

The failure of financial models to accurately predict future shocks has been a common story in financial history. For example, Nobel Prize winners Robert C. Merton and Myron Scholes were the masterminds behind Long Term Capital Management: a hedge fund which sought to make money from leveraged arbitrage opportunities in global financial markets. However, they suffered irreparable losses in 1998 when they failed to foresee the Asian and Russian financial crises. These crises represented the intersection of macroeconomic factors with financial market modelling; in the case of Russia, this involved defaults by Russia on government bonds. Because these factors were not able to be easily predicted or neatly factored into an asset pricing model, the fund suffered huge losses and was eventually bailed out. The main point of this story is to highlight the shortcomings of financial models to represent all material information in the economy.

The policy response to this shortcoming is to attempt to push for greater disclosure of information, as is examined in Chapter 3. In light of the emergence of climate change as one of the great "horizon issues" of this century, there has been a push by government and investors alike to request greater disclose of non-traditional financial information such as environmental, social and governance considerations. The purpose of this disclosure is to narrow the gap between the operational issues facing local investee companies and the investment decisions of global investors.

ESG factors, broadly defined, include material financial issues which impact the bottom line of a company but which may not easily be modelled in a financial statement (Hopwood 2009). The important characteristic of ESG issues is that they refer to explanatory variables which have an impact on financial performance. Although there is no pro-forma list of issues, the relevance of ESG factors to financial performance has been discussed in the literature in the context of management decisions (Hendry et al. 2007). Examples of relevant issues in the literature include environmental factors like resource efficiency (Gunningham, Kagan, and Thornton 2003; Derwall et al. 2005; Esty and Winston 2006), corporate governance jurisdictions (Bauer, Braun, and Clark 2008) and social impacts (Orlitzky, Schidt, and Rynes 2003).

Importantly this literature is distinguished from a longer literature on socially responsible investment (hereafter, SRI). The SRI literature refers to the positive or negative screening of asset allocation based on an agreed set of ethical policies by the investor (Sparkes and Cowton 2004; Juravle and Lewis 2008). By contrast, the literature described above is focussed on more accurately pricing traded assets. The confusion between these literatures has led to a lack of clarity because some academics have

sought to argue that ethical investments in fact driver higher financial returns – although this is yet to be conclusively demonstrated (Richardson 2009).

In this sense, the push towards greater financial disclosure of ESG issues is a natural extension to the economic geography literature around corporate governance and corporate finance. Whereas the corporate governance literature was focused on the legal form of protection for shareholders rights, ESG information disclosure and analysis is more concerned with the substantive issue of asset pricing. The chief concern is to narrow the gap in financial markets between the global investor and the local performance of companies. To the extent that greater information disclosure is able to address this gap, then financial markets may be able to address some of the market imperfections observed in the speculative bubbles of the past and the challenges for investors in the future in the context of climate change.

2.4 Relational geography and the investment process

The conceptualization of financial markets above as spaces of information transfer should not disguise the role of people in making financial markets work. Financial markets operate using a combination of information technology and human endeavour. Behind every computer screen and excel spread sheet sits a financial analyst interpreting the implications of their corporate valuations of businesses and exercising judgement to make investment decisions on behalf of their clients.

In order to examine the operation of financial markets at the inter-personal level, this thesis relies on the literature of relational economic geography. In Chapter 4, the human aspect of financial markets is exploited by examining the relational economic geography between financial intermediaries in the investment process (Boggs and

Rantisi 2003). Relational economic geography investigates the processes of institutional learning, personal interactions, and shared decision-making between individuals, firms, and larger institutions. Bathelt and Glückler (2005) develop an approach to relational theory in economic geography which places emphasis on the "contextuality" of economic decision making and the impact of relationships and agency in shaping economics rather than a more rigid view of organisational structure (Bathelt and Glückler 2005). In financial markets, the relational chains of command involved in making allocations of capital are often complex and involve multiple actors each performing a specialised task (Clark 2000).

In the network of investment decision-making, capital accumulates amongst retail investors (individuals) as well as institutional investors (such as pension funds or sovereign wealth funds) when the latter receive contributions from employers, employees or governments. In either instance, asset owners entrust their wealth to various investment professionals to invest in a spread of investments. Investment professionals often responsible for completing a financial transaction are known as asset managers. According to modern portfolio theory, asset managers make their decisions based upon a principle of diversification. This means that capital is diversified across asset class as well as physical geography in order to spread the risk as well as the return profile of their investments (Markowitz 1952).

Asset managers seek assistance in their decision making process from investment researchers who conduct detailed financial analysis on the valuation of various asset types. Additionally, investment consultants are employed to connect asset owners to the best asset managers and vice versa. The role of investment consultants is

to navigate the complex terrain of financial services and make sure that investors have access to the most reliable money managers in the market (Clark 2000).

This complex relational terrain is examined in detail in Chapter 4. By taking a particular focus on investment consultants, this thesis examines an area significantly under-addressed in the academic literature. Much of the economic geography literature has focused more broadly on the professional services. For example, Faulconbridge (2006) empirically examines the role of knowledge sharing across borders in the advertising sector. He examines the implications this has for the spawning of a global advertising industry and the importance of relational geography in configuring this growth (Faulconbridge 2006). Falconbridge has also applied relational geography to the globalisation of the legal profession (Falconbridge 2008).

By examining the investment consulting industry, we extend on the literature around relational processes of knowledge-sharing and information transfer in the professional services sector (Beaverstock 2004; Falconbridge 2007) to a new domain: investment consultants. Specifically, this thesis seeks to draw together the emerging literature on ESG information disclosure with the relational economic geography of the professional services sector by examining to what extent new understandings of ESG-linked financial valuation have travelled from companies (the local) to institutional investors (the global).

Like other sectors in the economy for tertiary services, financial communities are often tightly-knit with established customs and practices. This makes intellectual invention and the innovation of new investment practices extremely difficult. Notwithstanding the opportunity for interaction, the established practices of finance professionals are often reinforced by remunerative incentives which are resistant to

change. This inertia has drawn much criticism from the press and government in the most recent financial crisis where bankers' bonuses have been targeted as a symptom of the crisis and yet have been difficult to remove from the banking community.

The literature around relational economic geography therefore plays a role in understanding how information travels through the investment process of financial markets. Investment professionals are the agents of economic decision making, mobilising information across space and time to invest capital globally. The combination of relational mechanisms and the disclosure of financial information represent the two axes connecting the local operation and management of companies with the global investment decisions of the world's largest asset owners.

2.5 Carbon markets literature

The examination of financial markets discussed thus far has focussed on the disconnection between the local and global. In particular it highlights how the issues and financial concerns driving businesses on the ground are often out of sight and mind for global investors who are the owners of these companies. This disconnect may in part explain the severe asset bubbles and crises which financial markets have witnessed over the preceding centuries.

Broadly, the disclosure of ESG information has been one example of a practical measure designed to narrow the gap between local and global. In this thesis, however, we dig further to examine the financial implication of a specific subset of this information: information on companies' carbon emissions.

Carbon emissions have become a relevant financial liability with the introduction of carbon markets around the world. Carbon markets put a price on carbon

by capping the volume of carbon emissions which companies are allowed to emit and obligating companies to purchase licenses for excess pollution. In this way they empower the role of private actors in global environmental governance (MacKenzie 2006). The engagement of private actors to address environmental problems has itself been a subject of inquiry in the academic literature (Boykoff et al. 2009). Boykoff et al. (2009), for example, describe the normative assumptions which underpin ecological modernist approaches to environmental problems where market based initiatives have both monetary as well as environmental payoffs. This is at odds with alternative ideological approaches which favour governmental (Bakker and Bridge 2006) or socio-cultural processes (Barnett 2005) for environmental change and management.

The introduction of a 'carbon economy' can be observed in practice in Europe with the introduction of the European Union Emissions Trading Scheme (EU ETS) in 2005. The emergence of this market has coincided with greater disclosure of financial information about the carbon emissions of companies. The Carbon Disclosure Project, for example, is one such initiative which facilities greater reporting of this ESG issue. With the release of such information into the market, global investors are able to better understand the local outputs of their investment and thereby assess its financial prospects more precisely in the future.

This thesis models the impact of the EU ETS on the corporate performance of energy utility companies during Phase I (2005-2007) of the EU ETS. An underlying assumption of this empirical econometric analysis is that investors are relatively efficient in pricing the impact of carbon emissions into the listed stock price of these firms given the disclosure of information about corporate carbon emissions. Although there a numerous problems with making this assumption of an 'efficient market' around

carbon information (which are raised and addressed throughout this thesis), the disclosure of carbon emissions data via annual corporate reporting and under the Carbon Disclosure Project for the companies in our sample suggests that it is reasonable to assume investors are aware of carbon-related information for the companies in our analysis. In building our econometric model, this thesis relies on two bodies of literature.

The first is the environmental economics literature around the theoretical mechanics of carbon market operation. An important insight developed is the relevance of the degree of carbon cost pass through in the relationship between carbon pricing and stock pricing (Sijm, Neuhoff, and Chen 2006). Cost pass through refers to the transfer of costs (arising from the obligation to purchase carbon credits) from the producer through to the consumer in the form of higher electricity prices. Where there is 100% cost pass through then consumers bear to the full cost increase as a result of carbon-related financial liabilities. Where there is no cost pass through then the cost increase is borne by the producer themselves.

Numerous variables determine the level of cost pass through under a carbon market, including the elasticity of electricity demand from consumers, the level of competition in the market from other electricity producers, and the existence of low cost substitutes (Bonacina and Gulli 2007; Smale et al. 2006). However, not all these variables can be fully modelled econometrically. We focus primarily on the level of market competition in the European energy market given the complex variability in energy market geography in Europe (Glachant and Finon 2003; Sepibus 2008; Spence 2008). We rely on statistical metrics such as the Hirschdahl-Hilfendahl index and the four firm concentration ratio to construct a map of the geography of energy market

competition in Europe. This map is then fed back into our financial model to understand how carbon prices relate to stock prices under the EU ETS.

This leads to the second literature relied upon in our analysis: the nascent literature on the economic geography of carbon market. Knox-Hayes (2009a) examines the geography of carbon market through an institutional lens. Conducting empirical qualitative research into the financial professionals in the world of carbon finance, Knox Hayes uses relational geography to describe the complementarities between the structures and personnel of mainstream finance with the emerging carbon finance landscape. She also observes the relational networks involved in constructing carbon market design. These networks exhibit characteristics of path dependence within the politico-economic sphere while retaining dynamic elements which are motivated by coalition formations and interpersonal relationships (Knox-Hayes 2009c).

This work is a valuable contribution to the literature because it depicts the relational or social side of market development. However, this thesis extends on this in the "hard" direction of econometric modelling. By constructing a model for carbon/stock price interaction using a map of energy market competition in Europe, our findings suggest similarities between the importance of locality in mainstream finance and the importance of locality in carbon finance. Like Knox-Hayes (2009b), we argue that mainstream and carbon finance are complementary in the sense that both represent markets as textured topographies. Stock returns grow and shrink depending on how local factors such as market structure impact the on-the-ground operation of energy businesses. By demonstrating the role of (local) carbon emissions on the quoted stock price of energy utility firms, this thesis provides insight on the flow of investment into companies impacted by a price for carbon.

2.6 The geography of venture capital

The preceding discussion has focused on the academic literature around the role of geography in publicly listed markets. Publicly listed markets provide access to finance for companies which have carried out an initial public offering and issued shares to the market for purchase and trade. However, listed markets represent only part of the activity being carried out in financial markets around the world at any one time. Unlisted markets serve a vital function in the economy in taking entrepreneurial ideas from inception through to public listing.

In the final chapter, this thesis focuses on the role of geography in the unlisted market of venture capital, and in particular the clean tech sector. The clean tech sector, broadly defined, encompasses technologies and companies which seek to improve the efficiency of resource consumption in the global economy.

There has been a vast growth in academic interest over the last five years in the financing challenges to clean technology investment. This interest stretches across the fields of geography, law, economics, political economy, and politics. A key touchstone for this research was the Stern Review on the Economics of Climate Change. In this work, Sir Nicholas Stern sought to model various projections on global macroeconomic performance over the next century and put a price on the cost of inaction in climate policy (Stern 2007). In his recommendations to policy makers, Stern advocated for a suite of policies of which carbon emissions trading was a cornerstone (Stern 2009). Non-price based fiscal stimulus for clean technologies were also put forward by Stern (2009) in his policy suggestions.

Notwithstanding the fact that these policy suggestions point in the right direction for reducing the carbon intensity of the economy, they do not engage with the

geographic conundrums involved in rolling out effective policy solutions in different regions around the world. It is not sufficient to simply argue that governments must introduce fiscal policies to address technology development. This view does not respond to the different technologies emerging regionally, the viability of technologies in various climates, the different regulation governing jurisdictions, amongst other issues.

In order to address these issues, this thesis therefore relies on the economic geography literature to analyse capital flows in clean technologies regionally. We examine how geography – in terms of physical geography, regulatory settings, and capital market settings – impacts the commercialization of clean technologies. By addressing barriers to investment at the local level, price-based policies around carbon markets of the kind advocated by Stern (2007, 2009) are able to operate more efficiently. However, in the absence of *first* addressing these local market failures, it is likely that the imposition of a carbon price mechanism will simply increase the cost of goods and services without necessarily spurring innovation.

Two themes within the economic geography literature on venture capital are pursued in greater detail in this thesis. The first theme concerns the importance of clustering in the development of technology hubs in different regions of the world (Feldman, Francis, and Bercovitz 2005; Feldman and Francis 2004). The development of technology hubs often involves the combination of scientific endeavour, economic might, institutional capital, legal settings, amongst other factors (Feldman 2001; Porter 1990). Feldman and Bercovitz (2006), for example, focus on the university as a site for "knowledge-based economic development" and offer a framework within which universities serve as nodes for invention (Feldman and Bercovitz 2006). Within this

framework, it is possible to situate other key actors such as government (Feldman and Kogler 2008), professional service firms (Gompers and Lerner 2001), immigrant workers (Saxenian 2008) and other intermediaries which contribute to the ecosystem within which venture-backed companies grow.

The importance of geography in the emergence of venture capital hubs or otherwise is reflected in the uneven landscape for technology finance globally. Martin, Sunley and Turner (2002), for example, consider the regional anatomy of Europe's venture capital market which has traditionally lagged the United States (Martin, Sunley, and Turner 2002). Heger and Fier (2005) also conduct a similar analysis comparing the venture hubs around the United Kingdom compared to Germany (Heger and Fier 2005).

In the clean tech sector, the conditions for venture financing are different to other sectors. By taking a sector specific focus, this thesis endeavours to expand on the existing literature in venture capital clustering to date. In particular we examine why it is that clean tech investment has been stronger in the United States compared to continental Europe for clean tech start-up companies. We consider factors in the literature such as legal settings and market structures which may distinguish these two markets. By focusing comparatively on these two regions, we extend on the well established literature on different theories of the firm and shareholder in these two parts of the world (Bauer, Braun, and Clark 2008).

The second theme of relevance in the literature is the role of proximity in overcoming information asymmetry in venture capital financial valuation. Much has been written in the venture capital literature about the importance of investors' proximity to potential investee companies (Chen et al. 2009). Griffith, Yam, and Subramaniam (2007) consider the 'one-hour' rule in venture capital which suggests that

managers must be within one hour transportation of the headquarters of their prospective investment. Proximity in this instance is important because close-dialogue evaluation of the management team of small businesses is regarded as vital (Griffith, Yam, and Subramaniam 2007).

However, one way in which investment managers seek to overcome the tyranny of distance (and also mitigate risk) is to syndicate their equity investments. Syndication here refers to the shared ownership of a company between a number of investors. Syndication relationships are relatively under examined in the economic geography literature. However, Kogut, Urso and Walker (2007) have done some econometric research in this area to argue that investors prefer to syndicate domestically rather than across borders (Kogut, Urso, and Walker 2007). We examine this hypothesis further with qualitative research of investors on both sides of the Atlantic on their syndication practices as a way to free up the flow of capital across borders in the unlisted markets. This, again, provides a sector specific focus to the challenges in the unlisted technology financing markets globally.

2.7 The global financial crisis and climate change

The story which ties together the various literatures relied upon in this thesis is the story of financial markets as dynamic and imperfect ecosystems for capital flow. Although the examination of climate change on financial market operation is a new angle on this topic, the imperfection of financial market operation is an age-old story. As Kindelberger (2005) has described, financial crises are “a hardy perennial” (Kindelberger 2005).

The recent global financial crisis has sparked a wave of commentary seeking to diagnose the cause of the sub-prime mortgage bubble in particular and of financial crises more generally (Soros 2008; Stiglitz 2009). However, as Reinhart and Rogoff (2009) argue, there is a presumption underlying such an inquiry that the current crisis is somehow different from previous crises. Relying on a financial market dataset stretching back several centuries, Reinhart and Rogoff (2009) argue that capital flow/default cycles emanating out of emerging markets have been a feature of financial crises for several centuries. Although it is possible for economies to "graduate" towards more stable macroeconomic settings, booms and busts have always existed (Reinhart and Rogoff 2009).

For behavioural economists, the reason lies in individuals' inherent nature to overact to price signals in the market (Soros 1988). Soros' theory of financial market crisis begins from the position that no individual or institution is smart enough to act with perfect information. By this logic, knowledge of the "real" value or base-rate of an investment is never known with any certainty (Clark 2010). Rather, trading decisions are informed by a reflexive principle of *interaction* between, and in response to, other actors in the market (Soros 1988).

This is a characteristic which afflicts the individual as much as it does the regulator and government. In October 2008, Alan Greenspan, former Governor of the US Federal Reserve Bank was called before a US Congressional House Oversight Committee to be cross-examined on why he was not able to foresee the financial crisis. Greenspan's defence was that even the most intelligent experts leading one of the world's most powerful institutions with access to more information than almost anyone in the world was not smart enough to predict the flow of capital. He acknowledged that

economic forecasting "never gets to the point where it's 100% accurate" and that anticipating a crisis is "more than anybody is capable of judging".[2] As he said to the Committee:

> "And the answer is that we're not smart enough as people. We just cannot see events that far in advance."

Clark (2010) has extended on this view by examining the behavioural foundations of economic actors in a financial market. He has described these foundations as myopic because investors are better able (and indeed incentivized) to respond to the short-term ahead of the long-term. For example, by rewarding investment managers on performance fees paid over a 6 or 12 month cycle as opposed to a 3-5 year (or longer) cycle, investors are geared towards short-term reactions to the market rather than long-term value projections.

Economic geography's contribution, then, is to pay attention to these temporal and geographical dimensions. In particular, they serve to highlight the gap between theory and practice in financial markets. Whereas a study of financial economics will offer a set of pricing theorems upon which to determine asset pricing (which are an important way of modelling future cash flows), Clark's economic geography approach focuses on how time/space myopia amplifies the underlying imperfections in these models (Clark 2010). Investors continue to act on the basis of imperfect knowledge and with a bias towards the near-term over the far-term.

[2] As reported by Kara Scannell and Sudeep Reddy, *Greenspan admits errors to hostile House panel*, Wall Street Journal, Oct. 28, 2008. Available at http://online.wsj.com/article/SB122476545437862295.html

In this thesis, we examine another way in which the geographic dimension amplifies imperfections in financial markets noted by Clark (2010). As discussed earlier, this is the gap between the local and global in financial markets. This gap represents the difference between theory and practice in financial markets – that is, the gap between the locally informed investor and the globally distant investor. Local information is perceived in this thesis to offer benefits to financial market players. For example, knowledge of local market effects elucidates the way in which carbon pricing impacts the price of publicly listed energy utility stocks. For clean tech private equity investors, understanding local physical geography as well as regulatory and capital market geographies provides a more sophisticated understanding of the technology investment opportunities in the market. In both cases, location is identified as an important determinant.

However the practical benefits of locality may be easily lost in global financial markets where participants perceive the irrelevance of geography. These investors may be comfortable in relying on finance as exercised through detached mathematical models and third party intermediaries. This view of financial markets has been challenged by economic geographers as well as financial practitioners. Indeed, the blind faith placed in credit rating agencies on the appraisal of sub-prime mortgage credit worthiness suggests that the local/global gap is not just of interest to academics but to money makers as well.

Like Clark (2010), then, the local/global tension may be seen to amplify financial market imperfections prone to crisis in the future. This is particularly the case as climate change continues to emerge as a dominant issue. Climate change represents a geography paradox. Although climate change is clearly a global phenomenon, its

economic implications are ultimately felt locally. These effects vary from the introduction of domestic legislation (such as an emissions trading scheme) through to the physical effects of climate change.

The nature of the local/global paradox in climate change may be one of the key reasons that it has been difficult to form international agreement under the United Nations Framework Convention on Climate Change on domestic targets on emissions reductions by different countries, although this political issue is not addressed specifically in this thesis. It is also possible to see these tensions recreated in financial markets in the future.

2.8 Conclusion

The literature on the economic geography of financial markets is a growing field of academic research. As financial markets continue to be a dominant vehicle for providing access to finance for companies around the world, this academic research will continue to grow to capture the complexities between the local and global in financial market operation.

Globally mobilised investors like pension funds and sovereign wealth funds are unlike the asset owners of centuries past. Whereas centuries ago investments were necessarily local because the credit worthiness of an investment was based on personal relationships and local knowledge, economic globalisation has set a wedge in the investor/investee gap.

Addressing this gap is the challenge of modern finance. Information disclosure, financial intermediation, credit rating agencies, investment research bankers and many others are all agents acting to bridge this gap. The ability to bridge this gap reaps immense financial rewards for investors who are able to better understand the

implications of emerging issues like climate change on their investment portfolio. But the failure to do so may harbour the kind of disasters wrought by the recent sub-prime credit crisis of 2007.

To what extent financial markets will achieve this inter-connectivity in a world affected by climate change, an aging population, amongst other macro economic problems will remain to be seen. However, as Reinhart and Rogoff (2009) suggest, financial crises will continue to shape the economic landscape of the future. By applying an economic geography framework to understand how climate change and financial markets interact we do not claim to be able to prevent future financial crises. But the extent to which we are able to better understand the tensions which are at work will hopefully assist individuals and institutions to respond to crises more effectively when they arise.

Chapter 3 | Implications of the UK Companies Act 2006 for Institutional Investors and the Market for Corporate Social Responsibility

3.1 Introduction

Much is expected of the modern corporation. Shareholders seeking to maximize their return on investment pay close attention to reported earnings and stock price appreciation (Graham, Harvey, and Rajgopal 2005). Unanticipated negative movements in these variables can give rise to shareholder agitation, amplified by hedge funds and activist pension funds (Hebb 2008). Although this is characteristic of the Anglo-American 'market for corporate control,' these types of pressures have also been brought to bear on large continental European companies even though nation-state rules and regulations governing stakeholders' relationships have been slow to embrace shareholder rights (Bauer, Braun, and Clark 2008). The European Union (hereafter "EU") has sought to modernize member states' corporate law, responding, in part, to the reliance of member states on domiciled companies for long-term economic growth in the face of heightened global competition for market position and the integration of financial markets.

Community activists and some types of institutional investors have encouraged traded firms to respond to global challenges such as climate change and the welfare of employees and service providers in distant lands (Clark and Hebb 2005). For many activists these issues are about ethics and moral responsibility, given the enormous power of large corporations when compared to the majority of national governments. For some institutional investors, especially those with legal obligations regarding the

long-term welfare of beneficiaries, short-term shareholder value is balanced against the long-term growth and development of whole economies (Richardson 2007). In these cases, fiduciaries are self-conscious about the time horizon over which they reap value from investment; even if not intended, the largest of institutional investors have a stake in the long-term structure and performance of global markets (Hawley and Williams 2000).

Whether corporations have any obligation other than making a profit—the limit of corporate social responsibility associated with Milton Friedman's dictum proclaimed at the height of the Cold War—is subject to considerable debate (Clark, Salo, and Hebb 2008). For much of continental Europe, the corporation is foremost a social institution and is treated as such in corporate law (Hopt 2002). In many jurisdictions, the formal purpose of the corporation references the 'social good,' albeit in a variety of guises, often stating an explicit commitment to community welfare and economic value. Even in the Anglo-American world, companies seeking social kudos often proclaim commitment to community norms and expectations. Managing public expectations goes well beyond managing investor expectations, a fact-of-life recognized as such by non-governmental organizations (hereafter "NGOs") and community groups at the interface between media and markets (Bansal and Clelland 2004). Mobilizing public confidence in corporate responsibility while remaining duty-bound by statutory obligations to shareholder value is a challenging task (McBarnet 2007).

The issue of corporate responsibility has four distinct dimensions: social expectations, investor expectations (short-term and long-term), governmental expectations (statute and regulations), and theoretical-cum-academic expectations. We should take care not to discount the significance of any of these expectations, least of all

the theoretical or "in-principle" expectations of the academic community (Parker 2007). These expectations can be important, given that the debate about the relative value of national models of corporate governance in global financial markets will have far-reaching consequences for the nature and scope of standards adopted by supra-national legislative entities such as the EU and the International Accounting Standards Board (IASB) (Gilson 2004). The genesis of the UK Companies Act 2006 (hereafter "the Companies Act") is linked to Directive 2003/51/EC of the European Parliament and of the Council of 18 June 2003 (hereafter "the EU Modernization Directive"), as well as deeply-entrenched domestic conceptions of the proper responsibilities of corporate officers.[3] Understanding corporate responsibility, as embedded in the Companies Act, requires an appreciation of the interests of those stakeholders who sought to influence the conception and implementation of the Act.

Our paper has three goals. First, we show that the Companies Act is, in part, an expression of the EU modernization project, amplified by the UK Labor government (hereafter "the Government") to further the global status of the UK as a leading standard-setting jurisdiction. Second, we suggest that the Companies Act can be seen as an expression of conventional microeconomic theoretical expectations with regard to the proper roles and responsibilities of corporate officers rather than an expression of conventional corporate social responsibility (hereafter "CSR") discourse (Jensen 2000). By conventional CSR discourse we mean a theory of the firm in which the firm has a

[3] *See* The Companies Act, 2006, c. 46 (Eng.); EUR. PARL. & COUNCIL, Directive 2003/51/EC of the European Parliament and of the Council, June 18 2003, Amending Directives 78/660/EEC, 83/349/EEC, 86/635/EEC and 91/674/EEC on the Annual and Consolidated Accounts of Certain Types of Companies, Banks and Other Financial Institutions and Insurance Undertakings (hereafter "The EU Modernisation Directive"). This Directive was passed by both Parliament and the Council as required under the co-decision procedure. We understand from conversations with Cynthia A. Williams and industry sources that the UK Government was unaware of the EU Modernization Directive during its company law reform process, but added language to incorporate the EU process when they belatedly recognized that a parallel process was going on in Europe. However, we have not been able to verify this was the case.

responsibility to external stakeholders (whether social, environmental, ethical or otherwise). Third, we argue that the disclosure requirements of the Companies Act are entirely consistent with Anglo-American investor expectations with regard to the premium on the free-flow of market-sensitive data. While disclosure requirements seem to match the expectations of many social activists, especially regarding firms' long-term environmental liabilities, the motivating logic of such disclosure has more to do with the market pricing of corporate value than expansion of the scope of corporate social responsibility.

Indeed the current global credit crisis, which has its origins in widespread defaults on subprime mortgage loans in the United States, is an example where the lack of transparency in financial markets resulted in asymmetric information and the mis-pricing of the real risk behind traded mortgage-backed derivatives (Bicksler 2008). Whatever the nature and scope of disclosure, care should be taken not to exaggerate the commitment of institutional investors to disclosure regulation for ethical reasons as opposed to an interest in the more accurate determination of asset pricing. In conclusion, we distinguish between the demand and supply of disclosure and the interests of public and private pension funds.

In these ways, we challenge those who argue that the Companies Act is a major step forward in defining the nature and scope of corporate responsibility. We concede that it is important, but argue that its importance is to be found in its commitment to improving information disclosure relevant to market pricing. By our assessment, the Government was able to marry together otherwise competing expectations of social activists and investors in a model of disclosure that is quite innovative because it fitted well into information-dependent theories of financial market performance (Wilhelm and

Downing 2001). Equally, the Government was able to use this template to tame more radical amendments for disclosure on environmental footprints and global supplier-network conditions. Whether the form of disclosure on these issues will be effective depends, in part, on the degree to which institutional investors are willing to act on the information. Some may, but we suggest that many of the largest private pension funds will not because of conflicts of interest inherent in these types of institutions.

3.2 Development of the modern Anglo-American corporation and finance sector

3.2.1 Modern capitalism

In his treatment of post-war economic structure and performance, Shonfield marveled at the rate of growth in U.K. employment and income over the previous twenty years (Shonfield 1965). By his account, the chronic instability and poor performance of the U.K. economy through the inter-war years had been solved by the existence of built-in economic stabilizers and Keynesian control over the business cycle. Some forty years ago, Shonfield argued that the conflict over consumption and investment, which had bedevilled the first half of the twentieth century, would be resolved through the judicious use of national planning (especially regarding education and training), economic management, the welfare state, and the regulation of the large enterprises that dominated the economy. As for long-term growth, Shonfield suggested that many enterprises were of sufficient economic size to mobilize the internal resources necessary to invest in the next wave of innovation (Shonfield 1965).

Shonfield's treatise was matched in the U.S. by Galbraith's The New Industrial State (Galbraith 1967). Both writers were transfixed by the emerging "partnership"

between the nation-state and the modern corporation, suggesting that the bureaucratic management of markets and incomes were to their mutual advantage. Elsewhere, Clark develops these claims about the symbiosis between the nation-state and the corporation for Anglo-American economies in the years leading up to about 1973, emphasizing their implications for the management of labor resources and the consequent growth of private pension systems (Clark 2005). The golden era of growth was dominated by large industrial corporations, relatively high levels of unionization, and growing real incomes. It was also an era in which corporations held their assets as physical plant and equipment, market incumbency being the basis for long-term investment. Shonfield concluded that the "modern private enterprise" viewed itself as a "permanent institution" (Shonfield 1965).

Shonfield and Galbraith wrote of a mode of accumulation at its peak. Through the 1970s, the U.K. experienced high levels of unemployment, slowing growth in real income, and rapid de-industrialization as private institutions faced the full force of international competition for market share. While U.S. industry was not to face these competitive pressures until the 1980s, by the early 1990s Jensen argued that the U.S. industrial corporation had proven unable to respond effectively to growing market competition because of management entrenchment and an imperfect market for corporate control (Jensen 1993). Coming out of the 1980s, the U.K. economy had entered a new phase of accumulation where real incomes were now driven by employment in service industries and London's pivotal role in the emerging global financial industry (Clark 2003). By the end of the 1990s, the U.S. economy had also been transformed, albeit with greater income disparity and the remarkable persistence of a number of enormous industrial firms that refused to die (Monk 2008).

Our point in rehearsing the recent history of the U.K. and U.S. is to stress that, not so long ago, the modern corporation was a power in the land. It dominated domestic markets, controlled its financial destiny, and was an equal partner with the nation-state in fostering the growth and development of its home-market. The modern corporation and its associated unions could often negotiate their shares of revenue (retained earnings and wages) to their mutual benefit, leaving the residual to be paid as dividends to shareholders.

Three forces conspired to undercut the power of the modern corporation (Zingales 2000). First, the liberalization of product markets through the European Economic Community (followed by the EU) effectively pitted U.K. industry against its nearest neighbours. Notwithstanding the costs of competition, British firms resisted competition in part because of much lower rates of productivity growth and technological innovation compared to robust European national champions. Slow rates of growth turned into profound economic crisis. These competitive forces found in the momentum associated with twenty-first global economic integration now threaten continental Europe. Second, as industry in the UK failed under the weight of this resistance, the nation-state came to realize that the post-war "partnership" could no longer be relied upon to deliver employment and rising living standards. This political calculus effectively discounted hide-bound class alliances, replacing the partnership with a more distant relationship such that the corporation was increasingly seen as a means to an end (Campbell and Vick 2007). The nation-state invigorated the market for corporate control so as to sustain the growth of national income (if not the interests of corporate elites).

The fledgling financial services industry fueled the transformation of British

industry, the economy and society. Underpinned by the reserves of established banks and insurance companies, the assets of public and private funded pension systems created in the aftermath of the Second World War flooded into London. Thatcher's "Big Bang" liberalized London's markets, providing domestic savings with a global platform for portfolio investment around the world. Intended or not, the "Big Bang," combined with burgeoning market liquidity, gave the London market a significant "first-mover" advantage over continental rivals, reinforced by the in-flow from American investment houses followed by the acceleration of global financial integration from the mid-1990s. Third, pension funds and institutional investors swamped the internal resources of corporations, driving a wedge between the generation of earned income and the financing of corporate strategy and investment. As foreign banks came to London for a global and European location, the cozy alliances of the past were fractured.

Unlike much of continental Europe, the Anglo-American financial sector has grown separately from industry and the state. Because of the trust institution, the application of fiduciary duty as the governing ethic, and the legal separation of asset management from pension plan sponsors' treasuries, it is arguable that plan sponsors, being the origin of pension assets, are also, paradoxically, the object of financial institutions' investment strategies (Clark and Hebb 2004). Given the goal of maximizing the portfolio risk-adjusted rate of return, the average traded firm has been forced into a corner: being just one stock in large diversified portfolios, it is neither held nor traded on its particular merits nor is its management *necessarily* held to account for poor performance. It is all about the short-term pricing of stocks given the flow of information about actual and expected earnings and market capitalization.

Automated trading systems cued to changes in stock market pricing and linked to stock market indices dominate daily trading volume (Davis and Steil 2001).

The modern corporation has become the traded object of global financial markets and, in some cases, deliberately so (Clark and Wójcik 2007). Not surprisingly, the demand for information on its structure and performance has come to dominate debate over the proper substance of company law, pitting national traditions against the logic of global financial market integration (Strange 1997).

3.2.2 Institutional investors, markets, and disclosure

We have suggested that the growth of retirement savings in institutions held at arms-length from the immediate interests of sponsoring companies altered the balance of power in financial markets in favor of third-party investors. Elsewhere, the nature and significance of this transformation for the structure of Anglo-American financial markets is described in detail and is referred to by Clark and Hebb as the "fifth stage of capitalism" (Clark and Hebb 2004). This develops Robert Clark's 1981 account of the historical evolution of management theories over two centuries (Clark 1981). As pension and retirement savings accumulated over the second half of the twentieth century, a revolution was taking place in the investment of those assets, accentuating the growing separation between traded companies and institutional investors and their market intermediaries (Clowes 2000). This conceptual and analytical revolution has arguably remade the structure and performance of global financial markets in its image (MacKenzie 2006).

As is well-appreciated, even in crisis the vast majority of pension funds, mutual funds insurance companies, and endowments abide by the principles of modern portfolio theory (hereafter "MPT") (Campbell and Viceria 2002). In brief, these

principles are as follows: (1) there is a correlation between risk and return such that investment can be assessed in accordance with expected risk-adjusted rates of return; (2) investment strategy is about managing portfolio risk such that any particular investment and its associated risk and return characteristics should be judged against investors' overall objectives; and (3) markets are so efficient that active investing—picking winning stocks over losing stocks—is not a viable long-term investment strategy. MPT provides a rationale for holding large swaths of whole markets and treating particular stocks as components in a comprehensive strategy of investment management. Given the costs of active management and the unlikely prospect of being able to formulate a consistent winning strategy, passive portfolio investment is the operative strategy (Litterman and Group 2003).[4]

Systematic out-sourcing of investment management from all but the largest of pension funds has accompanied the revolution in financial markets (note that mutual funds and insurance companies have, by their very nature, tended to internally manage pension and retirement savings). There are significant economies of scale in managing the flow of assets from contributors to funds to managers and in return to funds and their beneficiaries (witness the market dominance of custodial firms like State Street Bank of Boston). Likewise, there are economies of scale in executing planned trading strategies that vary by asset class and market segment. Just as importantly, while many investment banks offer a full range of investment management services, these firms often claim a stronger reputation in one asset class over others (for example, PIMCO in

[4] This is not, of course, the full story. Recent research in the U.K. and the U.S. on the persistence of "winning" traders suggests that a small set of market players are able to produce out-performance in a systematic manner by virtue of their buying (but not selling) strategies. This is apparently the case for individuals as well as institutions (although the latter are likely to dominate the former). It is also widely believed that out-performance declines as the net inflow of assets to "winning" mutual funds dampens the capacity of those entities to sustain their distinctive strategies. *See, e.g.*, (Keswani and Stolin 2008)(employing a British data set of monthly fund inflows and outflows differentiated between individual and institutional investors to argue for a robust "smart money" effect in the United Kingdom).

bonds but not in equities). Specialized knowledge and expertise are a continuing source of competitive advantage, notwithstanding the claims made by bulge-bracket firms for the cost-advantages of complementary products (Clark 2003).

Just as importantly, the accumulated size, complexity, and time-sensitivity of global financial markets have effectively disenfranchised pension fund trustees from direct operational responsibility for investment management. Recognizing this fact, pension fund trustees have been left with the responsibility for overall investment strategy, informed, of course, by modern portfolio theory (Clark and Urwin 2008). Only rarely, and mostly in public pension funds, do trustees seek to influence the trajectory of particular stocks.

This story about the structure and control of investment management has been told a number of times. In recent years, the story has been complicated by a loss of confidence in the efficient markets hypothesis, which underpins the third MPT principle noted above, the rise and fall of hedge funds and alternative asset classes like infrastructure, and the search for alpha (a premium on active investment) over beta (the performance of whole markets). The global credit crisis has also undercut the credibility of less-than-transparent risk transfer devices such as collateralized debt obligations (for example, mortgages). It is apparent that only the best-governed funds and institutions focused on risk management and return volatility have been effective investors in these arenas. For all the publicity garnered by endowments' high compound annual rates of return, the average public and private pension fund has not been engaged in the frontiers of financial innovation nor has it been able to systematically out-perform asset-specific benchmarks (Lerner, Schoar, and Wongsunwai 2007).

What should be emphasized at this juncture is the degree to which institutional investors rely upon the veracity of market prices and the response of financial agents to those prices. The efficient pricing of stocks and bonds, let alone the more exotic financial instruments such as collateralized debt obligations is at the very heart of MPT. Even if the efficient markets hypothesis is not a full account of the anomalies and biases in market pricing and human behavior, it serves as a normative claim on the proper value of quoted prices (Huberman 2003). As such, it is not surprising that enormous attention is paid by institutional investors (acting on behalf of their pension fund clients) and governments (acting on behalf of the welfare of many millions of beneficiaries) to the informational content of market prices. In the end, the mispricing and systematic distortion of asset values represents a significant welfare cost to society and, more immediately, a constraint on the performance of investment managers (as apparent in the subprime credit crisis). In this respect, the scope of "disclosure" of market-relevant information by traded companies and related entities has become the litmus test of financial regulation (Hebb 2006).

As the record shows, however, no country has an unblemished record in these matters, particularly in relation to the auditing of declared corporate assets and liabilities (witness the Enron and WorldCom scandals in the U.S.) and the treatment of insider and outsider shareholders as regards the timely disclosure of market information (as in much of continental Europe) (Coffee 2002). La Porta et al. (1997) demonstrate the existence of very different national traditions as regards corporate disclosure policies and the variable significance attributed to global portfolio investors over entrenched domestic interests (La Porta et al. 1997).[5] Apparent differences between countries' disclosure

[5] While the problems of management entrenchment and the influence of insiders over outsiders are often discussed with reference to continental Europe, it is apparent that some analysts of corporate governance

regimes have prompted some of the world's largest pension funds to agitate for reform either directly through the lobbying of governments or through the leverage applied by the differential investment of their own assets by company and country (Hebb and Wojcik 2005). As such, some of the world's largest pension funds have been identified as important innovators in their own right, assuming the responsibilities and obligations of "universal owners" (Hawley and Williams 2007).

In this context, the election of the UK Labor government in 1997 and the booming securities markets in the run-up to 9/11 seemed to offer a chance for social activists to mobilize the power of institutional investors. As part of a larger debate over the prospects for a U.K. stakeholder society and the lessons to be learned about CSR from continental European social democracies, the Labor government was lobbied to make good on the promise to affect socially responsible investment (Hutton 1995). In 1999 the Government issued changes in regulations, the Occupational Pension Schemes (Investment, and Assignment, Forfeiture, Bankruptcy, etc.) Amendment Regulations, under the Pensions Act 1995 wherein trustees of occupational (and thereafter local government pension funds) were required to disclose in a written statement of investment principles the following:

> (a) "the extent (if at all) to which social, environmental or ethical considerations are taken into account in the selection, retention and realization of investments"; and
>
> (b) "their policy (if any) in relation to the exercise of the rights (including voting rights) attached to investments."[6]

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would dispute the presumption in favor of U.S. standards of corporate governance. *See, e.g.*, (Bebchuk 2005) (analyzing the costs of management entrenchment in the U.S. and the improper limits imposed on institutional investors in exercising their "ownership" rights).

[6] The Occupational Pension Schemes (Investment, and Assignment, Forfeiture, Bankruptcy etc.) Amendment Regulations 1999, 1999, S.I. 1849, cl. 2(4)(b) (U.K.).

For all the critical comment that has accompanied this regulation, there are three reasons why its impact has proven to be rather limited (Conley and Williams 2005). Most obviously, the change in regulation pre-supposed corporate disclosure on these issues whereas the nature and scope of corporate disclosure were not directly affected. In any event, though hardly recognized at the time, the effects of the change in regulation were to fall largely on fund managers rather than on pension funds. Fund managers were reluctant to engage with the issues unless directly required by their clients.[7] In this respect, the regulation did not *require* institutional investors to take social, environmental or ethical considerations into account in their investment decisions. The Government also rejected a proposal by the U.K. Social Investment Forum for amendment to the Financial Services and Markets Act 2000 to include the provision of environmental investment and related lending products within the Financial Services Authority's mandate.[8]

3.3 The emergence of mandatory reporting requirements of non-financial information

3.3.1 The EU Modernisation Directive

The EU Modernisation Directive was a product of the Lisbon Strategy of 2000 which

[7] The global finance industry's lack of responsiveness to social concerns, indeed social welfare, is one of the topics explored in (BOGLE 2005).

[8] U.K. Social Investment Forum, "UK Social Investment Forum Tells MPs of Need to Include Environment in Framework for Financial Services Regulator" (Press Release, April 19, 1999), at www.uksif.org/press/welcome/frameset.shtml; Financial Services and Markets Act, 2000. If limited in scope, the U.K. "reform" did spark legislative initiatives in continental Europe and Australia for fund managers to actively consider social, environmental and ethical concerns in their investment decisions. Sweden introduced the toughest provisions regarding social and environmental disclosure. Regulatory reforms in January 2001 required Sweden's five largest state-run pensions to incorporate environmental and ethical considerations in their investment strategies as well as report to the Government on the implementation of this policy: "investments activities shall take environmental and ethical considerations into account without lowering the overall objective of a high return." Fjärde AP-fonden (Fourth Swedish National Pension Fund), *A Presentation of Seden's New National Pension Funds* 4 (2001).

sought to build competitive and efficient European financial markets.[9] The Strategy set 2005 as the deadline by which the European Commission's Financial Services Action Plan ("FSAP") of 1999 would be implemented.[10] The motivating purpose of the FSAP was to "enhance the comparability of financial statements prepared by Community companies whose securities are admitted to trading on a regulated market."[11] Regulations which emerged from the FSAP included Regulation (EC) No 1606/2002 of the European Parliament and of the Council of 19 July 2002 which introduced the requirement that European-listed companies prepare consolidated accounts in accordance with International Accounting Standards from 2005 onwards.[12] The EU Modernisation Directive sought to ensure that annual and consolidated reporting for EU companies was in line with best practice, including the reporting of financial and non-financial information.

The EU Modernisation Directive was ambitious in its scope, amending both annual reporting under Directive 78/660/EC and consolidated annual reporting under Directive 83/349/EEC. It instituted a system of reporting whereby companies must provide "at least a fair review of the development and performance of the company's business . . . together with the principal risks and uncertainties that it faces."[13] Although this did not explicitly refer to environmental, social or governance factors of firms, the Directive provided that "where appropriate, non-financial key performance indicators relevant to the particular business, including information relating to environmental and employee

[9] Presidency Conclusions, Lisbon European Council (March 23-24, 2000), available at http://www.europarl.europa.eu/summits/lis1_en.htm.
[10] *Commission Communication Implementing the Framework for Financial Markets: Action Plan, COM (1999) 232* final (May 11, 1999), *available at* http://europa.eu/scadplus/leg/en/lvb/l24210.htm.
[11] EU Modernisation Directive, *supra* note 1 at cl. 1.
[12] 2002 O.J. (L 243) 1
[13] EU Modernisation Directive, *supra* note 1 at art. 1 cl. 14(a) and art. 2 cl. 10(a).

matters" shall be reported.[14]

The EU strategic plan subsequent to the Lisbon Strategy, the Action Plan on Modernising Company Law and Enhancing Corporate Governance in the European Union launched by the European Commission in May 2003, was one of the points of reference for the UK's 2005 White Paper on Company Law Reform ("White Paper").[15] The White Paper was framed around four strategic objectives: (1) to enhance shareholder engagement and a long-term investment culture; (2) to ensure better company regulation and a "think small first" approach; (3) to make it easier to set-up and run a company in the UK; and (4) to provide greater flexibility for corporate reforms in the future. The White Paper described disclosure reforms as "a further major step forward in improving company reporting and transparency and in promoting effective dialogue on the key drivers of long-term company performance."[16] Heightened disclosure standards were driven by a commitment to a more efficient market pricing of traded companies, implying that stock prices ought to be determined by long-term value.

Unresolved was whether non-financial disclosure had separate status or was dependent upon a demonstrable link to stock market pricing. The initial legislative effects of the EU Modernisation Directive and the White Paper on greater disclosure of financial and non-financial information came through in the 2005 amendments to the UK Companies Act 1985 (hereafter, OFR Regulations).[17] Among the items considered,

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[14] *Id.*
[15] Communication from the Commission to the Council and the European Parliament on Modernising Company Law and Enhancing Corporate Governance in the European Union—A Plan to Move Forward, COM (2003) 284 final (May 21, 2003), at 23; DEPARTMENT OF TRADE & INDUSTRY, COMPANY LAW REFORM, 2005, Cm. 6456, *available at* http://www.berr.gov.uk/bbf/co-act-2006/white-paper/page22800.html.
[16] *White Paper* at 10.
[17] The Companies Act 1985 (Operating and Financial Review and Directors' Report etc.) Regulations 2005, S.I. 2005/1011 (hereafter "OFR Regulations").

these amendments established the requirement for an Operating and Financial Review ("OFR") for quoted companies. One motivation behind these amendments was the incorporation into U.K. law of the new accounting requirements introduced under the EU Modernization Directive. There were, however, other important domestic considerations in the U.K.'s purpose and intended effects of these reforms.

The domestic considerations behind the OFR reforms can be elucidated from the Department of Trade and Industry's "Final Regulatory Impact Assessment on the Operating and Financial Review and Directors' Report Regulations."[18] The Department noted that sophisticated financial disclosure regime was needed to encourage capital market activity.[19] The key purpose and intended effect of the OFR was to improve *shareholder* engagement (as opposed to stakeholder engagement), and it was argued that clear, meaningful, and reliable information about the main drivers of a company's performance was the best way to encourage shareholders and potential investors to exercise effective and responsible control in their investment decisions.[20] It was also argued that where market asymmetries of information were overcome, investors would be more able to invest in capital markets with reduced adverse selection and therefore lower liquidity risks.[21]

Improved transparency through greater access to data on quoted companies should place shareholders in a better position to effectively protect their interests and control directors' overreach (Bauer, Braun, and Clark 2008). In addition, adopting the "fair review" standard from the EU Modernisation Directive would lead to "greater

[18] UK Department of Trade & Industry, Final Regulatory Impact Assessment on the Operating and Financial Review and Directors' Report Regulations, *available at* http://www.berr.gov.uk/files/file21361.pdf.
[19] *Id.* at ¶ 5.
[20] *Id.* at ¶¶ 4, 9.
[21] *Id.* at ¶ 8

transparency and precision of company reporting on performance on financial and non-financial matters."[22] Environmental disclosures were to be elements of non-financial "matters," acknowledging the pressure on businesses to account for the increasingly important intangible asset value of a firm based on its brand image and reputation.[23] In this way, although the OFR demonstrated similarities to the EU Modernisation Directive by requiring reporting on non-financial matters, the OFR's broader focus on shareholders' interests and the proper pricing of a company's future financial performance distinguished the OFR from continental European notions of stakeholder capitalism in favor of the predominant concerns of Anglo-American shareholder capitalism (Conley and Williams 2005).[24]

Indeed, the U.K.'s particular concern for shareholders' interests may explain the more rigorous disclosure provisions in the OFR compared with the EU Modernisation Directive. The EU Modernisation Directive applied to large and medium-sized companies without distinguishing between quoted and non-quoted companies, and framed its reporting provisions on financial and non-financial information generally without specific reference to the kind of information which would need to be disclosed nor the intended recipients of this information. However, the government made the U.K. position clear by emphasizing that the requirement to disclose non-financial information was directed at the interests of shareholders rather than stakeholders: "The Government believes that the shareholder base of quoted companies—typically large

[22] UK Department of Trade & Industry, *supra* note 16, at ¶ 13.
[23] *Id.* at ¶ 18. The significance of intangible assets for the modern corporation clearly varies by sector, and the history of a corporation. Methods of discriminating between corporations as regards their sensitivity to reputation have been developed, in part, based upon proprietary databases. *See, e.g.*, (Clark, Salo, and Hebb 2008)
[24] (Conley and Williams 2005) suggest that the OFR represented a push away from stakeholder capitalism within the U.K., which is contrary to what we argue. Rather, we claim the OFR distinguished itself from what we define as conventional CSR because it was ultimately focused on shareholders' financial interests.

and diverse—has different and additional needs to that of private companies, hence the requirement to prepare a more fulsome, and more forward-looking review than that required under the [EU Modernisation] Directive."[25] In this sense, the UK's OFR was largely motivated by a conviction that environmental and social information had a clear link to stock market pricing and future financial performance.

Although the reasons for the OFR's broad disclosure of non-financial information including, where appropriate, corporate environmental and social responsibility (hereafter, CESR) were grounded in conventional theories of the firm, they also satisfied NGO interests in corporate social responsibility. As discussed, these provisions directly incorporated the requirements for "fair review" reporting of a company's development, performance, or position as set out in the EU Modernisation Directive. However, they went further by requiring companies to report on "the main trends and factors which are likely to affect that company's future development, performance and position."[26] Additionally, OFR provisions gave substance to the EU Modernisation Directive's requirement for non-financial reporting on "environmental and employee matters."[27] Companies were to be required to include information about the environment including analyzing the impact of the company on the environment.[28] As well, companies were required to provide "information about social and community issues."[29]

In November of 2005, however, the UK Chancellor abandoned the new OFR provisions less than six months after they were introduced without consultation with the

[25] UK Department of Trade & Industry, *supra* note 16 at ¶ 14.
[26] OFR Regulations, *supra* note 15 at § 1(d).
[27] *Id.* at part 2, § 234ZZB, cl. 3(b).
[28] *Id.* at part 9, § 4, cl. 1(a).
[29] *Id.* at part 9, § 4, cl. 1(c).

Department of Trade and Industry, other Ministries, or relevant stakeholders.[30] The publicly stated reason for abandoning these provisions was the administrative costs associated with reporting. The then Chancellor (and now Prime Minister) Gordon Brown said: "I understand the concerns about the extra administrative cost of the gold-plated regulatory requirement that from April next year all quoted companies must publish an operating and financial review."[31]

The policy reversal was not met with universal acclaim by the business community. In any event, as we note below, these provisions reappeared in a weaker form in the Company Law Reform Bill ("Reform Bill") which was debated in the House of Lords and the House of Commons through 2006 before its passage as the UK Companies Act 2006[32] Lord Sharman during the Second Reading on the Reform Bill in the House of Lords assessed the political and business communities' positions on disclosure in the following terms:

> [T]he Chancellor's statement abolishing the OFR simply did not earn him the brownie points from the business community that he anticipated . . . [i]nvesting bodies like the notion of an OFR and the issues that have given rise to concern did not involve whether there should be an OFR, but involved some of the data that were to be required.[33]

3.3.2. Passage of the UK Companies Act 2006

[30] For example, in anticipation of the adoption of the OPR, the UK Accounting Standards Board had published an Exposure Draft in 2005 canvassing the likely scope of expected disclosure as well as various measures needed to implement the policy.
[31] *Chancellor Gives ONS Independence*, BBC NEWS, Nov. 28, 2006, *available at* http://news.bbc.co.uk/1/hi/business/4477516.stm; *see also* (Williams and Conley 2007)
[32] Company Law Reform Bill, 2005, H.L. Bill [34].
[33] 677 PARL. DEB., H.L. (5th ser.) (2006) 194.

In the Reform Bill, the companies' obligation to report non-financial information as per the OFR was replaced by company directors' obligation to produce an annual business review.[34] The Bill abandoned substantial provisions which had appeared in the OFR. First, the Reform Bill dropped the requirement for forward-looking reporting on the main trends and factors likely to affect the company's future. Second, although the business review would be required to include information on environmental and employee matters where appropriate, social and community issues were omitted.[35] Furthermore, environmental matters no longer explicitly included the impact of the business on the environment, and the requirement to disclose a company's environmental impact assessment policies and the success of their implementation was abandoned. Finally, whereas the OFR and the EU Modernisation Directive required businesses to report in a manner consistent with their size and complexity, the Reform Bill exempted businesses qualifying as "medium-sized" from reporting non-financial information.[36]

In debates through the House of Commons and House of Lords, however, the Government was pressured to reinstate many of the OFR provisions which had been removed in the business review section of the Reform Bill. Although there was lobbying from both the NGO and business communities, the key reforms which made it into the Bill were based on mainstream microeconomic theories of the firm and efficient markets vis-à-vis information disclosure, rather than a radical CSR model for the U.K. corporation.

In this respect, the Government's disclosure regime was consistent with Jensen's theory of the firm (Jensen 2000). An implicit assumption permeating debate in the

[34] Reform Bill, *supra* note 30, at § 390, cl. 2.
[35] *Id.* at § 390, cl. 4(b).
[36] *Id.* at § 390, cl. 7.

House of Commons and House of Lords was that information related to environmental and social matters is crucial for markets to accurately evaluate the market prices of firms. Jensen argued that the firm is a product of the relationship between principals (shareholders) and agents (management), and that shareholders and managers do not have the same interests. Consequently, resources (both pecuniary and non-pecuniary) are expended by both parties to maximize their private interests. Shareholders commit "monitoring expenditures" in order to oversee directors' actions and seek to limit activities that harm their interests.[37] Directors, on the other hand, give shareholders appropriate incentives in the contracting relationship to deflect suspicion and pay shareholders "bonding costs" to guarantee that shareholders will not hinder their activities.[38] Jensen described the total costs which arise from this "unavoidable" tension between shareholders and directors as "agency costs."[39] Agency costs can be positive and even desirable so long as the benefits to the firm's yield exceed the downside costs.

In the final version of the Reform Bill, disclosure was deemed necessary in order to give effect to the newly codified directors' duty to act in a way which is "most likely to promote the success of the company for the benefit of its members as a whole."[40] In carrying out this duty, the new drafting of Section 172 stated that directors would:

> [H]ave regard (amongst other matters) to:
>
> (a) the likely consequences of any decision in the long term;
>
> . . .
>
> (c) the need to foster the company's business relationships with

[37] *Id.* at 86.
[38] *Id.*
[39] *Id.*
[40] Companies Act 2006, c. 46, *supra* note 1, at § 172.

> suppliers, customers and others,
>
> (d) the impact of the company's operation on the community and the environment,
>
> (e) the desirability of the company maintaining a reputation for high standards of business conduct . . .[41]

In effect, this provision identified CESR matters as issues to which directors would need to turn their mind to in carrying out their duties for the benefit of the company. This is very different from CSR where the company is motivated by responsibilities towards external stakeholders.

In the Grand Committee stage in the House of Lords and throughout the passage of the Bill, the issue was whether the duty to promote the success of the company was a new duty, which therefore required a change in implementation arrangements to support this duty, or whether it simply made no difference. Lord Sharman's view was that a new duty would be formed to push the Anglo-Saxon model of corporate endeavor "to a more not quite pluralist society but rather a northern European model where there are a group of stakeholders [that] are involved."[42] This was contested by Lord Hodgson who argued that the Bill simply codified common law duties and therefore made no substantive difference to the existing legal position.[43]

Lord Sainsbury, Under-Secretary of State for the Department of Trade and Industry, sought to clarify the Government's position. Although he acknowledged that the Reform Bill would codify common law duties, he contended that it would make a

[41] *Id.*
[42] 679 PARL. DEB., H.L. (5th ser.) (2006) 169.
[43] *Id.*

substantive difference by identifying specific factors which are relevant to the success of the company.[44] In this way, the codification of directors' duties could be regarded as a monitoring cost imposed on directors so that shareholders and prospective shareholders could better assess the risk/return profile of UK firms. The significance of newly codified directors' duties, then, was not that they materially changed the relevance of CESR considerations in terms of the success of the company. Rather, it was that they explicitly acknowledged what had previously been taken to be implicit: the importance of CESR factors in protecting shareholders' interests and the long-term success of the company.

In the House of Commons, a company's environmental and ethical performance was interpreted as a financial value issue by the Conservatives, rather than as a purely environmental or conventional CSR issue. Justine Greening MP argued that:

> [A]t the heart of any successful company is an in-depth understanding of what its customers want and value. Perhaps more than at any time in the past, customers place a value not just on what they are purchasing from companies, but on the way in which companies have carried out their business in order to provide those products or services. Companies can therefore be at the forefront of the push to tackle environmental and ethical issues.[45]

She distinguished this financial value-based argument from a purely environmental-based case for the disclosure regime saying "[a]s the Minister said, company law is not

[44] *Id.* at 170.
[45] 450 PARL. DEB., H.C. (6th ser.) (2006) 889.

the best vehicle for addressing wider social and environmental concerns. We can address those objectives, as some Government Members have said, through domestic legislation, health and safety measures and environmental protection, on which progress has been made."[46]

Also debated was the need for an auditor's report to verify the validity of reported information. Baroness Thorton, in the Grand Committee stage of the House of Lords, identified quality assurance of the information as an issue which was raised from public consultations on the OFR regulations but which was not addressed in the Reform Bill.[47] Her concern was echoed by Baroness Miller who argued that unaudited information would result in the provisions becoming a "marketing bandwagon" for companies to promote their alleged "'ethical,' 'sustainable,' or 'fair trade'" products and services.[48] This concern was raised again later in the House of Commons where it was argued that much of the information presented by companies on environmental and social responsibility is public relations or "green-wash."[49] The House of Commons' focus on this issue indicated a specific intention to overcome the charge often made of conventional CSR discourse as an elaborate form of public relations (Conley and Williams 2005). The auditing of corporate reports was therefore central to making the information relevant to actual business performance rather than simply another avenue for marketing (Blair, Williams, and Lin 2008).

In the final version of the Companies Act, the provisions regarding the auditing of disclosed information remained weak. The only explicit obligation on the auditor is with respect to the directors' report more generally, which includes the business review.

[46] *Id.* at 890.
[47] 679 PARL. DEB., H.L. (5th ser.) (2006) 166.
[48] *Id.* at 167.
[49] *Id.*

At section 496 of the Companies Act, the auditor "must state in his report on the company's annual accounts whether in his opinion the information given in the directors' report for the financial year for which the accounts are prepared is consistent with those accounts."[50] There is no requirement to verify the validity of the non-financial information itself. This reflects the Government's eagerness to avoid a "prescriptive" or rules-based approach to reporting. The provisions which do apply to the quality of reporting hold directors liable for loss to the company suffered as a result of any untrue or misleading statements in the directors' report.[51] Personal liability also attaches to directors if they fail to disclose relevant information to the company's auditor or if they fail to take all relevant steps to do so.[52]

A related issue which attracted attention in the House of Lords was a late amendment to the Reform Bill suggested by the House of Commons on October 18, 2006 to require disclosure of "information about persons with whom the company has contractual or other arrangements which are essential to the business of the company."[53] This is particularly relevant to companies' supply chains. There were two substantive objections to this amendment debated by the House of Lords. First, it was thought by Baroness Cohen that disclosure of this information would be detrimental to business because of its commercially sensitive nature.[54] Second, there was a concern expressed by Baroness Noakes that the obligation would be too onerous, since it was unclear how much detail companies would need to provide so as to comply with the provision.[55]

The Government made two clarifications in response to these concerns. The first

[50] Companies Act 2006, § 496.
[51] *Id.* at § 463.
[52] *Id.* at § 418.
[53] *Id.* at § 417, cl. 5(c).
[54] 686 PARL. DEB., *H.L.* (5th ser.) (2006) 465.
[55] *Id.* at 471.

was to provide an exception to reporting on supply chain issues where "disclosure would, in the opinion of the directors, be seriously prejudicial to that person and contrary to the public interest."[56] Secondly, the Government did not intend disclosure to be particularly detailed, but to be sufficiently high-leveled so as to give an impression of the principal risks and opportunities facing the company.

While these clarifications were sufficient to win support for the amendment, they also highlighted the absence of rules and regulations which could serve as benchmarks for the quality and quantity of required disclosure. The omission of such standards reflected the Government's concern not to impose costly reporting obligations on companies, and to leave much of the nature of reporting to directors' discretion. But, as Lord Razzall commented in the final Consideration of Commons Amendments in the House of Lords on November 2006:

> [W]e support the NGOs in believing that the Government . . . ought to give some indication of what the standard reporting practice should be, which they have the power to do by regulation. The whole purpose of this is not only to obtain the disclosure of information itself, but also to provide a measure by which a number of ethical investors, or those who wish to invest within an ethical framework, can obtain comparisons between different companies. It would be difficult for those ethical comparisons to be made without some element of standard reporting practice which I feel

[56] *Id.* at 468.

> can come only from the Government.[57]

It was not just the NGOs but also members within the business community who were concerned about the lack of a clear reporting standard.

Ultimately, the disclosure regime promulgated under the final Companies Act 2006 incorporated elements of the EU Modernisation Directive. Nonetheless, there were significant differences in form and substance. In Section 417(2) of the Act, directors, not the company, are required to compile a business review "to inform members of the company and help them assess how the directors have performed their duty under section 172 (duty to promote the success of the company)."[58] Furthermore, for the reasons suggested above, the precise scope and scale of the business review was more rigorously worded than the EU Modernisation Directive, as follows:

> [T]he business review must, to the extent necessary for the understanding of the development, performance or position of the company's business, include:
>
> (a) the main trends and factors likely to affect the future development, performance and position of the company's business; and
>
> (b) information about (i) environmental matters (including the impact of the company's business on the environment), (ii) the company's employees, and (iii) social and community issues, including information about any policies of the company in relation to those matters and the effectiveness of

[57] *Id.* at 459-60. This echoed the principal purpose of the EU Modernisation Directive which was to generate a common reporting standard so as to allow comparison between European traded companies on financial and non-financial measures.
[58] Companies Act 2006, § 417, cl. 2.

those policies; and

(c) subject to subsection (11), information about persons with whom the company has contractual or other arrangements which are essential to the business of the company.[59]

3.4 The new role of CESR information in the finance sector

3.4.1 Disclosure standards and financial intermediation

As is the case in many areas of European policy making, member states are required to adhere to EU Directives unless they have previously agreed to exceptions specific to a member state (as for the U.K. in selected areas of policy making). While the EU does lead the U.K. in a variety of policy areas, especially as regards employment rights and conditions and environmental policy, it is arguable that the roots of the EU Modernisation Directive in the Lisbon Strategy (2000) and the commitment to pan-European integration of financial markets reflected the interest of the Government (and the city of London in particular) in a growing market for financial services as well as the unfettered flow of portfolio investment to Europe's largest traded companies. In fact, the EU Modernisation Directive came to the U.K. policy arena already committed to reinforcing U.K. global advantages in corporate governance and the "principles approach" over the "rules and regulation" approach to securities regulation (Ford 2008). In this context, the Companies Act can be seen as one element in a concerted campaign by the Government to reinforce the dominance of London in European financial markets, and the advantages enjoyed by London over New York in international

[59] *Id.* at § 417, cl. 5.

financial market transactions (Coffee 2002).[60]

As noted above, the Companies Act left company directors responsible for disclosing relevant information for business reviews of the long-term prospects of their firms. In doing so, the Act relied on a principles-based standard of accounting based on "a fair review of the company's businesses" while referencing the crucial issues to be considered.[61] It did not provide an explicit definition of the nature and scope of proper reporting on those issues. For some commentators, Parliament had neither the time nor the expertise to define the nature and scope of the implied reporting standards introduced through the legislation. Observers of the legislative campaign in the House of Lords suggest that the Commons' deliberations on the Bill were at best perfunctory, at worst uninformed.[62] Equally, the Chancellor's political sensitivity to claims about the costs of over-burdening corporate reporting narrowed the nature and scope of mandated reporting. As a consequence and not withstanding attention to the environment and employee circumstances in debate over passage of the Reform Bill, company directors were deemed responsible for determining the weight and significance (if any) to be attributed to these issues.

It could be argued, moreover, that the Government pulled back from providing

[60] Competition between financial centers for global position is a vital ingredient in debate over nation-state financial regulation (Wójcik 2007). In their assessments of the declining significance of Wall Street in relation to London both the Committee on Capital Markets Regulation (2007) and the Bloomberg and Schumer report suggested that one cause of this decline was to be found in the costs of U.S. securities regulation and especially the U.S. preference for detailed rules and regulations over principles (Bloomberg and Schumer 2007). This issue has re-emerged with the debate over the proper U.S. regulatory response to the sub-prime credit crisis; for some, the crisis was the result of banks and financial institutions circumventing the rules regarding capital adequacy and the like. By some accounts, a principles approach would have dampened such behavior putting the onus on the institutions to show that their investment practices were consistent with the intentions of regulators.

[61] Companies Act 2006, § 417, cl. 3.

[62] There is a certain irony in the capacity and willingness of the House of Lords to engage in the substantive issues of legislation (compared to their colleagues in the Commons). Since being elected in 1997, the Labor Government has sought to establish the primacy of the lower House by reforming the Lords. However, by excluding hereditary peers and by the appointment process, the Lords has become a chamber more than able to challenge the government of the day (King 2007).

explicit rules on CESR disclosure requirements in a manner consistent with the principles-based approach to accounting favored in the U.K. and EU. Indeed, in the absence of a principles-based approach it is likely that there would be no information disclosure on CESR risks and long-term uncertainties facing a company, as is the case in the U.S. The U.S. financial reporting regulation has shied away from the U.K. principles-based approach to accounting standards and a fair review override in preference to rule-based accounting which provides explicit guidance on what companies are required to report (Alexander 2007). In a 2003 U.S. Securities and Exchange Commission ("SEC") report, the SEC considered amending this approach in favor of an *objectives oriented* standard approach.[63] The Report argued in favor of standards framed in terms of an accounting objective "at an appropriate level of specificity" with "an appropriate amount of implementation guidance."[64] This debate remains unresolved in the U.S. Indeed, the reluctance of the SEC and Financial Accounting Standards Board to implement principles-based accounting standards may account for the lack of CESR reporting in the US, and will continue until clearer financial metrics are developed to analyze CESR information.

As a consequence, firms specializing in legal services, accounting and audit functions, and directors' training and compliance have entered the market to provide advice on reporting according to the Companies Act and its provisions. Service companies have relied, in part, upon professional bodies to supply guidelines on compliance in the absence of detailed Government rules and regulations and legal precedents that might provide authoritative interpretations. Similarly, a range of NGOs have come to the burgeoning market for corporate advice and third-party certification,

[63] SEC, *Study Pursuant to Section 108(d) of the Sarbanes-Oxley Act of 2002 on the Adoption by the United States Financial Reporting System of a Principles-Based Accounting System* (2003).
[64] *Id.* at Executive Summary.

moving from public opinion with respect to the proper scope of CESR to providing fee-based advisory services. Not surprisingly, the larger advisory companies have employed CESR specialists from the NGO sector and universities just as many of the larger FTSE-listed corporations have come to employ in-house CESR specialists with responsibility to build the information databases consistent with directors' newfound disclosure obligations. Armed with CESR information, disclosure has become, an important element of corporations' reputation management programs in the media and elsewhere (Clark and Hebb 2005).

Notwithstanding the boost to fee-based advisory services brought by the disclosure requirements of the Companies Act, it would seem that directors' compliance with the Act may remain specific to each company until 'best-practice' standards of reporting are established. By contrast, institutional investors demand standardized disclosure of market-sensitive information such that data are *comparable* between companies (especially those in the same industries and countries), *consistent* in definition and measurement over time, and *comprehensive* in nature and scope. Further, with the importance of real-time data providers such as Bloomberg, Reuters, and Thomson it is also apparent that institutional investors demand immediate access to this type of data directly from trading desks. Data-mining and the stress-testing of causal relationships with regard to corporate characteristics and stock-price movements have become essential to investment practice, whatever the past significance attributed to the efficient markets hypothesis (Clark, Hebb, and Wojcik 2007). See, for example, the success of the Gompers et al. test and its variants on the significance of companies' quality of corporate governance for stock value (Gompers, Ishii, and Metrick 2003).

Absent U.K. government rules and regulations governing the disclosure of market-

sensitive data on the long-term prospects of companies, market intermediaries have sought to supply standards and data. One of the most important providers of disclosure standards with respect to corporate balance sheets and the related data that flows through global financial markets is the London-based International Accounting Standards Board ("IASB"). However, the IASB has lagged behind EU and U.K. legislation on developing standards and metrics for these types of issues.[65] Independent of government and based upon independent expertise, the IASB is responsible for formulating and articulating corporate reporting standards consistent with the effective flow of market-sensitive information to global financial markets. Presumably, if the IASB were to introduce related standards it would neither allow directors' discretion as to the significance attributed to such standards, nor would it allow directors the option to select "relevant" data or information. The IASB, like other accounting standard boards around the world, mandates both the use of promulgated standards and the nature and scope of information to be disclosed (Alexander 2007).

In the space provided by the Companies Act, and the lack of engagement on these issues by the accounting standards boards, intermediaries have come to market with their own "standards" and products to match. As such, the absence of standard-setting by the Government on this issue is arguably a deliberate experiment in market-volunteerism. It is an attempt to let market agents digest the large volume of financial and non-financial information entering the marketplace so that it might pre-empt what CESR issues are regarded as important drivers for long-term sustainable economic growth. It would subsequently fall to governments to crystallize these market based

[65] Note, however, that the U.K. Accounting Standards Board (2006) has sought to influence the reporting of items subject to the "business review" sections of the Companies Act with a set of recommendations reflecting what they contend to be "best-practice." Lacking statutory force, as was to be the case through the OFR, these recommendations have not set industry standards.

models in more traditional regulatory standards.[66]

Historically, of course, agencies like Standard & Poor's, Moody's, and Fitch have provided company-specific single-score alphanumeric credit ratings to the market, allowing investors to evaluate in a comparable, consistent and comprehensive manner the market value of proffered debt. These companies use similar methods of assessment to come to their scores, matched by some of the more recent market entrants that offer specialized ratings on, for example, the nature and quality of corporate governance. As is well-appreciated, however, the mainstream ratings companies have not fared well in the aftermath of the 1990s tech bubble and the more recent subprime global credit crisis. Their methods of assessment and calibration of underlying credit risks have been subject to harsh criticism.[67] Mainstream rating companies have remained aloof from the calibration of CESR related issues, preferring, perhaps, to monitor the development of standards and data in this area before acquiring (at some time in the future) the market innovators.

We can distinguish between two generic approaches taken by intermediaries in the development of CESR standards and performance data. There are, as noted above, firms that begin with a comprehensive array of variables designed to capture the crucial issues relevant to CESR factors. Beginning with company annual reports and websites, these firms interview companies to augment their initial assessments. From there they develop qualitative scores to indicate corporate responsiveness to the issues as well as

[66] Presumably the Government will introduce such a standard once the metrics are clearer, and the private sector has "test-run" what the standard needs to include (so that investment companies can build their metrics in common agreement). See, for example, recent debate (early 2008) in the House of Lords over the Climate Change Bill where a proposed amendment would provide "guidance" on company reporting as to greenhouse emissions.

[67] There have been recent discussions in Europe and the U.S. on how to better regulate credit rating agencies and their methodologies. *See* Trade Union Advisory Comm. to the Org. for Econ. Cooperation and Dev., *Trade Union Advisory Committee, Financialisation and the "Sub-Prime" Financial Crisis—Issues for Future Regulation* (Sept. 5, 2007) (proposing issues that should be discussed with regard to the proper reaction by financial authorities).

their actual performance benchmarked against industry and country averages. The resulting scores across a number of indicators relevant to institutional investors rely upon directors' disclosure and the evaluation of collected data. In effect, these types of intermediaries seek to capture current performance against relevant standards and supply to the market their assessments of companies' likely future performance. For example, when assessing companies' environmental performance, ratings firms must determine the relevant issues, the indicator variables, and the extent to which the assessed companies could be said to be above or below the relevant benchmark (Clark and Salo 2008).

Instead of relying upon corporate disclosure and the willingness of corporations to be interviewed and assessed, a new generation of intermediaries have sought to develop quantitative estimates of corporate CESR 'liability' over a range of crucial variables relevant to corporations' long-term financial performance (McWilliams and Siegel 2000). Here, the intention is plain: to avoid the complications and costs involved in site-visits and qualitative ratings by building comprehensive and consistent databases on individual firms benchmarked against industry averages. Intermediaries rely heavily upon the public disclosure by corporations of their liabilities, augmented by stylized models of whole industries. In effect, these models seek to map the nature and scope of industry-specific systems of production and distribution being a means of referencing firms according to their relative performance. Based on this procedure, industry analysts can build stories of likely long-term environmental performance, innovation, and technological change. Analysts can identify firms that might be included, for example, in "best-in-class" sectorally-diverse investment portfolios.

Reference to corporate CESR 'liabilities' here should be qualified by the fact that,

in most cases, these quantitative metrics are measuring a company's exposure to financial costs *in the event* that regulation is implemented to price CESR externalities, rather than measuring a company's exposure to financial costs in relation to existing regulated liabilities or costs. In the context of emerging legal regimes to price carbon and other environmental outputs from industry, these quantitative metrics are helpful in anticipating firms' future cash flow risks should markets and regulations apply more exacting pricing regimes. However, since these projections are long-term, they are inevitably subject to uncertainty about both the future regulatory landscape as well as the future CESR performance of the firm.

Nevertheless, these quantitative estimates of companies' actual and disclosed liabilities, and their expected rates of change over time, can be very important for analysts seeking to build predictive models of stock price movements (Richardson 2002). Equally, quantitative estimates allow for rapid and systematic data sorting and comparison. For example, a single carbon-estimate may be sufficient for investment analysts to rank-order traded firms by industry, by country, and by market indices. By stripping out the judgment associated with qualitative scores, as well as the problems sometimes encountered when attempting to understand assessors' judgments and benchmarks, these types of intermediaries supply to the market data in much the same form that analysts encounter in their day-to-day trading.[68] These intermediaries are also clearly distinct from social activists, whose agenda is differently focused on the roles and responsibilities of the firm, and can therefore be distinguished from conventional CSR discourse in which the social and environmental interests of external stakeholders are a more dominant concern (Conley and Williams 2005).

[68] *See, e.g.*, Trucost Methodology Overview, http://www.trucost.com//howtrucostanalyses.html (last visited Nov. 11, 2008) (discussing the Trucost assessment methodology, which is one of the most important intermediaries in the London market for environmental accounting).

3.4.2 A new kind of regulatory strategy

The U.K. government's willingness to stand back and let financial intermediaries compete for the development of tools which adequately price the market value of CESR information is not only a uniquely shareholder-oriented approach to CESR, but also represents a unique type of regulatory strategy. Information-based regulatory strategies are not new to the field of corporate social responsibility. However, it is widely contested whether information-based strategies are truly "regulatory" in the command and control sense, or closer to a form of new governance in which firms (or other market actors) are merely "influenced" but are ultimately free to act of their own accord (Yeung 2005).[69] New governance theory argues that the CSR movement may more closely represent the latter. Under this characterization of the CSR movement, information disclosure is often used by corporations as a kind of public relations charade rather than a way of regulating corporate behavior (Conley and Williams 2005). New governance theory describes a "post-regulatory state" in which corporate behavior is transformed through interactions between various actors—other firms NGOs, government, and actors. Therefore, compared to regulatory mechanisms like mandatory information disclosure, highly networked communities are more influential in changing corporate behavior (Slaughter 2003).

Reflexive law theorists, however, adopt a slightly different approach. They acknowledge the role of various stakeholders in actively changing corporate behavior but argue that verifiable and comprehensive information disclosure is crucial to catalyzing this change. They argue that reliable mandatory reporting on, for example,

[69] A recent interesting example of this debate is the EU REACH regulation on chemicals production and trade. In this case, the disclosure of information has been a pre-condition to the existence of the market because chemicals producers are prevented from entering the market until they have disclosed the information on the chemicals' properties, risks, and methods of safe use, among other pieces of information (Fischer 2008).

corporate environmental performance, is important for stakeholder activism to have any real influence (Richardson 2002).

We argue that the corporate disclosure regime within the Companies Act is best described as a hybrid policy instrument which combines both command and control regulation and market based mechanisms (Yeung 2005). The control mechanism of the regime is the mandatory disclosure requirement (Ogus 1994). Although the absence of reporting standards weakens the substance of the "command" directed towards firms, the competition amongst financial intermediaries in London to interpret the disclosed data distinguishes the Companies Act from other disclosure regimes with weaker enforcement mechanisms (Clark 2002). While the effectiveness of some mandatory disclosure regimes (for example, product labeling) are limited by the ability of informed consumers to accurately interpret the disclosed information, the Government has sought to leverage the power of London's finance sector and market-price incentives to guarantee the quantity and quality of information to be disclosed. In this way, the market acts as an effective 'enforcer' of the disclosure provisions because financial intermediaries are closely scrutinizing information and putting pressure on firms to make the information reliable and relevant.

The market based mechanism used in the disclosure provisions is also unusual because the intention behind the provisions, as we have discussed, is to enhance shareholders' understanding of the business risks facing quoted stocks and improve competitive market pricing of these stocks. In terms of regulatory theory, this logic relies on consensual regulatory theory: a form of regulation which encourages participants to cooperate with each other. In this case, the company, investors, and financial consultants are brought into close contact on the issue of CESR information

and are encouraged to agree on what information is relevant to the long-term financial prospects of a particular company(Morgan and Yeung 2007). This type of regulation is therefore different from CSR disclosure regimes where the incentive to provide information is usually ethical rather than financial, and where some firms may be prone to exaggerate their CSR credentials without any direct repercussions (Conley and Williams 2005).

It is important to emphasize, then, that the Companies Act appears to move beyond the conventional characteristics of the CSR movement and integrates CESR information within a theory of efficient market operation rather than simply ethical and social responsibility. Unlike the CSR movement where the role of all stakeholders is prominent, the Government has given prominence to investors while simultaneously satisfying the interests of the NGOs and social activists. The goal of financial markets under the efficient market hypothesis is for quoted stock prices to fully reflect all the information available on the firm (Fama 1970). Ideally, market prices respond to new information quickly and accurately once the information is disclosed. However, where markets have not been given the opportunity to price financially material information because it has not been made available, then financial markets are exposed to the savage shocks such as we have seen in the subprime-led global credit crisis, and what we may expect to see if the physical consequences of climate change take place as predicted.

The Government's disclosure regime is an attempt to encourage financial intermediaries to price this information accurately and efficiently. The regime negotiates a complex balance. On the one hand, it explicitly acknowledges that CESR information is financially material and that it needs to be priced in order for markets to be informationally efficient. On the other hand, it acknowledges that, to date, the

efficient markets hypothesis has failed for two reasons. First, investors have not had access to reliable CESR information. Second, they have lacked a common metric to accurately analyze this information. Since financial markets have failed to price CESR information to date, the Government appears to be intervening to assist investors in pricing CESR risks over the long term. By developing a complex regulatory regime which gives financial intermediaries an incentive to fill this gap, the Government acts as a regulator of information disclosure on both environmental and social matters, as well as a protector of the integrity of the quoted stock price of traded securities(Graham, Harvey, and Rajgopal 2006).

The disclosure regime also addresses the assumption under the efficient markets hypothesis that sharp-eyed arbitrageurs are able to rapidly move prices after the announcement of market-sensitive information. Although this may be true for some types of information (for example, mergers and acquisitions, dividend announcements, and so forth), arbitrage opportunities are limited in instances where information is expensive to acquire, verify, and process (Barberis and Thaler 2003). The Government has implicitly acknowledged that CESR is an example of "expensive" information because CESR information has conventionally been of unreliable quality and difficult to measure in terms of financial materiality. The U.K.'s disclosure provisions are an attempt to overcome this hurdle because the onus is on directors to interpret what information is "essential" to the business and to report on trends and factors which are likely to affect the future development, performance and position of the business. In this way, the CESR information, which is to be disclosed under the Companies Act, is intended to be crucial to a firm's business operations.[70]

[70] This is another instance in which the disclosure regime under the Companies Act (2006) moves beyond conventional CSR drivers, where a company's CESR activities rarely include their "core" activities.

The approach under the Companies Act is characteristic of Anglo-American shareholder capitalism because it empowers small investors and "outsiders" who do not share the privileged "insider" relationships that stakeholders in continental Europe might enjoy with top-level management.[71] This approach also empowers small investors in relation to institutional investors, since the latter usually have superior data-processing technology and organizational capacity to digest and analyze this information (Chen 2007). This may be intentional, since institutional investors, who own seventy percent of all listed equities in the U.K., have been slow to respond to CESR issues. This may be, in part, explained by the paucity of quantifiable metrics to analyze CESR data which has meant that institutional investors have been cautious of CESR information. It remains to be seen whether financial intermediaries will be able to develop metrics that are sufficiently rigorous for institutional investors to change their tune on this issue.

Finally, it should be noted that the Companies Act disclosure regime should be distinguished from other information-based policies because it places the obligation to report on directors (through the annual business review), rather than on the company at large, as is common in public relations-driven CESR. By pinning disclosure obligations on directors in conjunction with amendments to directors' duties discussed above, the Government is demonstrating a prescient understanding of corporate behavioral change. In agreement with reflexive legal theorists, Gunningham et al. have argued that the attitudes and style of top-level management are highly correlated with firms'

[71] High levels of information transparency on CESR are also consistent with the EU's strategy of building more integrated and competitive capital markets across Europe. Under a closed market structure a premium is placed on special relationships between 'insiders' and the firm. These relationships facilitate the flow of private information, which is fully digested before being released to the market. However, the fair review accounting principles of the EU Modernization Directive as discussed are attempts to build greater harmonization of markets around transparent and well-informed markets.

environmental behavior compared with other variables such as jurisdiction, size, or annual turnover (Gunningham, Kagan, and Thornton 2003). In addition, managers and shareholders can exert greater change on firm-wide behaviors in the Anglo-American firm, compared with NGOs and the public (Aguilera et al. 2007). In this respect, the Government's decision to place the business-review reporting obligation on directors may be an effective way to engage high-level managers and directors within the firm.

3.5 Implications and conclusions

The premise of this paper is that the modern corporation is both the object of investment for the global financial sector and the source of value for society. As the object of investment, the modern corporation is subject to the theories and practices of the investment industry being, more often than not, just one element amongst many in market based portfolios. Its "value," in this respect, is contextual: it is priced against market information concerning its expected value relying upon common metrics and comparative market performance. As such, the modern corporation has no intrinsic value—whether investors hold, or do not hold, a corporation in their stock portfolios depends upon their overall desired risk-adjusted rate of return. We recognize, of course, that this is characteristic of Anglo-American economies wherein the financial sector has become virtually autonomous from the so-called "real" economy (Allen and Gale 2007). But it is increasingly the case for continental European economies, and especially their largest traded corporations that seek the benefits of global financial markets (Bauer, Braun, and Clark 2008).

At another level, the modern corporation is the principal source of value for society. Obviously, it provides employment and earned income as well as tax revenue for governments. In many countries, its share of national income has grown

dramatically over the past fifty years—so much so that the "partnership" between the state and the corporation, so important for post-war politics and policy, has been heavily discounted. For many, this is the 'normal' state of affairs. But this has meant that the modern corporation carries two rather different sets of expectations: as the means of generating income for distribution through society, and as the medium through which social expectations are to be, in part, realized. We noted the tension between these expectations, arguing that the Companies Act was conceived to enhance the global competitiveness of U.K.-listed corporations given EU and domestic debate over the proper purpose of the corporation with respect to social and environmental standards. When pressed to explain its preference, the U.K. Labor Government favored the former over the latter.

Nonetheless, it is apparent that the Government, market analysts, and social activists have joined together in an uneasy alliance to promote greater disclosure of information to a broad array of constituents. The disclosure movement has been driven by financial market agents concerned to better price, on a comparative basis, one company over others. This claim for the disclosure of market-sensitive information has proven extremely powerful, buttressed by theories of market efficiency and related notions of market equitability wherein "insiders" and "outsiders" are deemed deserving of access to the same information (Wilhelm and Downing 2001). If it appears as an unassailable economic good, the disclosure movement is also a means to an end wherein the autonomy of corporate executives is brought to account on the assumption that disclosure can discipline hubris and a penchant for empire-building (Bauer, Braun, and Clark 2008). For continental Europe, of course, the disclosure movement is part of a larger process whereby hitherto sheltered national champions have been integrated

into the global financial community.

For the EU, concerned about the social responsibility of the modern corporation, the interest of financial agents in disclosure has been an opportunity to articulate a broad range of items for disclosure while advocating standards by which the quantity and quality of information are to be judged. The EU Modernisation Directive sought to combine both in a way that would meet the interests of the social partners or stakeholders in an expansive definition of corporate responsibility. The U.K. embraced the opportunity to re-write U.K. company law but with a particular flavor (captured in our recounting of the parliamentary debate over its passage through the House of Lords). The U.K. Government introduced the principle that company directors ought to disclose market-relevant information on the long-term prospects of the firm, including, where relevant, reference to social and environmental matters. This was hardly a ringing endorsement of corporate social responsibility; the Government sought at every opportunity to narrow the scope of such a requirement to that which would be appropriate for market valuation of company prospects.

In effect, the Government passed on the opportunity to embrace continental European social democracy. In doing so, it reinforced its apparent commitment to the competitiveness of U.K. financial markets and especially London's place in the global competition for incorporation, cross-listing, and international financial transactions. The Government's reluctance to set reporting standards on certain matters including social and environmental issues has prompted rapid growth in market based solutions to these questions. We have argued that in the absence of government reporting standards, financial intermediaries have sought to provide measures to the extent that financial agents require consistent, comparative and comprehensive metrics for assessing

corporate value. There has been a remarkable burst of private investment in metric-making, some of which rely upon qualitative judgment, others of which are entirely quantitative in the manner made popular by the real-time data streams that flow across the trading desks of major financial institutions. Once again, metric-making has advantaged London as one of just a few truly global centers of financial innovation (Clark 2002).

Not surprisingly, metric-making has brought into being remarkable coalitions of interest and institutions linking the NGO community with banks, venture capital partnerships and pension funds. If stymied by the Chancellor's repudiation of the OFR, through the Companies Act, the NGO community has found a willing audience in segments of the financial industry (if not always the corporate sector). But at this juncture we emphasized that metric-making is a supply-side activity—it is all about articulating standards and measures of measurement for the investment industry on the assumption that the demand for such metrics will follow the lead provided by statute. Whether this will actually occur remains to be seen. The Government has embarked on a remarkable experiment in reflexive "regulation," eschewing political leadership in the hope that the social expectations of activists will be taken up through the interests of financial agents in pricing the value of major companies.

However, the interest of pension funds and institutional investors in CESR metrics remains cautious given the regulatory history in this area in the UK. We noted, for example, that the UK Labor Government's 1999 disclosure policy on ethical pension fund investment was still-born; it failed, at a rudimentary level to encourage pension funds and their service providers to engage in the issues. By contrast, the relevant provisions of the Companies Act concerning the long-term prospects of firms are likely

to have far more important affects than the change in regulations to the Pensions Act 1995. In any event, recent research has indicated that many pension funds and their trustees have not made real efforts to match their investment policies to community expectations as regards social and environmental matters (Caerlewy-Smith, Clark, and Marshall 2006). In part, reluctance to engage CESR issues can be explained by a narrow interpretation of fiduciary duty that excludes reference to anything other than the risk-adjusted rate of return. Equally, we have also shown that many trustees, especially those that are experienced, recognize the complex nature of the issues involved and the lack of widely-accepted decision-metrics relevant to investment strategy. Too often, consideration of CESR issues is event-specific, undercutting the strong interest of pension fund trustees in a well-governed investment strategy.

In any event, many private sector pension funds are opposed to these types of interventions in all but the most obvious cases. This is for two reasons. First, private sector pension fund boards typically include senior executives whose principal concerns are their own status and promotion in the company (most important) and the solvency of the fund in relation to corporate revenue and growth (very important). In the U.K., many funds are staffed by "secretaries" who are company employees; deliberation over investment strategy is often truncated and reliant upon consultants. In effect, private pension funds have neither the interest nor the capacity to engage with the issues. At best, pension fund boards are likely to follow the lead on social and environmental matters provided by highly reputable investment houses whose investment products integrate these matters into the expected pricing of offered portfolios. Alternatively, a demonstrated link between risk and return *and* environmental liabilities and management capacity may attract the interest of boards; at the margin, unless held by

government to account for such decisions, pension boards may simply ignore the issues.

By our interpretation, the U.K. Companies Act 2006 provides a political recipe for reconciling two competing interests in the value of the modern corporation. Where the Government might have required certain reporting standards and where it might have introduced mandatory disclosure on significant social and environmental concerns, the Government sought to enhance the competitiveness of London's financial markets in relation to Frankfurt and Wall Street. In this respect, the Government underwrote the prospects for market-intermediation rather than directly regulating corporate social and environmental responsibility. We have already witnessed the devastating effect which poor disclosure regulation can have of global capital markets in the form of the subprime global credit crisis. Let us hope that the strategy embedded in the UK Companies Act will assist in mitigating similar shocks in the future.

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Chapter 4 | The Role of Investment Consultants in Transforming Pension Fund Decision-making: The Integration of Environmental, Social and Governance Considerations into Corporate Valuation

4.1 Introduction

The global financial crisis of late 2007 and beyond is arguably the most severe financial crisis since the Great Depression. A number of the world's leading bulge-bracket financial institutions have either gone bust or been bailed out by government; global capital markets remain in a climate of unease and limited confidence; and governments around the world had to return to Keynesian pump-priming fiscal policies to stimulate domestic economies into action and salvage the financial sector.

The scope and scale of this crisis has encouraged academics to reflect on what went wrong. While it is popular for journalists to lay blame on the generic figure of the City Banker, this view does not given sufficient credit to the fact that the world's largest asset owners themselves have suffered deep blows from this crisis. Indeed, the shortcomings of financial markets appear to be more complex than the big bonuses of bankers alone.

In order to delve beneath the surface, this chapter examines the investment processes around the world's largest asset owners: pension funds. Given their long-term time horizons and their exposure to multiple geographies and sectors, pension funds have been described as "universal owners" (Hawley and Williams 2007). With command of USD 28.2 trillion of the USD 74.3 trillion global fund management industry, pension funds have a vested self-interest in the stability of global financial markets (IFSL 2008). In the context of a global financial crisis, universal ownership

should, in principle, make pension fund managers conscientious participants in systemic reforms to the economy. Yet it is questionable whether most pension funds are actually capable of effectively employing their strength as universal owners.

In order to examine this we adopt an economic geography approach to examine the relationships between actors and institutions engaged in the investment process of pension fund money. We extend on the literature on pension fund governance (Clark 2000) by specifically examining the role of investment consultants. Investment consultants act as intermediaries between pension funds and asset managers. As such, their relational geography in the investment process gives them a conflicted role: they are both 'thought leaders' driving innovation in investment management practices while also being contractually committed to the demands of their client.

We use the emerging concept of environmental, social and governance (hereafter, ESG) considerations as a lens through which to examine the relational geography of investment consultants. ESG considerations are a valuable analytical tool in the context of the financial crisis as we argue that the failure to incorporate ESG considerations into investment analysis is a contributing factor to the current crisis facing financial markets. We develop our arguments from a series of six case studies collected from questionnaires sent to leading global investment consultants with the assistance of the Asset Management Working Group of the United Nations Environment Programme Finance Initiative. The six investment consultants relied upon are headquartered in the UK, the US, and Japan. However, their operations are spread across other markets (e.g. Canada and the Netherlands) with large funded occupational pensions[72].

[72] The geography of pension funds is quite diverse. Countries with large occupational pension funds relative to GDP include the US, UK, Canada, Australia, the Netherlands, Switzerland and Japan.

This chapter proceeds in the following manner. The second section sets out what we perceive to be the geographical conundrum at the heart of the global financial crisis. The subsequent section then examines the emergence of ESG integration as an effort to bring investors closer to the local conditions facing their investments. We note that this chapter does not assert the merits of ESG as an investment tool but is rather interested in its penetration and uptake within the pension fund investment process. Section 4.4 locates investment consultants within the relational geography of pension fund investment management. Section 4.5 discusses the data used in the chapter to examine these issues and section 4.6 presents the results of consultants' views on ESG integration techniques and principles in detail. The final section discusses the implications of these results in terms of the difficulty of driving new alternative methods of investment analysis.

4.2 The recent global financial crisis

There has been much speculation as to the underlying causes of the recent global financial crisis. Ostensibly, the trigger for the crisis in late 2007 was the gap between US housing prices and the traded value of sub-prime mortgage derivatives on global financial markets. When housing prices collapsed in late 2007 and job stability decreased, the growing default rate on mortgages illuminated an asset bubble in the sub-prime mortgage market.

The specific shortcomings in the sub-prime mortgage market may be attributed to various factors including failures in asset pricing, risk disclosure and credit rating (Soros 2008; Stiglitz 2008). Indeed, many investors after the onset of the crisis pointed

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Although funded pension arrangements are increasing in other countries through reform of public pension systems, actual assets under management remain small.

the finger at credit rating agencies which had inaccurately graded the risk profile of mortgage-backed financial products. However, these events arguably signal a far deeper malaise in the operation of global financial markets. What this crisis revealed is the gap in financial markets between the asset price traded by global investors and the on-the-ground risks and opportunities facing local companies (and indeed home owners) in the real economy. As much as financial models and mathematical sophistry attempts to recreate real world risk through complex modelling, it is only ever an approximation of the real thing. It is the gap between the *global* investor and the *local* investee, which often lies at the heart of the world's asset pricing bubbles (Clark, Dixon, and Monk 2009).

Disclosure of financial information plays a crucial role in attempting to narrow this gap. According to the efficient market hypothesis of financial markets, asset prices fully reflect all publicly available information in the market. In practice, however, only a fraction of information relevant to the likelihood of success or failure of a particular company is reflected in balance sheet disclosures under standard accounting practice. What is missing is a wealth of information surrounding the operational and macroeconomic challenges facing a prospective investment. This ranges from the failure to gauge the macroeconomic risk of default on Russian government bonds which led to the collapse of Long Term Capital Management through to poor estimates of the future income stream of home mortgagees outer-suburban Detroit which triggered the sub-prime mortgage crisis.

An important move to fill this gap has been the push towards greater information disclosure and analysis of ESG considerations. ESG considerations encompass a wide spread of issues from the corporate governance regulations facing an investee company

through to the social and environmental challenges impacting market conditions in the future. An example of an issue falling within the environment subset of ESG issues is climate change. Climate change represents an external uncorrelated variable which has not been fully priced into current financial modelling. As such it has been described by Sir Nicholas Stern as potentially the greatest market failure in human history (Stern 2007).

Disclosing information on climate change and feeding this into investment analysis is therefore an attempt to build a bridge between the global investor and the local environmental challenges facing a particular business (Forrest, Ling, and Lanstone 2006; UNEPFI 2004). However, the failure to do so perpetuates the shortcomings of existing asset pricing models illuminated by the recent global financial crisis.

4.3 ESG integration as investment tool

The integration of ESG information as a tool in investment analysis (referred to here as "ESG integration") needs to be clearly distinguished in the academic literature from the field of socially responsible investment (SRI). The fundamental distinguishing feature between these two approaches is motivation. Whereas SRI is essentially motivated by ethical imperatives and aims to actively shape the market, ESG integration is motivated by economic imperatives and is a risk-analytics tool aimed at capturing the effects of environment, social and corporate governance considerations on the risk-adjusted return of portfolios. In this regard, ESG integration is arguably a more tangible and effective method of addressing such issues given conventional investment practice, which relies heavily on quantitative measures and standardised benchmarks (Forrest, Ling, and Lanstone 2006).

The SRI literature has a long history stretching back to the 1980s where it had strong uptake amongst European funds such as the Stewardship Fund in the United Kingdom and Varldnaturfonden in Sweden (Louche and Lydenberg 2006). The attempt behind these early funds was to focus investment in assets that were regarded by those investors as "socially responsible". From the practitioner perspective, sell-side analysts were engaged in constructing portfolios that satisfied a particular appetite for non-financial goals. Within the academic literature, however, defining which investment goals are "socially responsible" has been contested based on different moral, ontological, ideological, and functional definitions of social responsibility (Sandberg et al. 2009). SRI has been used to describe investment portfolios that achieve a sufficient level of financial return as well as offering social, environmental and other non-financial benefits (Sparkes and Cowton 2004). This definition of SRI is fundamentally politicised because each investor, as a consumer of financial products, demands their own mix of non-financial goals and outcomes making the construction of a commonly agreed upon "SRI portfolio" practically impossible (Davis and Thompson 1994; Hendry et al. 2007).

Separately to this prerogative, a body of literature has developed on the *economic* consequences (as opposed to the ethical consequences) of social, environmental and corporate governance variables on the financial performance of the investments. This literature has spawned many streams of academic research in finance, law (Black and Coffee 1994) and management (Davis and Thompson 1994). On the one hand, quantitative research has been carried out trying to use social (Orlitzky, Schidt, and Rynes 2003), environmental (Derwall et al. 2005) or governance (Bauer, Braun, and Clark 2008) variables to explain shareholder returns. This literature at times has faced

methodological challenges by virtue of the fact that environmental, social or corporate governance data has often been located within SRI-related products, either in an aggregated fashion or in the form of self-assessed qualitative metrics. This has given reason to qualify the conclusions of much of this quantitative research. On the other hand, the literature has focussed on the ability of ownership rights and shareholder activism to change corporate management. This literature has mainly focussed on changing company's governance in light of Jensen and Meckling's (1976) agency theory (Clark and Hebb 2004; Hebb 2008; Neubaum and Zahra 2006). Whatever limitations may be placed on the conclusions reached by this research, it is clear that the underlying economic motivations of this research stream fundamentally distinguish it from the ethical overtones of the SRI literature.

ESG integration has emerged as an investment tool that clearly falls within this latter economic-focussed literature. Championed to a large extent by the United Nations Environment Programme Finance Initiative and major sell-side investment houses around the world such as Goldman Sachs, UBS, and JP Morgan, ESG integration is a new investment tool which is focussed on risk analytics and identifying long-term 'alpha' drivers (above benchmark returns). In other words, it is about more precisely determining the impact of environmental, social and corporate governance considerations on asset pricing and the future cash flow of businesses. As such, it is a split from the primarily ethical/market-transforming mandate of the SRI community and as such has attracted some consternation from academics within this community (Richardson 2009).

By way of example, the relevance of ESG integration in more accurately making asset pricing estimations is evident in the growth of so-called new paradigm firms (Lev

2001). New paradigm firms describe businesses where a significant proportion of their market valuation is attributable to intangible assets such as good will, corporate reputation and brand valuation. This means that market valuation for these businesses is often at a significant premium to the book value of the physical assets of these firms. This is in contrast to "classical model" firms which dominated the early 20th century. Here, market valuation was closer to book valuation because the firm's assets where primarily physical and tangible assets such as plant and equipment (Clark and Salo 2008).

Traditionally, new paradigm firms might have been restricted to media companies or consumer retail (such as GAP Inc.) where fashion and style are crucial to making sales. However, more recently intangible assets make up a remarkably large proportion of market valuation. For instance, the book value of assets in the S&P 500 only account for 20-25% of corporate valuation (Ned Davis Research 2007). This highlights the importance for investors of understanding how ESG issues are driving the local operation of their investments.

In the context of consumer concern about climate change, mainstream businesses in the utilities, resource, and automobile sectors are increasingly exposed to risks around their environmental reputation. For example, the success of General Electric over the last five years has in part been attributable to sales from its 'Eco-magination' product line across 2007-2009. Similarly Toyota Motor Corporation has been able to out-compete American car companies in part on the growth of consumer demand for hybrid cars. Another instance where environmental considerations have impacted future cash flow has been in the case of energy company Royal Dutch Shell. It has been argued that Royal Dutch Shell lost a large amount of goodwill following the

Brent Spar incident in 1995 (Esty and Winston 2006; Gunningham, Kagan, and Thornton 2003).

The importance of ESG integration in financial analysis is therefore closely related to the shortcomings of financial markets to connect local issues with the mathematical models build by physically distant global investors. ESG therefore intimately connected with improving corporate valuation as opposed to achieving ethical objectives per se (Clark and Knight 2009).

4.4 The conflicted role of the investment consultant

Financial markets are more than a combination of mathematical models and information. Behind every investment decision there is a complex inter-personal process and set of personal relationships which integrate available information into a buy/sell/hold decision for investors. The extent to which ESG considerations feature in investment analysis depends on how this knowledge feeds into the relational geography of investment decision making. Relational geography is simply concerned with the "social interactions between economic agents" (Boggs and Rantisi 2003). It is alert to complexity and reactivity in economic systems which qualify the pure application of mathematic models to economic decisions.

The literature on the relational geography of pension fund decision making to date has mainly focussed on governance architectures in pension fund trustee boards (Clark and Urwin 2008). Ambachtsheer et al. (2008) for example argue that board-level competence is a serious limitation in the flow of pension fund capital (Ambachtsheer, Capelle, and Lum 2008; Clark and Urwin 2008; Clark, Caerlewy-Smith, and Marshall 2006). As a result, trustee boards widely rely on investment consultants for financial

advice[73], effectively making them crucial actors in the investment decision-making process (Maatman 2005). Yet despite such an important role, it is questionable whether investment consultants are effective at driving an investment agenda that includes ESG integration. This chapter extends on this literature by focusing on the behaviour and practices of investment consultants in particular. Before doing this, it is necessary to situate investment consultants within the pension fund investment process.

Although the structure of pension fund investment management can vary by jurisdiction, the organisational structure of the investment process is arguably fairly standardised. For the sake of exposition, we focus primarily on illustrating the case of trust-based pension jurisdictions. In these jurisdictions—where the vast majority of global pension assets exist—employers and/or employees make contributions to a fund, which is held in a trust and overseen by a trustee board. Depending on the actual size of the pension fund, administration can be either internal or external, or various degrees thereof depending on the particular administrative task. Large pension funds, given scale effects, often have separate physical pension management organisations. Smaller funds, by contrast, generally delegate most day-to-day management processes to external providers. These tasks range from benefits management and reporting, all the way to actual fund management (Clark 2000).

Regardless of size, the board of trustees sits at the centre of the investment process and is ultimately responsible for the actions of the administration of the fund. Often, mainly with larger funds, members of a board will also sit on an investment committee together with other experts to make recommendations to the board on the

[73] We note that not all pension funds operate in trust-based legal environments, particularly those in civil law countries. However, other jurisdictions, such as the Netherlands, have comparable fiduciary systems of investment oversight (for the Netherlands see (Maatman 2005)). Ultimately, investment consultants are typically involved at some point during the investment decision-making process.

allocation of assets, choice of investment managers, and other financial matters—with smaller funds, separate investment committees generally do not exist. In making decisions regarding the choice of investment managers and asset allocation, trustee boards often employ the advice of external investment consultants. This is particularly the case with smaller funds, given limited or non-existent internal resources for researching investment managers and devising an optimal asset allocation given the fund's risk parameters. Yet even larger funds employ outside consultants to aid in making decisions. A stylised rendition of this organisational structure is visualised in Figure 1.

[Insert Figure 4-1 here]

From a slightly stylized though empirically grounded perspective on best-practice investment consulting (Clark and Urwin 2008), the principal responsibilities which investment consultants are called on to consult encompass three overlapping areas: organizational coherence, people, and process. Regarding 'organizational coherence', investment consultants assist with the formation and clarification of a pension fund's organisational strategy and mission. This is more detailed than simply articulating the goal of maximising beneficiaries' financial returns, which is a trustee's legal obligation. It also involves clarity around the selection of benchmarks, identifying a long-term strategy, and drafting mission statements and statement of investment principles (Juravle and Lewis 2008; Clark and Urwin 2008).

Consultants' responsibilities also include assisting trustees in the recruitment of competent fund managers and administrators to provide financial planning advice and

advice on asset allocation. This is the 'people' aspect of the pension fund investment chain. Investment consultants facilitate the negotiation of investment policy statements between asset owners (funds) and investment managers, so that both parties to the contract have clearly mandated objectives. In this respect, the extent to which a fund has an interest in focussing on short-term or long-term investment horizons and the decision to adopt particular investment methodologies, such as ESG, is largely decided by trustees *with* the assistance of investment consultants (Juravle and Lewis 2008).

In certain cases consultants may also become responsible for managing the on-going relationship between asset owners and managers and the investment 'process' broadly. They evaluate the performance of investment managers on a regular basis and make recommendations for hiring new managers based on which managers have demonstrated a strong performance in asset classes and methodologies that align with trustees' mission and risk appetite. They may also be required to structure products for the pension fund to invest in directly where there is no external expertise available.

Given the intimate role investment consultants have in trustee decision-making, they have been described by some practitioners as 'the gatekeepers' of pension fund investment management (Davis, Lukomnik, and Pitt-Watson 2006). Although the term 'gate keeper' arguably overstates the 'supervisory' aspect and functional capacity of investment consultants, they can still play a pivotal role in board operations and are one of the first stops for advice and thought leadership when trustee boards need assistance. They could be more rightly characterised as sophisticated filters of information, or as one consultant suggested to us 'important digits in the combination' that unlocks investment management.

The flipside to the consultants' privileged position is that they are also the subjects of client demand. The dynamics of the financial services industry are such that consultants are required to follow clients' orders. The tension between these two positions—as adviser, and as service provider—means that consultants may find themselves in a compromising position. They may be prevented from exercising their leadership at the very moment when it is most needed because a client misunderstands them, is ignorant, or ignores the advice given to them (but likewise, it is entirely possible that consultants themselves may display irrational behaviour either because they are actively hostile, stubborn, or ignorant or because they perceive a threat to their business relationship with the client). As we demonstrate below, this fundamental characteristic is a significant barrier to ESG integration.

4.5 Data and methodology

The findings in this chapter draw on the responses of a number of leading international investment consultancies to a detailed questionnaire sent out by the United Nations Environment Programme Finance Initiative's Asset Management working group in 2008 (see Chapter 4 Appendix 1). Twenty investment consulting firms were contacted in the USA, Canada, UK, France, Germany, Sweden and Japan. The recipients were asked to provide detailed responses to 19 open-ended questions. These questions covered a number of topics broadly categorised within the following topics: fiduciary duties in the management of pension fund assets; evaluation procedures for investment managers' performance; investment practices used to monitor investment managers such as requests for proposals and analysing their proxy voting track-record; attitudes towards ESG in investment research; and the legal language used to define the relationship between pension funds, consultants, and investment managers.

The response rate to the questionnaire was relatively low: responses were received from 6 of the 20 consultants contacted. Notwithstanding this low response rate (30%), those who did respond represent some of the largest and most important global investment consultants by size of assets under advisement and international reputation. Except for one Japanese consultant with a domestic practice, these consultancies represent the world's largest and arguably the most influential global investment consulting firms with global institutional, tax-exempt assets under advisement of USD 8 trillion collectively as of June 2008. This represents approximately 30% of the world's pension funds assets as at the time the questionnaire was completed. Individually, the consultancies varied in worldwide institutional tax-exempt assets under advisement of less than USD 700 million to almost USD 3.6 trillion as of 30 June 2008 as set out in Figure 2 (Pensions&Investments 2008).

[Insert Table 4-1 here]

These respondents were spread across three geographies, with response received from two offices in each of the UK, US, and Japan respectively. In each case, the questionnaires were completed by Principals (very senior consultants) within these firms and were cross-checked with team managers in international offices to ensure that they represented the general view of the consultancy as far as possible. Notwithstanding the global coverage of the consultants who responded to the questionnaire, these responses are not intended to cover the entire field of investment consulting globally or indeed regionally. This is one of the limitations of our data set given the low response rate. Rather they provide insight into the views held by consultancies which advise

pension funds day to day on the issue of ESG integration. These case studies therefore provide scope to reflect on the institutional uptake of ESG integration in pension fund investment management within developed financial markets.

We individually evaluated the level of expertise in ESG integration amongst the respondents and placed them in one of three categories in Figure 2. In evaluating these categorisations we took into account the number of staff employed on this issue, years of experience in advising on ESG, and the depth and breadth of the responses given. The respondents we considered to be most experienced in ESG integration (hereafter, "market leading consultants") were housed within the Responsible Investment teams of the UK and US offices respectively of two international consultancies, which were world leaders in terms of their depth of market power, geographical scope, and total world-wide, tax-exempt institutional assets under advisement as at 30 June 2008 which were in excess of USD 2 trillion. The moderately experienced respondents in ESG integration (hereafter, "moderately experienced consultants") were Principals housed in the UK and US offices respectively of two international consultancies with strong market presence predominately in Europe and the US and with total world-wide, tax-exempt institutional assets under advisement as at 30 June 2008 between USD 1 trillion and USD 2 trillion. Finally, the least experienced respondents in ESG integration (hereafter, "least experienced consultants") were Principals housed in the Japanese offices of an international and domestic consultancy respectively. These consultancies advised on total institutional assets of less than or equal to USD 1 trillion.

It is important to acknowledge that there may be some scope of bias in the results. For example, larger investment consultants may have more capacity and experience to advise on ESG integration because they may have a larger budget to hire

this expertise rather than a genuine commitment to the importance of the issue. Furthermore, experienced firms may have a financial incentive to overstate the significance of ESG integration in order to attract more demand amongst the pension fund client base. The fact that these responses were provided in connection with a public UNEP FI report means that there is some scope of respondents to have a financial or marketing agenda. However, the fact the respondents were told upfront that their responses would remain anonymous helps balance this biased effect.

4.6 Investment consultants as agents for ESG integration in investment thinking

In this section we analyse the responses to the questions asked in the questionnaire, disaggregating them by *organizational coherence, people* and *process*, as per the three principle areas of the consulting relationship discussed in section 3. Although the questions were not framed along these three responsibilities in the questionnaire, we have structured our analysis using this framework as it provides a useful tool for in-depth examination of investment consultants' behaviour and investment practices.

Our analysis of the questionnaire responses indicated that the ability of investment consultants to lead change in investment thinking around ESG integration appears to be influenced by the degree of expertise and knowledge the consultant is able to bring to the client regarding the subject. Higher levels of expertise create situations in which the consultant can take a strong position in the consultant-client relationship by providing institutional clarity to trustee boards, offering direction on the selection of the best fund manager, and lead clients out of a myopic short-term strategy and a culture of limited index-backed mandates. However, where consultants lack expertise the survey

responses provide examples of how consultants can be dominated by the client and take a subservient position with respect to investment advice.

4.6.1 Organizational coherence of ESG

The market leading consultants with the most specialised knowledge of ESG were confident to relate ESG to their clients in economic terms. They had the language to explain how ESG considerations can have a material impact on corporate financial performance and therefore on portfolio performance, as the following response indicates:

> "An increasing body of evidence exists to show that ESG factors can impact investment performance…. We believe ESG factors fall within the purview of fiduciary duty where they are or may be material to long term capital preservation. ESG factors may also contribute to the growth of investments as related opportunities are sought."

The strength of these connections varies across sector, geography, investment strategy and asset classes and market leading consultants are able to position themselves in relation to clients as "leaders" who could guide their client through this complex terrain. For example, one market-leading consultant revealed that ESG integration was more important in asset classes exposed to long-term trends such as long-term long-only equities. As such, investment strategies that are highly geared towards short-term returns will fail to integrate these long-term dynamics into their allocations and will therefore be exposed to higher long-term risk profiles.

This leadership position and knowledge directly translated into a more active involvement in pension fund governance. For example, the two leading consultants both maintained global investment manager databases, which included information on ESG integration capacity within the investment manager community. These consultants were therefore able to provide benchmarking services to rank managers for their clients. They also had boilerplate templates for investment management contracts and investment policy statements, which could be amended to offer ESG capabilities to the client. They also expressed comfort in exercising active engagement strategies with company management as well as a variety of other tools such as voting rights and ownership strategies.

Lack of knowledge and expertise on ESG amongst moderately experienced and less experienced consultants, however, positioned these consultants as "followers" with respect to their clients. They were only willing to address ESG issues on an ad hoc basis and then only when the client had raised these issues first. This placed them in a weaker position with respect to the client and meant that they were subservient to client demand, as the following response suggests:

> "It is at the discretion of clients to ensure ESG criteria are relevant to their particular fund objectives, investment beliefs and governance arrangements".

This meant that they were unable to offer advice on fund managers with ESG capabilities until the client gave permission for a request for proposal to be issued. They also expressed greater reluctance to incorporate ESG related considerations into the investment management contracts and investment policy statements

The lack of expertise not only placed the consultant in a weaker position in the client relationship, but it was also consistent with conceptual confusion about what ESG integration actually meant. Specifically, as suggested by the following response, they confused ESG with SRI, which meant that they conceived of ESG in ethical rather than economic terms:

> "In terms of institutional investors, the circumstances where investment decisions are designed to be closely linked to the institutional mission and objectives are most conducive to deep consideration of ESG considerations."

Here "institutional mission" is a reference to mission-related investing which is a distinctive approach to ethically motivated investment decisions. The mis-categorisation of ESG as an ethical concept was most pronounced amongst the least experienced consultants in our data, who were based in Japan. For them, ESG integration was synonymous with ethical investing and was only thought to apply to environmental polluters, human rights abusers and other "antisocial forces movements (sic)". Although it is not possible to generalize these conclusions Japan-wide, there is certainly emerging empirical evidence to suggest that meaning of terminology such as SRI, corporate social responsibility (CSR) and responsible investment (PRI) is highly conflated amongst Japanese pension funds and that there is substantive confusion on the distinction between the ethical and economic issues at play (Aging, 2008). As such, the investment cultures within the Japanese setting deserve further research (Sakuma and Louche 2008).

By mis-categorising the issue as ethical rather than economic, investment consultants may lead clients away from considerations, which in fact have a very tangible impact on financial returns. Empirical research on trustee board decision-making has shown that when issues are framed in terms of ethical responsibility, trustees are less responsible than average members of the public (Caerlewy-Smith, Clark, and Marshall 2006). The lack of knowledge around ESG integration appears to be most pronounced around environmental and social issues as opposed to corporate governance, which has a deeper history in the academic literature (Bauer, Braun, and Clark 2008). One comment given by a moderately experienced consultant indicated that when an ESG issue is apprehended in financial terms, then the consultant is willing to promote its importance in investment management:

> "We believe that examining the corporate governance of companies is an essential aspect of investment management. However, the impact of environmental and social policies is not currently considered essential."

Knowledge and expertise therefore appear to be crucial commodities in negotiating consultants' relationship with pension fund boards. Greater levels of knowledge influence the level of leadership consultants feel comfortable to exercise over clients, and the extent to which they are able to provide more robust professional services. Lack of knowledge, by contrast, can lead to situations of active harm where conceptual confusion means that considerations material to portfolio returns are not brought to clients' attention.

4.6.2 People

In a professional service based industry such as investment consulting, the depth of human talent within an organisation is an important measure of the organisation's experience. This is no different for ESG integration, because firms with the most sophisticated understanding of ESG integration tools also employed the largest number of full time staff. The market leaders had full time staff focussed on ESG integration in offices around the world, primarily the UK and the US. This compared with less experienced firms in which consultants dealt with ESG considerations on an ad hoc basis depending on client demand.

As discussed above, investment consultants can play an important role in building relationships between asset owners and asset managers around areas of common interest. However, a challenge in establishing these networks has been the lack of expertise within fund managers. Market leading consultants felt that sell-side firms still had a long way to go before ESG integration services were widely available when investors needed them:

> "Not all managers, across geographies, asset classes and styles have the inclination or ability to abide by such [ESG] language and it might be dangerous to include it [in investment management contracts] otherwise (sic)."

The lack of expertise at the fund manager level has been acknowledged by leading industry groups such as Fair Pensions, although they have noted improvements over the last five years (Pensions&Investments 2008). Jaworski (2007) also supports the above findings with a survey of 88 sell-side and 240 buy-side institutions in Europe,

which indicate that there is weak dialogue and networking between buy-side investors and sell-side analysts around ESG considerations (Jaworski 2007). This lack of expertise in the financial community appears to be an impediment for some investment consultants' ability to form networks of communication around ESG integration. For example, the market leading consultants indicated that they are reluctant to draft legal clauses into investment management contracts between trustees and fund managers with respect to ESG integration because there may be a lack of fund managers who would be able to carry through with this obligation.

Notwithstanding the difficulties in forming networks of communication around ESG integration, leading consultants are beginning to develop tools to assist asset owners to form and evaluate relationships with asset managers. For example, leading consultants have begun to rate fund managers based on their ESG competency in parallel with overall investment rating. Evaluation takes place routinely and takes into account both quantitative and qualitative data such as "idea generation, portfolio construction, management and implementation". This information is compiled into global databases about global investment managers in a manner which is comparable and standardised. Processing information and applying evaluative metrics can be understood as the first step towards taking leadership for clients on these issues (Lowenstein 1996). This is consistent with Lowenstein's (1996) contention that financial agents are only able to manage what they can measure.

Moderately experienced consultants by contrast are to a larger extent reliant on the client to express an interest in ESG integration before expertise is forthcoming. Indeed these consultants only provide ESG integration advice on demand and have no full-time

institutional capacity in this issue. The short supply of expertise may also be correlated with poor quality advice in the sense that one consultant appeared to confuse ESG integration's economic motivations with SRI's ethical motivations:

> "We have an organised group of investment consultants, research consultants, and analysts who focus on the spectrum of issues in mission investing/ESG/SRI strategies."

Although they acknowledge that consultants have some role in raising the issue with clients, they are more likely to wait for trustees with the assistance of employers to take the first initiative. These insights complement the analysis on organizational coherence above but again highlighting the importance of knowledge and expertise for fostering effective relationships around ESG integration. The development by some consultants with deep knowledge to apply evaluative metrics to fund managers' performance is the first step towards building strong webs of knowledge around pension fund trustee boards.

4.6.3 Process

The capacity of investment consultants to transform pension fund governance through knowledge and leadership may be restricted by barriers within the investment culture of consultants themselves, which are overhangs from the client-focussed nature of the industry. One such barrier is the strong culture of short-term investing within finance. Short-termism in financial markets is a problem which has been identified amongst pension fund executives and refers to the tendency to place more weight on immediate

issues instead of actively dealing with future uncertainties and opportunities (Black and Fraser 2000). This manifests itself in quarter-to-quarter or half-yearly reporting which tracks performance over short time period rather than longer time frames, such as 3-5 years. These longer time frames are typically more suited to ESG integration because there is a significant turn around time before, for example, new strategies in green product innovations come into play and affect a company's performance.

The market leading consultants have identified this barrier and have actively sought to advise clients to adopt long-term timeframes for their investment strategy. This means, for example, hiring and retaining managers on the basis of long-term performance rather than quarter-to-quarter benchmarks. However, some of the less experienced consultants did not believe that timeframes featured as a barrier to ESG integration into clients' portfolios. This is because manager performance was evaluated in terms of execution of a particular strategy rather than returns after a period of time. This view again reflected a perception of ESG integration as an ethical investment strategy. The key point to take away is that where asset owners are focussed on meeting short-term financial performance objectives, then their portfolios are more likely to be inadvertently and negatively exposed to long-term influences such as ESG issues. It falls to consultants to advise asset owners away from a short-sighted view of performance such as this.

This feeds into a second barrier which is the use of tracking error limits and index-referenced mandates as benchmarks for financial performance. The use of these benchmarks as targets for fund financial performance penalizes the integration of ESG into portfolio construction. This is because the majority of companies currently do not fully take advantage of the ESG value drivers within their business operation over the

long term (Esty and Winston 2006). This means that market-wide indices are in general composed of companies, which are focussed on short-term gains rather than long-term growth. Since ESG integration requires a firm to make an investment or judgement call on the future, the cash flow benefits to the company will be realised over a longer time than is reflected in quarterly market indices.

One strategy to overcome this barrier is for asset managers to seek absolute returns rather than market returns. This means that funds set a target for an acceptable positive financial return over a nominated time period (for example 5% p.a.) rather than tracking the market. Indeed, the market leading consultants noted that they observe a trend amongst their clients away from strict limits towards structures and policies, which are friendlier towards absolute return strategies. However, they acknowledge that this trend faces significant cultural barriers to take-up. For example, many institutional investors continue to rely on tracking error to minimize their portfolios' deviation from the market rate of return. This is perceived to be an important risk mitigation mechanism.

The hurdle that this may pose for ESG integration was highlighted by international consultancy based in the UK in the context of defined benefit pension schemes. They pointed out that if a fund with an integrated ESG policy performs more poorly than the index and that scheme enters the UK pension protection fund, then trustees might be in breach of their fiduciary duty even if the majority (but not all) of the membership are in favour of the ESG-related screen. The fundamental difficulty here is that although the ESG integration strategy is intended to lead to financial out-performance of the portfolio over the long-term, it may result in lower performance or higher volatility in the short-run as firms in the market capitalize on short-term gains.

This is less of a problem in defined contribution pension schemes because beneficiaries directly take on the investment risk for ESG integration. [74]

Finally, the incentive structure for managers can compound the barriers created by an investment focus on short-term returns and therefore penalize ESG integration. The market leading consultants argued that fixed or capped management fee structures had a neutral effect on ESG-integration approaches. By contrast, performance based fees can be structured to incentivize short-term gains. This comment suggests that where fee structures are poorly framed, investment professionals can be motivated by financial incentives which are against the best *long-term* interests of their clients. This suggests that if as a consequence of the financial crisis incentive structures become better aligned—either through regulation or more effective pressure from buy-side firms—to outcomes over a longer period (e.g. tying remuneration to performance over a period of say three years), this barrier to ESG integration may diminish. Indeed, as remuneration incentives are stretched, ESG issues become more salient. In many ways, then, ESG integration itself can be a way of mitigating misaligned incentives, as the nature of ESG issues calls attention to longer-term problems material to performance.

4.7 Implications and conclusions

Investment consultants have privileged positions in driving the direction of global pension fund investment. As such, investment consultants are in a position to drive the

[74] What may be needed is a change in investment culture, which allows for a greater deviation from the index for periods of time where less conventional investment strategies are adopted. In addition, it may be helpful to more widely implement specific ESG-integrated indices as benchmark for performance for the management of pension funds assets over the long term. These kinds of indices have been around for some time now with the Dow Jones Indexes, STOXX Limited and SAM Group launching the Dow Jones Sustainability Indexes (DJSI) in 1999. The real barrier is therefore translating this into investment culture.

manner in which investments are made and concern is given to longer-term risks not readily priced and understood in the market. The risks of climate change to corporate profitability over the long term is one such example of an ESG consideration that large long-term investors might arguably need to consider when making investments and deciding on their asset allocation. However, our survey responses provide some examples in which profound gaps of expertise and understanding (scepticism notwithstanding) within the investment consulting community can inhibit the dissemination of ESG integration as an investment tool in financial analysis. Indeed, one potentially strong explanation for the low response rate of the questionnaire is the high degree of scepticism and/or lack of knowledge of ESG.

There may be a number of reasons why some consultants may struggle with knowledge gaps around ESG integration. For example, ESG information is often disclosed to the market in an unfamiliar manner, such as corporate sustainability reporting or qualitative judgments made by directors. This may conflict the mainstay of financial market agents who are accustomed to information that is 'comparable', 'verifiable', and 'electronically storable and transmittable' (Berger et al. 2002).

The accounting challenges associated with ESG integration are significant and are slowly being recognised by the academic and practitioner community. It has been suggested that it may be necessary to identify new approaches to fair accounting in order to capture these new dimensions, such as instituting wider principle-based accounting or instituting new investment procedures whereby investors and investee companies engage in deeper dialogue (UNEPFI 2009). Novel regulatory approaches are beginning to emerge around this issue such as the new ESG reporting obligations under the UK Companies Act 2006 and the Accounts Modernisation Directive 2001 in Europe

which requires greater disclosure on corporate governance, and social and environmental impacts (Clark and Knight 2009).

However, the difficulty in understanding ESG information and deploying ESG integration as a tool is not a reason to ignore it when the cost of doing so may be great (Kiernan 2007). Rather, investment consultants could use their position and power to build networks of collaboration and communication to bridge the knowledge gap. There is no doubt that there have been very substantial improvements in the number and scale of collaborative approaches amongst financial institutions over the last 5 years (Guyatt 2007, 2008). This includes the emergence of numerous not-for-profit advocacy networks such as the Network for Sustainable Financial Markets, the UNEP FI, and the World Business Council for Sustainable Development, as well as private sector sell side advisories such as RiskMetrics, On Values, and the Enhanced Analytics Initiative (Guyatt 2007).

However, there is also some evidence to suggest that consultants face barriers to leading clients on the issue of ESG integration, especially where those consultants are in subservient positions with respect to their clients. Caught between their role as adviser to pension fund boards and their position as servant to the client, investment consultants can be both providers of new understanding but may find themselves ultimately led by the demands of their clients. Although consultants have a clear professional duty to raise substantive issues with their client base, they may ultimately be trapped by systemic ignorance within their client base. Amongst some least experienced consultants surveyed this leads to a problematic situation in which critical issues are only addressed if the client raises them first. This passivity with respect to the client

may constitute negligence in cases where clients are shielded from widely recognised systemic issues because of consultants failing to bring these issues to their clients' attention.

An important tool for building relationships of understanding discussed in this chapter is knowledge, training and expertise. We find examples where consultants with greater ESG experience and knowledge are more confident and able to take leadership positions for their clients with respect to ESG integration compared with their inexperienced counterparts. Consultants who lacked expertise on ESG integration tended to confuse it as an ethical issue rather than an economic issue. This error is highly problematic in light of the fact that trustee boards have a weak appetite for ethical considerations (Caerlewy-Smith, Clark, and Marshall 2006). Therefore ESG integration presented to trustees in this manner is likely to be dismissed to the fund's financial disadvantage.

We also find barriers to ESG integration within the investment culture of consultants and fund managers more generally. The prevalence of myopia in investment time horizons is coupled with an incentive structure for remuneration that rewards short-term returns of asset managers. There is also a reliance on index-referenced mandates and tracking error limits which result in portfolios being tracked to short-term markers for financial success. This penalizes the use of ESG integration as an investment strategy to the extent that its dynamics play out over a longer time frame. Wider adoption of absolute return strategies may provide some relief in the future towards this structural barrier.

As the current financial model undergoes a thorough reassessment in light of the global financial crisis, investment consultants are required more than ever to be alert to

developments in financial innovation. ESG integration as an investment tool aimed to capturing the effect of systemic environmental, social and governance considerations on portfolio returns is likely to feature prominently in such innovation. Yet while investment consultants command tremendous delegated authority in investment management from pension fund executives, they are also subject to the restrictions of a client-focussed industry. Nevertheless, this predicament may erode as networks of knowledge and expertise around the issue of ESG grow, particularly as advocates continue to stress their case.

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Figure 4-1. Investment chain for asset allocations in pension investment chain for asset allocations in pension funds, adapted from Clark (2000)

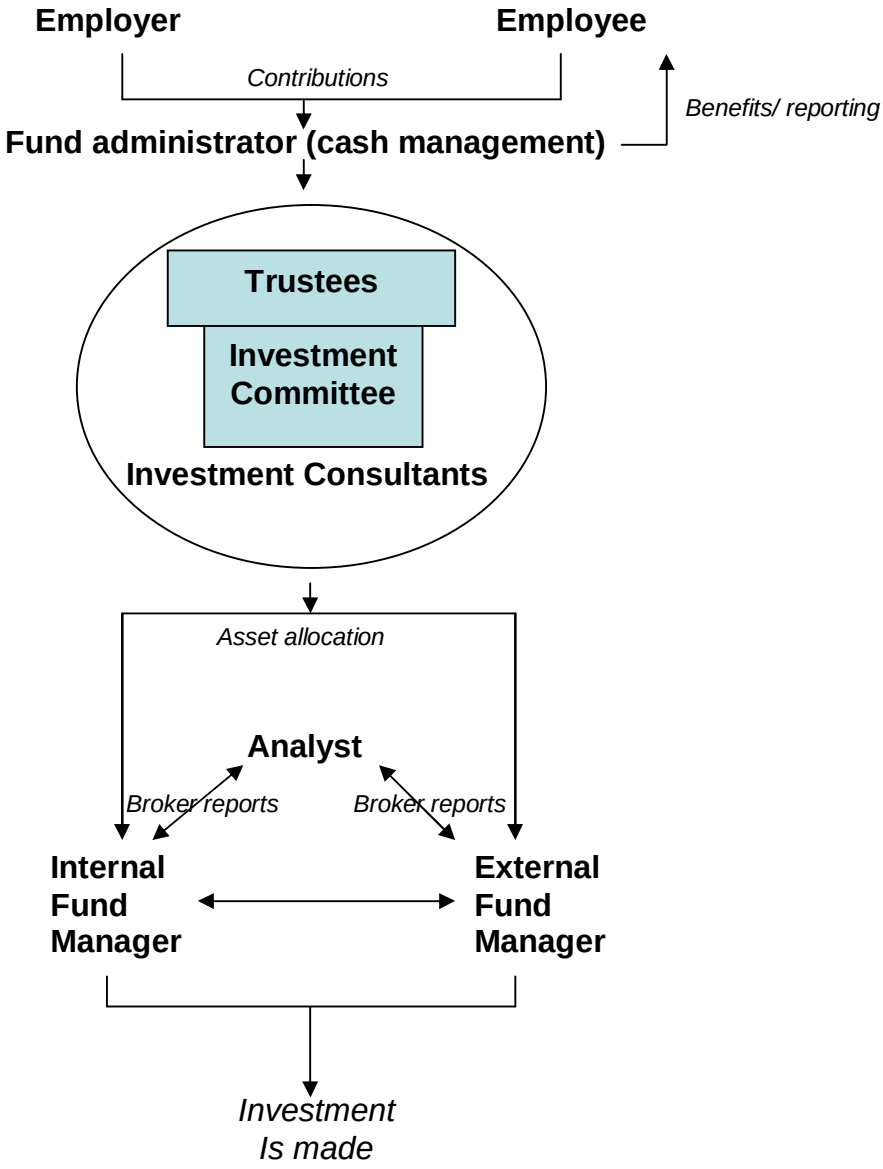


Table 4-1. Description of investment consultant respondents

Descriptor	Consultant 1	Consultant 2	Consultant 3	Consultant 4	Consultant 5	Consultant 6
Level of ESG experience	"Market leading"	"Market leading"	"Moderately experienced"	"Moderately experienced"	"Least experienced"	"Least experienced"
Firm Scope	Global	Global	Global	Global	Global	National
Respondent's Office	UK	US	UK	US	Japan	Japan
Seniority of respondent	Principal	Principal	Principal	Principal	Principal	Principal
Type of respondent	Specialist	Specialist	Mainstream	Specialist	Mainstream	Mainstream
Verification of survey	Cross-checked across global practice	Cross-checked across global practice	Cross-checked within national office	Cross-checked across global practice	Cross-checked within national office	Cross-checked within national office
Worldwide assets under advertisement as at June 30 2008[75]	Tier 1	Tier 1	Tier 2	Tier 1	Tier 2	Tier 3

[75] These categorisations have been used to maintain the anonymity of the respondents: (1) Tier 1 = over USD 1 trillion; (2) Tier 2 = USD 500 billion to USD 1 trillion; (3) Tier 3 = less than USD 500 billion.

Chapter 4 Appendix 1

UNEP FI Asset Management Working Group survey questionnaire for investment management consulting firms

For the sake of completeness and comparability, and in order to facilitate analysis and synthesis, we request that you kindly respond in the following format:

On fiduciary duty

Q1. Does your firm have a unit or consultant staff dedicated to working with clients who request ESG integration, have an SRI mandate, or have investment policy guidelines concerning, for example, climate change? If not, how are you prepared to respond to clients with such requests?
Q2. Have you observed an increase in client interest on ESG matters when selecting investment managers?
Q3. Do you consider that integration of ESG matters is a requisite aspect of investment management? Please explain why.
Q4. Do you consider that integration of ESG matters is a requisite aspect of investment management as part of fiduciary duty? Please explain why.
Q5. When considering the interests of the ultimate owners of capital (beneficiaries, insured individuals, mutual fund investors, and so forth), do the interests that ought to be considered by fiduciaries go or do not go beyond purely financial interests? In other words, under what circumstances do you see ESG factors requiring consideration in investment management? Please explain.
Q6. In your view, where does the responsibility for the exercise of ESG integration reside? How does it distribute as between trustees, pension fund managers, investment managers, and consultants? What is the role of each?

On ESG criteria

Q7. Which ESG issues or criteria do you consider are most relevant for inclusion in your client's investment policy statement? For example, issues or criteria having to do with climate change, resource scarcity, pollution generally, reputation risks, human rights, and so forth.
Q8. In your view, can ESG fiduciary duty be discharged solely or primarily through exercise of voting rights? Please explain.
Q9. In your view, can ESG fiduciary duty be discharged solely or primarily through exercise of engagement and dialogue with company managements? Please explain.
Q10. In your view, does ESG fiduciary duty require taking action on whether one holds or refrains from holding certain stocks or bonds in a portfolio? Please explain.

On evaluating competence

Q11. Do you currently evaluate an asset manager's abilities to incorporate ESG factors in valuation or portfolio composition as part of your overall assessment of investment managers, regardless of whether a mandate calls for specific socially

responsible investment, environmental investment, ethical investment, sustainable investment, or the like? If so, how much weight do you assign to this as part of your total evaluation or ranking? If not, do you have concrete plans to do so in 2008 or 2009?

Q12. What criteria do you currently use to evaluate competence in ESG integration for purposes of a dedicated socially responsible investment mandate, environmental, ethical or similar mandate? Indicate relative weightings if you wish.

On proxy voting

Q13. Do you routinely investigate the proxy voting and engagement record of asset managers as concerns environmental and social issues? Or do you only do this if a mandate is specifically SRI, or ethical, or environmental, or the like? Please explain.

On requests for proposal (RFPs)

Q14. Do you habitually include questions on ESG policy, form of integration and competence on all RFPs, or only when mandates specifically call for ESG?

On governing ESG in mandates

Q15. In your experience, do the typical timeframes for review and evaluation of manager financial performance discourage ESG integration? What improvements would you suggest?

Q16. In your experience, is the prevalent incentive structure for managers neutral towards ESG integration, does it penalize, or does it promote such integration?

Q17. In your experience, is the prevalence of tracking error limits or index-referenced mandates neutral to or does it penalize ESG integration?

On legal language

Q18. Should legal language on ESG integration be part of investment management contracts between institutional investors and investment managers? Please explain. If you currently use such language, kindly attach these texts, or an example of text that you see as exemplary or best practice.

Q19. In your view, should language on ESG integration be part of investment policy statements? Please explain. If you have model language, kindly attach such texts, or an example of text that you see as exemplary or best practice.

Open-ended suggestions

Kindly outline your suggestions for obtaining better operationalisation of ESG integration in institutional investment concerning the question areas above or any other areas we may have overlooked.

Chapter 5 | The Economic Geography of European Carbon Market Trading

5.1 Introduction

Climate change has been identified as one of the greatest economic and political challenges facing the world economy this century. The immensity of this challenge is in part due to reconciling the global nature of the problem with the need for action at the sub-global level, whether regional, national and/or local. This problem of collective action is an inherently geographical challenge. It requires coordinating action globally amongst a highly differentiated political, economic and social landscape.

In order to address this challenge, market based policy approaches have been argued to be a crucial part of achieving an international solution. Chief amongst these is the introduction of carbon markets. A carbon market is a market based solution designed to optimise the allocation of capital in the context of a carbon-constrained world by putting a price on carbon and letting the market operate efficiently around this price. This is in contrast to (although typically used in complement with) direct government interventions through, for example, environmental standards or direct investment in technologies where national or local governments make decisions on collective action. The ability of carbon markets to successfully address the collective action problem embedded in the climate challenge is in part contingent on how well carbon markets can be scaled up and inter-linked by governments globally (Grubb 2009). The introduction of a carbon market within a single country or even region alone is arguably insufficient to create the radical transformations needed to effectively de-carbonize the global economy.

Faith in market based solutions to address global problems extends on the rise of financial markets as key institutions in the allocation and coordination of capital over the last half century. The ability of financial markets to create cross-border infrastructure which enables the allocation of capital for economic goods and services around the globe rapidly and seamlessly has been one of the defining characteristics of modern global economic development. Schmitter (1997) has argued that this may have shifted the locale of international economic integration away from national polities towards new institutional actors as the agents of international economic change (Schmitter 1997). However, this issue remains an open question which economic geographers have sought to address in a number of areas within the economy including industrial relations, corporate governance, training systems and financial markets (Clark and Wójcik 2007; Wójcik 2002; Dunford 2005; Christopherson 2002). Clark and Wójcik (2007), for example, have argued that the notion of seamlessly operating global financial markets must be understood in the context of spatial and temporal specificity about the way capital flows within these markets.

The chapter turns the lens of economic geography on one of the emerging economic challenges of our time: the development of inter-linked carbon markets to address global climate change. Knox-Hayes (2009c) has examined the importance of complementarities in developing new global markets for carbon-linked products out of the existing financial market structures in New York and London. While Knox-Hayes' (2009b, 2009c) work examines the role of institutional settings in developing a nascent carbon market, it leaves unexamined the economic impact of new carbon-linked products. These products arguably have an impact on the underlying economies where carbon markets operate.

The chapter addresses this gap by empirically examining the operation of the European Union Emissions Trading Scheme (EU ETS) – the world's first regional carbon market. We examine how this carbon market impacted the stock performance of European energy utility companies, taking into account geographical dimensions of time and space. With respect to differentiation across time, we empirically examine whether investors responded to the operation of carbon markets differently for Phase I (2005-2007) compared to Phase II (2008-2012). These two phases represent two distinct periods in the operation of the EU ETS in terms of regulatory and institutional structure. With respect to differentiation across space, we empirically examine whether the location of the majority of a company's installed capacity influenced the financial impact of carbon trading on that company.

The chapter contributes to the emergent carbon market literature as one of the first quantitative empirical studies on the economic geography of carbon market trading. The importance of the time dimension through the phasing-in of carbon markets across distinctive regulatory blocks makes intuitive sense from a theoretical and policy perspective but has been empirically under-examined econometrically. Additionally, by using individual company data rather than pooling corporate data, we are able to draw conclusions albeit tentatively about the role of location and geography in the financial impact of carbon trading. Although the relatively limited amount of traded financial data for carbon markets restricts the depth and breadth of our findings, they leave scope for follow-up study as carbon markets develop to maturity in Europe and elsewhere.

The structure of the chapter is as follows: section 5.2 sets up the economic and policy context of carbon markets in Europe. Section 5.3 then ties these broader issues to a theoretical framework for research on the economic geography of European carbon

markets. Section 5.4 presents the data used to empirically examine the effect of economic geography and market structures on carbon market operation and section 5.5 sets out the methodology used. Section 5.6 then discusses these results and section 5.7 concludes by drawing the potential implications of the findings for economic geography and policy makers addressing climate change.

5.2 Carbon markets in context

As the science of climate change places pressure on governments to urgently decarbonize the global economy, policy makers have turned to market based solutions to reduce the carbon intensity of the economy. Carbon markets have been promoted as a crucial policy intervention for addressing climate change, of which the cap and trade system is the most prevalent (Hasselknippe 2003).

Under a cap and trade carbon market, companies within a national jurisdiction are given a limit (cap) on the volume of carbon emissions or their equivalent which they are allowed to emit annually. If they exceed this limit then they are legally obliged to purchase carbon emission allowances to offset their pollution. Each allowance purchased represents a volume of carbon emissions or their equivalent abated (one tonne per an allowance) from various approved projects. The cost of allowances is intended to act as a financial disincentive for carbon pollution.

The caps set for companies under the EU ETS regulation differ for Phase I compared to Phase II. This means that although the carbon market continues to trade year on year, Phase I and Phase II are institutionally distinctive. The policy intention behind this is to phase-in the financial impact of carbon gradually over time. Although the caps during Phase I were quite lenient, Phase II (and then Phase III, and so forth) are

intended represent increasingly arduous carbon caps (Smale et al. 2006). This adds a time dimension to the operation of the EU ETS.

The price of carbon allowances is determined by the market price settled daily by participants in a financial market specifically for carbon emission allowances. During Phase I of the EU ETS, European carbon emissions allowances (EUAs) were traded on a number of platforms across Europe including London, Leipzig, Oslo, and Paris at a single arbitrage-free price (Daskalakis, Psychoyios, and Markellos 2009). Although the trading platforms are located within Europe, the financial intermediation involved in originating and trading carbon emissions allowances spawns an increasingly global financial network of bankers, lawyers, and project developers around the world (Knox-Hayes 2009b, 2009c). An emerging strand of literature in the economic geography of carbon markets examines the geography of the professional services market itself. Knox-Hayes (2009b) argues that the clustering of professional expertise in London and New York reflects the way in which the carbon market has emerged in complementarity with conventional capital markets. This clustering also suggests the potential for these cities to become hubs for new financial and technological innovation (Wójcik 2009).

While the financial infrastructure of carbon markets may be globally integrated, the question of whether the economic impact of carbon markets is geographically differentiated remains open. The relevance of economic geography for carbon market operation has important policy implications. If some economies are more negatively affected by the price of carbon compared to neighbouring economies then this may be grounds for increased government support for research and development investment in alternative technologies. Geographical differentiation may also impact multilateral

negotiations to introduce a regional carbon market because governments will act in their self-interest to avoid the comparative disadvantage of their economies.

The relevance of economic geography in modern economic development has been developed in the varieties-of-capitalism literature which has emerged over the last decade and a half to offer a more delineated view on the contours of modern economic development. A key theoretical challenge in this literature has been to diagnose an appropriate analytical unit for examining economic variety (Peck and Theodore 2007). While Soskice has argued for the on-going relevance of the nation as a constructive influence in the behaviour of firms and institutions in the presence of global economic forces (Soskice 1990, 1991), Hollingsworth and Boyer have argued that individual institutions have increasingly become nodes for economic coordination in their own right (Hollingsworth and Boyer 1997). This debate remains robust in the study of macro economies (Hall and Soskice 2001; Hollingsworth and Boyer 1997; Crouch 2005), but it is still relatively unexplored within some sub-sections of the economy such as the development of carbon markets.

In order to examine the relevance of geography in the context of carbon market development, the chapter draws on the nation versus institution distinction within the varieties-of-capitalism literature and applies empirical methodologies from economic geography to examine the effect of geography on carbon market operation.[76] Clark and Wójcik (2007) have offered some direction on empirical approaches to examining the geography of finance.

One approach has been to map the flow and trade of capital around the world. This approach offers a complex topography of global finance, illustrating where capital

[76] The importance of methodological innovation between economic geography and the varieties-of-capitalism literature has been underscored in the economic geography literature (Peck and Theodore 2007).

pools and from where it runs away (Clark 2005). A second approach has been to examine the role and significance of borders in affecting financial market operations. La Porta et al. (2002) made a seminal contribution to this inquiry by mapping differences in corporate governance regimes based on distinctive legal traditions. They showed that border distinctions remained deeply embedded in the functioning and structure of financial markets, with common law (such as Anglo-American) countries exercising different corporate governance structures to civil law (such as continental European) countries (La Porta et al. 2002). A third approach has been to examine the spatial and temporal heterogeneity of information (Clark and O'Connor 1997). This draws on the previous two approaches by examining how information and local knowledge can flow across borders in financial markets. Recent research in this area has mapped out the flow of publicly traded market data (Gompers, Ishii, and Metrick 2003; Bauer, Braun, and Clark 2008) in order to highlight the corporate governance geography identified inLa Porta et al. (2002).

The chapter builds on the logic of the second and third approaches to economic geography by developing a new geographical lens to investigate the impact of carbon markets on the corporate performance of companies. We use as our measure of economic performance the quoted stock price of publicly traded energy companies.[77] These prices reflect investors' long-term assessments of the valuation of these companies taking into account all presently available information. With reference to economic geographic markers of space and time, we rely on information about the differences between Phase I and Phase II of the EU ETS to examine the impact of timing on investors' perceptions of carbon market operations. For location, we examine

[77] There are alternative measures of economic performance in the context of carbon trading (Anger and Oberndorfer 2008; Demailly and Quirion 2007; Zachmann and Von Hirschhausen 2008).

the role of market structure and company level characteristics as an explanatory variable for the financial impact of carbon markets. These are explained in greater detail in the following section.

5.3 Theoretical framework

According to economic theory, putting a price on carbon should impact the financial performance of companies obligated to purchase carbon emission allowances. However, the nature of this impact – whether it has a positive or negative effect on a company's cash flows – depends on whether a company bears the ultimate cost of carbon directly or whether it is able to pass it through to customers (Smale et al. 2006).

If a company is forced to bear the cost internally then we would expect to see a negative relationship between the carbon price and the company's traded stock price. However, if a company can pass the cost through to consumers, then the financial cost borne by the company is neutral (Sijm, Neuhoff, and Chen 2006). In some cases, a company may pass on more than 100% of the carbon cost it incurs thereby profiteering from the carbon scheme. This would result in a positive relationship between carbon price and stock price.

In the econometric model set out in section 4 we empirically examine the sign and significance of the relationship between carbon pricing and European electricity stock prices. We examine the time dimension by comparing the spot prices for emissions allowances which are traded for compliance in Phase I of the EU ETS with future prices which are traded for compliance in Phase II of the EU ETS. Although traded concurrently, these products are linked to two distinct phases in the deployment of carbon markets and therefore provide an opportunity to examine how investors

respond to the staging of carbon markets. We would expect to see different relationships emerging between stock prices, and spot and future carbon prices respectively.

However, we are interested in examining whether there is a latent geographical effect which explains differences in the way stock prices respond to carbon prices. The first hypothesis we develop (hypothesis one) posits that the energy market structure into which a company sells its electricity affects the way in which carbon liabilities impact cash flows and, by extension, stock price.

The reason why energy market structure might affect cash flows is because it impacts the ability of companies to pass the marginal cost of purchasing emissions allowances through to customers in the form of higher electricity prices. According to economic theory, Bonancina and Gulli (2007) argue that companies selling electricity into a purely competitive energy market ($N = \infty$) sell electricity at a the marginal cost of production: that is, the full cost of carbon is passed through to customers in the short-run. This means that rising carbon prices will have a neutral impact on a company's balance sheet. Over the long-run, however, the increased price of electricity will result in reduced demand and a new equilibrium price will be set in which firms with the best technology will be able to profit. This will result in different firms having a mixture of a neutral or negative impact on their balance sheets from carbon liabilities depending on how well they have been able to adapt to changing market conditions (Bonacina and Gulli 2007).

At the opposite extreme, companies which sell into a monopolistic energy market structure ($N = 1$) are able to manipulate prices more easily. They are therefore able to either pass as much of the cost of carbon as they wish: most likely 100% or more than 100%. This will result in either a neutral or positive impact on cash flows from

carbon prices in the short-term. In the long-run, however, even monopolistic firms will be required to respond to declining demand for electricity due to increased prices.

In practice, most European electricity market structures are oligopolies falling between these two extreme positions. In order to characterise the energy market structure within which our sample companies operate we used national borders as our unit of analysis. This is not an ideal assumption as the characteristics which define energy market structures are not always limited to national borders. Nevertheless, the highly nationally regulated nature of electricity markets in the EU as well as the concentrated ownership of electricity utilities in Europe where a number of companies own and operate a majority of their installed capacity within a single country suggests that country borders may be a suitable unit of analysis for the European energy market.

A second hypothesis (hypothesis two) which explains differences in the way stock prices respond to carbon prices posits that individual characteristics of energy companies influence investors' perception of corporate valuation. This hypothesis may exist in complement to hypothesis one.

The first aspect to this is the amount of free carbon emission allowances allocated to firms during Phase I of the EU ETS (Neuhoff, Martinez, and Sato 2006; Smale et al. 2006). When companies were allocated free allowances, each free allowance offset the financial liability borne by that company when it purchased carbon emission allowances. The ratio of free allowances to amount obligated to purchase was different for each company but in theory this was not related to the country where the firm is located (Kettner et al. 2008).[78] We would expect that where the ratio is close to 1

[78] In some extreme cases, companies received more free allowances than the number of carbon emissions they were obligated to purchase.

then the impact on carbon liabilities on company balance sheets would be neutral whereas where the ratio is close to 0 then the impact is more likely to be negative.

The second aspect to hypothesis two is the carbon intensity of a company's electricity generation process. This may impact the financial cost of carbon for electricity utilities because companies which have more carbon intensive processes will be required to purchase more carbon emission allowances for each unit of electricity generated compared to their less carbon-intensive peers (Veith, Werner, and Zimmerman 2009). Therefore the balance sheets of carbon intensive companies are more likely to be negatively impacted by rising carbon prices than less carbon intensive companies.

Carbon intensity may be defined in two different ways. One definition of carbon intensity is the "capacity-weighted carbon intensity". This is the ratio of carbon emissions to generation capacity (kg/MWh) (Veith, Werner, and Zimmerman 2009). In theory, companies which emit more carbon per a unit of electricity generated, such as coal-fired power stations, will have higher ratios then low carbon intensive companies, such as nuclear or renewable power stations. A second definition of carbon intensity is the turnover-weighted emission rate ("turnover carbon intensity"). This is the ratio of carbon emissions to total turnover or revenues (tonnes/million USD) in the company.[79] An advantage of this definition is that it translates carbon emissions into a financial ratio which compares a company's sales to its direct financial liability in meeting its carbon compliance obligations.

[79] This definition is used by a number of private sector environmental consulting firms, including Trucost. Trucost is a private consulting company which collects company information from annual reports and aggregates this data in a proprietary database. Although the database is reliable and is used in the article, the relevance of the carbon intensity measure adopted by Trucost is open to debate. For this reason, the article uses alternative metrics for measuring carbon intensity in addition to the Trucost metric.

In sum, our theoretical framework is intended to examine how time and space influences investors' valuation of carbon pricing on company returns. Differences across time would be exhibited by a statistically differentiated relationship to carbon pricing across Phase I (reflected in carbon spot prices) and Phase II (reflected in carbon future prices). Our theoretical framework then takes this analysis further by testing two hypotheses to explain what drives the increment to stock returns from carbon returns. Hypothesis one on market structure suggests that companies in more competitive energy market structures would experience a negative or neutral relationship with rising carbon prices whereas more monopolised market structures are more conducive to neutral or positive relationships. In hypothesis two we would expect companies with close to full free allocation to have a neutral financial impact for the cost of carbon, and companies with high carbon intensive processes to have a negative financial relationship with rising carbon prices compared to their less carbon intensive competitors.

5.4 Data and descriptive statistics

To examine the impact of economic geography on the operation of the European carbon markets, we take an empirical approach by building a time series econometric model using traded carbon data and the logarithmic daily stock returns of European energy companies from *Datastream*.

The European energy utility companies used in our sample are chosen by compiling a list of all publicly traded companies involved in electricity generation in Europe within the EU-25[80]. We then eliminated companies for whom there was a lack of information for the whole period. Because we are interested in examining market

[80] The expansion of the EU to include Romania and Bulgaria (EU-27) only took place on 1 January 2007 so data from companies in these countries is limited to after that date.

structure as delineated by national borders, we also eliminated companies which had less than 50% of their installed and operational capacity within a single country. Focussing on firms where the majority of installed capacity is within a single country is a proxy for studying national level effects and represents a compromise, albeit imperfect, between larger sample size (by including companies with more geographically dispersed capacity) with degree of national embedded-ness. The resulting sample size of 19 companies was comparable to similar studies in the literature (Oberndorfer 2009; Veith, Werner, and Zimmerman 2009). However, unlike the econometric approach taken in Oberndorfer (2009) we do not pool the company data in our model. This enables a more differentiated approach to company and country level effects between carbon and stock pricing than in this approach.

To examine the price of carbon for spot trades we use the Bluenext (previously Powernext) EUA spot price (*P* in Euros/ton of CO2e) between 24 June 2005 to 31 December 2007. This price series reflects the cost of carbon emission allowances purchased to meet regulatory commitments during Phase I of the EU ETS. For future trades in compliance with Phase II of the EU ETS we use the ECX future EUA carbon price between 22 April 2005 and 31 December 2007. Comparing the relationship between stock prices and these two carbon price series respectively elucidates investors' perception of the two different phases of the carbon market. This facilitates an examination of how time features in the economic geography of carbon market operation.

In order to control for the effect of other influences on the stock returns of the sample companies, we used a number of control variables in order to make sure our econometric model is well specified. In accordance with the literature, we use the

logarithmic daily returns of the one month forward prices of Brent Crude oil (Euros per barrel) and of natural gas from Intercontinentalexchange (ICE, London; Euros per 100 000 British Thermal Units) which controls for energy price fluctuations. Energy price fluctuations are statistically significantly correlated with electricity prices and by extension energy utility stock return. They are used in the literature for financial models to explain stock returns in the energy sector (El-Sharif et al. 2005). We also used large cap national market indices for each of the countries in our sample to control for domestic market effects such as economic or political news events. The choice of the appropriate index for each country was made based on whether the index had a broad industrial base and was exclusively composed of nationally listed stocks in order to capture idiosyncratic national economy factors. These indices are described in details in Chapter 5 Appendix 2. Where it was necessary to make currency conversions, the historical exchange rates recorded by the European Central Bank were used.

In order to examine the effect of market structure and individual company characteristics as described in the theoretical framework in section 3, data was collected from a number of sources. Data on the carbon intensity of sample companies was collected from Trucost and from the publicly disclosed data in annual reports, as recorded on the Carbon Disclosure Project database.[81] These descriptive statistics are reported in Table 5-1.

[Insert Table 5-1 here]

[81] The Carbon Disclosure Project is a voluntary initiative to encourage companies to publicly disclose their environmental consumption data.

Providing data to reflect the market structure of the European energy sector was more challenging. In economics, a traditional measure of market structure within a country is the Lerner Index (Lerner 1934). However, due to insufficient publicly available data to calculate the Lerner Index in the countries in our sample, we considered market concentration measures as a proxy for national market structure characteristics. The CR4 ratio sums the market share of the four largest companies within a market. Typically, low CR4 reflects low levels of concentrated ownership in the market consistent with competitive market structures. CR4 of around 40% reflect competitive markets with low concentration, CR4 around 60% reflect oligopolies with moderate levels of ownership concentration, and monopolies have CR4 close to 100% with high levels of ownership concentration (Webster 2003). The results of the four company concentration ratio (CR4) were calculated using publicly available data (Domanico 2007) and are recorded in Table 5-2.

[Insert Table 5-2 here]

In order to improve the robustness of our market structure characterisation, we cross-check our CR4 rations with the Herfindahl-Hirschman Index (HHI) measure of market structure. This is also reported in Table 5-2 and is calculated as:

$$HHI = \sum_{n=1}^{n} s_i^2 < 1$$

where s_i is the market share of firm i in the market, and N is the number of firms. The index ranges between 0 and 1. Generally, if the HHI is below 0.1 the market is not concentrated, if it is between 0.1 and 0.18 it is moderately concentrated, and if the HHI is over 0.18 the market is regarded as concentrated (Webster 2003). The HHI measures for the EU countries examined in the chapter are reported in Table 5-2 using publicly available data (Sijm et al. 2008).

The final characterisation of market structure relied upon in our model is an aggregate of both the CR4 and HHI measures and is reported in the last column of Table 5-2. As reported, there is a strong level of correlation between the CR4 and HHI measures for market structure even though these are calculated independently. This strengthens the reliability of our characterisations. Where low levels of ownership concentration are reflected in both the CR4 and HHI measures, we describe the market structure as competitive. We find that the most competitive energy markets are those in UK and Finland. By contrast where the CR4 and HHI both reflect high levels of concentration then we describe the market as monopolistic. Greece and France have more monopolised energy market structures because they each have a single dominant player which has dominant market share. Where concentration levels fall between these two poles or where the two measures suggest that the levels of ownership concentration are mixed (both moderate and high levels of concentration), we describe these markets as oligopolies. We find that the European energy markets of Germany, Spain, Italy, Portugal, and Austria fall within this category because they have a small number of firms which control a relatively large ownership stake.

5.5 Methodology

To investigate the effects of carbon returns on energy company stock returns, a two stage approach is followed. In the first stage, we estimate an expanded Capital Asset Pricing Model (CAPM) using OLS, while correcting for heteroskedasticity (White 1980). The standard CAPM approach used in the econometric literature includes overall market returns as an explanatory variable for stock returns over time (Lintner 1965; Sharpe 1964). However, because we are interested in energy stock returns and the impact of carbon returns in particular under an efficient capital market assumption, we expand the standard CAPM to include oil, gas and carbon prices as control variables in the estimated equations. This is consistent with the literature on energy stock prices and is intended to avoid misspecification of the econometric approach (Oberndorfer 2009; Boyer and Filion 2007). The resulting first stage model is as follows:

$$R_{it} = \alpha_i + \gamma_{0i} R_{index,t} + \gamma_{1i} R_{carbon,t} + \gamma_{2i} R_{gas,t} + \gamma_{3i} R_{oil,t} + \varepsilon_t \qquad (1)$$

where R_{it} represents the logarithmic daily returns on company i. $R_{index,t}$ is the logarithmic daily return on the national stock market index and $R_{carbon,t}$ is the logarithmic daily return on the carbon price (spot; future). $R_{gas,t}$ represents the logarithmic daily return on the (one month) forward gas price, and $R_{oil,t}$ represents the logarithmic daily return on the (one month) forward oil price.

Two separate models are estimated for R_{carbon} using the carbon spot price and the carbon future price series respectively. This is to compare investors' different reactions to Phase I and Phase II of the EU ETS. In April 2006, the spot price of carbon crashed when it was revealed that there had been an over-allocation of free carbon allowances.

As a result, a structural break (Chow 1960) is used to break the model into two sub periods: 22 April 2005 – 24 April 2006 and 28 April 2006 to 31 December 2007. The results of the sub-period model are reported alongside the full period results. The carbon future price was unaffected by the over-allocation, but a similar structural break has been estimated for consistency. A positive coefficient for carbon returns can be interpreted as carbon returns moving in the same direction as a company's stock returns. This is consistent with the hypothesis that companies were able to profiteer from the carbon market. A negative relationship suggests that companies bear the cost of carbon internally.

While this first stage analysis is useful in understanding the direction of the relationship between carbon returns and stock returns, it does not indicate what factors motivate the increment to energy stock returns caused by carbon returns. In our theoretical model above we hypothesise why either country-level or company-level factors might explain this relationship. In order to examine these empirically a second stage analysis is undertaken. This second stage approach is an improvement on the methodology used in Veith, Werner and Zimmerman (2009) where dummy variables are used in the first stage OLS regression to account for various explanatory variables. By using individual firm and country level data we are able to examine underlying geographical and company-level trends in a more targeted and detailed manner than a cruder, dummy variable approach.

In the second stage analysis, the coefficient generated in equation (1) for the elasticity of carbon returns is regressed on data regarding the market structure for each company (Hanushek 1974).[82] This model is estimated using generalized least-squares,

[82] Following Hanushek (1974), this procedure is often used in the recent environmental economics literature (Hanushek 1974). See, e.g., (Eichholtz, Kok, and Quigley forthcoming).

incorporating the variance-covariance matrix of the parameters estimated in equations (1). It is represented by equation (2) below:

$$\hat{\gamma}_{1i} = \alpha_i + \eta_i M_i + \varepsilon_i \qquad (2)$$

where M_i represents the market structure of the country where the company operates. The dependent variable in each case, $\hat{\gamma}_{1i}$, is estimated separately for carbon spot returns and carbon future returns respectively. To contrast the effect of market structure on stock returns with individual company (institutional) features, three variations on this model are estimated. In the first instance, the model in equation 2(a) is estimated:

$$\hat{\gamma}_{1i} = \alpha_i + \beta_{1i} M_i + \beta_{2i} FA_i + \varepsilon_i \qquad (2a)$$

where FA_i represents the ratio of free carbon allowances given to the company during Phase I of the EU ETS. This examines the effect of free carbon allowances issued to each company as a decisive factor in stock returns compared to market structure. A second variation is equation 2(b):

$$\hat{\gamma}_{1i} = \alpha_i + \varphi_{1i} M_i + \varphi_{2i} CTI_i + \varepsilon_i \qquad (2b)$$

where CTI_i represents the log of the carbon intensity of the company's turnover. This examines the effect of carbon intensity of each USD of turnover for each company in the sale compared to market structure. Finally equation 2 (c) is estimated:

$$\hat{\gamma}_{1i} = \alpha_i + \delta_{1i} M_i + \delta_{2i} CI_i + \varepsilon_i \qquad (2c)$$

where, CI_i represents the capacity weighted carbon intensity of the company's production process. This examines the effect of the carbon intensity of each company's technology as compared to market structure as an explanation for the financial impact of carbon markets on stock returns.

5.6 Results and discussion

From the results of the first stage analysis reported in Table 5.3 we can see that carbon returns did impact the quoted stock returns of energy utility companies under the EU ETS. This relationship is not uniform and differs in size and statistical significance across companies in our sample.

[Insert Table 5-3 here]

The presence of a statistically significant relationship between carbon and stock returns for some companies at 5% confidence levels indicates that investors are responsive to carbon pricing in corporate valuation. However, in all cases the sign of this statistically significant coefficient is positive. This is interpreted as stock returns moving in the same direction as carbon returns: as carbon returns rise so too do energy stock returns.

A positive and statistically significant relationship is consistent with the view that a number of energy stocks were able to profit from the introduction of a carbon market in Europe by passing on more than the cost of purchasing carbon allowances. As the price of these allowances increased then these companies were able to sell these allowances as a windfall profit. From a policy perspective, this is problematic as it indicates that investors did not believe that the carbon market was a financial deterrent for energy utility companies emitting carbon. This means these companies had little or nor incentive to invest in new technology and innovation to reduce their future carbon emissions.

Comparing the number of statistically significant relationships for the carbon spot with carbon future price series it appears that investors were able to respond to the staging of the carbon market across time. The time dimension features in the significance of carbon markets on financial performance in two respects. Firstly, for emissions traded for compliance during Phase I of the EU ETS, we observe 6 out of 19 companies in our sample exhibit a statistically significant (positive) relationship between 22 April 2005 and 24 April 2006. However, after April 2006 carbon returns no longer exerted any significance on stock returns. This is what we would expect because the carbon spot price crashed towards zero when it was revealed that there was an excess of free allowances and therefore no demand for emission allowances. Investors' responsiveness to this announcement indicates that investors are responsive to news about carbon markets in their stock pricing and are efficient in factoring in sudden political events which change the trajectory of the carbon market.

The second way in which time is relevant is in the differentiation between Phase I and Phase II of the EU ETS. For Phase I, only 6 of 9 companies demonstrated any

statistically significant reaction to the carbon markets and these were all clustered in the period to April 2006. However for Phase II there are statistically significant responses to the carbon market both before and after April 2006 as well as for the period as a whole. This means that investors were able to distinguish between the two stages of the carbon market and realize that these were two phases were differentiated. This is a promising policy outcome because it suggests that phasing in the introduction of a carbon markets can work. Investors are able to distinguish between the two phases and respond to the price of carbon according. In this sense, timing is an important factor in the way carbon markets influence equity pricing.

An important qualification which should be made is that the size of the coefficients reported is small. Therefore although these coefficients are positive they are also relatively close to zero with a range between 0.021 and 0.082. This means that the level of profiteering should not be overstated and in most cases the impact of other factors such as movements in the national indices or energy prices is relatively more important than carbon. Nevertheless, as carbon markets build momentum and grow beyond their current nascent stages, these coefficients may be expected to reverse sign and grow in magnitude.

In many instances, carbon pricing had no statistically significant impact on stock returns. Indeed 11 of the 19 companies in our sample demonstrated no relationship with carbon pricing in either the spot or future markets. This is also problematic from a policy perspective but is not entirely surprising. Indeed, the fact that the quantities of carbon allowances required to be purchased were so small may mean that investors simply did not think that carbon was relevant to a company's cash flow in many cases. Nevertheless, the fact that there is a difference between some companies where there is

a significant relationship to carbon and some companies where there is not suggests that investors are aware of a carbon price and are relatively efficient in working out when carbon matters and when it does not. One extrapolation from this is that if carbon markets were developed to impose a stronger financial deterrent on pollution, then investors may be efficient in picking this up and responding to their corporate valuations accordingly.

In order to extend the analysis of these results beyond the relationship between carbon returns and stock returns across the Phase I and Phase II time periods, we undertake second stage regressions to examine the role of market structure and individual company characteristics in driving the financial significance of carbon. These results are reported separately for Phase I and Phase II with carbon spot returns (Phase I) reported in Table 5-4 and carbon future returns (Phase II) reported in Table 5-5. This distinction is intended to capture differences across time in the economic geography carbon market operation.

[Insert Table 5-4 here]

[Insert Table 5-5 here]

Turning first to carbon market operation during Phase I of the EU ETS, the results in Table 5-4 indicate that investors believe market structure is a strong driver behind the financial impact of carbon for energy stock valuations. Model (1) which reflects the regression output for equation 2 above indicates that market structure was statistically significant at 5% levels of confidence before 24 April 2006 but not afterwards. This is

consistent with the results reported in the first stage regressions in Table 5-3 above and shows that investors are responsive to sudden, structural changes in the carbon market. Announcements made in April 2006 which resulted in the carbon spot price crash flowed through to the equities price valuations for energy stocks. The conclusion which can be drawn from this is that carbon markets do not operate in a vacuum but rather are a live feed into the functioning and operation of modern capital markets and the economy more generally. Notwithstanding the doubts identified above about the policy effectiveness of carbon markets in achieving the desired re-allocation of resources, investors do take carbon price information seriously and factor it into their pricing decisions.

The coefficient for market structure in model (1) is reported as -0.032. The interpretation of the negative sign here is that although market structures play an important role, the characterisation of this role is contrary to our hypothesis one. Hypothesis one posits that as companies move towards open and competitive market structures from closed and monopolistic structures, then the level of price manipulation decreases and therefore there is less profiteering from carbon pricing. However, a negative coefficient suggests the reverse is happening: that as companies move towards a competitive energy market there is a stronger, positive correlation between stock returns and carbon returns.

This result is highly paradoxical and difficult to explain. It is not at all clear why companies operating in more monopolised energy markets should experience less profiteering and price manipulation as a result of carbon market operations. One possible explanation for this might be that these results reflect the particular political environment in European energy markets in which governments with near-monopoly

energy markets have pre-emptively acted to stop profiteering by regulating electricity pricing. There are numerous examples in Europe where these governments have regulated electricity prices often explicitly excluding carbon costs in the setting of electricity pricing. This creates a paradoxical situation in which near-monopoly energy markets in fact have less price manipulation around energy pricing than oligopolistic energy markets like Germany, the UK and Finland. Although these latter markets are more 'open' on the market structure spectrum, they still fall short of perfect competition because larger players are able to exert more force on the pricing of electricity.

There is some empirical evidence to support this explanation of the counter-intuitive results reported. In Greece, for example, which is reported in Table 5-2 as having the most monopolistic energy market structure in our sample, electricity prices are set by the Ministry of Development with advice from the Regulatory Authority for Energy (RAE 2007; Iliadou 2008). According to Law 2773/1999, so long as the Public Power Corporation (Greece's monopoly energy company) continues to hold more than 70% market share, the Ministry sets the price of electricity in the wholesale and retail market on a 'total cost plus' basis. This means that although the cost of inflation, energy fuel prices, and other infrastructure costs may be passed through to consumers, the cost of purchasing carbon emission allowances is explicitly prohibited. This regulation clearly creates a situation in which price manipulation over carbon pricing is strictly prohibited. If markets for financial information are efficient around the knowledge of this regulation, then investors will correctly assume that there will be no profiting from carbon returns reflected in PPC's stock price. Indeed, evidence to suggest investors are aware of this information is the investment research advice provided by one leading investment bank which identified this issue for PPC's projected cash flows (HSBC

2008). Electricity pricing restrictions and regulation in Europe's near-monopoly energy markets can also be seen to a lesser extent in France. In France, the government is also solely responsible for electricity pricing upon periodic review rather than the nation's monopoly entity, EDF, setting prices itself. However, unlike Greece, there is no strict prohibition on carbon cost pass through into electricity prices in France.

The possible higher prevalence of price manipulation in Europe's more open energy oligopolies has come to media attention in Germany, which is one of the more competitive energy markets in our sample. In December 2006, RWE (one of the companies in our sample) received a statement from the German Federal Cartel Office accusing it on improper methods in forming wholesale electricity prices for industrial customers. It was accused of passing on more than the full cost of carbon. Although RWE was able to avoid legal suit over this issue through legal settlement (RWE), our results in Table 5-3 show that RWE is a firm which exhibited a statistically significant positive relationship between carbon returns and stock returns.

These facts do not provide a comprehensive picture for why our results suggest that companies in oligopolistic energy market structures exhibit a stronger positive increment to their stock returns from rising carbon returns compared to monopolistic market structures. However, the regulation of electricity pricing does offer a possible albeit incomplete explanation for these counter-intuitive findings. Although it is difficult to robustly show empirically, there is a broad trend which can be observed as countries move from closed to open energy market structures in Europe. As countries move in this direction, there is generally less regulation of electricity pricing. A qualitative overview of this trend in electricity pricing regulation is described in more detail in Chapter 5 Appendix 1. Indeed, despite attempts to liberalise European energy

markets through regulation reaching back to the 1990s, empirical evidence shows that opening up energy markets has been slow to follow.[83]

The importance of market structure described here in the Phase I grows in breadth and significance for Phase II as reflected in the second stage analysis for carbon future returns reported in Table 5-5. Unlike Phase I where the market after April 2006 falls flat, the statistical significance of market structure in driving the impact of carbon pricing remains across the entire second phase of the market. The coefficients are both in the same direction (negative) which suggests that investors thought that companies in our sample operating in oligopolistic energy markets would be more able to grow their stock returns from rising carbon returns.

This result has implications for the importance of time in the economic geography of carbon market operations. The fact that investors treated Phase II differently to Phase I indicates that investors are responsive to the notion of carbon markets as staged markets for compliance. This means that they treat each stage of the carbon market differently according to expectations around the particular institutional and regulatory settings for that market. Carbon markets are therefore more complicated than a single homogenous market for trading carbon but are rather highly differentiated according to the structural characteristics that are attributed to them by governments. This offers some hope for policy makers to isolate the structural mistakes in one phase of the carbon market from future phases in order to enable the proper staging or phasing in of carbon pricing and to control the impact on corporate investment.

The discussion of these results so far has captured the importance of time (staging of carbon markets) and space (market structure) in carbon market operation.

[83] EU regulations to promote liberalisation of ownership and transmission within the EU include the Directive 96/92/EC of the European Parliament and of the Council of 19 December 1996 concerning common rules for the internal market in electricity, O.J. L 27/20; 31.1.1997.

However, it might be argued that there are unexplained variables driving these trends such as individual companies' characteristics like free allowances and carbon intensity. In order to examine this issue we build models (2), (3) and (4) in Table 5-4 and Table 5-5 to examine each of these factors in turn.

In model (2), we control for the effect of the ratio of free allowances given to firms. Hypothesis two suggests that firms with higher allocations of free allowances proportionate to purchased allowances would profiteer from rising carbon returns. Interestingly, the coefficient for free allocation is not statistically significant for either Phase I or Phase II. At the same time, the coefficient for market structure remains statistically significant for all cases. The conclusion we can draw from this is that the arrangement around electricity pricing and carbon cost pass through is a much more important driver in investors' minds compared to free allocations when assessing the financial implication of carbon markets. The one exception to this is the over-allocation of free allowances in April 2006 for Phase I. Investors clearly acknowledged this changed the dynamics of the carbon market for that period, although this was an isolated case and did not apply equally to Phase II. The relative importance of market structure over free allocations makes intuitive sense because investors do not have information about the ratio of free allocations at any one time. Because investors do not know a company's carbon emissions until annual reports recording historical emissions are released, we would not expect this information to be reflected in the reactions of investors trading equities in real time.

Extending this analysis in models (3) and (4) to carbon intensity enables us to control for different energy production processes as well as different sized companies because our carbon turnover intensity measure uses turnover as a proxy for size. As we

suggest in hypothesis two, firms with low carbon intensive processes might be expected to outperform their more carbon intensive competitors.

Once again, we find no statistical significance of note amongst our reported carbon intensity coefficients. At the same time, market structure prevails as a statistically significant (and negative) explanatory variable for excess carbon-related returns. This is also a surprising outcome and suggests that carbon costs as represented in the amount of carbon emissions allowances to be purchased is not closely correlated with the carbon intensity of companies' production processes. Indeed, data collected on companies' production processes was independent of the carbon market whereas the allocation of carbon allowances under the carbon market is a political process decided upon by national governments. This conclusion is also problematic from a policy perspective as it suggests that the metrics determining the financial implications of carbon markets are not based around the underlying carbon-intensity of production processes (and by extension the environmental credentials of various energy generating technologies) but rather other factors such as politics. A further explanation of the politics and economics around carbon allowance allocation deserves further examination beyond the current chapter.

5.7 Implications and conclusion

As governments around the world move towards the unifying logic of the market to price carbon and address the global challenge of climate change, it is important to realize that carbon markets are highly complex policy tools. Far from being a panacea to climate policy, carbon markets must be understood in the context of a diversified geography in which the financial implications of carbon markets play out across time and space.

The chapter represents an early but far from perfect attempt to empirically examine the operation of carbon market trading on the underlying economies involved. The conclusions and implications which can be drawn from the reported results is limited by the relatively short time period (just over two and half years), the small sample size (only 19 companies), as well as the thousands of unexplained factors and pieces of information which motivate investors in the efficient pricing of any listed equities. Yet these limited parameters are all that exist for a nascent market which is only beginning to take form and is still in its experimental stages in Europe as well as other jurisdictions around the world like North America, Asia and Australia. The implications of the chapter therefore need to be followed up as more data becomes available in the future in these regions.

One implication which emerges from these results is that carbon markets are a very time-specific market. Carbon allowances do not trade as a long-lived commodity in the way companies, for example, are traded. Rather carbon allowances have a finite life which expires with the end of each phase or stage of a carbon market's construction. This means that the financial implications of carbon for investors, corporations, and corporate innovation more broadly are closely tied to the institutional structures of the period in which carbon is traded. This is promising for policy makers who wish to stage the introduction of a fully-fledged carbon market without the mistakes of one period carrying into subsequent periods. But it also means that investors may not be making long-term investment decisions around the price of carbon. They know that the financial implications of carbon will change over time as new policies are formulated for each period and this may negatively impact the continuity of investors' long-term decision making. The efficiency of financial markets and information around the staging of

carbon markets is evident in the marked statistical differences between the impacts of carbon on stock returns in Phase I compared to Phase II. If policy makers are to change the long-term decisions of energy companies around the investment in new technologies and innovation then an important implication of this research is that they must reconcile the need for long-term price signals with the episodic nature of the EU ETS in which financial decisions in Phase I are independent of financial decisions in Phase II.

A second important implication for our results which requires further investigation is the importance of market structure in delineating the financial consequences of carbon markets. Clearly the assumptions we make about *national* market structures in Europe as well as the selection of our sample companies are open to re-interpretation in future academic studies in this field. However, following the assumptions we make it appears that the energy market within which companies operates differentiates the financial implications of carbon markets.

Our results are highly counter-intuitive, suggesting that companies in more closed energy markets are less able to profiteer from rising carbon prices via cost pass through and price manipulation compared to their oligopolistic counterparts. A possible explanation for this finding may be the deliberate regulation of electricity pricing in near-monopoly European energy markets which makes price manipulation around price more difficult. The European-specific nature of this explanation will qualify, but should not diminish, the significance of this finding. In essence, we argue that the institutional context around the pass through of carbon costs is important to the way carbon pricing feeds through the economy and corporate valuation. As the chapter shows, that institutional context may be shaped by a unique mix of market structure and unusual restrictions on pricing regulation. However, this is far from a universal phenomenon and

it is reliant upon researchers and policy makers in emerging carbon jurisdictions to better understand the empirical levers driving the financial implications of carbon trading in emerging jurisdictions like North America and elsewhere.

Aggregating our findings on timing and market structure, we believe there may be important policy implications for corporate innovation and investment in new technologies. If companies operate in an institutional context in which they are able to pass through the cost of carbon then they may have little genuine incentive to invest in new technologies and production processes. While economic theory may suggest that over the long-term this problem may correct itself as electricity demand corrects to short-term price spikes, the episodic and time-sensitive nature of carbon market development suggests that such long-term consistency may be currently lacking. It appears that investors do not yet regard carbon as a long-term price point upon which to make their decisions. Rather, the price of carbon and its financial implications are closely tied to the institutional characteristics of the particular carbon market phase in play.

The importance of time and space in carbon market development is juxtaposed against our findings on the significance of company level factors like free allocations and carbon intensity. The statistical insignificance of free allocations may be explained by the relative inaccessibility of emissions information for real time trading. However, the statistical insignificance of carbon intensity is harder to explain. Although a possible explanation is an inconsistency between emissions caps and carbon-intensity of productive technologies, this is a problematic conclusion as it suggests that carbon markets may be susceptible to external political and lobbying interests rather than environmental considerations alone. However, the paucity of data prevents us from

testing this hypothesis in great detail and deserves further research beyond the confines of the present chapter.

Looking beyond the findings of the chapter towards the broader implications for the future of carbon market development it is clear that carbon markets face a highly complex economic and political challenge ahead. Even as developed country governments go to international negotiations under the United Nations Frame Convention of Climate Change with carbon market proposals to reduce carbon emissions, it is clear that the need to inter-link or globalize carbon markets beyond national borders is crucial to a global solution to climate change. Indeed, some commentators have begun to address design issues around an inter-linked North American and EU ETS carbon market (Tuerk et al. 2009; Sterk and Kruger 2009). Whatever course such a market may take, it is clear that careful attention must be paid to how this market may operate differently across jurisdictions and across time. Our findings suggest that the institutional context of carbon cost pass through will be an important issue in untangling the economic geography of a global carbon market, and that balancing short-term staging against the need for long-term price signals will be a significant economic challenge.

Carbon markets might therefore be best understood as a raised relief map in which the cost of carbon flows across the contours of economies in a highly uneven manner. Although we have used market structure to analyse the EU ETS, further research might investigate how carbon costs aggregate differently across different sectors in the economy, or across economies with different industrial bases. In terms of international competitiveness, for example, it might be interesting to consider how

carbon-intensive coal economies like Australia and Canada respond differently to carbon pricing compared to more technology-led economies like Japan and Europe.

Whichever direction future research on the economic geography of carbon markets take, it is clear that geography must play a key role in understanding the emergence and development of this new market. Rather than placing blind faith in a global carbon price as the panacea of international climate policy, carbon markets must be understood in all their complexity across physical and spatial geographies, however defined. The inherent tension between global solutions and local economies makes climate change a natural area for economic geography to make an important contribution.

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Table 5-1. Company level characteristics of sample companies

Companies	*Country*	*Free allowance ratio*[a]	*Capacity-weighted carbon intensity (g/kwh)*[b]	*Turnover carbon intensity (tonnes/million EUR)*[c]
EVN	Austria	0.670	469	2906.67
Verbund	Austria	0.918	121	1335.16
Fortum	Finland	0.927	100	1931.79
EDF	France	0.938	90	1465.59
ENBW	Germany	1.000	250	1361.68
EON	Germany	0.916	520	2264.71
RWE	Germany	0.905	750	3790.43
Vattenfall Europe	Germany	1.027	416	4722.09
PPC	Greece	1.020	945	11483.22
Edison	Italy	0.933	547	2656.35
Enel	Italy	0.839	520	2024.04
Enipower	Italy	1.133	389	774.23
Electricidate de Portugal	Portugal	0.910	475	3055.10
Endesa	Spain	0.800	430	3068.39
Iberdrola	Spain	0.747	289	1863.50
Union Fonesa	Spain	0.660	477	4298.62
British Energy	UK	0.600	110	2177.89
Centrica	UK	1.190	394	462.83
Scottish & Southern	UK	0.772	868	1827.04
Sample Average		0.693	328.18	1945.79

Note: [a]The free allowance ratio is the proportion of carbon emission allowances which were issued for free to companies compared to the amount they were required to purchase according to their national allocation during Phase I of the EU ETS. Ratios greater than 1 indicate an excess of free allowances issued.
[b]The capacity-weighted carbon intensity measures the CO2 emissions (g) emitted for each unit of electricity generated (kwh).
[c]The turnover carbon intensity measures the total CO2 equivalent emissions (tonnes) for each 1 million Euros of turnover.
Source: Trucost proprietary database and company financial reports.

Table 5-2. Country level characteristics

Country	CR4	CR4 description (concentration)	HHI	HHI description (concentration)	Market Structure
Austria	0.44	Moderate	0.1849	Moderate	Oligopoly
Finland	0.28	Low	0.0730	Low	Competitive
France	0.88	High	0.7800	High	Monopolistic
Germany	0.68	Moderate	0.1320	Moderate	Oligopoly
Greece	1.00	High	0.9604	High	Monopolistic
Italy	0.70	Moderate	0.2668	High	Oligopoly
Portugal	0.68	Moderate	0.3664	High	Oligopoly
Spain	0.6	Moderate	0.1405	Moderate	Oligopoly
UK	0.45	Moderate	0.0597	Low	Competitive

Source: Own calculations based on Sijm et al (2008) and Domanico (2007).

Table 5-3. First stage regression on the effect of carbon returns on stock prices

	EVN	Ver-bund	Fortum	EDF	ENBW	EON	RWE	Vatten-fall	PPC	Edison	Eni Power	EDP	Endesa	ENEL	Iber-drola	Union Fenosa	British Energy	Centrica	Scottish & Southern
EU	AT	AT	FIN	FR	GER	GER	GER	GER	GR	IT	IT	POR	SPN	SPN	SPN	SPN	UK	UK	UK
22 April 2005- 24 April 2006																			
Spot	-0.010	0.069*	0.079***		-0.017	0.005	0.037***	0.002	0.003	0.002	0.013**	0.009	0.000	0.008	-0.01	-0.008	0.051***	0.043***	0.021**
	[0.028]	[0.036]	[0.029]		[0.016]	[0.017]	[0.010]	[0.017]	[0.019]	[0.007]	[0.007]	[0.010]	[0.007]	[0.006]	[0.007]	[0.010]	[0.017]	[0.015]	[0.009]
Future	-0.009	0.040	0.072**		-0.017	0.012	0.062***	-0.004	0.016	0.010	0.013	0.017	0.023**	-0.004	-0.012	0.028*	0.09**	0.047*	0.03
	[0.035]	[0.028]	[0.031]		[0.025]	[0.020]	[0.019]	[0.023]	[0.025]	[0.016]	[0.012]	[0.014]	[0.011]	[0.014]	[0.010]	[0.015]	[0.037]	[0.028]	[0.018]
28 April 2006- 31 Dec 2007																			
Spot	-0.014*	0.011	0.005	-0.001	0.005	-0.005	0.002	-0.003	-0.01	0.007	0.006	0.000	-0.002	0.003	-0.001	0.005	-0.006	0.002	0.002
	[0.007]	[0.009]	[0.007]	[0.008]	[0.006]	[0.007]	[0.008]	[0.009]	[0.011]	[0.009]	[0.005]	[0.006]	[0.005]	[0.004]	[0.006]	[0.005]	[0.009]	[0.009]	[0.006]
Future	-0.004	0.032	0.056***	0.021	0.012	0.01	0.008	-0.024	-0.023	-0.018	0.000	-0.006	0.009	0.006	0.024	-0.032	0.067	0.002	0.009
	[0.030]	[0.039]	[0.021]	[0.039]	[0.021]	[0.033]	[0.032]	[0.037]	[0.045]	[0.032]	[0.019]	[0.024]	[0.033]	[0.019]	[0.028]	[0.026]	[0.049]	[0.039]	[0.025]
22 April 2005- 31 Dec 2007																			
Spot	-0.011	0.018	0.013		0.004	-0.002	0.004	-0.002	-0.013	0.003	0.008*	0.002	-0.001	0.003	-0.003	0.004	0.002	0.003	0.003
	[0.007]	[0.011]	[0.010]		[0.005]	[0.006]	[0.008]	[0.008]	[0.011]	[0.008]	[0.005]	[0.005]	[0.005]	[0.004]	[0.005]	[0.005]	[0.009]	[0.009]	[0.006]

Future	-0.010	0.037*	0.065***	-0.008	0.011	0.043**	-0.010	0.005	0.002	0.009	0.009	0.016	0.001	0.000	0.028**	0.082***	0.031	0.025*
	[0.026]	[0.023]	[0.021]	[0.018]	[0.018]	[0.018]	[0.020]	[0.022]	[0.016]	[0.010]	[0.012]	[0.013]	[0.012]	[0.012]	[0.013]	[0.029]	[0.023]	[0.015]

Note: This table shows the effect of carbon returns (spot and future respectively) on company stock returns, controlling for the following independent variables: the respective national indices returns where sample companies are located, returns of (one month) forward price of gas, and returns of (one month) forward price for oil. Logarithmic returns in all cases. White standard errors are used to correct for heteroskedasticity and are reported in parentheses. Significance at 1% (***), 5% (**), 10% (*).

Table 5-4. GLS regression results on the effect of carbon returns on stock returns in the EU ETS spot market

22 April 2005- 24 April 2006	(1)	(2)	(3)	(4)
Market Structure	-0.032**	-0.033***	-0.033**	-0.029**
	[0.011]	[0.011]	[0.014]	[0.012]
Free allocation		0.036		
		[0.035]		
Carbon Turnover Intensity			0.001	
			[0.010]	
Carbon Intensity				0.000
				[0.000]
Constant	0.074	0.045	0.066	0.077
	[0.021]***	[0.035]	[0.067]	[0.022]***
Observations	18	18	18	18
R-squared	0.34	0.38	0.34	0.36
Adj R-squared	0.3	0.3	0.25	0.28

28 April 2006- 31 Dec 2007	(1)	(2)	(3)	(4)
Market Structure	-0.001	-0.002	0.001	-0.001
	[0.003]	[0.003]	[0.003]	[0.003]
Free allocation		0.012		
		[0.008]		
Carbon Turnover Intensity			-0.004	
			[0.002]	
Carbon Intensity				0.000
				[0.000]
Constant	0.004	-0.006	0.029	0.005
	[0.007]	[0.009]	[0.016]*	[0.007]
Observations	18	18	18	18
R-squared	0.01	0.14	0.17	0.03
Adj R-squared	-0.05	0.02	0.06	-0.1

22 April 2005- 31 Dec 2007	(1)	(2)	(3)	(4)
Market Structure	-0.004	-0.005	-0.002	-0.004
	[0.003]	[0.003]	[0.003]	[0.003]
Free allocation		0.014		
		[0.008]		
Carbon Turnover Intensity			-0.004	
			[0.002]	
Carbon Intensity				0.000
				[0.000]
Constant	0.01	-0.001	0.035	0.013
	[0.006]	[0.009]	[0.016]**	[0.007]*

Observations	18	18	18	18
R-squared	0.1	0.25	0.25	0.17
Adj R-squared	0.04	0.14	0.15	0.06

Note: This table examines the factors which drive the effect of carbon spot returns on the stock performance of companies. Column (1) shows the effect of market structure. Column (2) shows the effect of market structure when controlling for the free allocation of emission allowances. Column (3) shows the effect of market structure when controlling for the carbon turnover intensity for each company. Column (4) shows the effect of carbon structure when controlling for the carbon intensity of the electricity generation process. Significance at 1% (***), 5% (**), 10% (*).

Table 5-5. GLS regression results on the effect of carbon returns on stock returns in the EU ETS futures market

22 April 2005- 24 April 2006	(1)	(2)	(3)	(4)
Market Structure	-0.037**	-0.038**	-0.045**	-0.038
	[0.013]	[0.013]	[0.016]	[0.014]
Free allocation		0.023		
		[0.042]		
Carbon Turnover Intensity			0.01	
			[0.012]	
Carbon Intensity				0.000
				[0.000]
Constant	0.087	0.068	0.022	0.086
	[0.024]***	[0.042]	[0.076]	[0.026]***
Observations	18	18	18	18
R-squared	0.34	0.35	0.37	0.34
Adj R-squared	0.3	0.27	0.29	0.25

28 April 2006- 31 Dec 2007	(1)	(2)	(3)	(4)
Market Structure	-0.030***	-0.029**	-0.028**	-0.022
	[0.010]	[0.010]	[0.013]	[0.010]
Free allocation		-0.027		
		[0.033]		
Carbon Turnover Intensity			-0.002	
			[0.009]	
Carbon Intensity				0.000**
				[0.000]
Constant	0.061	0.083	0.077	0.069
	[0.019]***	[0.033]**	[0.062]	[0.017]***
Observations	18	18	18	18
R-squared	0.35	0.38	0.35	0.52
Adj R-squared	0.31	0.29	0.26	0.46

22 April 2005- 31 Dec 2007	(1)	(2)	(3)	(4)
Market Structure	-0.034	-0.034***	-0.039***	-0.032**
	[0.011]	[0.011]	[0.013]	[0.012]
Free allocation		0.007		
		[0.035]		
Carbon Turnover Intensity			0.006	
			[0.010]	
Carbon Intensity				0.000
				[0.000]
Constant	0.077	0.071	0.038	0.079
	[0.020]***	[0.035]*	[0.064]	[0.021]***

Observations	18	18	18	18
R-squared	0.39	0.39	0.41	0.4
Adj R-squared	0.35	0.31	0.33	0.32

Note: This table examines the factors which drive the effect of carbon future returns on the stock performance of companies. Column (1) shows the effect of market structure. Column (2) shows the effect of market structure when controlling for the free allocation of emission allowances. Column (3) shows the effect of market structure when controlling for the carbon turnover intensity for each company. Column (4) shows the effect of carbon structure when controlling for the carbon intensity of the electricity generation process. Significance at 1% (***), 5% (**), 10% (*).

Chapter 5 Appendix 1

Description of the Electricity price regulations in the European Union

Country	Market Structure	Electricity pricing regulation
Austria	Oligopoly	No intervention in electricity price setting.
Finland	Competitive	There are no controls on electricity price although the Energy Market Authority reserves the right to intervene and adjust prices. There is currently no regulation restricting carbon cost pass through in the formation of prices.
France	Monopolistic	Price is controlled by the Government with periodic review. However, the cost of carbon is included at present in the tariff price.
Germany	Oligopoly	No intervention in electricity price setting.
Greece	Monopolistic	Greek Ministry of Development sets the electricity price with advice from the independent Regulatory Authority for Energy. A 'total cost plus' basis is used although the cost of carbon is explicitly excluded from the tariff price.
Italy	Oligopoly	A bifurcated market in which parts of the market are free and parts are regulated depending on whether the customer is described as "eligible". There is currently no restriction on carbon cost pass through in the formation of prices.
Portugal	Oligopoly	Prices are heavily regulated by the Portuguese regulator, Entidade Reguladora dos Serviços Energéticos, which sets the tariff every three years with an option to revise annually. Current tariffs are set to include all marginal costs including the cost of carbon.
Spain	Oligopoly	Prices are set by the Spanish government. Where this tariff has fallen short of the cost of carbon, the government has subsidised the deficit directly. However, the Royal Decree Act 3/2006 stated that freely allocated emission allowances will not be included in the compensation as of 1 July 2007.
UK	Competitive	No intervention in electricity price setting.

Chapter 5 Appendix 2

Country	Index Name	Coverage
Austria	Austrian Traded Index	Composed by Wiener Börse to reflect the Vienna Stock Exchange
Finland	OMX Helsinki 25	Market weighted index to reflect the Helsinki Stock Exchange
France	SBF 250	Represents France's largest 250 companies by capitalisation on the Paris Euronext.
Germany	DAX	Composed by Deutsche Boerse to represent the Frankfurt Stock Exchange
Greece	Athens General Index	Broad-based index to reflect the Athens Stock Exchange.
Italy	S&P/MIB Index	Capitalisation weighted index composed by S&P and Borsa Italiana to reflect the Italian equities market
Portugal	PSI Geral	Composed to represent the Euronext Lisbon
Spain	Madrid Stock Exchange General Index (IGBM)	Broad-based index to reflect the Madrid Stock Exchange.
UK	FTSE All Share	Composed to reflect the London Stock Exchange (represents 98% of capitalisation)

Chapter 6 | The Economic Geography of Clean Tech Venture Capital

6.1 Introduction

Climate change has been identified by governments and policy makers globally as one of the greatest market failures the world has ever seen (Stern 2007). The source of this failure is the emission of carbon dioxide equivalent which scientists have identified as the basis for global warming. Given that the balance of probability in the peer reviewed science sides with the anthropogenic origins of climate change, governments have sought to tread a prudent path towards increased intervention.

As the politics of climate change has moved towards increased government intervention (Giddens 2009), the economic policies best able to deliver the transition to a low carbon economy have come under increased scrutiny. There has been a general consensus amongst policy makers that a suite of policies is necessary to properly address climate change (Stern 2007). However, there has been relatively little empirical research on which policies have been most effective in driving economic transition in practice as opposed to in theory.

The underlying assumption in this paper is that technological innovation lies at the heart of effective economic transition in the context of climate change. Although there is always a welcome role for decreasing global consumption and improving production efficiencies, the Hardinian tragedy of the commons has historically been averted through the introduction of technological intervention (Hardin 1968; Ridley 2010). Yet the levers of technological innovation are notoriously hard to diagnose in any sector for economists and geographers alike (Rosenberg 1994; Popp and David 2010). Methodologically,

economists have sought to 'measure' the drivers of innovation through quantitative data such as patent data (Johnstone, Hascic, and Popp 2010). Economic geographers on the other hand have applied more qualitative tools to examine the characteristics underpinning ecosystems of innovation (Feldman 2001; Feldman, Francis, and Bercovitz 2005; Saxenian 2002).

This paper takes an economic geography approach to examine the arenas of technological innovation in clean technologies (hereafter, clean tech) in particular. Although the term "clean technologies" (or "clean tech") is relatively new and has taken on a variety of meanings, in this paper we define it as the subset of technologies aimed at transforming the carbon base of the *energy* sector. These technologies are predominantly on the supply side and refer to biofuel technologies (liquid fuels derived from biomass rather than petrochemicals), renewable energy generation technologies (such as solar, wind, tidal, etc), and technologies which complement coal-fired electricity generation to reduce its carbon-intensity (such as carbon, capture and storage). On the demand side, clean technologies refer to technologies which improve the efficiency of energy demand (such as smart meters).

Our empirical approach pays close attention to the drivers and barriers to clean tech innovation from the perspective of those involved in the financing of new technology: entrepreneurs, venture capitalists and private equity managers. A deeper understanding of the environment around clean tech innovation has broader implications for the policy interventions required to assist economic transition to a low carbon economy. In particular, it is relevant for optimizing the mix between carbon price policies and technology policies which are increasingly recognized as the twin wings of effective climate change policy (Stern 2009). In contrast to price policy where neoclassical economic assumptions around

efficient markets place faith in the unifying logic of the market around a singular price signal, technology policy has traditionally been more attuned to the geographical, institutional, and fiscal drivers of change.

We examine the economics of climate change more closely in Section 2 of this paper in relation to the broader literature around technology finance. Section 3 then sets out the empirical methodology adopted in this paper to understand the environment for clean tech innovation in North America and the United Kingdom. Section 4 presents the results with a discussion, and Section 7 concludes by drawing out the broader implications of the research for economic geography and policy.

6.2 Background on the economics of climate change

The intersection between climate change and economics is a highly contested space in which deep ideological differences lie beneath the surface of any empirical research study and the assumptions made therein. This section engages with the theoretical debate underpinning the literature on the economics of climate change and environmental governance.

This paper is premised on the notion that technological innovation is an appropriate response to the contemporary challenge of climate change. This premise reflects an increasingly dominant view held by so-called ecological modernists that market based initiatives are able to deliver both economic growth and environmental outcomes for the economy (Boykoff et al. 2009). This view, however, is not unanimously held. Critics of this position argue that such market based approaches to environmental governance are too insular and "marketize" the environment without examining how this approach limits the possibility for other, more state-based solutions (Newell 2008). They also argue that

excessive faith in the market discounts the capacity for change through socio-cultural processes (Bakker and Bridge 2006).

Both positions have valuable contributions to make to the complex terrain of environmental governance. In this paper, while the examination of technology and financing may be described as being 'neo-liberal', we seek to diagnose the limits at which markets are able to generate new technological innovations. This limit provides an entry point for the state to play a role in targeted intervention and involvement. As such, this paper is concerned with the optimal interaction between market and government based initiatives to support the development of technological responses to climate change.

Amongst those of the ecological modernist persuasion, we can examine the optimal interaction between the market and a more direct role for government by distinguishing between two positions. These two positions are described here as the 'induced innovation hypothesis' which places faith in the organizing principle of price mechanisms alone, and 'command and control regulation' which places faith in a more centralized system of governance. According to the induced innovation hypothesis first stated by Hicks (1932), the greatest impetus for innovation is changes in the price of factors of production. This represents a pure market based solution to environmental innovation in which inventors able to act freely around various price signals in the market without distortion by government (Hicks 1932). In the specific context of climate change, Newell et al. (1999) have argued that energy price increases are the most direct method for spurring environmental innovation (Newell, Jaffe, and Stavins 1999). Their conclusion is based on empirical work on the uptake of energy efficiency technologies under energy price scenarios.

This conclusion is contested by Porter and Linde (1995) who argue that command and control regulation is the best driver for environmental competitiveness. They argue that regulation sets a transparent performance standard for firms in the market around which competition can freely take place (Porter and Linde 1995; Porter 1991). Jaffe et al. (2004) challenge Porter and Linde (1995) methodologically on the basis that their research is driven by case studies rather than quantitative evidence, implying it has limited explanatory power. Whatever the validity of this criticism, theoretically these two approaches is distinguished by their faith in the role of price mechanisms alone as the lever for driving technological innovation (Jaffe et al. 2004).

More recently, the introduction of carbon emissions trading schemes in Europe[84] and elsewhere has revived debate about the theoretical tension between the price-focussed induced innovation hypothesis and non-price based direct action in the context of climate change innovation. Although there are purists on both sides, a number of leading academics have argued that both measures may be relevant in driving innovation when used in a complementary way and in a targeted manner. In *Blueprint for a Safer Planet*, Stern (2009) notes that both carbon pricing as well as technology policy are key to addressing climate change:

"[T]he presence of a range of other market failures and barriers mean [sic] that carbon pricing alone is not sufficient…Technology policy, the second element of a climate change strategy, is vital to bring forward the range of low-carbon and high-efficiency technologies that will be needed to make deep emissions cuts."

[84] The EU Emissions Trading Scheme was introduced into force in 2005.

This view is supported by a number of economists and policy makers and is grounded in the realization that climate change embodies two separate, but often conflated, market failures (Shellenberger et al. 2008; Acemoglu et al. 2009). The first market failure (which is well recognised) is the failure of the market to put a price of carbon which is an environmental externality. This means that there is little or no incentive for the market to adopt environmentally-friendly technologies. This failure is addressed with the introduction of a carbon price signal.

The second market failure (which is less well recognised) is underinvestment by the private sector in the deployment and diffusion of new technologies. According to the economic theory, this market failure arises because private investor are not fully compensated for the public good or positive externalities derived from research and development (R&D) investment in a new idea. This is because the spill-over effects of this investment are captured by competitors who indirectly benefit by replicating the intellectual property and take advantage of new technological know-how. The presence of this incentive asymmetry creates a barrier to private investment in new technology.

A second factor in this second market failure is the existence of 'adoption externalities'. This means that users of new technologies only become familiar with a new technology after using it for a period. Without this "learning-by-doing" knowledge latent in the market, the adoption of new technology is too costly to great because consumers prefer familiar technologies over learning a new set of skills. This presents risk for a private investor because they are forced to bear the cost in the event the market does not adopt the technology.

Finally, incomplete information is a factor in this market failure because investors bear the risk or uncertainty around the future returns to investment on a new investment.

This information asymmetry is greatest when investors are required to make a larger upfront investment compared to when only a small amount of investment is at stake (Jaffe et al. 2004).

The macroeconomic implication of these factors which contribute to the second market failure is that government intervention is required. However, because these factors are not associated with the cost of carbon, they are best addressed with well-targeted technology policy (Popp and David 2010). Indeed, as Acemoglu et al. (2009) show with economic modelling of different policy scenarios, social welfare outcomes are optimized when both carbon price and technology policies are used with the latter deployed in a temporary and targeted fashion (Acemoglu et al. 2009). This view has been too heavily discounted but price-theory purists however, as Stern (2009) acknowledges in his latest policy treatise, Blueprint for a Safer Planet:

> "Many commentators are sceptical about technology policy, saying it is wrong for bureaucrats to 'pick winners'. There is something in this, but it is also naïve or dogmatic in its underlying assumption that markets work perfectly unless distorted by government. In this case, markets do not work well unless *assisted* by government" (p111).

Notwithstanding the shift in mainstream economic thinking towards the greater role of technology policy in climate change innovation, quantitative economic methodologies are not necessarily well-suited to engaging with the complex ecosystems which drive innovation and technology development more generally. This is because innovation and the barriers innovation faces is often a non-linear process involving the convergence of

many non-quantitative variables including regulation, government support, and worker expertise amongst a multitude of other factors (Saxenian 2008). Rosenberg (1994) argues that an appropriate methodology for studying technological innovation must be focussed locally and empirically rather than be derived from theory alone:

> "By "getting down into the trenches", examining the particular sequence of events and institutions within particular industries, one can extract insights into the process by which technology grows – knowledge of the kind that cannot be deduced from some merely theoretical framework".

Economic geography is particularly well suited to conducting empirical research by "getting down in the trenches" in a particular locality. By going local and analysing the agglomeration of factors which inform innovative ecosystems, economic geography is able to offer key insights into the market for clean technologies and the particular barriers or opportunities which clean technologies face in getting to market and accessing finance within a particular region. Diagnosing these factors is the first step towards drawing broader policy implications for well-targeted technology policy.

Drawing on the economic geography literature, this paper extends on three issues which traditionally inform technological innovation and applies them to the specific context of clean tech innovation. Our objective is to better understand the characteristics driving and/or impeding clean tech innovation in North America and the United Kingdom with a view to extrapolating broader implications for the formation of well-targeted clean tech technology policy.

One issue traditionally examined in the economic geography literature on innovation is the role of proximity in investor-entrepreneur relations. Physical proximity between entrepreneurs and investment managers has been identified as a stronger marker for successful innovation because it allows investors overcome information asymmetry about the potential of a particular business proposition. Griffith, Yam and Subramaniam show that most venture capital investors invest in companies which are within several hundred miles of their headquarters (Griffith, Yam, and Subramaniam 2007). Where investors invest outside their own locality then Chen et al. (2009) show that investors demand a risk premium in the form of above-average returns (Chen et al. 2009). They also demand different financial structuring for non-proximate investments which mitigate financing risks, such as more financing rounds with smaller sized investments at greater frequency (Gompers and Lerner 2001). Furthermore, where investments are made cross-border, the size of investments is typically larger (Aizenman and Kendall 2008), which suggests that the companies are usually more mature companies and therefore less risky. Although these findings are quantitatively shown for the United States, they have also been demonstrated to a lesser extent in other geographies (Aizenman and Kendall 2008), as well as other asset classes (Coval and Moskowitz 1999). The role of location in clean technology innovation is examined in greater detail in Section 4.1 below.

A second issue which has been identified as a driver of technological innovation is the ability of entrepreneurial firms to access appropriate risk capital within a particular economy. Klagge and Martin (2005) argue that where financial hubs are geographically decentralized and offer risk capital with relatively low transaction costs then venture capital investing is likely to be more prolific. These conditions have traditionally been present on the west coast of the United States (Klagge and Martin 2005). By contrast, in

the UK and continental Europe where financial centres are highly centralized and disposed towards rigorous bank financing or large-cap capital markets then venture capital investing is more likely to be scarce (Klagge and Martin 2005; Martin, Sunley, and Turner 2002; Heger and Fier 2005). Given the very different type of capital requirements for clean technology deals, the relevance of these distinctions will be empirically examined in this paper in Section 6.2 below.

Finally, the *ecosystem* for allowing early stage technology companies to flourish has typically been examined in the literature. This refers to clustering effects and the importance of social networks within a local geography (Feldman 2001; Porter 1990). Saxenian (2008) argues that the clustering effect of tightly-knit social networks delivering legal, financing, scientific, and management expertise is a key driver of successful venture capital investments. While these elements are not sufficient when taken individually, the convergence of these factors creates networks which attract venture capital investment. This local phenomenon is at odds with the global nature of climate change in which one might expect clean technologies to be widely diffused across borders. This is much a product of demand for clean technologies globally as well as a push by venture capital firms to reap the rewards of global expansion. This issue is explored in greater depth in Section 6.3 to examine how the local and global interact in clean tech venture financing.

The central inquiry of this paper, then, is to bring the methodologies and literature of economic geography to bear on the emerging challenge of clean tech innovation needed to address climate change. As we can see from the recent economic literature and theory, the role of price mechanisms alone as the levers for innovation has been shown to be limited. Although a carbon price is vital, it alone does not address all the market failures involved in taking an idea to market. Economic geographers, who have long had insight

into the multifaceted way in which economic communities (especially entrepreneurial ones) operate, have an opportunity to contribute to this problem. Using the methodology discussed below, our aim is to better describe the investment process behind clean tech innovation with a view to extrapolating the broader implications for policy makers.

6.3. Methodology

In order to capture the dynamic factors at play in ecosystems for clean tech innovation, we adopt an in-depth semi-structured interview approach. This involves conducting close dialogue interviews with a number of leading clean tech investment professionals in the United Kingdom and United States (Clark 1998).

We focus on investment professionals in the United Kingdom and United States because North America and Europe these are the two dominant regions for clean tech investment identified in the New Energy Finance statistical data on clean tech capital flows regionally in Figure 1.

[Insert Figure 1]

By approaching investment professionals in both geographies we are able to compare and contrast their approaches to clean tech investments in order to triangulate our findings, as well as identify geographically-sensitive differences between these two regions.

Thirty-four professionals in total were interviewed. All were active in clean tech investments as venture capitalists, private equity investors, and clean tech entrepreneurs. Seventeen participants were based in the United States, predominantly California and New York, and seventeen participants based in the United Kingdom and worked in a mixture of UK-focussed as well as pan-European investment funds.

Each interview lasted approximately an hour and was conducted in confidence and with assurance of no citation (see Chapter 6 Appendix 1). This was important as often the respondents were in direct competition with each other and given the importance of public reputation to fund-raising, lack of anonymity may have compromised the reliability of the responses (Goldstein 2003). Although there are drawbacks to qualitative research in terms of the reliability of the comments made, every effort was made to independently cross-check the responses for consistency.

Similar questions were raised with each of the interviewees with reference to case studies from their portfolio experience as well as statistical trends from the data discussed above (Quattrone 2006). This approach was helpful to ground the respondents' comments in practical experiences in order to support the veracity of the views expressed as well as clarify the points made. Another key factor in ensuring the reliability of the views expressed was access to the key market markers in the clean tech VC/PE space in both the USA and United Kindgom (Goldstein 2003). Every effort was made to contact the leading players in the field through dialogue with the relevant venture capital industry associations, academics, entrepreneurs, as well as personal references and recommendations by each of the venture capitalists themselves.

The interviews were conducted in a semi-structured manner with the broad objectives of the research and framing questions sent in advance of each interview. The interviews generally covered the following issues: the first set of questions covered the drivers for the location of clean tech investments. This included questions such as 'How regulatory conditions impact the investment environment of clean tech firms?', 'Does physical geography impact the operation or valuation of clean tech businesses?', and 'how does this differ across sectors?'.

The second set of questions examined whether there was a pattern in the way deals were structured once agreement was formed that they should go ahead. This includes questions such as ‘is there a trend in the kind of deals you invest in based on the level of technological maturity?’, ‘Does the capital intensity of deals vary across sectors?’, ‘How do you syndicate the investment in your portfolio companies?’, and ‘how do you perceive the route to exit for your portfolio company?’.

Finally the third set of questions examined how a locally-based venture capitalist is able to take advantage of global opportunities. These included questions like ‘Do investors sources deals locally or internationally?’, ‘How do you take advantage of emerging opportunities in China and India?’, and ‘How do you help your home-based companies access those opportunities?’. The results of our empirical findings are discussed in the following section.

6.4 Discussion of results

6.4.1 Location and clean tech

A unique feature of clean tech investment products is the fundamental importance of physical geography in the way the end product (electricity) is generated and sold into the market. Renewable energy technologies comprised a significant portion of the investment portfolios of investment managers interviewed. In each case, it was pointed out that generating renewable energy is completely dependent on the natural environmental elements for energy yield, whether those elements are the amount of wind, sun, tidal energy, geothermal energy, or some other source. In each case, the defining characteristic of generating renewable energy is not only that it is an intermittent source (that is, it cannot be generated continuously), but also that the amount of electricity (yield) which can be

generated by the same technology in different locations significantly varies according to the physical environmental conditions. This means that the ability of a renewable energy technology to sell electricity into the grid is inherently connected to the location of the technology and the environmental conditions of that location. In other words, the performance of renewable energy technologies and the end market for renewably generated electricity are both highly dependent on physical geography.

This makes renewable energy a very different product to technologies in the biotechnology or information communication technology sectors which compete with clean tech for venture capital. Once a particular drug is developed or mobile phone application conceived, those products can be sold globally to any consumer with a health problem or a desire to purchase a digital technology. While social or economic geography may influence the sales of those products, physical geography does not play a part in where the market for those technologies will be located. This distinguishes clean tech amongst other technologies as a *physically* decentralized market.

Speaking about an investment in a UK solar energy technology company, one investor said that a solar investment is similar to a real estate investment in that it is all about physical location:

> "[Performance] is very, very subject to location, especially in solar which I know better. You have to ask questions like: Is there [interference from] dust? Is their [interference from] moisture? Do I have to feed my [solar] modules? What is the trajectory of the sun? Do I have to track the sun or can it just be left in place? Where is there shading from trees? Are there other things which will interfere with the performance? You can't lose a couple of hours of power because it really

> affects your yields…So it's like real estate. It's all about location. We spend a lot of time on location".

The importance of physical geography is not confined to solar technologies or to Europe. Similar relationships were emphasised by numerous investors in the United States. Giving an example from the biofuels sector, one investor commented that investors had initially underrated the importance of physical geography when first coming into the market 10 years ago. However, experience had shown that biofuel businesses are highly dependent on the location of feedstocks:

> "The key cost drivers in biofuel production are feedstock costs and transportation costs. Knowing which feedstock you want and being located close to them is a key challenge".

In one case study provided by an investor, a portfolio company had struggled financially because it had not foreseen the need to adapt their fuel production processes to the available local feedstock. The company had used a recent financing round to fund research and development around optimizing the efficiency of its sugar fermentation process in the lab. However, when investors later asked them to demonstrate their techniques at scale in a real-world commercial plant they realized that they had not taken into account the local feedstock type. This meant that the feedstock used in the lab was different to that close to its production sites. This was a major problem for the company for two reasons. Firstly, in the short-term it threatened the commercial viability of the business because it suddenly faced significant supply chain concerns and/or unexpected transportation costs with

respect to its feedstocks. This problem, though serious, is not necessarily unique to clean tech. However, the second problem was unique to clean tech. The investors now realized that it was not possible to 'scale up' their business model to sell their technology globally as they originally hoped. Their end-market was no longer the biofuel market generally but rather the subset of the biofuel market which was co-located with a particular feedstock type. The end-market for their product, they realized, was suddenly and necessarily very specific, very decentralized, and very local.

The fact that clean tech deals are so closely tied to physical geography arguably has implications for the future landscape of global energy markets. In conventional (fossil fuel based) energy markets which characterize today's supply of energy, large multi-national corporations such as BP and Shell are able to achieve significant vertical integration. Because a barrel of oil is valued equally the world over, these companies are able to achieve economies of scale by owning assets in exploration, refinement, transportation and distribution to sell a uniform commodity in a global market. By contrast, renewable energy is non-uniform and highly decentralized. As we have seen, a solar technology which works in Texas, United States does not necessarily work in England, United Kingdom. Thus, the supply of alternative energy technologies is unlike convention energy in that it is not a commodity but rather a niche product which must be sold into local markets by people who understand the local environmental conditions. This means the market structure may be ill-suited to the global economies of scale achieved by contemporary energy conglomerations.

Evidence that the renewable energy generation market is already beginning to congeal around local drivers was clear from the comments of a sovereign-backed purchaser of renewable energy technologies. This respondent emphasised that they went to

great lengths to find the optimal technologies for their conditions rather than purchase a "straight out of the box" technology from an established player:

> "We want to find the solar [technology] that is going to work in the Middle East and in our conditions. We have the largest solar panel testing going on in the world. We have more than 40 panels and 40 companies testing their solar panels back to back in a half square mile area working out which ones are going to perform the best in our environment. And our environment is different [to other geographies]. We have extremely high heat. We have extreme humidity and we have dust storms….So what performs best in Abu Dhabi may be the exact opposite from what performs best in Germany or Japan where it's a cooler climate, it is drier, you don't have dust storms but you have less sunlight."

This comment reiterates the point that clean tech is a very local and geographically sensitive market, thereby distinguishing it from other technology markets in health and digital communications. A possible implication of this in the context of the economics around climate change discussed in Section 2 is that renewable energy technologies may struggle to reach economies of scale in their cost base in the free market. Because they must sell into niche markets and supply intermittent power supply, they face significant barriers to market entry when competing against the economies of scale achieved in conventional coal-fired electricity. This suggests that government intervention is a necessary pre-condition for the creation of a clean tech market. Through our close-dialogue interviews, we sought to examine this hypothesis by examining the role of

regulation in the clean tech market. One west coast venture capitalist had a very definite view:

> "Regulation drives clean technology"

Across the Atlantic, a UK investor shared a similar view:

> "Government subsidy was and is the most important driver in this market. Without it the market would not take off."

The level of regulation required to drive clean technology investment is a source of discomfort for many investors. Venture capitalists pride themselves on being the frontiersmen of capitalism because they are better able to navigate the information symmetries and risk/reward premiums of new ideas than the general market. They are naturally resistant to government intervention which they see as distorting the market and propping up bad ideas. Indeed, as one famous west coast venture capitalist responded when approached for an interview on the role of government in clean tech investments:

"I don't have time to meet with a socialist like you".

Yet the paradox of this sentiment is that while these views might be defended in biotechnology and information communication technologies where venture capitalists have a successful track record, no investor has succeeded in clean tech without significant government intervention. Indeed a colleague of the above quoted west coast venture

capitalist admitted that in the absence of feed-in tariff regulation in particular, many businesses would not be able to compete with coal-fired electricity.

Evidence of this can be found in the collapse of the Spanish solar technology market in 2007. Feed-in tariffs offer a price subsidy to renewable energy generators selling electricity from a stipulated source into the local gird. In Span solar feed-in tariffs were wound back in 2007 after national targets were met earlier than expected. In the absence of a feed-in tariff many solar companies in Spain went bust and were unable to continue their business in adjacent markets unassisted. The critical role of feed-in tariff in renewable energy market formation and development was clear from this European investor's comment:

> "Feed-in tariffs in Germany in solar made a big difference and people made a lot of money. This gave a very strong pull to the market and this has been key to the success of a variety of solar companies".

Another way in which regulation makes a big difference for clean tech investors in both the United States and Europe is through standards or regulations which change the demand for clean tech products. Standards are described as demand side or "market pull" measures before they offer greater certainty to businesses that their products will be purchased (Burer and Wustenhagen 2009). These measures are in contrast to feed-in tariffs discussed above which are supply-side or "technology push" measures and require direct fiscal support by the government. Investors viewed demand side measures as a critical component of government intervention as the below comment reveals.

> "Governments have really got a role in setting standards and letting business respond around that market pull. So for example in the U.S you will need to see average fuel economy standard which strives to improve fuel efficient. This will last when the subsidies disappear"

And

> "The key role of government is to invest in clean energy and then legislate efficiency"

These views reflect the findings of Porter and Linde (1995) who argue that regulation (as opposed to price) is the strongest driver of technology innovation. Although our qualitative evidence reflects perceptions or reactions to regulation by venture capitalists and business people, this does not discount their significance. Instead, investors' perception of regulation is a direct influence on investor confidence and risk appetite. These are the barriers which the theoretical literature in Section 2 has identified with respect to market barriers. By empirically identifying similar sentiments in the market we are able to show that these barriers exist in clean tech investment. In particular, the above comments are especially relevant to the "adoption externality" discussed above because investors appear concerned about the role of regulation in guaranteeing an end-market for sales.

In spite of this, no importance was placed on carbon markets in the investment decisions of the clean tech venture capitalists and private equity investors interviewed in both the United States and Europe. This response was interesting given that Europe has had a carbon market in operation since 2005. Although investors broadly supported the

principle of a price of carbon, they argued that the marginal impact of a carbon price changed decision-making once a technology was well-established and proven in the market. This might therefore be relevant for project finance. However, they pointed out that for early-stage investors, these mechanics were too far removed from the management and technical challenges of building businesses and supporting demand for their products and services in the market early on.

These comments suggest that the price versus regulation debate in the literature does not involve two mutually exclusive positions. Rather these two policy tools are targeted at two different *stages* in the path towards technological innovation. Whereas targeted regulation helps address early stage barriers to entry, carbon pricing is more effective when a technology is proven and is ready to be deployed. This point bears some relevance for policy makers considering the staging of regulation to develop an alternative energy market.

A final way in which regulation impacts the geography of the clean tech investment landscape is the regulation around the connection and transmission of renewable energy into the electricity grid. This was identified as an issue which had remained under the radar but which was very important for businesses ready to generate renewable energy. One US investor with experience in law and finance made the following comments:

> "Regulation makes a huge difference and transmission makes the biggest difference by far. In the US, energy and environment regulation is very complex. For any approvals there are 15 bodies with lots of charters and regulations attached to each. Transmission differs across states and jurisdictions. There is not one

> authority; there are multiple sources of authority. So the legal geography has a profound effect on the nature of the electricity market and sales in the US".

A major UK solar energy company seeking to expand its market share in continental Europe acknowledged a similar challenge for its business.

> "There is currently no harmonization in the energy grid at the moment in Europe. It is very country specific access. You need a grid connection via a local utility in the local grid. You need local authorisation and you need national authorisation. So from a sheer geographical perspective grid access for our business is location dependent and a major challenge".

In summary, close dialogue with clean tech investment practitioners reveals that the clean tech sector is characterised by the importance of physical and regulatory geography in a way which is unique compared with other sectors. This importance is based on the fact that renewable energy technologies are dependent on physical conditions to generate electricity. Also important is the role of regulation in supporting the commercial viability of many nascent businesses which face hurdles in reaching profitability. Better understanding these dependent variables should inform the direction of well-targeted technology policy to alleviate investment barriers.

6.4.2 Access to finance and clean tech

The financial structure of clean tech deals is very different to other technologies competing for venture capital such as biotechnologies and digital communication technologies. This is because, unlike in health and digital communications where the product which reaches

the market is unique and each unit is sold separately, renewable electricity is a homogenous product which is directly substitutable and delivered via a piece of large-scale infrastructure on an intermittent basis. The unique technology which is developed by scientists and engineers is typically fitted into a large utility which then generates electricity and sells it into the grid.

Because renewable energy technologies are delivered through utilities, they are expensive to build and demonstrate at commercial scale. A typical renewable energy plant (such as a wind farm) in the UK or US may cost upwards of US$100 million to build. Drugs, on the other hand, cost a fraction of this to demonstrate, and digital applications a fraction of that again. The large capital requirements of clean tech deals pose a unique financing challenge. Typically, banks or project financiers provide debt finance for deals of this size. However, because they are lending large sums of capital they are typically risk averse especially towards technology risk. Venture capitalists on the other hand are willing to take technology risk but do not have the funds under management to contribute equity for such a large deal. This tension – described as the capital intensity problem in the below quote– is a unique feature of the financing landscape for clean tech innovation. One investor summarised the problem faced by all investors as follows:

> "I think definitely on the capital intensity dimension there's a huge barrier there [to doing clean tech deals]. The downturn in the economy hasn't helped but it is a structural problem. We can simply refer to this valley of death issue where we have enough venture capitalists with enough clean tech capital who are willing to invest in earlier and sort of mid-stage companies. But when companies need $100 million

> factors we actually frankly need project finance. But they don't want the technology risk".

In a case study to illustrate this point, one UK investor with US$100 million under investment described an investment in a waste to energy technology which extracted methane from waste and converted it into electricity. This company realized that its revenue stream would need to come from royalties in licensing its technology to project developers interested in installing the technology in infrastructure. However, it has struggled to find any project developers interested in committing US$80 million in equity and debt finance to deploy this technology. Given that the venture firm is unable to finance the deployment itself, the company has been forced to cut its staff and other costs and wait for a project developer to come along with a strong risk appetite for their technology.

The "valley of death" faced by investors who are trying to help companies reach technological maturity has significantly restricted the ability of venture capital investors to do deals in the sector (Grubb 2004; Burer and Wustenhagen 2009). One major US investor said that capital intensity and the delays involved in refining a technology are a main reason why they do not invest in prospective companies:

> "Capital intensity and timeframe to commercialisation tend to be the really big reasons why we cannot go through with deals. For energy or clean tech, if a company is seven years to commercialisation then it's not a company we could typically invest in."

These challenges may help to explain the trends identified in the clean tech financing statistics in Figure 2 below. These statistics from New Energy Finance indicate that internationally capital has been flowing more strongly into private equity expansion capital and later stage VC rather than early stage investments. These later stage deals take place once a technology has been proven at commercial scale and therefore does not contain the level of technology risk which impedes bank or project finance.

[Insert Figure 2]

The comments from investment professionals interviewed suggest that money has been flowing to these later stage deals because the returns are more predictable and certain. With the technology risks reduced in these more mature companies, investors' role is more closely tied to making a contribution in strategy and marketing rather than developing the technology. This finding empirically supports one of the theoretical market failures identified in Section 2 which well-targeted technology policy should address. This is the incomplete information which investors have on the future returns of a new investment. Typically, infrastructure-style deals are financed on the basis of very predictable cash flows over a long time frame. Given that clean tech deals do not have this luxury because of uncertainties around price, yield, and technology performance, the qualitative evidence from our interviews suggests that a real barrier to investment is the capital intensity of early stage clean tech deals. This may explain why venture capital flows unevenly in clean tech deals and pools in technologies at later stages of maturity.

The "valley of death" financing gap is a unique characteristic of clean tech deals around the world and must be addressed through carefully targeted technology policy.

However, does the problem exist to the same extent internationally or do some regions face more severe financing barriers than others? In order to examine this issue we considered distinctions between the United States and the United Kingdom in the ability of their regional venture capital and financial markets to address the market failures around clean tech.

A number of investors felt that European investors were more disadvantaged than US investors by this problem because of the typically smaller size of funds available in Europe. This is an important point because it suggests that with shallower pools of capital available, European investors and entrepreneurs may be left stranded by liquidity shortages as their companies seek expansion capital for research, development and growth. While this is a generalization, one UK based venture capitalist openly raised this problem:

> "How do you get the funds to scale up a technology if it requires a minimum of US$50 million. Think how much of your funds you need to do that if you've got a US$100 million fund – which in the US is on the small side. In the US you might be lucky and have a large mega fund, but in Europe US$100 million is about medium size".

The relatively smaller pool of clean tech venture capital in Europe compared to the United States is evident from the statistics in Figure 1 above. It is difficult to speculate why this might be the case, although some reasons are considered below. However, one reason from investors' comments might be the success stories of some west coast venture capitalists which have been able to raise mega funds on the back of their financial reputation. This

reputation feeds a virtuous circle in which more money is raised enabling the valley of death financing risks to be increasingly easy to overcome.

When speaking to investors, numerous UK venture capitalists pointed to Khosla Ventures, Vantage Point and Kleiner Perkins in the US with admiration. These firms have been able to raise mega funds in excess of US$1 billion, which is significantly larger than any other clean tech fund globally. This has allowed them to support transformative investments in electric cars and desalination plants more aggressively than would be possible in the UK. As Khosla has mentioned in relation to his clean tech investment strategy:

> "The goal is very much to take risks that nobody else will take".

One option facing any venture capital investor seeking to access a larger pool of capital to meet the financial needs of a company is to "syndicate". Syndication refers to the partnership of investors formed to co-invest in companies. This is as much a risk mitigation mechanism as it is a strategy to access larger pools of risk capital. Given the shallower pool of venture capital in Europe compared to the US, one option for European investors may be to syndicate their clean tech investments more rigorously with their US counterparts. Investors on both sides of the Atlantic were approached on this issue to ask whether syndication across the Atlantic has been a feature for their investments. Surprisingly, investors indicated that there had been relatively little syndication although different reasons were given. In Europe, investors were keen to syndicate with North American investors but found that US investors were typically US-centric and uninterested

in doing venture deals in Europe. One UK investor who had spent part of their career in North America made the following observation:

> "It is hard to syndicate in the US because there is a cultural difference. Kleiner Perkins is very sophisticated. But there is a very US-centric approach in the US. Warburg was successful because it had foreigners who had travelled across the US and Europe but that was an exception"

Evidence of a closely-knit network of investors in the United States is supported in the quantitative research of Kogut, Urso and Walker (2007). They show that syndication in North America typically takes place in trusted, repeat relationships with known investors within the United States (Kogut, Urso, and Walker 2007). Admittedly, however, discussions with a number of US venture capitalists born outside the US suggest that they recognised this culture and they were keen for this culture to change. One Israeli-born venture capitalist working in the US made the following comment:

> "We should do more syndication in Europe with a European partner. …I don't know why this hasn't happened to date. I don't have the US culture so I may be different.".

The reluctance of US venture capitalists to frequently syndicate deals in Europe may have an economic rationale. A number of US investors approached mentioned that the nature of early stage technology deals requires proximity to local management. As a company is growing, the most important work must be done in defining the product, defining the

market, and recruiting the right management team. Without regular physical access to the entrepreneurs based in Europe, US investors felt that they were not sufficiently in control of the risks involved to make an investment. This insight is strongly supported by the role of geography in venture capital where early stage investments typically take place close to the head office (Griffith, Yam, and Subramaniam 2007).

However, US investors acknowledged that there may be an exception to this as companies reached maturity and had proven their technology. With these early stage corporate risks mitigated, US investors acknowledged that there might be more justification for investments in Europe, albeit with a trusted European partner:

> "When you are investing overseas it is hard to invest a long way away at the early stage. This is contrast to a company which already has a CFO [Chief Financial Officer, CTO [Chief Technical Officer], and so forth…We won't do any early deals in Europe – more likely a later stage deal."

The structural challenges to doing clean tech deals given the latent technological risk combined with the capital intensity of infrastructure deals may explain the flow of capital across the various stages of technology financing. Two trends appear most pronounced. Firstly, capital appears to be pooling in private equity expansion capital and later stage venture capital more rapidly than early stage venture capital. This may be explained by the relative attractiveness of these more mature deals because the underlying technology is proven. Secondly, risk capital appears to be pooling in the United States ahead of Europe although this trend is reversed for asset financing. Although it is difficult to explain the causation behind these statistics, the trend is consistent with strong history of syndication

amongst US firms as well as success stories in the US which helps deepen the pool of risk capital available for clean tech deals in the US compared to Europe. This has broader implications for how to foster clean tech innovation in these respective regions, which will be considered at greater length in Section 5.

6.4.3 Globalizing clean tech VC/PE

As we have discussed above, the importance of physical and regulatory geography in the market for clean technologies means that the investment landscape is much more conducive to local pockets of expertise and technologies rather than clean tech investments being simply globally traded commodities. The impact of this is that venture capital expertise in the clean tech sector tends to be less clustered around Silicon Valley compared to other sectors, like semi-conductors, where Silicon Valley is the clear expertise hub internationally. This point was grasped by one billion dollar west coast investor:

> "VC finance in Silicon Valley is concentrated around semi-conductors and the internet. But in clean tech there is no restriction on geography. Technology now comes from everywhere.

However, while Silicon Valley is not necessarily the hub for all clean tech venture capital in the way it has been for other sectors, local expertise and clusters are still an important criteria for success. This same US investor makes the point with the following clarification:

> "Each geography has its speciality. In Australia there are good companies in solar concentrator technology and geothermal. You go to Denmark for wind technology.

> China has the world's best battery technology….This just means we have to travel a lot more for our deals"

For Silicon Valley, building its expertise in clean tech has involved maximizing the complementarity of skills, expertise and venture experience from the adjacent sectors like the semi-conductor and internet sectors where there is a lot of cross-over. Many west coast investors pointed out that there has been a marked increase in the quality of entrepreneurs pitching companies to them because many from the 'old' sectors are now re-branding and re-skilling themselves for clean tech problems:

> "When I first started in clean tech [in Silicon Valley] there were a handful of entrepreneurs and they were mainly [energy] scientists and not typical Silicon Valley entrepreneurs. …That's changed. Basically everyone who was in software of communications and semi [semi-conductors] is now in clean tech".

US venture capitalists based in Silicon Valley are also keen to market the fact that they continue to have a competitive advantage in clean tech investing notwithstanding the globalization of clean tech investment opportunities. The key factor identified by Silicon Valley experts is the densely populated ecosystem of professions in the Valley which are able to build businesses. This involves the combination of lawyers, bankers, entrepreneurs, scientists, engineers, and government officials who are all able to contribute to a favourable investment ecosystem for clean tech venture investment. One Silicon Valley veteran describes it in this way:

> "We believe that entrepreneurship in clean tech and other sectors is a bit like nature. If you have some great seeds and plant them in lousy soil they won't grow well…But if you have a good habitat then you will get a good crop. Good entrepreneurship without a good habitat is very difficult. This is all about the business, social and political environment. The talent base and the educational base and technology base are important as well as the infrastructure."

Even the European investors who had worked on both sides of the Atlantic acknowledged that Silicon Valley had a competitive advantage for commercializing new technologies:

> "Silicon Valley has a natural competitive advantage. Immigration is key to this. Indians, Chinese, Vietnamese, French, Israelis, Americans all go to Silicon Valley and start companies. There are millions of people, there's sunshine, there are great universities which provide new entrepreneurs. There are lots of people who have made money and given money. You can raise capital basically with a few phone calls. I can get to know the right people and get great mentoring from people. People know how to exit [investments]. And people are willing to fail and start again. There is a great natural market there".

These comments are revealing for two reasons. The first is that they depict Silicon Valley as a dynamic system in which the "soft" or inter-personal factors are as or perhaps even more important to technology innovation than the hard physical assets. Although the hardware of universities and national laboratories is important, it is the people who occupy these institutions and provide mentoring, motivation, skills and intellectual capital which

provide the most benefit. The importance of dynamic migrant populations is something which is also supported in the case study research of Saxenian (2008).

Secondly, these comments emphasize the importance of culture in fostering venture investments. When asked why Europe has fallen short of attracting the financial returns and volume of venture investment that the United States has, a number of investors pointed to culture as an explanation. One US national who has moved to the UK and worked in European VC for the last two decade made this comment:

> "The problem is fundamentally that for a whole bunch of reasons European VCs have historically been risk averse and that has stopped them from making good returns which has made them more risk averse again, and it's been a vicious cycle. Some have tried to break this cycle …but there are not many. It requires investing seriously and aggressively."

Beyond culture, public institutions providing access to capital on the public markets have also been a source of blame. Although research has been done into access to bank financing versus public market financing across Europe (Martin, Sunley, and Turner 2002), relatively little has been done into the various types of public markets accessible in Europe compared to the United States. In the United States, NASDAQ has been the main market for listing for mid-sized technology companies who are unable to list on the mainstream markets. In the United Kingdom, the Alternative Investments Market (AIM) has sought to provide a similar alternative to the London Stock Exchange. However, many have found AIM an unsatisfactory alternative and this has blocked capital raising for technology firms. One describes it has follows:

> "AIM has been a failure. It is too small, too illiquid and too many companies listed which didn't know what they were doing. There have been more people trying to delist from AIM than list. This is something the US has over Europe."

Some European investors, however, are less pessimistic about the fate of AIM for European venture capital. They feel that access to small-cap public markets is not an impediment for Europe and that there will be a reversion of Europe's decentralized public markets.

> "As public markets come out of the deep freeze [of the recent financial crisis] I think we will see the emergence of other European and local exchanges. We'll see more activity on things like the Euronext and the Neumark in Germany for example."

These comments offer some hope for regions seeking to support clean tech innovation outside Silicon Valley. They suggest that rather than the "model" for technology innovation in the United States being spread throughout the world, each region will find its own institutional and environmental settings which will best suit the deployment of venture capital investment in clean technologies. Clean tech is especially conducive to the localisation of venture capital models given the decentralized nature of the viable technologies discussed above.

There is some movement amongst US clean tech venture capitalists to respond to local opportunities which might exist beyond their borders. A number of US venture

capital firms interviewed were seeking to set up clean tech offices for their firm in China and India. These US investors have found that it is important to set up *local* offices in foreign countries rather than conduct activities from their US headquarters because of the stark differences between the regions. This is clear from the comments of one US investor responsible for setting up his firm's Chinese office:

> "I think most recognize that China is a huge potential market in all sorts of clean tech technologies…[But] my personal opinion is that to compare Silicon Valley with China is dangerous. I think you have to understand the idea of building businesses in the local context as opposed to trying to compare them."

The importance of local business conditions appears to be a particularly high priority in clean tech given the physical and regulatory geography component of the businesses involved:

> "If you look for instance at semiconductors, that is one example of a global industry where industry trends and customers are fairly global. When you look at sectors such as consumer or clean tech, I would make the assertion here that clean tech is much more local in nature because the markets [for sale] are frankly local. Particular examples are wind and solar technologies."

These opinions were supported independently by US VC investors entering markets in China and India. In all cases, the foreign offices of US headquartered firms employed local

staff, sourced deals locally, conducted due diligence locally, and ultimately used the local market as the first market for their product:

> "I used to screen deals for India in the Unites States five years ago. But we have recruited a team on the ground in China and in India now and they screen them."

These interviews with clean tech venture capital practitioners suggest that fostering clean tech innovation is a geographically decentralized activity. Rather than a US model being spread globally, each region is discovering its own institutions and settings which are conducive to new local industries. This does not suggest that venture capital can be replicated everywhere or that institutions do not matter – indeed, the United States remains the pre-eminent destination for clean tech investment according to the statistics of capital flow (see Figure 1). However, the globalization of this investment will require something more than the translation of these skills to foreign markets. Rather, local networks, culture, and institutions will all contribute to the local ecosystems of clean tech innovation which will emerge around the world as the demand of clean tech products grows.

6.5 Conclusion and implications

The central inquiry of this paper has been to better understand the levers for and barriers to technological innovation in the emerging clean tech sector. Identifying these characteristics is notoriously hard to diagnose not only because of methodological challenges in measuring innovation but also because the conditions for innovation are not always transparent and rarely quantitative (Rosenberg 1994). By "getting into the trenches" and interviewing leading investment professionals engaged in financing clean

tech innovation in the United States and United Kingdom, we have sought to empirically address this inquiry drawing on the tools used in the economic geography literature.

Our findings suggest that clean tech innovation is a unique process which faces barriers to private investment which differ from other technology sectors such as biotechnology and digital communications for a number of reasons. Firstly, the fact that the generation of electricity by clean technologies is dependent on the local physical environment means that the market is decentralized and localized. This impacts the ability to "scale up" a single innovation and distribute it globally.

Secondly, we find that regulation plays a crucial role in addressing the systemic barriers clean tech faces compared to conventional energy. While regulation often intersects with the private sector, in clean tech it plays a uniquely important role simply because the barriers to entry are so high. Indeed, we find no examples were clean tech innovation has entered the market unassisted by government intervention.

A key unique investment barriers we discuss is the capital intensity of clean tech deals given that deals have a mixture of high technology risk and large utility-style costs. Our close dialogue with investment professionals suggests that adoption externalities and information asymmetry are very real impediments to private investment in new ideas. These barriers are more severe in some regions compared to others because the underlying risk capital markets in North America compared to the United Kingdom are very different.

We also find that the tight ecosystem of technical and business skills, public sector support, expertise, and connections - many of which cannot be quantified in econometric data – are vital levers for clean tech innovation. They feed into the confidence of investors to put money behind ideas as well as the ability of entrepreneurs to sell their ideas into the marketplace. However, these ecosystems are not monopolised by the United States in the

case of clean tech. Given the highly distributed nature of clean technologies, regional niches are emerging for specific technologies such as wind technologies in Denmark, battery technologies in China, geothermal technologies in Australia, and so forth. The localization of clean tech innovation means that the geography of clean tech venture capital is much more decentralized than we see in other sectors.

These dynamics present both opportunities and challenges for nurturing clean tech innovation for both businesses as well as policymakers alike. The key point we seek to make is that both the market and government are required to act strategically to address the unique hurdles to clean tech innovation. In this way, neither a pure market based price mechanism nor a pure state centred regulatory approach is appropriate to develop and finance the hardware of the future low carbon economy. In seeking to identify the limits of where the market is able to operate unassisted and where the government should play a stronger role, we draw two broad conclusions for prudent policy making.

The first conclusion is that many early stage clean tech innovators do not regard carbon pricing as the solution to their financial hurdles. Although they face a number of barriers to promoting new ideas these are often based around uncertain payoff from risk technology and associated market failures. This supports the theoretical views of Acemoglu et al. (2009) that the climate challenge involves two distinct market failures of which the lack of a price for carbon is only one.

Our findings suggest that the market failures around climate change can be differentiated by the stage of maturity of the technology in question. For early stage technology investments, the market barriers are primarily around technology risk which is particularly acute in the clean tech sector. This failure is best addressed by well-targeted technology policy to remove the hurdles we have identified. However, once a technology

is mature, the relative cost of production compared to coal-fired electricity is skewered because of the failure to price carbon externalities. This failure is best addressed through direct pricing mechanisms. Thus, rather than a competition between price versus technology policy instruments (Porter and Linde 1995; Newell, Jaffe, and Stavins 1999), these policy tools must be seen as complementary and addressing different stages of the innovation process (Stern 2009).

The second conclusion is that appropriate responses to promoting clean tech technology innovation must be responsive to regional differences. It is not possible to apply the same policy to an equal extent across regions. For example we find that the depth and structure of venture capital markets appears to have a profound influence on the type of clean tech businesses which attract investment. Strong appetite for risk capital is conducive with early stage investments whereas other markets prefer later stage asset financing deals. This trend would need to be more closely examined in more detailed data across regions. We also find that different regions have unique advantages for certain technologies which could be fostered through direct action by governments. US venture capital firms operating in China and India for example find that they need to source deals and recruit personnel locally. This is consistent with the view that the market for clean tech innovation is not at all flat.

This paper has tried to focus on a few key issues which impact clean tech innovation in particular. However, further research is needed to examine these findings more closely both amongst different types of investors as well as within different geographies. Although we do not rely on econometric data to measure innovation, we do not believe this is necessarily a limitation for this research. As we have argued, the levers for innovation are often highly complex and hard to separate in multi-variable regression

modelling. While this may limit the extent to which we can generalize our findings, by focusing locally and digging into the trenches of clean tech innovation practices, this paper identifies how economic geography can be used to articulate the drivers for innovation and, by extension, areas for further government intervention.

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Figure 6-1. New clean tech VC/PE investment globally – by region

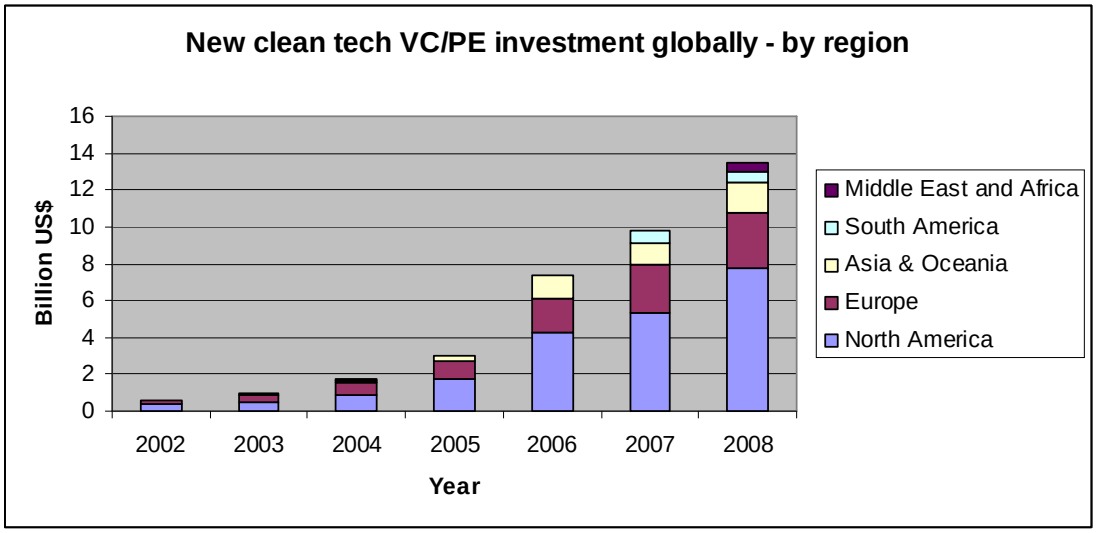
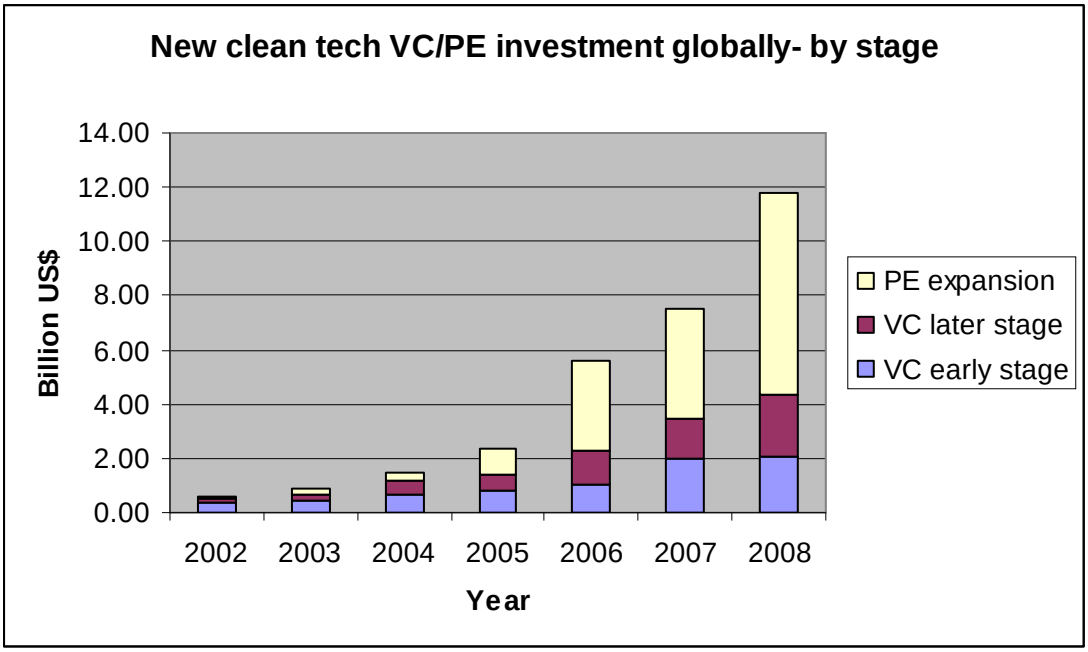


Figure 6-2. New clean tech VC/PE investment globally – by stage



Chapter 6 Appendix 1

List of Interview Participants

Interview Number	Date	Organization Label	Interlocutor Position	Interview Location
1	16/8/2009	Wheb Ventures	Investment Manager	Oxford
2	17/8/2009	Amadeus Capital Partners	Investment Manager	London
3	20/8/2009	Fidelity	Investment Manager	London
4	20/8/2009	Price Waterhouse Coopers	Project Financier	London
5	24/8/2009	3i	Investment Manager	London
6	25/8/2009	Signal Lake	Investment Manager	Washington DC (phone)
7	25/8/2009	Zouk Ventures	Investment Manager	London
8	25/8/2009	Capital for Enterprise	Investment Manager	London
9	27/8/2009	Solar Century	Business Manager	London
10	3/9/2009	Environment Technology Fund	Investment Manager	London
11	7/9/2009	Oxford Capital Partners	Investment Manager	Oxford
12	10/9/2009	Good Energies	Investment Manager	London
13	10/9/2009	Price Waterhouse Coopers	Project Financier	London
14	11/8/2009	Oxford Capital Partners	Investment Manager	Oxford
15	5/9/2009	Bessemer Venture Partners	Investment Manager	Palo Alto
16	7/9/2009	Draper, Fisher, Juvetson	Investment Manager	Palo Alto
17	7/9/2009	Draper, Fisher, Juvetson	Investment Manager	Palo Alto
18	8/9/2009	Levensohn Venture Partners	Investment Manager	San Francisco
19	8/9/2009	Physic Ventures	Investment Manager	San Francisco
20	8/9/2009	Masdar City	Business Manager	San Francisco
21	8/9/2009	Stanford University	Professor	Palo Alto
22	9/9/2009	Vantage Point	Investment	San Bruno

			Manager	
23	9/9/2009	Bessemer Venture Partners	Investment Manager	Palo Alto
24	9/9/2009	Armageddon Energy	Entrepreneur	Palo Alto
25	9/9/2009	Sequoia Capital	Investment Manager	Palo Alto
26	15/9/2009	Westly Group	Investment Manager	Palo Alto
27	19/9/2009	RRE Ventures	Investment Manager	New York
28	19/9/2009	Braemer Ventures	Investment Manager	New York
29	28/10/2009	Capital for Enterprise	Investment Manager	Sheffield
30	29/10/2009	Imperial Innovations	Investment Manager	London
31	5/11/2009	Foresight	Investment Manager	London
32	6/11/2009	Frog Capital	Investment Manager	London
33	6/11/2009	Wheb Ventures	Investment Manager	London
34	6/11/2009	Wheb Ventures	Investment Manager	London

Chapter 6 Appendix 2

Financing the gaps in clean tech businesses – interview questions

Research Focus

As governments and financial markets around the world seek to address the dual crises of global recession and climate change, the clean technology sector has emerged as a contender for growing fiscal stimulus and private investment.

Although venture capital has traditionally played a key role in financing early-stage technology in healthcare and ICT, the clean tech sector brings new investment challenges and requires new business models. This research aims to better define the investment theses driving clean tech investing by private equity and infrastructure investors. We seek to identify patterns in the kind of deals which are getting financed (stage of maturity/ technology/ size etc) and those deals which are being left behind.

Secondly, this research intends to identify those areas where the market fears to tread and where a heightened role for government intervention is required. We hypothesize that private money is avoiding early stage investments with high technology risks where the cost of demonstrating technology feasibility is high. We seek to interrogate the effectiveness of government initiatives (e.g. carbon regulation, feed-in tariffs, regional development funds, demonstration grants, technology incubators, etc) and identify public policies and institutions which might help bridge the equity gap and challenges facing the clean tech sector in particular.

Specific Questions

1. Investment thesis of your firm

How do you define clean tech and what investment strategy do you have for extracting value from the clean tech sector?

What are the drivers for your business and how do you source your deals?

What patterns can you observe from the deals you finance and the deals you let go in terms of stage of technology maturity/ size of deals/ business model?

Are the investment opportunities over the next 5-10 years to be found in developing new technologies, or implementing current technology, or both?

What do you see as the major challenges or hurdles in financing deals in the clean tech space?

Has the fund-raising appetite for ‘green’ investment weakened over the last 3 years more than general market sentiment? Is clean tech a bubble?

How do you see the investment case changing in the clean tech space over the next 10 years (e.g. do you expect a lot of market consolidation)?

Why do you think there is a big difference between the US and UK in terms of the funds invested in this sector? Is this fundamental or policy-driven ?

2. Public investment mandate

Are there gaps in the market where governments can or should play a greater role (e.g. financing high technology risks, public infrastructure funds, skills-training etc)?

Have government initiatives influenced the quality or quantity of your deal flow or your ability to invest/ follow on (e.g. carbon market regulation, R&D programs, feed-in tariffs, stimulus packages, tax breaks or subsidies)? Do you see these as economically sustainable?

What kind of policies and public institutions are needed to meet the early-stage clean tech equity gap while avoiding public sector inefficiencies?

About the Researcher

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Chapter 7 | Conclusion

7.1 Introduction

This thesis is at the intersection of two of the most challenging issues facing our generation: the functioning of global financial markets and the problem of global climate change. In this thesis I seek to examine the interaction between these two issues. Specifically I am concerned with the impact of climate change on the role and operation of global financial markets; as well as the role financial markets play in the solution to climate change. This thesis straddles both these issues by examining the axiomatic principles which underpin global financial markets. I apply the analytical rigour of economic and financial geography to derive significant findings about how financial markets can respond to climate change as well as provide the solution to climate change.

This thesis has been researched during a period of immense public attention to both these issues. In 2006, the publication of the Stern Review on the Economics of Climate Change for the first time put an estimated economic price on the cost of inaction in the context of climate change. This was in response to the growing momentum in the peer-reviewed scientific community on the anthropogenic origins of climate change. In 2007, this led to the award of the 2007 Nobel Peace Prize to international political campaigner Al Gore and the body of scientists at the Intergovernmental Panel on Climate Change. The political momentum built up by these events influenced the election of Prime Minister Kevin Rudd in Australia and President Barack Obama in the United States of America. This momentum culminated in the goodwill brought to the negotiations for a new international agreement under the United Nations Framework on Climate Change in

Copenhagen in December 2009. By all accounts, these negotiations failed to meet their public expectations.

At the same time, the period between late 2007 and the present has witnessed one of the starkest global financial crisis in recent decades. Global capital markets have been struck by the most severe credit freeze in recent memory. Large private institutions such as Freddie Mac and Fannie Mae in the United States and Northern Rock in the United Kingdom have been bailed out by government coffers, and one of the largest investment banks in financial history, Lehman Brothers, declared bankruptcy in September 2008.

These two issues – climate change and the financial crisis – were not ostensibly connected. Yet, beneath the surface, this thesis argues that there are systemic issues in the operation of financial markets which make them vulnerable to the kind of shocks posed by climate change. Similarly, the technological solutions to climate change which financial markets will facilitate will require more sophisticated thinking than the operation of simple neoclassical price instruments on carbon. In this concluding chapter, I draw together my findings and comment on the broader implications of this thesis. I will first highlight the principal findings of this thesis according to the four substantive chapters of this thesis. I will examine how these contribute new insights into the existing literature. I will then extrapolate from these findings to suggest the broader relevance of this research for financial markets and addressing climate change into this century. The final section of this chapter will point out how the limitations of my thesis can be addressed in future research.

7.2 Principal findings and contribution to the literature

This thesis argues that as well as being vital to the mobilization of global capital, financial markets are imperfect systems which are prone to booms and busts. At the heart of tackling financial market imperfection is the role of information in connecting the local

issues facing companies with the global preoccupations of macro investors and hedge funds. In the drive towards greater and more detailed information disclosure in financial markets, this thesis argues that information on climate change related risks looms as one of the major issues for reform. I argued that there is scope for not only more information disclosure in financial markets on climate related risks, but also better interpretation of those risks by financial intermediaries.

This thesis then proceeded by investigating how economic geography features in two important financial markets impacted by climate change. Firstly, in the publicly listed markets for energy utility stocks I argue that market structure has an influence on investment flows in the presence of a carbon market. This finding is based on empirical analysis of the first phase of the European emissions trading scheme. Secondly, in the clean tech private equity market I argue that physical and regulatory geographies have a significant impact on the investment proposition of clean tech private equity investments. This explains the pooling of clean tech private equity in certain regions. Also, capital market conditions for risk capital have an important influence on the location of clean tech venture capital investment. In order to provide a more detailed summary of the principal findings in this thesis and the contributions it makes to the academic literature, I have summarized the key findings as follows.

In the literature review (Chapter 2), I argue that an economic geography perspective informs an analysis of financial markets as both local and global spaces. On the one hand, the growth of asset securitization since the 1970s, the role of brokerage technology in interlinking capital markets across borders, and the emergence of mega institutional investors such as pension funds epitomize the globalization of financial markets. On the other hand, finance remains mercurial in its patterns of flow and

agglomeration (Clark 2005). Location matters in finance because it helps bridge the asymmetric information barriers in the market place and gives certain investors 'an edge' in an inefficient market setting.

By exploring the contrast between the global and local in financial markets, I rely on the insights of Clark et al. in response to the recent financial crisis (Clark, Dixon, and Monk 2009). However, I extend on this by drawing analogies between the current financial crisis and the future challenges of climate change. Like the weaknesses of the sub-prime credit rating processes, climate change injects a financial risk in capital flows which is not fully understood but will vary across geography and regions depending on their respective vulnerabilities to the physical (and indeed regulatory) impacts of climate change. To the extent that financial actors fail to actively engage with the apprehension and interpretation of these risks, then financial markets are susceptible to a systemic failure. This systemic failure is represented by the gap between the local risk/return profiles of investments on the ground, and their traded value according to fast-moving valuations of geographically distant investors. The principal conclusion of this chapter, therefore, is that economic geography lies at the heart of financial market imperfection.

In the first substantive chapter of the thesis (Chapter 3), the role of information in bridging the gap between local and global in financial markets is examined. Specifically, we examine the role of information which traditionally may have been regarded as extra-financial information such as prospective environmental, social and corporate governance risks facing a particular asset.

The legislative process behind the recent passage of the UK Companies Act 2006 is examined. This Act mandates the disclosure of environmental, social and corporate governance information in annual reporting. We argue that this represents an attempt to

address a market failure in the operation of mainstream financial markets. In this way, it is an extension of Anglo-American approaches to shareholder rights which value the importance of efficient market pricing. This is in contrast to an alternative approach adopted in continental Europe towards a stakeholder approach to the modern corporation. Such an approach would support information disclosure for different reasons – to preserve ethical and social objectives for the corporation.

This chapter charts a new course in the academic literature which distinguishes the ethical motivations in the CSR literature from the price-based motivations in the economics literature (Conley and Williams 2005; Fama 1970). By identifying the legislative provisions of the UK Companies Act within the latter literature, we contribute to a new understanding of the role of "extra-financial" information on mainstream corporate valuation. Disclosing information is the first step towards closing the gap between the local extra-financial risks facing companies and the interests of global institutional investors. This chapter therefore sets up the intersection between financial markets and climate change more broadly around the issue of information and asset pricing.

In Chapter 4 we describe the relational geography of the institutional investment process. Financial markets are revealed to be more than the sum of information, mathematical models, and money transfer technology. Rather they are intricate networks of human and institutional relationships, relying on the judgement of investment analysts who act on behalf of asset owners.

In this ecosystem of institutional investment decision-making, we locate the investment consultant as both a gatekeeper and a follower. They are gatekeepers to the extent that they provide third-party, arms-length advice to pension fund trustees on the

management of pension fund wealth. Simultaneously, however, they are beholden to their clients (pension fund trustees) and the variety of expectations they have around (short-term) returns, investment strategies, and so forth.

Our principal findings are derived from questionnaire surveys completed by six leading investment consulting companies. These questionnaires focussed on how the respondents treated environmental, social and corporate governance risks in their investment analysis and advice to pension fund clients. Although few in number, the responses serve as valuable case studies on how these issues are regarded by the leading investment consulting companies.

The principal findings were that there was a stark distinction in the quality and depth of understanding of the above issues across the various consultants. Whereas the same consulting companies led the field in terms of number of staff employed, understanding of the issues, and investment practices adopted, other companies disregarded these issues as optional, ethical considerations. This suggests that there is inertia in the culture and intellectual understanding of some key institutions on how these risks will impact financial markets over the medium to long term. The unwillingness to extend the gaze of investment management beyond the short-term was reinforced in some cases by remunerative practices which gave financial incentives for short-term returns.

These findings extend the literature on pension fund governance by turning the analytical gaze on investment consultants who have been relatively under-examined in academic research. Much of the professional services literature has focussed on pension fund trustees (Ambachtsheer, Capelle, and Lum 2008; Clark 2000), law firms (Falconbridge 2007), advertising companies, or other financial service firms. This chapter also offers empirical examination of an issue which has otherwise been the focus of

theoretical examination in the legal and investment management literature (Woods forthcoming). Notwithstanding the importance of this theoretical approach, the advantage of an empirical methodology is that the relational geography of investment management and the practical challenges to changing investment decision-making are made more acutely obvious. These findings are also supported in the recent work of Guyatt, which has also sought to conduct empirical research on the institutional investment process (Guyatt 2007, 2006).

The introduction of carbon markets have emerged as a key regulatory response to climate change. Carbon markets put a price mechanism on carbon and are intended to force companies to adapt by investing in new technology. Europe is currently the only region with an operational carbon market scheme known as the European Union Emissions Trading Scheme (EU ETS). In Chapter 5, we examine how the EU ETS influences stock prices for energy utilities companies which are listed on Europe's capital markets and are affected by the price of carbon

Applying a time series economic regression using data sets on stock prices, carbon prices, and individual company level data, I argue that carbon prices impact stock prices differently across borders. Specifically, I argue that the energy market structure within which an energy utility operates impacts the ability of that utility to pass carbon prices through to electricity prices. This suggests that rather than carbon markets operating as a single harmonized market for energy market transition, carbon markets have implications for financial markets which vary across geography.

Notwithstanding limitations to the construction of our econometric model, this chapter contributes to the relatively sparse empirical literature on carbon markets. Although much has been written on the theoretical operation of carbon markets (Sijm,

Neuhoff, and Chen 2006; Smale et al. 2006), there has been relatively little analysis of how these markets work in practice (Veith, Werner, and Zimmerman 2009; Oberndorfer 2009).

In taking an empirical approach from the perspective of economic geography, this chapter also extends the economic geography literature on carbon markets. Knox Hayes has focussed on the institutional infrastructure behind carbon markets with a particular focus on the development of carbon markets in Europe and the United States (Knox-Hayes 2009b, 2009c). By contrast, this chapter focuses on the geography of capital flow as measured by stock prices as a result of a inter-jurisdictional carbon market. The importance of geography has implications for the construction of carbon market policy by governments around the world as will be considered in sections 7.3 and 7.4 of this chapter.

If Chapter 5 examines the 'top down' approach to climate policy via a carbon market, Chapter 6 examines climate policy from the 'bottom up' by examining the financing challenges facing new technology investment in the clean technology space. Price policy (the top down approach) and technology policy (the bottom up approach) are *both* necessary to find the technological solutions to addressing climate change (Stern 2009). However, I argue in this chapter that commentators have under-estimated the geographical complexities involved in a robust technology policy for climate change.

Extending upon descriptive statistical analysis with close dialogue interviews on both sides of the Atlantic, I argue that clean tech financing presents a unique geographical challenge. Firstly, unlikely other sectors like biotechnology and information communications, the technological solutions to generating renewable energy are dependent on the physical environment for their yields. This means that each technology will operate differently in different physical conditions and therefore the technological solution is

necessarily decentralized. This makes the business model for clean tech very different to, for example, biotechnology or information communication technology. The global appeal of these products means they have very low market risk once the technology is developed.

Secondly, I argue that clean tech financing is highly contingent on regulatory geography. A number of the clean tech investors interviewed reiterated the importance of feed-in tariffs and regulatory measures for providing an end market for their products. By contrast, carbon markets were considered uninfluential at the early stages of technology development. This finding is important because it indicates that clean tech financing will cluster in different pockets around the world where the regulatory environment (amongst other things) is favourable.

A third finding in this chapter is the importance of proximity and location in developing technologies from concept to commercialization. A number of investors argued that it was critical to retain a close working relationship with the management of these small businesses and to provide a individually targeted financing strategy for their particular commercial needs. The importance of proximity restricted the ability of even the largest venture capital funds in Silicon Valley from "going global". Where US venture capitalists sought to enter the markets in India and China in the clean tech space, they found they needed to recruit local staff, source local deals, and sell into domestic markets.

These findings are an important contribution to the policy discussion on optimal climate change policy. They redefine macro-picture perspectives on technology policy put forward by Stern (2009) and others which understate the importance of local solutions to technology finance. These findings also extend the existing literature on the geography of venture capital and innovation to the unique settings of the clean tech sector. Although Feldman et al. have commented on the importance of tight ecosystems for skill-sharing

and management expertise in the path towards commercialization (Feldman, Francis, and Bercovitz 2005), the particular role of regulatory and physical geography for clean tech investments is a unique contribution.

7.3 Broader implications of the thesis

The principal findings of this thesis arguably have a broader implication beyond the economic geography literature. In particular, they go to the question of effective environmental governance in the context of climate change. The bigger policy issue at stake in this thesis is the viability of market based solutions to climate change given the challenges it presents between nations as well as between generations. The main implication expanded upon below is that a market based approach to addressing both climate change mitigation and adaptation *also* requires the role of direct action by government to correct market imperfections. Markets are not able to perfectly interpret the complex information at work in the market place. As a result, faith in market based approaches much be accompanied by strong and appropriate government intervention.

The strong support for markets playing a role in addressing climate change continues the rise of economic rationalism as the dominant theme in public policy and economics over the last twenty five years. This approach places faith in the organizing principle of markets to allocate finite resources efficiently and spur innovation in new technologies. The alternative approach to environmental governance places faith in the organizing power of the state to manage the transition to a low carbon economy. For some commentators, although the state is an imperfect entity for environmental change, it is a less conflicted entity because it resists the “marketization” of the environment (Newell 2008).

These two approaches are not necessarily mutually exclusive. Indeed, governments are able to support a mixture of *both* approaches to effectively address the tragedy of the commons in which finite resources must be rationed between a growing global population. However, one of the implications from the analysis in this thesis is that the application of market based principles to address climate change is by no means a simple or predictable process. It is insufficient therefore to argue that market based approaches to mitigating or adapting to climate change simply involve the application of a price mechanism on carbon. Rather, this thesis has examined a plethora of other factors including market structure, physical environment, regulation, and capital market characteristics which influence how a price signal operates across economies and geographies. These issues must be attended to in order to understand the implications of a market based approach to environmental governance. This, then, is the first broad implication of this thesis.

In order to mediate the role of markets in environmental governance, this thesis has focussed on the role of information to bridge knowledge gaps. These gaps broadly exist between the global and the local: between government decision-makers and locally affected communities; and between institutional investors and companies responding to daily events. An important policy implication from this thesis is that there needs to be greater disclosure of the risks (both physical and regulatory) to businesses in the context of climate change. Voluntary initiatives such as the Carbon Disclosure Project are beginning to fill this gap, albeit in a piece-meal fashion. Regulation such as the UK Companies Act 2006 also attempts to formalize this process. The most recent regulatory change has been a move in February 2010 by the Securities and Exchange Commission in the United States to require public companies to disclose “material” information related to climate change.

These should be regarded as positive reforms by regulators and, as argued in Chapter 3, essential to the efficient operation of financial markets into the future.

However, a broader implication from this thesis is that even if information is disclosed to the market place to respond to climate change, there is no guarantee that market agents are able to deliver. This suggests that direct government intervention will necessarily continue to play an important role in environmental issues, even if this role is at times simply supervisory.

In this thesis, the shortcomings of market agents are examined in the role of investment consulting companies in understanding and advising on the ESG risks facing their clients' investments. The failure of market agents to respond to these systemic risks facing businesses around the world bears some resemblance to the market failures which have characterised the recent global financial crisis. By failing to apprehend systemic risks in the underlying credit-worthiness of assets (in the case of the financial crisis, sub-prime mortgages), global capital markets are susceptible to crisis when the gap between 'real' and 'traded' values comes to light. An important implication from this thesis is that asset owners such as pension funds and mutual fund investors must be more proactive in monitoring the performance of their managed funds. By applying the right kind of long-term incentives, asset owners are able to force financial intermediaries such as asset managers and investment consultants to closely consult long-term systemic issues like climate change. However, in the absence of asset owner activism, the drive towards short-term returns threatens to sustain and prolong the myopic behaviour of financial agents (Clark 2010).

The final broader implication of this thesis goes to the construction of an appropriate policy programme to mitigate climate change. On the mitigation front, an

assumption in this thesis is that climate change is caused by anthropogenic carbon emissions and that mitigating climate change involves reducing these emissions. A market based approach to this problem is to introduce a carbon emissions trading market as discussed in Chapter 5. However, even when information on carbon emissions is disclosed to the market, understanding the impact of that information on a company's bottom line is extremely complex and shaped for various economic geography drivers. Notwithstanding this, it is far from certain that a carbon price alone is sufficient to change the microeconomic investment decisions of new technology investors. As I examine in Chapter 6, the development and staging of technology policy around private equity investment in clean technologies is vital to the development and commercialization of solutions to address climate change.

Examining the behaviour of clean tech venture capital and private equity investors, I argue that there are a number of investment barriers to clean tech innovations which are unrelated to the price of carbon. These barriers are closely related to the geographical drivers behind clean tech investment. The implication of this is that appropriate climate change policy will require both a carbon price mechanism *and* direct action to kick-start microeconomic investment. Indeed, the importance of direct action such as subsidies and feed-in tariffs is discussed in detail in Chapter 6.

From the empirical findings in Chapter 6, it may be possible to infer that governments must *stage* the introduction of a carbon market in order to facilitate effective energy market transformation. In the first instance, it appears that direct action policies are needed to remove the investment barriers posed to clean tech investment by geographical variables (such as shortage of risk capital, perverse policy incentives, amongst other considerations). It is only once these factors are addressed that a carbon price signal can

operate in such a way to change production decisions at the margin. However, without these earlier stage issues being addressed first, the introduction of a carbon price risks a direct transference of price onto consumers without a competitive market for alternative energy solutions. If this inference is accurate it has important implications for how governments should stage the introduction of appropriate climate policy.

7.4 Future research

As described in Chapter 1, this thesis applies a mixed method approach to address the challenges facing financial markets in the context of climate change. By attempting to grapple with new and sizeable issues, it has left open a number of areas in which future research can go into greater depth.

A future research agenda would try to expand on the theoretical contributions which economic geography can make to the debates around climate change economics and financial crises. This thesis has tackled the theoretical issue by considering the local/global tension in financial market operation (Clark, Dixon, and Monk 2009). However, there is room for greater elaboration here. In particular, economic geographers are well placed to contest the universalizing theories of climate change cost projections and carbon pricing signals which macroeconomists have been more than willing to engage in. Notwithstanding the importance of macroeconomic modelling and projections, it is necessary to recognize the shortcomings of this approach especially with respect to the regional and sector-specific hurdles facing companies and individuals.

This leads to a second area for future research – an expanded empirical research agenda on how financial markets are responding to the challenges of climate change. Empirical research makes a valuable contribution to social science inquiry. While it is less able to verify general or abstract principles, it is able to clarify the application of principles

within a particular case study. These case studies may be located at the region, country, company or indeed individual level. In this thesis, the case studies examined are necessarily focused in their scope and scale: energy utility stock prices under the EU ETS, and clean tech private equity in North America and the United Kingdom. A future research agenda would seek to extend these case studies into new regions and sectors to gain a more holistic picture of financial market operation. Such an approach would be aided by the employment of both quantitative and qualitative methodologies, as pursued in this thesis. Given that climate change is a global phenomenon, it is important for the implications of climate change to be carefully understood on a regional basis and for the research to focus as locally as possible. This would be the focus of future research.

A third potential area for future research is on the adaptation side of climate change. This refers to responses to the physical effects of climate change on the economy and is largely unaddressed in this thesis. This omission would be addressed in a future research agenda as the physical effects of climate change on the local economies and communities are poorly understood at present (Thornes and Randalls 2007). This is partly because historical weather event data is a poor predictor of future extreme weather events. Also, data on the probability of future extreme weather events is often the property of global insurance and reinsurance companies. The 'commoditisation' of nature through the proprietary ownership of such data has important theoretical implications for environmental governance which are beyond the scope of the present thesis (Randalls 2009). A future research agenda would seek to examine this area in greater depth. It would seek to understand what implications public disclosure of such information would have on financial markets and policy development.

Finally, a focus in this thesis has been the development and deployment of clean technologies in the developed economies of Europe and North America. However, as these technologies come to market, the global economy will face the challenge of deploying these technologies at scale in the world's developing countries. The scale of infrastructure finance required to achieve this feat is immense and represents one of the greatest business and policy challenges of the future. The challenge of raising and deploying such volumes of finance has arguably been the cause for stalemate in the international negotiations under the United Nations Framework Convention on Climate Change.

Over the course of my thesis, I have engaged in additional research with the Organisation for Economic Cooperation and Development in Paris, France, the Australian Treasury, and the World Bank in Jakarta, Indonesia to address this challenge. This has led to the publication of the policy paper *What Role for Public Finance in International Climate Change Mitigation* which informed the international negotiations in Copenhagen in December 2009 on strategies to address the international financing challenges around climate change (Doornbosch and Knight 2008). I have also advised the Ministry of Finance in Indonesia on these issues and have been engaged in a report for the World Bank on the future of climate finance for countries in the Asia Pacific Economic Cooperation region. A future research agenda would seek to extend on the academic and policy implications of this work. Specifically, it would examine the challenges facing infrastructure financiers as they seek to roll out proven technologies at scale in developing countries. The challenge here is both one of financing as well as one of economic development. It requires direct public investment, regulatory intervention, and significant volumes of private finance. The challenge of coordinating these three issues is the natural extension on the private equity research examined in this thesis.

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