RESIDENTIAL REAL ESTATE INVESTMENT IN EMERGING ECONOMIES: THE CASE OF GHANA

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DEDICATION

To my family:

Evelyn

Genevieve

Michelle

Wilfred (Junior)

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To God be all the glory!

DECLARATION

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ABSTRACT

Although it remains small compared with advanced economies, in Ghana there is a growing residential stock which constitutes the basis of an emergent real estate investment market. Much of the recently constructed stock is income-producing rented accommodation, and falls in the formal sector of the market – where sale and leasing transactions are systematically documented in the records of the Ghana Land Valuation Board.

The research presented in this thesis makes several contributions to knowledge and understanding of residential real estate markets in Ghana. First, and most fundamentally, it demonstrates that it is feasible to construct technically robust indicators of residential market performance from the records held by state agencies, through the construction of hedonic models which suggest processes of price determination are consistent with those found in other countries. Time series produced from these models, running from 1992 to 2007, document for the first time trends in capital values, rental values and investment returns for a substantial part of the Ghanaian residential market.

This thesis also explores practical applications of the newly created residential performance indices. The current research examines the differentials in price determination and performance across the main submarkets of the Accra-Tema conurbation, the dynamics of change in market prices over time against economic and financial indicators, and the returns achieved on residential investment compared with Ghanaian equities and Treasury Bills.

The results demonstrate that the residential market has seen strong rental and capital appreciation over the past fifteen years, yielding investment returns ahead of the high rate of general inflation. Compared with other Ghanaian asset classes, residential real estate shows both a rate of return and a level of risk which sit between those on fixed income and equities investments, in line with fundamental theory and experience in other countries. As in other countries, residential real estate returns show low correlations with those on equity and fixed income investments, suggesting a strong case for real estate in a multi-asset portfolio.

Beyond the Ghanaian market, this thesis suggests the process of constructing residential indices from records held by state land registration and taxation authority may be replicable in other African countries where there are similar systems of land administration and management, provided that the task of data assembly and validation is feasible.

CHAPTER 1 INTRODUCTION

The research in this thesis is a contribution to knowledge and understanding of real estate investment in emerging economies, in the form of an analysis of residential investment performance in Ghana. The work has three primary goals. First, to demonstrate the feasibility of collating useful primary data on residential investments from the paper archives of the Ghana Land Valuation Board. Second, to develop models of residential transaction prices and rental values which are sufficiently robust to create the first Ghanaian indices of residential market prices and investment returns, over a long enough run of years to provide useful research insights. Third, to demonstrate some of the potential applications of these models and indices in the analysis of residential price and rent determination, the performance of residential sub-markets, the dynamics of price changes, and the comparative performance of real estate against other Ghanaian assets.

The research focus is on the development of formal real estate markets through a detailed case study of Ghana, which it is hoped provides findings and models which may have a wider application in other emerging markets. In this research, formal real estate market refers to residential assets transacted on well-defined contracts that are registered with the state land registration systems. The primary objective of this thesis is to construct for the first time, and from original data sources, reliable measures of prices, rents, yields and total returns over time for investments in

income producing residential real estate. By using transaction-based data from the Land Valuation Board covering the years 1992 to 2007, the foundation of this thesis is laid by employing hedonic modelling to create indices of residential real estate values from the state land registration and valuation systems in Ghana.

Ghana is a West African country, with a population of 21 million (Ghana Statistical Service, 2005), bounded by the Gulf of Guinea to the south, Cote d'Ivoire to the west, Burkina Faso to the north, and Togo to the east. It was the first Sub-Saharan colony to gain independence from Britain on 6 March 1957. From 1966 to 1991, the country was politically and economically unstable, disrupted by a series of military coups. Constitutional reforms in 1992 have been followed by a period of stable multi-party democratic governance, and sustained economic growth.

On the World Bank's World Development Indicators, Ghana's gross national income per capita (purchasing power parity) in 2007 was US$ 1,330 – ranking 178th out of 207 countries. On this measure, it stood 11% below the average for countries classed by the World Bank as "low income", but 39% below the average for Sub-Saharan Africa (World Bank, 2008). The economy has seen a fairly steady progress in the ten years to 2007 (see Appendix 1.1). Real Gross Domestic Product (GDP) growth has been sustained and has run at an average rate of 5.1% per year through the ten years, rising to 6% per year through the last four years. GDP per capita has risen steadily since the early 1990s, growing at an average of 2.5% per year over the

ten years to 2007. Inflation, though still at 10.5% in 2007, has become less volatile and shows a downward trend since 1995.

This research is motivated by the view that real estate plays an important role in the development process for countries such as Ghana, and one that has received little attention in the literature on development economics, emerging market finance, or international real estate investment markets. Real estate markets contribute to economic development in a number of ways. A flexible and efficient supply of real estate is indeed, needed to support economic growth, and to attract inward investment in productive sectors. In the capital markets, the expansion of real estate stock and rise in its value form a major part of the accumulation of wealth associated with successful economic development. Those real estate values in turn represent a primary source of collateral for commercial banks to lend to individuals and enterprises. Real estate, in addition, is a major potential source of tax revenue for central and local governments, especially in Sub-Saharan African countries where cash-based informal economies hamper the collection of other forms of taxation. For example, the total revenue from stamp duty in Ghana increased by 573% from US$1,083,211 in 2000 to US$7,284,679 in 2007, an annualised increase of 31% per year in revenue over the seven year period (Land Valuation Board, 2008). Finally, as exemplified by the Asian crisis in the late 1990s, incorrectly priced and unstable real estate markets are major risk components for the banking and financial systems (Renaud and Mera, 2000).

Despite their importance, real estate investment markets in emerging economies, particularly in Africa, have received surprisingly little attention in the research literature. In Ghana specifically, a very small existing literature has focused primarily on the description of formal versus informal real estate market mechanisms with very little quantitative analysis of market performance. Although the growth models used in standard texts on economic development emphasise the role of savings and investment in the development process, the specific role of real estate in that process of capital accumulation is rarely mentioned. There is however, an extensive literature on what might be termed the foundation stage in the development of real estate markets – establishing legal title to land, and land registration systems. The second stage of the process – the development of investment markets – has been relatively neglected, and is the primary focus of this study.

Against this background, the current research seeks to achieve the following specific objectives:

First, establish as far as possible robust information on real estate values and trends in value over time for residential markets in the cities of Accra and Tema in Ghana;

Second, create and test residential price and rent models based on that data:

Third, construct indices for residential investment markets, the first ever for the Ghanaian real estate market;

Fourth, explore applications of the indices to the analysis of the residential investment market in terms of differentiation between sub-markets and linkages with the macro-economy;

Fifth, examine residential investment performance within a broader investment context, matching its return and risk against competing asset classes such as equities and Treasury Bills; and

Finally, propose improvements in the Ghanaian real estate market mechanisms and further areas for research.

It is hoped that this research will not only stimulate the development of the real estate investment market in Ghana but also act as a demonstration project for the application of the methodology in other African countries with similar land administration and management systems. Such systems – originally based on British practice – exist in countries such as Nigeria, Kenya, Uganda, and Tanzania.

The remainder of this thesis is divided into six Chapters. Chapter 2 is a literature review, which takes a general framework of theory and evidence on economic development, financial systems and real estate markets in emerging economies, with

a detailed review of previous studies on real estate markets in Ghana. Chapter 3 examines in detail the methods used in the construction of residential price and rent indices, and explains the choice of hedonic methods used in the empirical analysis.

Chapters 4 to 6 explain the data sources, results and conclusions on the original empirical work which constitutes the primary contribution of the current research. Chapter 4 describes the transaction data used in the analysis and then establishes original hedonic models of transaction prices and rental values, with several tests for robustness. From those models, annual price and rent indices are constructed which track the overall market's performance from 1992 to 2007. In Chapter 5, the price and rental models are further developed to produce estimates of yields and total returns in nominal and real terms. These measures are used to investigate variation in returns across sub-markets, and the linkages between investment performance and the wider economy. Chapter 6 examines the performance of residential markets within a broader investment framework, setting the performance of residential markets against Ghanaian equities and Treasury Bills. Chapter 7 summarises findings, discusses implications for policy and areas for further research, and concludes.

CHAPTER 2 REVIEW OF LITERATURE

This Chapter reviews literature on real estate as an investment medium in emerging economies, from several perspectives. First, it examines the treatment of real estate in the literature on economic development, noting the lack of attention to the topic in macro-economic development theory, but an extensive literature on land rights issues. Several real estate investment issues have also been raised from studies on individual markets and mixed asset portfolio with real estate and other asset classes included for developed countries. There is however, little evidence that these issues are of relevance in emerging economies (Sections 2.1 and 2.2).

Second, it looks at the literature on the role of real estate investment in the financial systems of emerging economies. Here there is a large literature on mortgage lending mechanisms for residential owner-occupation but relatively little work of direct relevance to the objectives of this thesis. Investment and financing structures have been studied mainly through the prism of financial "crises", and rarely in periods of steadier market evolution (Section 2.3).

Third, and in more detail, the Chapter reviews academic and industry research on emerging real estate investment markets, working from a top-down framework of

globalising real estate investment through work specific to African countries and Ghana (Sections 2.4 and 2.5).

Finally, Section 2.6 takes from previous research, unfortunately confined to developed economies, indicators of the performance of real estate investments, and residential real estate, against competing asset classes.

2.1 Real estate in economic development

Early theories of economic development, originating in endogenous and exogenous macro-economic growth models such as "Harrod-Domar and Solow-Swan" (see Solow, 1956; 1957) placed a strong emphasis on saving and investment, and thus on the accumulation of productive capital, as a primary factor in development. A country with a higher saving rate is expected to experience faster growth rate. Singapore, for example, had a 40% saving rate in the period 1960 to 1996 and annual Gross Domestic Product (GDP) growth of 5% to 6%, compared with Kenya in the same period which had a 15% saving rate and annual GDP growth of just 1% (World Bank, 2008). General texts on development economics (for example, Ghatak, 2003), however, make no specific reference to the role of real estate within that process of capital accumulation.

Since the 1980s, development economics has paid much more attention to institutional structures, and the barriers to development created by market inefficiencies, and the adequacy of institutional structures (Romer, 1990). In the land and real estate sector, these concerns are reflected mainly in the large literature on land rights, considered in Section 2.2.

Despite the importance of real estate to the total value of capital stock and investment flows, there are few sources which attempt to measure the total value of real estate stocks, or their size in comparison with other tangible or intangible assets, across countries at different stages of economic development. In developed economies, real estate is a large element of total capital stocks, and of total personal and corporate wealth (Miles, 1990; Miles *et al.,* 1991; and Miles *et al.*, 1994). At a global level, for example, Brown and Matysiak (2000) estimate that real estate – broadly defined as commercial and residential as well as farmland and other interests – accounts for 55% of the total value of wealth.

Prompted by the growing globalisation of real estate investment markets, a number of studies have attempted to estimate the value of "investible" commercial real estate stocks in developed economies. "Investible" real estate defined as high quality commercial stock excluding residential real estate makes up the bulk of the portfolios of institutional investors in advanced investment markets. Hughes and Arissen (2005), the most recent of these studies, uses a method originally developed

by Liang and Gordon (2003) to estimate the size of commercial real estate markets. Based on the small number of countries where reliable figures on the total real estate stock are available, the total real estate value is estimated as a simple function of GDP and GDP per capita, with further adjustment for geographically small but wealthy states such as Singapore.

Hughes and Arissen (2005) estimate a country's investible commercial real estate value by:

$$RE_i = GDP_i \times 0.45 \qquad [1]$$

for developed countries; and

$$RE_i = GDP_i \times 0.45 \, (GDH_i / 20{,}000)^{1/3} \qquad [2]$$

for developing countries

where:

RE_i = country investible commercial real estate value;

GDP_i = country Gross Domestic Product; and

GDH_i = country Gross Domestic Product per capita.

"Developed" countries are defined as those with GDP per capita above $20,000. "Developing" countries below this threshold include the lower income EU countries such as Portugal and Greece, and the transition economies of Eastern Europe.

For developed countries, investible real estate value is set at the fixed ratio of 45% of GDP (Hughes and Arissen, 2005). For developing countries, by definition,

investible real estate value is a rising diminishing function of GDP per capita, tending towards the limit of 45% at the threshold of $20,000 per capita. The estimation method is simplistic, excluding factors such as population density and planning regimes which might plausibly be expected to lead to varying real estate values for given levels of GDP and GDP per capita. But it quantifies the plausible propositions that, in terms of orders of magnitude, the value of real estate stocks is strongly associated with the size and wealth of economies.

For the "developing" countries covered by Hughes and Arissen (2005) the results suggest that the value of investible real estate value rises from 13% of annual GDP for the poorest countries covered (Vietnam), through to 42% in middle-income countries such as Greece (Table 2.1). The estimates also provide a basis for the comparison of the value of real estate stock with the total capitalisation of stock markets. Since the size of stock markets relative to GDP varies enormously, investible real estate as a fraction of stock market value in the developing countries runs from a low of 16% in Malaysia to 200% or more in Bulgaria, Venezuela and Slovakia. In developed countries, real estate runs from 20% of stock market value (Switzerland) to 95% (New Zealand). Extending the Hughes and Arissen (2005) formula to a full set of African countries puts the range in investible real estate value as a fraction of GDP from 8% in the poorest countries (Burundi and Ethiopia) rising to between 20% and 28% in the most prosperous (Algeria, Libya, South Africa and Botswana). The rate for Ghana is estimated at 15%.

Table 2.1: GDP, commercial real estate & stock markets (selected countries)

Country	GDP ($Bn)	GDP per capita ($)	Real Estate Stock ($Bn)	Stock Market Capitalisation ($Bn)	Real Estate as % of Stock Market	Real Estate as % of GDP
Vietnam	40	480	5	n/a	n/a	13%
India	583	548	79	450	18%	14%
Philippines	80	923	13	35	37%	16%
Indonesia	231	970	38	81	47%	16%
Ukraine	53	1,094	9	23	39%	17%
China	1,618	1,239	288	1,354	21%	18%
Colombia	86	2,041	18	30	60%	21%
Thailand	145	2,238	31	107	29%	21%
Peru	62	2,250	13	22	59%	21%
Romania	59	2,635	13	16	81%	22%
Bulgaria	20	2,662	5	2	250%	25%
Brazil	535	2,904	126	339	37%	24%
Russia	462	3,162	112	339	33%	24%
Turkey	244	3,546	62	104	60%	25%
Argentina	146	3,733	38	58	66%	26%
Venezuela	99	3,963	26	7	371%	26%
Malaysia	106	4,509	29	187	16%	27%
Chile	79	5,017	23	123	19%	29%
Poland	216	5,604	64	70	91%	30%
Slovakia	33	6,137	10	5	200%	30%
Mexico	654	6,235	200	220	91%	31%
Hungary	83	8,248	28	34	82%	34%
Czech Rep	91	8,847	31	38	82%	34%
South Korea	612	12,689	237	529	45%	39%
Taiwan	292	12,840	113	502	23%	39%
Slovenia	28	13,844	11	7	157%	39%
Portugal	146	13,893	58	64	91%	40%
Greece	173	16,227	78	128	61%	42%

Source: Hughes and Arissen, 2005

For selected emerging economies (Egypt, Haiti, Peru and Philippines) de Soto (2000) provides estimates of the value of real estate stocks at the opposite end of the spectrum measured by Hughes and Arissen (2005), focusing on the value of untitled

land occupied by the urban and rural poor. By estimating the cost of building materials and collecting selling prices of completed buildings through a survey, de Soto (2000) puts the value of Haiti's untitled real estate holdings at US$5.2 billion in 1995, representing nine times the value of all assets owned by the government and 158 times the value of all Foreign Direct Investment. In Peru, de Soto estimates the value of informally held rural and urban real estate to be US$74 billion, representing five times the total valuation of Lima Stock Exchange in 1998. Similarly, the estimated value of untitled real estate in the Philippines in 1997 was US$133 billion; four times the capitalisation of 216 domestic companies listed on the Philippines Stock Exchange, seven times the total deposits in the country's commercial banks, and fourteen times the value of all foreign direct investments. In Egypt, de Soto finds the value of the country's untitled real estate to be US$240 billion, thirty times the value of all shares on Cairo Stock Exchange.

The evidence on the market values of real estate stock across countries is thin, and particularly lacking on estimates for the residential stock in emerging markets. It is however, clearly established that the values of land and buildings are large relative to other asset classes, and they tend to rise through the process of economic development.

2.2 Land title and land registration

Though the role of real estate in the accumulation of capital and wealth which drives economic development is very lightly covered in the literature, there is a vast literature on the legal and institutional structure of land markets in emerging economies. One long-standing strand of research has concentrated on land ownership, land titling and the productivity of the agricultural sector (see Okoth-Ogendo, 1969; 1991; 1993; Bentsi-Enchill, 1975; Piermay, 1986; Chauveau, 1997; and Mathieu *et al.,* 1997). An interest in the institutional framework of land markets has been extended and refreshed by de Soto (2000) and his followers, who argue that the absence of legal title to land occupied by both the urban and rural poor in emerging economies is a critical cause of underdevelopment. This Section first gives a general overview of theory and evidence on land title, and then narrows the focus to research specific to African countries, and to Ghana.

Deininger (2003) provides an extensive review of research and policy on land titling and land registration issues. He argues that good land administration system provides benefits to individuals, communities, firms and nations. The economic benefits arise because modern cadastres improve credit security, raise agricultural productivity, increase the transparency of the housing market, and support land market analysis.

The argument for the benefits of land title systems is supported by a body of evidence on the productivity and values of land under secure and insecure titles. Feder (1988) argues that in Thailand, land ownership titles induced higher investment in farming capital, and titled land had significantly higher market values and higher productivity per unit. Farming output in Thailand was 14% to 25% higher on titled land than on untitled land of equal quality. Similarly, Dowell and Leaf (1992) find registered land in Jakarta, Indonesia to be worth 73% more than comparable land held by a weak claim. Feder (2002) measures land values on titled lands in 1996 to be 43% above values of untitled lands in Indonesia. For the Philippines, the study reports a margin of 56% in 1984, and 72% in 1996 for Brazil. The highest value difference of 81% for titled land against untitled land in 1988 is reported for Thailand.

While theoretical importance of tenure cuts across rural and urban sectors, research has concentrated on the former and often underestimated the importance of tenure in the latter (Werlin, 1999). De Soto (2000) adds a more general argument that lack of secure land title means that large amounts of real estate is "invisible and sterile" in the market place. In a survey of four emerging countries the research suggests that dealing in such real estate assets is extremely difficult because the law keeps them out of the formal real estate system. It further argues that, due to its fixed nature and indivisibility, real estate with secure, clearly defined, and easily transferable ownership rights is ideal collateral. Real estate registration, therefore, fixes

economic characteristics so that they can be used to secure commercial and financial transactions. The study also argues that recorded titles are needed to create credit and generate investment seemingly aims at bringing into the formal sector all real estate assets through proper legal registration. Overall, de Soto concludes that land titling is the bedrock to deploying real estate as collateral for access to credit, which in turn is a critical factor in the development process.

These far-reaching claims have not gone uncontested. Deininger (2003) observes that land titling is not necessarily equal to higher tenure security. Even where formal law decrees that land should be fully tradable, such legislation may be impossible to implement as in Kenya (Atwood, 1990). In the case of India, Pender and Kerr (1999) find formal proof of land ownership had little impact on credit supply, either because other factors strongly affected credit access by small producers or because foreclosure by banks is not an option. Deininger (2003) concludes that formal land title may not have an effect on access to credit in three situations: first, where the option of foreclosure is not feasible; second, where the necessary financial infrastructure and/or banking system that will lend to small producers are not available; and third, where the profitability of projects by potential users of credit is low.

Though the goal of tenure security is an important policy objective in most emerging economies, land administration systems have often failed to provide clear

titles, resulting in numerous boundary disputes and counterclaims of ownership rights (see Fred-Mensah, 1999 for Ghana; and Chauveau, 2000 for Cote d'Ivoire). Adlington (2002), and Sanjak and Lavadenz (2002), go so far as to suggest that land administration systems worldwide are characterised by institutional rigidities, overstaffing and corruption, which often seriously undermine public confidence.

Ghana falls in with the general historic development and current status of land administration systems described above. As in many other emerging countries, land registration systems have a long history. Woodman (1988) and Agbosu (1990), claim land registration in Ghana was first introduced in 1883 with the Land Registration Ordinance, followed by Land Registry Ordinance in 1895. Though these statutes form the distant antecedents to the current systems of land registration, they were created by the colonial administration mainly to protect land rights of minority white merchants. Even in the coastal areas where colonial interests in the land market were at that time most developed, plural tenures under which systems of common law enacted by legislation and customary law continued to coexist (Woodman, 1988).

A post-colonial Land Registry Act was passed in 1962 (Act 122). The Act had a nationwide coverage but, like its predecessors, it recorded only formal transaction deeds and did not register proprietary interests established under customary claims. In 1986, an extension of the system was introduced by the Land Title Registration

Law (PNDCL 152). For the first time, this law provides for systematic registration of all interests in land under both common law and customary ownerships.

By the late 1990s, however, the progress of registration was still been limited to the major cities of Accra, Tema and Kumasi. Even within those areas, the law prescribes systematic registration but its implementation remains patchy. The transition from Act 122 to PNDCL 152 has not been properly managed due to institutional bottlenecks such as lack of cooperation between land sector agencies, lack of capacity and resources, plus reliance on numerous, overlapping and often out-dated statutes (Ministry of Lands and Forestry, 1999).

To address these problems, the Government of Ghana introduced its first comprehensive national land policy in 1999 (Ministry of Lands and Forestry 1999). The National Land Policy sets out an ambitious long-term registration strategy, to be implemented over 15-25 years. The policy aims to:

> *stimulate economic development, reduce poverty and promote social stability by improving security of land tenure, simplifying the process for accessing land and making it fair, transparent and efficient, developing the land market and fostering prudent land management*
>
> (Ministry of Lands and Forestry, 1999).

The main tool for implementing the National Land Policy is the on-going Land Administration Project (LAP) under the Ministry of Lands, Forestry and Mines which seeks to co-ordinate the activities of six land agencies - the Land Valuation

Board, Lands Commission, Land Title Registry, Office of the Administrator of Stool Lands, Survey Department and Town and Country Planning Department (Ministry of Lands, Forestry and Mines, 2006).

Security of land tenure, supported by clear legal title is widely seen as critical to the efficient use of real estate as well as to economic development. Meanwhile, the extent to which land registration alone is a sufficient condition for an efficient real estate market remains debatable. Land titling may need to be coupled with rights to foreclosure and institutions willing to lend to borrowers to provide accessible credit for real estate investment in most emerging economies such as Ghana. Land registration systems in Africa and Ghana in particular remain partial and often inefficient.

2.3 Real estate and financial systems in emerging economies

This Section focuses on the role of real estate in the financial systems of emerging economies, specifically the development of market mechanisms and institutions for equity and debt finance. Work on the financial systems of emerging economies is most extensive in two areas: the performance of equity markets, viewed primarily from the standpoint of investors from the advanced economies (see Patel and Sarkar, 1998; and Bekaert and Harvey, 2003); and the development of residential mortgage lending institutions (see Jaffee and Renaud, 1996; and Menkhoff *et al.*,

2006). Work in equity markets is outside the scope of this thesis. The work on mortgage markets for owner-occupation is relevant in so far as it casts some light on financing mechanisms for real estate development and investment.

The large and long-standing literature on housing mortgage lending systems outside the advanced economies has been expanded since 1990 by work on the transition economies of Central and Eastern Europe. For that group of countries, Jaffee and Renaud (1996) question why rapid development of the banking sector in most transition economies has failed to take the lead in developing a housing finance system. Erbas and Nothaft (2005) suggest the failure is common to most emerging economies because home mortgage markets are not well-developed. Primary mortgage markets have not existed on significant scale in most emerging economies; the mortgage lending that occurs tends to serve only higher-income households.

Outside the advanced economies, the linkages between real estate and financial systems have attracted the attention of researchers primarily in the context of financial "crises", in particular the Asian crisis of the late 1990s. Indeed, the crisis generated a large volume of evidence on the financial structure of real estate markets in those countries through that period (for a review, see Mera and Renaud, 2000). Most countries in Southeast and East Asia recorded sustained and extremely high economic growth prior to the crisis. This phenomenal performance was

translated into the real estate market; as Foreign Direct Investment (FDI) increased, the economy grew, and the demand for high quality real estate also grew accordingly, which triggered off a rise in large rise in values, and flood of new development supported by bank lending. Mera and Renaud (2000), find bank exposure to real estate loans as high as 20% to 50% of all loans in these countries. The combined effect of the over-exposure of banks to real estate and the subsequent collapse of the real estate markets exposed the countries in the sub-region to economic and financial crises.

In other emerging countries, and above all in African countries, information on the status of real estate as an investment medium – its market value against other asset classes, its importance in the portfolios of institutional and private investors – is thin or non-existent. Similarly, there is very little literature on the availability of loan finance secured against real estate assets, or on the importance of real estate lending in the balance sheets of the banking system.

2.4 Globalisation of real estate and emerging economies

Recent years have seen a large rise in cross-border flows of real estate investment, and an even more dramatic increase in the flow of real estate capital from advanced countries into Asia and the transition economies of Central and Eastern Europe. This globalisation of real estate investment has been accompanied by a growth in

research on the real estate markets of emerging and transition economies, from both academic and industry sources. Firms of real estate intermediaries have also expanded the coverage of the standard market indicators available in mature real estate markets – such as rental growth, capital growth, price and rental indices, yields, total returns, and market stock – to embrace a widening range of "emerging" markets in Eastern Europe, Asia, and Latin America.

As with research on emerging equity markets, much of the work on these emerging real estate markets from academics as well as industry sources takes viewpoint of investors from the advanced economies. It focuses on questions like the ability of new markets to meet the standards of professionalism and transparency required by inward investors (for example, McGreal *et al.*, 2001 on Central and Eastern Europe; and Jones Lang LaSalle, 2004 on measures of transparency), or on the portfolio benefits of international diversification (for a general review, see Sirmans and Worzala, 2003).

The outcome is an expanded list of countries, which have begun to attract the interest of investors and researchers at the same level as the "mature" markets of North America and Western Europe. Seek (1995) gives one of the earliest characterisations of real estate market maturity for emerging countries, based on the strength and structure of the economy, foreign investment-levels and controls, market size, and quality of infrastructure. Specifically, for the South-East Asian

region, the study argues that real estate market evolution has been a function of city growth or urbanisation, emergence of the investment market and a profound shift in principal areas of the national economy. On these typologies, in the mid-1990s, Singapore was rated as the only advanced real estate market in the region. Research has emphasised the unique cultural and institutional factors affecting the operation of national real estate markets. In Thailand, the Bangkok prime office market was, for example, characterised by a dominance of family-controlled business organisations (Armitage, 1996), reinforced by a prohibition of real estate ownership-control by 'aliens', and severely affected by restrictions on repatriation of profits.

Keith *et al.* (2000) in a study of Central and Eastern European countries point out that the development of real estate markets has been constrained by a wide range of factors including lack of adequate legal framework and the lack of stable banking and financial services systems. These institutional constraints mean that transitional economies have less developed real estate markets than market economies with comparable per capita incomes. Thus, Belniak and Schwartz (2000) describe the Polish real estate market as under-developed in comparison with the equity market, and the volume of real estate transactions, as minuscule given the size of the country. The study suggests real estate transactions are hampered by insufficient legal documentation, weak real estate professional advisory services, and characterised by difficult access to land and mortgage registers. It concludes that

real estate transactions in Poland are extensively influenced by inflation and high mortgage rates with limited supply of mortgage finance.

In a qualitative comparative study, McGreal *et al.* (2002) examine the evolution of real estate investment markets in three Central European countries of Hungary, Poland and Czech Republic, and find a thin investment market in each of the selected capital cities. The development of real estate markets in those countries, it is argued, has been constrained by a number of issues including risk factors associated with the lack of real estate registration systems. Similarly, Kaganowa *et al.* (2005) find real estate markets in emerging economies to have poorly developed systems of data collection, access and dissemination. Commenting on real estate investment markets in transitional East European economies, Adair *et al.* (2004) conclude that:

> *Data transparency is a key characteristic of a mature market, and markets that are able to demonstrate that they possess such data have a competitive advantage and are more likely to attract private sector investment funds.*

The most systematic and extensive classification of real estate markets by indicators of data transparency and other measures of "maturity" can be found in a "Global Transparency Index" produced by Jones Lang LaSalle (2004, 2008). The construction of the Index embodies the factors considered important by global real estate investors. The Global Transparency Index (GTI) is a weighted score of subjective ratings by Jones Lang LaSalle staff covering five sets of factors – the

availability of accurate financial and market information, the regulatory and legal environment, the security and enforceability of real estate ownership rights, financial disclosure and governance of listed real estate companies, and zoning and building regulations. Only two African countries – South Africa and Egypt – are covered by the GTI.

An indication of how most African countries are not covered by the GTI might rank in the perceptions of global real estate investors and can be estimated by cross-referencing with the wider country coverage of the World Economic Forum's "Global Competitiveness Index" (World Economic Forum, 2008). Across the countries where both are available, scores from the two systems correlate strongly (0.82). Ukraine, the lowest ranked country on the GTI, scores 4.09 on the Global Competitiveness Index (GCI). All African economies except Algeria, Morocco and South Africa are ranked as less competitive than Ukraine with, for example, scores of 4.25 for Botswana, 3.81 for Nigeria, and 3.49 for Zambia. Ghana is ranked 102nd out of 134 countries covered by the GCI, with a score of 3.62. The comparison suggests that African real estate markets, with the exception of Algeria, Morocco and South Africa, are currently well outside the investment horizons of mainstream global real estate investors.

Real estate market size, though it is not incorporated in the Jones Lang LaSalle Transparency Index, is a further factor bearing upon the interest of global investors.

Markets which are small in total value are less likely to offer investments in the large lot sizes, or the levels of liquidity preferred by these investors. The rankings of countries on this criteria produced by industry sources (Jones Lang LaSalle, 2004; 2008) include Europe, North and South America, Asia but exclude all but two African countries (South Africa and Egypt). Applying the formula by Hughes and Arissen (2005), based on GDP and GDP per capita (given in Section 2.1) to African economies, yields a rough estimate of the value of investible real estate in each country, which can be compared with those in other markets currently attracting the interest of global investors.

In total, the value of investible real estate in 49 African countries in 2006 (including the most transparent markets of South Africa, Egypt, Algeria and Morocco) using the formulae in Hughes and Arissen (2005) is estimated at US$139 billion, representing only half the comparable total for the Netherlands. South Africa, by a large margin the largest single African real estate market accounts for 40% of the total for the continent, but still ranks as a real estate market equal to no more than three-quarters of the size of Ireland. With US$2.7 billion total investible real estate value, the estimated figure for the nascent Ghanaian market represents in turn only 3% of the total for South Africa (US$91.3 billion).

A large increase in global real estate capital flows has, in the last decade, been a major factor increasing the transparency and information of a set of "emerging" real

estate markets. The business environment and the size of higher-quality real estate investment stocks, in African markets (with the exception of South Africa) place them well outside the investment horizons of these investors. For the immediate future, therefore, the evolution of African markets is likely to be driven by domestic rather than foreign capital flows.

2.5 Real estate markets in Africa

For the reasons given in Section 2.4, African countries lack active investment markets, and to a large extent the primary sources of market evidence, which shape real estate research in the advanced economies and in a growing list of transitional and emerging economies. Only two of the firms of global intermediaries – Knight Frank and Investment Property Databank (IPD) – produce market indicators for African countries.

Knight Frank Research (2007) provides key performance indicators –yields, rental growth, total returns, market stock, and sale prices – for major cities in nine countries (Botswana, Kenya, Malawi, Nigeria, South Africa, Tanzania, Uganda, Zambia and Zimbabwe). Prime yields typically between 10% and 15% are far in excess of those in mature markets (for example 5% in U.K).

IPD's indices are based on the valuation and cash flow records drawn from the portfolios of major investors. This type of valuation based index is the primary source for the evaluation of historic real estate performance in mature real estate markets, and such indices now exist for around 22 countries (IPD, 2008b). IPD provides commercial real estate performance indicators for only one African country, South Africa.

Constructing such an index demands a substantial base of professional investors, who conduct full open-market valuations of their assets to international standards at least once a year. It is unlikely that these conditions can currently be met in most African countries outside South Africa. Any efforts to create measures of market performance will probably require alternative methodologies; such indices based on real estate transactions data.

Published research on the South African real estate market is limited to Newell *et al.* (2002). Using the CB Richard Ellis Index – an appraisal based index – covering 350 income producing real estate assets running from 1980 to 1999, the research reports the retail sector performed with real total returns at 2.5% per year for the period. It also finds the risk profile for real estate investments, with standard deviations in the range 5% to 8%, to be significantly below that for stock market (27%) in the post-apartheid era.

Outside South Africa, published research on African real estate markets has mainly been concerned with institutional structures and constraints on market development. One substantial body of works deals with land tenure and ownership rights, often suggesting that traditional forms of land ownership constrain real estate development and investment (see Larbi, 1994; Kasanga and Kotey, 2001; and Antwi and Adams, 2003 for Ghana; O'Connor, 1983; and Omirin, 1994, 1998, and 1999 for Nigeria; Okoth-Ogendo, 1982 and Migot-Adholla *et al.,* 1994 for Kenya).

A second strand of work deals with the scale and consequences of governmental intervention in land markets (see Asiama, 1990; Antwi, 1995; Kasanga *et al.,* 1996; Adams *et al.*, 1996; Quan, 1997; Hammond, 2006; and Asabre, 2007). These studies arrive at similar general conclusions, that such interventions have often taken the form of policies which are either skewed towards a small segment of the society or produced investment disincentives.

A third, smaller, body of research concentrates on the technical requirements for laying the foundations for efficient real estate data recording (Karikari *et al.,* 2003; Fiadzo, 2004; CHF International, 2004; Mahama, 2006; and Buckley and Mathema, 2007). These studies recommend a common agenda of developing reliable database to support a more robust empirical analysis of the real estate market in Ghana.

The small number of studies specific to Ghana which deal with the estimation of real estate values and returns are of the most direct relevance to the objectives of this thesis. The earliest work of this type is Asabre (1981). It applies hedonic analysis to explain the sale price of vacant lands in Accra. Original data on 211 transactions of vacant urban sites from 1974 to 1978 were obtained from the Bank of Housing and Construction (now liquidated) and three unnamed major real estate brokers in Accra, and subsequently cross-checked with the Lands Department (now Lands Commission and Land Valuation Board). The results suggest that variables such as location, zoning, land tenure, ethnic clustering, time-of-sale, lot size, and site services contribute to the determination of land values in the formal sector. The results also suggested that stool lands – in customary ownership – were sold at discount prices. The study however, does not extend to any estimates of changes in land values over time.

More recently, Antwi (2002) investigates the relationship between price of building plots and explanatory variables including date of transaction, state of development of the land, neighbourhood quality, whether the land was obtained from government or customary land owners, source of finance, the extent of market search undertaken before purchase, sources of market information, perception of real estate rights purchased, and the cost of registration in the informal sector. The study applies hedonic methods to transaction-based primary data from a sampled survey of 305 market participants such as land purchasers, customary landowners and real estate

consulting firms, and is limited to the performance of the informal real estate market in Accra. It finds real estate titling and tenure are not significant factors in price determination, suggesting that all purchasers perceive they are effectively buying perpetual real estate rights. Market information is also found to be informally acquired by all land purchasers and therefore not an important variable in price determination. As in Asabre (1981), no time series estimates of prices are produced.

The only previous work which seeks to generate measures of change in residential values again deals primarily with the informal sector (Antwi and Omirin, 2006). Primary data on rental values and lease premiums were obtained from a survey of tenants in Accra, and also from market tenants, owners and land agents in Lagos, Nigeria. The survey evidence on rental yields and capital growth were used to construct estimates of total returns from 1999 to 2003, and to compare the performance of the informal with the formal real estate market in Accra. The study estimates real annual capital growth of 10% per year in the formal residential market in Accra, with an average rental yield estimated at 6%. It also suggests yields and performance in the formal and informal sectors are broadly comparable.

Both information sources and published literature on African real estate markets are, on the whole, limited. With the partial exception of South Africa, there are few sources, and no long time series, of the market indicators of prices, rents, yields, occupancy rate, nominal and real returns which are the primary data used to track

conditions in mature markets. Again, the South African real estate markets share characteristics of mature markets in terms of data quality and transparency, valuation standards and the active participation of international market intermediaries such as Knight Frank and IPD.

Given the lack of primary data, published research on African real estate markets has consisted mainly of studies which are narrow in scope, and focussed on the workings of informal markets rather than the nascent formal real estate markets in higher quality modern stock, which this thesis seeks to examine as a substantial contribution to literature. It is against this background that this thesis employs transaction based data to analyse the formal real estate markets' performance in a robust manner in contrast to the approach in previous studies as well as to examine residential real estate as an investment medium.

2.6 Real estate investment and residential property

After the context of emerging economies, a second point of reference for the research is the performance of real estate investment, in particular in leased residential units. This section is a brief review of the factors which determine the expected performance of residential investments and the evidence on realised returns across a number of countries. Due to the lack of information on emerging markets discussed in Section 2.5, the discussion is limited to the small number of

countries among developed economies where there are real estate performance histories long enough to reach robust conclusions on the characteristics of real estate returns.

Residential investment is one part of the investment market in income producing real estate. Though it is subject to fundamental demand, supply and leasing factors which may vary from those which apply to (say) the office sector, the predominant characteristics of the cash flow are common to all forms of real estate investment. These cash flow characteristics, in turn, generate the expected risk and return profile of real estate as an asset class.

In introductory texts, it is conventional to treat real estate cash flows as blend of fixed income and variable income (Hoesli and MacGregor, 2000; Geltner et al, 2007). The fixed income element is the current rent payable by tenants which is typically fixed by lease contracts up to the next lease expiry or rent review. This is essentially a bond-type income stream: the primary risk attached to it is that of tenant default. The variable income element is the rental payments which will apply following future lease expiries and rent reviews. This element is subject to multiple risks, but the predominant risk is the variability in market rental prices over time, driven by shifts in the balance of occupier supply and demand. Risks which apply to the variable income element – market rentals, leasing, voids – are all heavily influenced by the state of the economy. So the variable income risk shares with

equity investments a large exposure to economic fluctuations which also influence corporate earnings and dividends. Despite the common economic risk factor, the risk inherent in the variable component of real estate investment would generally be considered to be lower than the risk of equities. In part, this is because the length of lease contracts (and in some countries lease terms such as upward only rent reviews or inflation linking of rental uplifts) insulate some of the real estate income from market driven rental and occupancy fluctuations. A more important factor, however, is that returns on direct real estate investment are normally considered without leverage (even if leverage is used), whereas returns on equities are inherently leveraged by the use of debt within companies.

From this analysis, in short, real estate risks are in part shared with fixed income investments, and in part with equity investments. Overall real estate risk is therefore expected to fall between fixed income and equity investments. In an efficiently priced market, it would accordingly be expected that returns on real estate investment will also sit between those on fixed income and equity investments.

Beyond this simple characterisation of the cash flows and associated risk, there are additional factors to be taken into account. Real estate if often subject to rates of taxation on transactions, income or capital gains which are different from those applied to fixed income and equity investments, so that the relative required returns gross of tax may depart from the simple risk pricing formula. Real estate is also

much less liquid than investments in securities, and subject to higher portfolio overhead costs. Expected real estate returns will therefore include a further return premium for costs and illiquidity over and above that required to compensate for risk. Finally, real estate investments are subject to physical and economic depreciation over time – factors which do not apply to fixed income investments, and are covered for equity investments by corporate spending rather than by the investors themselves. Although expenditures incurred to offset depreciation may be netted off prior to the statement of investor returns, the rate at which assets in real world portfolios may not be fully covered by those expenses.

Several of these additional factors in the real estate risk premium – notably illiquidity and depreciation – are technically difficult to measure. All of them will be likely to vary considerably between types of real estate, and across countries. Despite these problems, however, it remains the common assumption among analysts and investors than expected real estate returns and risks lie between those on risk free fixed income investments and those on equities.

Validating these expectations by the analysis of realised investment returns is, unfortunately, clouded by problems in the measurement of the returns achieved on real estate portfolios (Kolbe and Greer, 2006). The representativeness of indices forms one set of issues. In the absence of a central trading exchange or a sufficient volume of reliable transactions evidence, the most widely used real estate

performance indices are constructed by sample survey of large-scale investors – mostly institutional funds, pooled investment vehicles, or listed companies. The extent to which these indices capture the full market (a figure which it itself hard to estimate), or may be taken as representative of the market mix of property types and investors, is therefore highly variable across countries, and to a degree uncertain even in the best covered countries.

Further issues are raised by the basis of measurement. In the records of major investors, the market values of assets are estimated by periodic valuations. The use of valuations as market price proxies introduces a number of widely recognised problems of price smoothing at the level of individual assets and also through the process of index aggregation (Geltner, 1993). As a result, valuation based indices will tend to understate the true volatility of the market. Though a range of adjustment techniques have been developed to "correct" the understatement of risk, the most appropriate method and scale of risk adjustments are still actively debated in the academic literature (Chaplin, 1997; Geltner *et al,* 2002; Bond *et al*, 2006).

Numerous studies have documented the realised returns on real estate investment in comparison with other asset classes. Among the earliest work, Ibbotson and Siegel (1984) used valuation-based data to show that US real estate returns from 1960 to 1982 ran, in line with expectation, between equities and bonds. With the expansion of the coverage of real estate indices across countries, the number of markets and

range of time periods reviewed by researchers has expanded dramatically. Sirmans and Worzala (2003), in an extensive review of the literature, record 15 analyses of real estate returns and risks in a multi-asset context across a large number of countries. The findings on the relative returns and risks are inconclusive, partly due to the wide range of indicators and time periods used.

Table 2.2 Total Returns by Asset Class, 1987-2007

	T Bills	Long Dated Government Bonds	Real Estate	Equities
Annualised Total Return % pa				
Australia	7.3	10.1	9.8	12.6
Canada	5.6	9.0	9.2	10.9
France	5.3	8.6	8.3	12.0
Ireland	5.9	8.2	16.3	9.6
Netherlands	4.7	7.2	10.2	12.8
Sweden	6.3	9.8	8.1	15.8
UK	6.8	8.6	10.1	10.3
USA	4.5	8.0	8.8	11.9
Standard Deviation % pa				
Australia	3.5	9.9	8.5	13.6
Canada	3.0	7.0	7.5	15.2
France	2.9	8.6	8.5	23.1
Ireland	3.0	8.7	11.3	25.4
Netherlands	2.3	8.8	3.3	20.1
Sweden	3.8	10.1	12.5	30.9
UK	3.0	7.8	9.2	14.7
USA	1.9	7.3	6.6	16.7
Sharpe Ratio				
Australia	-	0.28	0.29	0.39
Canada	-	0.49	0.48	0.35
France	-	0.38	0.35	0.29
Ireland	-	0.27	0.91	0.15
Netherlands	-	0.28	1.64	0.40
Sweden	-	0.35	0.15	0.31
UK	-	0.22	0.36	0.24
USA	-	0.48	0.65	0.45

Source: IPD, NCREIF, EcoWin

On a country by country basis, the realised returns on real estate show a variable relationship with other asset classes. In all cases, real estate returns have delivered a substantial risk premium over risk-free Treasury Bills, running from 1.9% per year in Sweden to 10.4% per year in Ireland. In three countries (Australia, France, Sweden) real estate returns have, contrary to expectations, run below those on government bonds; in Ireland, returns have been ahead of equities. Only four (Canada, Netherlands, UK and USA) out of eight countries, therefore, show the expected risk premium on real estate between equities and bonds; in all of those four countries, the differences in mean returns between real estate and bonds are statistically insignificant at the 10% level.

The comparison of risk across asset classes also often departs from the expected picture of real estate risks between bonds and equities – which is apparent in realised returns in only four countries (Canada, Ireland, Sweden and UK). An F-test shows that the difference in variance between real estate and bonds is significant at the 10% level only in the cases of Ireland and the UK. Apparently low risk on real estate investments is generally attributed to the smoothing inherent in valuation based indices. A range of methods for "desmoothing" index results to correct for this understatement of risk have been proposed. In the UK, the typical adjustment applied in practice by asset allocators would result in an uprating of the observed standard deviation by a factor of 1.3 to 1.5 (Key and Marcato, 2006).

Because real estate is expected to deliver an additional premium for illiquidity and costs over and above the compensation for simple volatility, the Sharpe Ratio for real estate would be expected to be above those for the other asset classes. If estimates of standard deviation were uprated to compensate for index smoothing, the Sharpe Ratios shown would of course be reduced. Even without any such adjustment, real estate Sharpe Ratios are above those on other asset classes only in four countries (Ireland, Netherlands, UK and USA). In all four countries, real estate Sharpe Ratios would remain above other asset classes even with an upward desmoothing adjustment in observed standard deviations by a factor of 1.3, and in the cases of Ireland and the Netherlands with a desmoothing factor of 1.5.

The available evidence on realised real estate returns is, in summary, thin in terms of coverage of countries and length of data series, and completely lacking reliable data for any emerging markets. What long-run evidence there is suggests that real estate investment markets have, over the last twenty years, frequently failed to deliver the expected risk and return profile. In part this may be attributed to problems in performance measurement – the representativeness of indices, and the smoothing inherent in valuation based measures of returns. The failure of observed returns to match the expected pattern may also of course be attributed to the fairly short historical series, and possible period-specific features which obscure the true long run picture – such as the protracted real estate crash of the early 1990s, or the long fall in inflation which has boosted returns on long bonds.

Within real estate investment, the residential sector is relatively lightly covered in the literature. The portfolios of large scale investor portfolios are, in most developed markets, dominated by the office and retail sectors. Residential property accounts for less than 1% of portfolios covered by the industry-standard index produced by IPD; in the USA, it accounts for 24% of the portfolios tracked by the NCREIF index. In other countries, weights in residential property above 10% are the exception (IPD, 2008b).

The cash flow characteristics, and therefore expected return and risk characteristics, of residential investment are somewhat differentiated from those of other types of real estate (Mansfield, 1999). Although individual households are likely to be subject to a higher risk of arrears or default on rental payments than the large corporations which dominate occupancy of commercial properties, the risks are more widely spread across a large number of tenancies and therefore more predictable and less damaging to cash flow. In most countries, pressures on the housing stock through population growth, rising wealth, household fragmentation and (in some cases) land shortages or planning restrictions have tended to lead to house price inflation above the rise in capital values of commercial property. As a generality, therefore, residential may be expected to be a relatively low risk and high capital growth sector by comparison with other forms of income producing real estate, and would therefore be expected to be held on somewhat lower running yields.

Table 2.3 Real Estate Returns by Sector, 1997-2007 % pa

	All Property	Retail	Office	Industrial	Residential
Annualised Total Return % pa					
Canada	13.0	13.1	13.0	13.6	11.3
Finland	8.7	10.2	8.0	9.5	9.0
France	12.3	17.9	12.8	12.5	9.9
Germany	3.4	4.6	3.0	6.1	4.4
Netherlands	11.4	11.9	10.5	11.4	11.5
Sweden	10.9	12.2	10.1	11.3	13.5
UK	11.4	11.3	11.1	12.2	16.9
USA	12.9	13.7	13.3	12.9	12.6
Standard Deviation % pa					
Canada	3.7	3.9	5.2	2.4	3.5
Finland	2.5	2.9	2.5	2.5	3.5
France	4.8	5.2	5.4	3.7	5.0
Germany	1.7	1.1	2.3	1.0	1.6
Netherlands	2.9	1.9	3.7	2.9	3.7
Sweden	6.8	4.8	8.2	6.6	3.1
UK	6.4	7.4	7.4	6.2	3.5
USA	4.2	4.9	6.0	4.0	3.5
Sharpe Ratio					
Canada	2.51	2.44	1.79	4.21	2.18
Finland	2.18	2.39	1.87	2.48	1.64
France	1.93	2.84	1.80	2.55	1.37
Germany	0.13	1.32	-0.10	2.91	0.73
Netherlands	2.77	4.60	1.97	2.85	2.25
Sweden	1.13	1.90	0.83	1.23	3.33
UK	1.00	0.85	0.83	1.16	3.42
USA	2.25	2.08	1.64	2.35	2.60

Source: IPD, NCREIF

Table 2.3 summarises realised returns over the last ten years for eight countries where residential is a sufficiently large component of mainstream investment portfolios to be recorded by the standard indices. Residential investment returns in each country have run fairly closely in line with the national commercial investment markets. There does not appear to be any common characteristic of residential investment returns relative to the remainder of the real estate market. Returns, for

example, have run well below other real estate sectors in Canada and France, but above all other sectors in Sweden and the UK. Similarly, residential shows exceptionally low risk in the UK and Sweden, but moderate to high risk in other countries.

As discussed above, investment in real estate is expected to generate returns and risks between those on equities and bonds, with an added premium in return for illiquidity and costs above those on equities and bonds. Given that returns and risks between equities and bonds can be replicated by a mixed portfolio of those two asset classes, these characteristics alone do not constitute a strong case for real estate within the mixed portfolio. Without other factors, real estate would be attractive only to investors with a high tolerance for illiquidity, the ability to dilute costs through favourable tax status or economies of scale, or an ability to out-perform the market through superior timing, stock selection or management skills. On these factors alone, real estate investment would be expected to be mainly the preserve of the organisations less concerned about liquidity (such as life insurance funds), or with tax exempt status (such as charities and pension funds), or with the resources to spread costs and acquire market intelligence (large investors of all types).

In fact a much stronger case for real estate in a multi-asset portfolio rests in its diversification benefits due to low correlations with other asset classes. Research

findings across many countries concur that real estate shows low correlations with other assets, and in the majority of cases that these low correlations justify a substantial allocation to real estate – typically in the range 10% to 20% - in mixed asset portfolios (Sirmans and Worzala, 2003; Lee and Stevenson, 2006). The theoretical case for diversification benefits from real estate investment is surprisingly weak, and neglected by the literature. If fundamental pricing theory suggests real estate returns are a blend of fixed income and equity characteristics, it would seem to follow that real estate risk would be blended from the same factors as bond and equity risk.

Table 2.4 Correlations in Annual Returns with Real Estate, 1987-2007

	T Bill	Long Dated Government Bonds	Equities
Australia	0.13	-0.46	-0.03
Canada	-0.19	-0.25	0.18
France	-0.09	-0.41	0.11
Ireland	-0.30	-0.12	0.34
Netherlands	-0.22	-0.02	0.15
Sweden	-0.24	-0.30	0.25
UK	-0.33	-0.24	0.27
USA	-0.10	-0.27	0.04
Unweighted Average	-0.17	-0.26	0.16

Source: IPD, NCREIF, EcoWin

However, as Table 2.4 shows, again using the most recent information, it is empirically very strongly the case that real estate returns show low or negative correlations with equities and bonds in all countries for which sufficient long-term evidence exists to provide reasonably robust statistics. Correlations between real

estate and equities returns average 0.16 across countries, with a range from -0.03 to 0.35. Correlations between real estate returns and fixed income investments have been negative in all countries. These results are in line with many other studies across a number of countries and time periods which uniformly show strong diversification benefits from the inclusion of real estate in mixed asset portfolios).

Outside the developed markets covered by established indices, evidence on the portfolio benefits of real estate investment is limited to the work of Olaleye *et al.* (2008) on Nigeria. This study uses rental and capital value transactions for the period 1998 to 2003 for the Lagos, Abuja and Port Harcourt to suggest that portfolio diversification strategy for investors largely depends on comprehensive data, which require careful maintenance.

For the purposes of the present research, the main points from previous work are that real estate investment in general is expected to deliver moderate returns and risks between equities and bonds, but that realised performance in particular countries often may fail to match the expected pattern. Residential investment, on the available evidence, may be expected to produce performance broadly in line with overall real estate investments, but again with considerable variation across countries. The most conclusive finding from previous research is that real estate investment provides strong diversification benefits against equity and fixed income investments. While these results are a well-established part of the framework for

investment markets in developed economies, parallel evidence for emerging markets is virtually non-existent.

2.7 Summary

From a theoretical perspective, and also from the limited evidence on actual values of real estate stocks, real estate plays a major role in the process of economic development. The lack of literature to explore this role is not only surprising but also suggests a need to investigate the operations of the real estate markets in emerging economies.

Research and policy on the development of formal real estate markets in these economies have concentrated on establishing land registration systems, on the assumption that improved security of tenure is the key element in the process. Other necessary conditions – such as access to sources of equity and debt finance for development and investment, and the creation of clear rental contracts – have not been covered in the available literature.

The attention of researchers and investors in income producing real estate is heavily skewed towards developed economies, leaving emerging economies with small but rapidly growing formal markets uninformed by the standard market indicators such as rental growth, yields, total returns and market stock. As seen above, formal real

estate markets in Ghana, in particular, have continued to receive very little attention from researchers and policy-makers, and are likely to remain dominated by domestic rather than foreign investors. This thesis will therefore fill a clear gap in existing research by primarily using archive data from the Land Valuation Board, Accra to analyse the past performance of residential real estate markets in Ghana.

Finally, as demonstrated by a wealth of research in developed economies, a substantial benefit of the production of real estate indices is to inform investment markets of the case for the inclusion of real estate, and residential real estate, in mixed-asset portfolios.

CHAPTER 3 RESIDENTIAL PRICE MODELLING

3.1 Introduction

As noted in Chapter 2, there are no data sources in Ghana which would support the construction of a valuation-based real estate index. Though the rented residential market in Ghana is relatively large, accounting for 22% of all households, and a much higher 41% in Accra, investment in the residential stock by institutional investors and other large owners likely to conduct recurrent valuations has been marginal. Large scale operators in the market have in recent years focused on the development of commercial real estate units – offices and retail – for both sale to owner occupiers and renting. Residential investments are predominantly held by small private buy to let investors, with no requirement to conduct recurrent valuations. As explained in Chapter 4, however, it is possible to track a large number of transactions in this sector.

Overall market prices for residential real estate are intrinsically difficult to measure from transactions evidence because of changes in mix of quality in properties transacted over time. This Chapter briefly discusses the general issues raised by the measurement of residential market prices. It then discusses the strengths and weaknesses of the three commonly used methods of price estimation – simple averages or medians, repeat sales and hedonic approaches (Sections 3.2 to 3.4), in

order to select the method most suitable to the data available in Ghana and the objectives of this research. Section 3.5 considers the technical issues associated with the preferred method, hedonic modelling. Section 3.6 concludes with an explanation of the choice of the hedonic modelling approach used in the empirical analysis which follows in Chapter 4.

Several empirical approaches have been proposed in the literature for modelling residential pricing. The choice of an appropriate method depends partly on the purpose to be served, and partly on the volume and scope of the available data (Gallimore *et al.,* 1996; Malpezi, 2003; Lum, 2004; and Sirmans et al., 2005). Residential real estate investments, in contrast to office, retail and industrial markets which are internationally generally measured by valuation based indices, carry the general advantage of larger volumes of transactions evidence and relatively homogenous building characteristics, so that performance indices can be constructed from sales and lettings evidence. Data limitations generally become a problem in residential market analysis only when more than an annual frequency is required for the index (Case and Watcher, 2003; and Sirmans *et al.*, 2005).

Residential real estate is an asset for which prices can be regarded as a composite of three main sets of factors: the physical attributes of individual properties; the location characteristics of the areas in which they sit; and the legal structure of their ownership and occupation (Malpezzi, 2003).

Physical features are in turn a bundle of attributes including the type of structure (detached, semi-detached or flat), size as measured by plot size, floor area, number of bedrooms, number of bathrooms, the presence of garage and outhouse, number of storeys, and in addition, age, decorative and structural condition. A set of location characteristics includes travel times, the main employment sectors and shopping centres, and the quantity and quality of major amenities such as schools and parks. As a durable and indivisible asset, its market value may be influenced by legal interests and use rights: freehold or leasehold ownership, the nature of occupants and the terms of occupational leases. The capital and rental prices of an individual property in the open market are therefore the outcomes of a large set of factors: design, orientation and decoration; the bundles of legal rights and interest; and the fixed location. In combination, these factors generate the unique price and rent for each asset. Since property attributes cannot be separately traded, there is no direct measure of determining individual contributions to prices and rents without recourse to the others.

Residential real estate buyers and occupiers are also not heterogeneous. Each of them may put a different value on specific property characteristics. That is, the "market price" of a property at any given time may be defined as the highest price at which a willing vendor would be able to find exactly one willing buyer. As there is only one market spot price for any specific property, all other potential buyers are likely to be precluded from buying that property once the transaction is concluded.

However, this market clearing price can fluctuate over time, with changes in expectations about future increases in the market clearing prices among potential purchasers, or due to changes in the availability in the market of particular property features. Furthermore, changes in the cost of financing and transaction may result in general market price movements.

Since real estate values – prices and rents – are important for economic and financial developments, accurate measures of their level and growth rate are highly desirable for economic analysis, financial analysis, and public policy. From an economic perspective, residential real estate is a major store of individual wealth. The occupancy of property also accounts for a large fraction of household expenditure. Changes in residential prices are therefore a strong influence on consumer spending and saving decisions and hence affect overall economic performance (Herring and Wachter, 1999, 2002). From a financial perspective, lending institutions rely on estimates of market value to contract mortgages and estimate lending risks (Herring and Wachter, 1999; Mera and Renaud, 2000). And from a social policy standpoint, residential real estate prices determine housing affordability and the access of different social groups to adequate housing, an important public policy goal in all economies. Finally, for market participants in real estate investment, residential price indices are inputs to asset allocation and investment decisions.

Robust and widely accepted residential price indices may therefore contribute to decisions on macro-economic and housing policies, and set important price signals for the capital markets in both equity and debt. Seeing that real estate gains increasing prominence as an investment medium in emerging economies, the construction of residential real estate price and rent indices will provide the signals or inputs needed for developing and implementing effective government policies on real estate, and for achieving efficiency of capital markets.

Based on real estate transactions data, there have generally been three commonly used approaches in the construction of residential price and rent indices. These are the average or median, repeat sales, and hedonic methods, each of which is discussed in the following sub-Sections.

3.2 Average price methods

The average or median price method is the simple calculation of average (unweighted or value weighted), or the median, of all observed transactions prices in a given period, represented as prices per unit (such as the average for one bedroom versus three bedroom flats), or prices per square metre. It has two main advantages. First, the method is the simplest and most direct approach to price measurement. Data requirements are minimal – only the sale prices, perhaps sub-divided by the main types of property transacted or divided by floor area, are

required (Meese and Wallace, 1997; Hoesli, 2000; and Case and Wachter, 2003). It essentially ignores the problems of real estate heterogeneity, which makes the data collection process far less onerous than if additional property characteristics, such as size, age, quality, lease terms among others, also have to be collected (Case and Wachter, 2003; Lum, 2004; and Hansen, 2006).

Second, average or median methods do not require any econometric intervention. Market measures are derived directly from all or a representative sample of residential transactions during the given period to compute the average or median price level. The median method will generally be taken as more appropriate if price distributions show significant skewness. In addition, any fluctuations in the quality mix of real estate assets sold over time, particularly the weightings of the most or less expensive units, will in general have a smaller impact on median than on average price (Case and Wachter, 2003).

The most serious downside of average or median measures is rooted in the heterogeneity of real estate assets. The average or median method takes no account of the characteristics of each property. It effectively treats assets as a homogeneous units and it does not provide for the impact of individual property characteristics. It therefore fails to control for any changes in quality mix of the properties for which prices were observed in each period. It is difficult to rule out that transactions in one period of time could possibly be of "low" quality residential units, whereas in

subsequent periods relatively "high" or a mix of "high" and "low" quality real estate assets are transacted. If there are changes in quality mix, the average or median method provides an inaccurate indicator of the true evolution of prices over time. In cross sectional analysis, similarly, averages or medians will give an inaccurate measure of differences in market prices between locations with varying quality mix.

The simple average or median method also has more subtle shortcomings. It does not account for estimate for differing turnover rates or transaction times for different grades of real estate within the total stock. The sample of observed transactions may therefore be a biased representation of the total stock, and open to biases which may shift with market conditions. Average or median price measures therefore tend to overstate price increases if properties with relatively rapid price growth are over-represented among transactions, and vice versa (Hoesli, 2000; Case and Wachter, 2003; and Hansen, 2006).

The second form of this method is the weighted average, typically used in mature markets such as UK and US. The method permits prices to be weighted according to certain property characteristics, thereby ensuring that the mix of properties in the index remains constant. Property representatives are created based on the different characteristics they possess and weights, which reflect the percentage of total sales that each property representative accounts for are assigned. The weights may be revised periodically to reflect changes in market structure. The data requirements of

this method are minimal. The only data field that is required is price of the representative property in each time period (Case and Wachter, 2003). The weighted method is preferred to simple average because it adjusts for variation in quality of the transacted properties and also ensures that the published index in any period is robust and unaffected by future transactions (Chau, 2006). The weighted average method is however, limited by data characteristics as they may not be fully comparable across markets or over time (Case and Wachter, 2003), and is therefore not widely used.

The foregoing review suggests that the average or median method can possibly be appropriate for market price estimation only when there is virtually no change in the composition of properties transacted between periods, and also when all elements of the stock trade at the same frequency. As a number of studies have demonstrated, it is unlikely that these conditions will exist, or can be proven to exist, so the average or median method is limited in application (see Meese and Wallace, 1997; and Lum, 2004). This drawback explains such estimates of market price have been decreasingly used for the practical tracking of real estate markets, and are even more rarely used for rigorous research.

3.3 The repeat sales method

Originally proposed by Bailey *et al.* (1963), and further developed by Palmquist (1982), and Case and Shiller (1989), the repeat sales method provides an alternative market price estimation technique which is based on observed price changes for properties transacted more than once over the sample period. The method hypothesises that when a given property transacts twice, many or most of its characteristics will have remained unchanged between transactions. If so, the change in price alone represents an unbiased estimate of change in market prices for that particular type of property. The application of the repeat sales method requires a regression model to extract the estimate of change in market prices from a sample of repeat sales transactions in the following general form:

$$\ln\left(\frac{P_{is}}{P_{if}}\right)=\sum\beta_t D_{it}+\varepsilon_i \qquad [3]$$

where p_{if} is the price of the first sale;

p_{is} is the price of the second sale; and

D_{it} is the time dummy with a value of -1 for the period of initial sale; a value of 1 for the period of second sale; and a value of 0 otherwise.

The repeat sales method is appealing because, as with average or median method, this approach demands no more than observed transaction prices to construct

estimates of change in market prices. In the simple form of the method, there is no need to collect additional evidence on the asset specific attributes for each transaction

The main point of weakness in the repeat sales method is the fundamental assumption that the quality of each property used is unchanged between transactions. It is clearly open to question where, for example, depreciation, capital spending on extensions and refurbishments are common and likely to significantly impact on price or rent determination. If, say, it is considered that capital expenditures on refurbishment or alteration are a significant factor, the repeat sales method becomes more data intensive in that information on expenditures has to be collected, or estimated.

A considerable body of literature, for example, Case and Shiller, 1987; Shiller, 1991, 1993; Goetzmann, 1992; Goetzmann and Spiegel, 1995; Follain and Calhoun, 1997; Meese and Wallace, 1997; and Gatzlaff and Geltner, 1998 advocates the use of repeat sales method, primarily based on evidence from the US residential market. Rossini *et al.* (1995) and Costello (1997) by using Australian data, also provide evidence in favour of repeat sales method against the median approach. These previous studies have employed various forms of methodology, which include the arithmetic, geometric and hedonic-repeated approaches.

Bourassa *et al.* (2006) however, suggest the sale price appraisal ratio (SPAR) method, which is based on sale prices and valuations, is an alternative to the repeat sales. SPAR index is formulated by relating real estate sale prices to their respective valuation estimates. As a sale price model-based approach using auxiliary valuation data, SPAR is determined by matched pairs of data in a similar manner as the repeat sales method. It is more data efficient than the repeat sales method in that it uses all sale transactions available for the period rather than just repeated sales. Whilst the repeat sales method is more suitable in mature markets with relatively high frequent transactions, Wal *et al.* (2006) argue the SPAR method is a good real estate price index choice in markets with few transactions. The SPAR method additionally appears to have more to offer than the other traditional methods of hedonic, average and repeat sales (Vries *et al.*, 2007) but its application has been restricted to only a few countries such as New Zealand, The Netherlands, Sweden and Denmark (Rossini and Kershaw, 2006) because it demands high quality matching sets of both transactions and valuation evidence.

Despite its wide acceptance, the literature also emphasizes inherent problems associated with the repeat sales method. The restriction to properties with two or more sale observations inevitably reduces the sample sizes contributing to the price estimation, and increases the risk of biases in the sample selection rule. It may also be argued that the repeat sales method is inefficient in its use of data. Discarding the evidence available from properties transacted only once may ignore a very large

amount of potential information from those transactions, and again, potentially increases the risk of sample selection bias. Some forms of sample selection bias may, moreover, be highly likely in the nature of the method. A systematic bias against newer properties, for example, may be expected simply due to the lack of prior transactions. Since relatively small numbers of properties sell frequently (for estimates, see Case and Shiller, 1989; and Abraham and Schauman, 1991), the application of the repeat sales method outside large and liquid markets such as the United States of America and the United Kingdom is therefore likely to be particularly problematic.

3.4 The hedonic method

The term "hedonic", etymologically, is derived from the Greek word "hedonikos", which translates as "pleasurable". In economics, the term hedonic indicates the derived utility or satisfaction from consuming goods and services. Lancaster (1966) and Rosen (1974) are regarded as founders of the conceptual basis of hedonic modelling, resting on the hypothesis that consumers' utility is derived from the bundles of attributes of the goods and serviced consumed. The hedonic technique therefore assumes consumer goods are aggregate of different attributes, some of which, as they cannot be sold separately, do not have an observable price. Regarding real estate markets, for example, it is impossible to purchase separately the lounge, bedroom, the panoramic view, the good quality of air, or the good

quality landscaping. For this reason, the technique postulates that the economic value or price of individual attributes determines the exact price for the commodity, all other factors held constant. Freeman (1979) improved upon the conceptual basis of the hedonic technique in the valuation of environmental goods. Whilst in the particular case of real estate markets, characterised by supply inelasticity, Diamond and Smith (1985) further rationalise the method by tracing its applicability to the neoclassic scheme of the theory of consumers' demand.

Clearly, the hedonic method is particularly appealing for highly heterogeneous goods such as real estate, where individual property assets explicitly show widely varying attributes in terms of location, structure, quality and size. The widespread use of the method rests on several features. First, it rests on multiple regression analysis, a well-understood methodology with techniques and statistical tests extensively documented in applications across many fields of research. In real estate in particular the basis of the method matches with the concept of market value as "the most probable price" of an asset based on an array of attributes with varying utility to different purchasers, and therefore the outcome of a probability distribution. And third the hedonic method is not limited to the estimation of market prices, because interpretation of the regression coefficient casts light on the process of price determination.

Hedonic pricing models for real estate therefore attempt to make use of all available evidence on transactions, typically taking in the largest set of attributes for each property available in the primary source of data used. Like the average or median method it covers the entire sample of market transactions. And like the repeat sales method, it offers a solution to problems of variable quality mix.

For these reasons, the majority of studies on residential real estate price estimation, for example, Griliches, 1971; Linneman, 1980; and Halvorsen and Pollakowski, 1981; Hoesli, *et al.*, 1997; Simons, *et al.*, 1998; Ding, *et al.*, 2000; Fletcher, *et al.*, 2000a; Tse, 2002; Berry, *et al.*, 2003; and Flaherty, 2004 employ the hedonic modelling techniques to compute real estate price levels that could be translated into price movements for price index construction.

Malpezzi (2003) in a recent survey of the hedonic modelling literature argues that controlling for quality is essential in real estate market analysis. The research finds hedonic pricing model to be more transparent than other methods, and broader in its potential applications. The hedonic method is the only method which possibly provides a direct measure of the contribution of different property attributes to final prices, and also makes an explicit adjustment for changes in quality mix over time, or differences in quality mix between sub-markets. It is therefore useful to understanding the general process of real estate price formation, as well as the estimation of price levels and changes.

Lippe (2001) and Li *et al.* (2006), similarly, argue hedonic models are the most powerful and useful real estate pricing approach. The studies submit that the method has an advantage of being objective and also as an explicit quality assessment tool, which is very relevant to achieving the objectives of this thesis.

3.5 Issues in hedonic modelling

Hedonic pricing models are not free from limitations widely commented upon in the literature. Besides its doubtless advantages, the method has a number of limits which add to the generality of respecting the hypothesis on the diverse characteristics of real estate markets (Lippe, 2001; Sirmans *et al.,* 2005; and Wen *et al.*, 2005). Thus, it seems to be applicable only in dynamic markets with a large number of observations, as the model requires a good quality of data, and also depends on sufficiently transparent market. Hedonic estimates of market values my also be biased if there are expectations of changes in the value of attributes such as environmental quality, or anticipated future uses. Finally, the method inevitably relies on some *a priori* assumptions concerning the relationship between sale prices and property attributes based on either or both deductive or inductive grounds. Methodological issues include the validity of assumptions about the functional form of relationships between independent variables and prices, which may plausibly be non-linear or subject to complex interactions, the homogeneity of markets over space, and problems of statistical interpretation.

Thus the widely researched limitations of the hedonic model include difficulties in choosing an appropriate functional form for the price equation, and specification of variables, the form of locational variables, the extent of data requirements, ambiguities in the interpretation of coefficients, statistical difficulties in dealing with issues of heteroscedasticity and multicollinearity, and spatial dependence (Case *et al.*, 1987, 1989; Case and Wachter, 2003, Adair *et al.*, 1996; Malpezzi, 2003; Brasington and Hite, 2005; and Bateman *et al.* 2007). Each of these issues considered as problematic in the hedonic model is discussed separately below.

3.5.1 Functional form

The correct application of the hedonic approach requires the positive verification of the hypothesis that the real estate market offers a continuous range of choices so that for all combinations between goods and environmental conditions purchasers are able to comply with the principle of diminishing marginal utility with respect to the environmental characteristics. In addition, purchasers must enjoy equal opportunity to access the market with same cost of information, transaction and transfer. The issue of functional form concerns the nature of the relationship between hedonic factors and the statistical functions which most closely capture the true relationships between dependent and independent variables. In the literature, the most commonly found functional forms are *linear*, *semi-log*, and *log-linear models* (see Adair *et al.*, 1996; Malpezzi, 2003; and Triplett, 2004).

As for any statistical method, the reliability of hedonic price estimation depends on correct model specification. Issues surrounding an appropriate functional form have been extensively discussed in the hedonic modelling literature but, for some at least, they have not been fully resolved (Halvorsen and Pollakowski, 1981; and Butler, 1982). Malpezzi (2003), indeed, argues there is no theoretical basis for choosing a functional form. The study contends that economic theory does not point to a specific form, leaving alternative specifications in principle equally valid. Malpezzi *et al.* (1980) and Hansen (2006) thus propose data quality and not fundamental principle as the criterion based upon which an appropriate functional form should be determined. In contrast, Triplett (2002) argues the purpose of estimating hedonic models is to adjust prices for quality differences. Therefore, an imposition of a functional form on the data that is inconsistent could create an error in the quality adjustment procedure. Mis-specification of the functional form may introduce bias into the regression equation (Fleming and Nellis, 1984).

Whilst the problem of determining the correct model specification or functional form remains unresolved, in practice, Case *et al.* (1991) claim the results of hedonic models are in fact, quite robust to reasonably minor violations of this condition. The research shows that estimated prices could be fairly close to the true prices so long as most of the important real estate characteristics are included.

The three functional forms are as follows.

The Linear Model is expressed as:

$$P(x_i) = \beta_0 + \sum_{j=1}^{n} \beta_i X_{ij} + \varepsilon_i \qquad [4]$$

where $P(x_i)$ is the sale price of property j at time i, β_i are the coefficients, x_i are the independent variables (property characteristics), and ε_i are the random errors.

This specification is based on the hypothesis that a property consists of a bundle of characteristics, to each of which a value can be attached, and that the price of a specific property is expressed as a linear function of its characteristics. The sale price in equation [4] is specified as an absolute amount and, typically, it is regressed against untransformed explanatory or independent variables using standard Ordinary Least Squares regression methods.

The underlying assumption in such a model is that each additional increment of continuous variables (such as number of bedrooms or floor area) has the same marginal value as previous increments. This appears to be a violation of the hypothesis of diminishing marginal utility under which the marginal contribution to price of, for example, an additional bedroom would decline as more rooms were added to a property (Tse, 2002; and Malpezzi, 2003). Thus the relationship between price and explanatory variables may not be linear.

The Semi-log Model is expressed as:

$$\ln P(x_i) = \beta_0 + \sum_{j=1}^{n} \beta_i X_{ij} + \varepsilon_i \qquad [5]$$

where $\ln P(x_i)$ is the natural logarithm of sale price of the real estate at time i, β_i are the coefficients, x_i are the independent variables (property characteristics), and ε_i are the random errors.

This form of the model treats price as a variable in natural logarithms, which is then regressed against untransformed independent or explanatory variables. This specification, in effect, imposes an assumption that all explanatory variables are subject to diminishing marginal utility (Fletcher *et al.* 2000a).

The Log-linear Model is expressed as:

$$\ln P(x_i) = \beta_0 + \sum_{j=1}^{n} \beta_j \ln X_{ij} + \sum_{k=1}^{n} \beta_k D_{ik} + \varepsilon_i \qquad [6]$$

Where $\ln P(x_i)$ is the natural logarithm of the price, β_j and β_k are the coefficients, $\ln x_{ij}$ are the natural logarithms of continuous independent variables, D_{kj} are the dummy or discrete variables, and ε_i are random errors.

This form of the model expresses price and some property characteristics as continuous in natural logarithms. It also recognizes that some important property characteristics – such as forms of tenure, or quality indicators – will be measured by discrete variables or coding, which are left untransformed. From OLS estimations, the signs and magnitude of coefficients on each attribute may be directly interpreted. However, unlike the linear and semi-log, the log-linear model allows that the variation in the price of each characteristic is interdependent with other characteristics.

The semi-log and log-linear models, which employ natural logarithm of the dependent variable, have a significant advantage in reducing any problems of heteroscedasticity in the data (see Hill and Melser, 2005; Section 3.5.5 below provides more detailed discussion on heteroscedasticity). Apart from Hoffmann (1998) who finds that the three functional forms are not significantly different in their explanatory power, other studies including Murray and Sarantis (1999) recommend the semi-log model.

More recently, Li *et al.* (2006) observe that analysts in practice tend to use measures of "goodness of fit", which include R^2 and standard error of the regression, as the criteria for choosing between functional forms. The study argues that semi-log and log-linear models are the most widely used in hedonic studies because, based on adjusted R^2, they generate a better "goodness of fit" than the linear model.

Malpezzi (2003) in a general review of hedonic price literature also argues against the linear form primarily on the grounds that the price impacts of any single property characteristic is interdependent with other characteristic, so that prices are nonlinear. The research, in summary, provides four primary arguments in favour of the log-linear specification:

It allows for variation in the interdependence in the price impacts of property characteristics, and thus permits the price impact to vary proportionally with the real estate quality and size;

The model offers coefficients that have a simple and appealing interpretation (but see Section 3.5.4 below for a fuller discussion);

The model is one which is less likely to give rise to problems of heteroscedasticity, or changing variance of the error term (see Section 3.5.5 below); and

By allowing for a mix of continuous and discrete variables, the model allows for flexible specifications of the explanatory variables.

3.5.2 Specification of variables

The second set of issues in hedonic modelling surrounds the selection and specification of explanatory variables. In principle, the hedonic model assumes that all property attributes, which impact upon prices, are included in the explanatory regression. In practice the prices of properties are subject to influences from a very wide set of factors, some of which may not be common to all properties, and many of which may not be systematically captured in any data source. Taking account of

all influences on prices may therefore demand an unfeasibly large data set, and pose problems with degrees of freedom in the regression models. The possible exclusion of some important price determinants as independent variables in the regression may lead to biased estimates of market price.

From a wide ranging review of previous studies across several countries, Malpezzi (2003) extracts a set of hedonic variables that can be taken as a "standard set" likely to achieve a high degree of explanatory power in most markets. This "standard" variable list includes the number of bedrooms, floor area, type of property, type of heating and cooling systems, age, and tenure plus structural features such as the number of garage, quality of finishes, neighbourhood qualities, locational features such as distance to the central business district and important amenities. Commenting on possible variables that are to be included in hedonic modelling, Hulten (2003) argues the practical case that in most studies, the selection of explanatory variables is determined mainly by the range and reliability of the measures available in the primary data source(s) for the analysis.

While in principle it may be that any hedonic model is strictly speaking incomplete, the critical test is how well the available set of property attributes performs in explaining variance in market prices. Thus, Sirmans *et al.* (2005) in a review of recent studies posits there is an almost limitless number of explanatory variables that could be included in a hedonic regression. The study, however, produces a set

of key attributes, similar to those of Malpezzi (2003), which include lot size, floor area, age, number of storeys, number of bathrooms, number of rooms, number of bedrooms, fireplace, central air-conditioning, basement, garage, deck, pool, brick exterior, distance to CBD and year of transaction as the most commonly used property characteristics in hedonic regression.

3.5.3 Classification of locations

Difficulties or inconsistency in capturing locational characteristics is a third problem area in hedonic modelling. A very wide range of measures, from simple postcodes through to the quality of school districts, accessibility to amenities, and socio-demographic neighbourhood groupings have been used in the literature to denote locational attributes which influence price. Some studies (see Watkins, 1999; and Bourassa et al., 1999) have applied techniques such as principal components and cluster analysis to define real submarkets from large sets of locational variables. At the other end of the range, Fletcher *et al.* (2000a) and Berry *et al.* (2003) define residential markets on the basis of simple post codes. Other studies, for example, Greaves, 1984; Adair and McGreal, 1994; Gallimore *et al.*, 1996; Adair *et al.*, 1996; Hoesli *et al.*, 1997; Simons *et al.*, 1998; and Ding *et al.*, 2000 define market segmentation using a mix location and neighbourhood characteristics.

Conniffe and Duffy (1999) and Fletcher *et al.* (2000a), however, suggest there are fundamental difficulties in defining and measuring location variables. The studies

contend that despite the importance of location in real estate price determination, there is no definitive or consistent definition in the literature of how that influence should be captured. Individual studies have, thus, typically applied the most readily available data source to influence their choice of locational variable definition.

In this study, we define location based on a set of neighbourhood characteristics widely accepted in the market and by planning authorities in Ghana, in a manner similar to Gallimore *et al.* (1996), which classifies data into neighbourhoods of similar characteristics.

3.5.4 Interpretation of coefficients

A fourth area of debate in hedonic modelling relates to potential errors in the interpretation of the coefficients of explanatory variables, particularly in log-linear specifications. Whilst it is correct to say that the coefficient of a continuous variable multiplied by 100 is equal to the percentage effect of that variable on real estate price, *ceteris paribus*, the interpretation of the coefficient is different for discrete or dummy variables. Thus, Halvorsen and Palmquist (1980) claim that a misinterpretation of coefficients can result in substantial errors in reporting the results:

> *Since a dummy variable enters the equation in dichotomous form, the derivative of the dependent variable with respect to the dummy variable does not exist. Instead, the coefficient of a dummy variable*

measures the discontinuous effect on Y of the presence of the factor represented by the dummy variable.

For dummy variables, the research explains that the relative effect on price or rent (g) can be expressed as:

$$g = \exp(c) - 1 \qquad [5]$$

where c is the coefficient of the dummy variable.

And the percentage effect of the dummy variable on price or rent is given as:

$$100 \times g = 100 \times \exp(c) - 1 \qquad [6]$$

where c is the coefficient of the dummy variable.

In this thesis, the interpretation of results is in a manner consistent with the principles of equations [5] and [6] to show the influence of real estate attributes on the market price and rent. The current research therefore interprets coefficients of continuous variables differently from those for dummy variables by employing equation [5]. In explaining the marginal effect of all individual discreet variables on real estate price and rent, equation [6] is adopted.

3.5.5 Heteroscedasticity

The presence of heteroscedasticity – statistically meaning the variance of the error term in a regression is not constant over the range of data used – has been widely

identified as a problem in hedonic modelling as its presence may result from non compliance with restrictive assumptions, thereby invalidating the statistical tests. One of the underlying assumptions of standard ordinary least squares (OLS) approach is an equal variance of the error term (homoscedasticity). In effect, the variance of the error term should not differ, for example, between property types such as detached and semi-detached, or with differences in (say) property size.

Several studies have looked in detail at the issue of heteroscedasticity (for example, Goodman and Thibodeau, 1995, 1997; Fletcher *et al.*, 2000b; and Stevenson, 2004) and suggested diagnostic tests and / or corrective measures. Generally, these studies have concluded that problems of heteroscedasticity are most often associated with the age or size variables. For example, as a property increase in size, Fletcher *et al.* (2000b) contend there is greater potential for differences in the design and quality of fittings, which may lead to increase variation in the prices or larger properties, and lead the null hypothesis of homoscedasticity being rejected.

Stevenson (2004) suggests that age of properties is the most common root cause of heteroscedasticity. The study argues that as properties age, it becomes more likely that they are renovated. Since the timing and extent of renovations may differ between individual properties, and also since the extent of renovations may not be recorded in the available data, the unexplained variance of prices will rise with increasing age. Stevenson (2004) also advocates that older properties may be

influenced by vintage effects as in Goodman and Thibodeau (1995), such that property prices may rise with age. But Stevenson (2004) argues the interlinkage between the increase in price beyond a certain age, and the variable in the quality of the property tends to result in a non-linear relationship between price and age. And that whilst prices drop initially, they however, start to rise at a certain point but due to the inconsistency in the quality of older properties this may yield an increasing variance in the residuals as property age increases.

The data used in this thesis mostly covers newly developed residential assets and, as such, age was excluded as an explanatory variable. Following the findings in Stevenson (2004), that age effects are the predominant driver of heteroscedasticity, corrections for this problem are possibly not required in this case. Furthermore, Hill and Melser (2005) conclude that the use of a log-linear hedonic model specification, as in this research, tends to mitigate any problems of heteroscedasticity.

3.5.6 Multicollinearity

The price of a property is the product of a bundle of attributes used as explanatory variables in a regression. Individual attributes may be related and therefore cross-correlated, as is clearly the case, for example, of number of rooms and total floor area. The existence of correlated independent variables is referred to as multicollinearity. Its presence violates the assumption that explanatory variables are linearly independent. It therefore becomes difficult to distinguish the individual

effects of the inter-correlated independent variables by reference to the regression coefficients. The presence of multicollinearity does not introduce errors or bias into the overall specification of a regression model, but does affect the interpretation of regression coefficients and may increase the danger of over-fitting (Case and Wachter, 2003; and Malpezzi, 2003).

Thus, Greene (2000) diagnoses three effects of multicollinearity. First, small changes in the variables used produce wide swings in the parameter estimates. That is, parameter estimates become very sensitive to the addition or deletion of explanatory variables. Second, the estimation coefficients tend to have high standard errors. What is implied here is that had the interdependence among the explanatory variables been low, the estimated coefficients would have been statistically more significant. Third, coefficients are more likely to have the "wrong" sign or implausible magnitude.

One of the standard ways to deal with multicollinearity as proposed in the literature is by using more data. Though this approach may offer a solution, it is often restricted by the limited sources of data available on real estate markets. This thesis therefore applies what appears to be the most frequently used approach – the exclusion from the regression of a variable from the set of variables which seemingly are correlated (see Sirmans et al., 1998).

In this thesis, one locational variable (Emerging Upmarket) is excluded as well as one real estate type (semi-detached), so that coefficients of the retained variables are analysed and discussed relative to the excluded. Also excluded is year 1992 from the time dummies, which in turn is treated as the base year for the index construction.

3.5.7 Spatial dependence

Spatial dependence as defined by Mueller and Loomis (2008) occurs when spatially correlated variables are omitted in a regression model. In traditional hedonic price modelling, the contextual variations over space are usually specified using "fixed" coefficients – derived from location dummy variables – to assess their direct effect on property prices and rents. The issue of spatial dependence may seem therefore to be related to the topic of location classification (see Section 3.5.3) but it has rather been treated differently in the literature (Brasington and Hite, 2005; and Bateman *et al.* 2007). Its specification has been based on the assumption that the marginal prices and rents of structural property attributes are invariant through space (Mueller and Loomis, 2008). Real estate market heterogeneity shows distinctive neighbourhood effects on real estate values (Goodman and Thibodeau, 2003) and tends to be the major source of spatial autocorrelation among residuals if not adequately handled in the model. For example, an additional 100 square metre of

residential floor area may not generate the same amount of marginal effect on price or rent for all submarkets or locations.

Spatial autocorrelation explains the average correlation between observations based upon replicated realisations of the geographic distribution of property attributes (Griffith 1988, 1990, 1992). Spatial effects on real estate values are therefore two fold: neighbourhood effects and adjacency effects (Can, 1992). The study denotes the former as the internalised values of geographical features, also referred to as exogenous effects. The latter explains spatial spill-over effects, that is, the impact of the characteristics of close surrounding properties – endogenous effects. Exogenous effects can actually be manifold, ranging from city-wide structural factors to local externalities. And endogenous effects occur when characteristics of surrounding or adjoining properties are internalised in the property price or rent, leading to spatial dependence or association (Can, 1992).

The debate on issues of spatial dependence is inconclusive (Kestens *et al.*, 2004) but Can (1990, 1992) and Casetti (1997) contend the issues can be resolved by employing parametric pricing models such as the log-linear form. In this thesis, issues of spatial dependence have been addressed in two ways. First, as seen in section 3.5.3, location variables have been carefully defined in line with official residential zoning criteria in Ghana (see Ministry of Local Government, 1990) and

also consistent with findings in the literature (see Gallimore *et al.*, 1996). Second, the log-linear hedonic functional form has been used.

3.6 Summary and conclusions

This Chapter has critically reviewed the use of three alternative residential pricing models. It also examined in detailed the three most frequently used specifications of hedonic models, the issues which have to be taken into account when constructing hedonic models and when interpreting their results.

From the review, it is clear that the choice of a modelling approach is not a purely technical problem, one of finding the "best" statistical solution. In any study, the selection of method is in part dependent upon the three additional factors. First, the underlying market structure - the frequency of trading and heterogeneity of property attributes. Second, the volume and quality of data available, in particular how well property attributes are recorded. And third, the objectives of the analysis – whether it is aimed primarily at capturing price trends, or also aims to investigate the processes of price determination and differentiation between areas. On all three counts, it is concluded that hedonic modelling is appropriate to the context and goals of this thesis.

As discussed in the next Chapter, the data set available for analysis is fairly large – 3,250 capital transactions and 1,130 rental transactions but spread over 16 years and

across several locations with distinct characteristics. This heterogeneity rules out the use of simple mean or median measures. In Section 5.5 below, it is in fact demonstrated that changes in quality mix over time have been a significant influence on the evolution of average prices. The limitations of sample size also in principle reduce the potential applicability of repeat sales methods; in practice, the method of recording transactions – which does not include unique property identifiers – would make the collection of repeated sales observations very difficult. Finally, it is intended to use the analysis in part to check that methods commonly used in developed countries also apply in the emerging formal Ghanaian market, and to investigate differences in price across locations. From this viewpoint, again, it is necessary to use a method which provides a transparent explanation of how prices are related to the underlying attributes of properties, which argues for the hedonic method.

A pre-requisite for the use of hedonic methods is the availability of consistent information on those attributes which are believed to determine prices – which is of course also the drawback of the method, in demanding greater data collection. On this count, the primary sources used in the analysis – transactions and property records held by state agencies – do cover the set of attributes (a pre-existing location classification, a number of measures of the salient size and specification characteristics of residential units, some information on landscape quality and legal

forms of ownership) most commonly found in the literature to be the dominant determinants of residential prices.

Given the selection of the hedonic approach, further choices have to be made on the appropriate function form of models. This research constitutes the first robust analysis of the formal Ghanaian residential market therefore a large part of the effort involved has been in the collection and testing of primary data and the research is not intended as a contribution to the theory of hedonic modelling. Though the merits of varying approaches are still debated in the literature – as indeed are more complex combinations of hedonic and repeat sales approaches – the log-linear form of hedonic model has been selected because it is the most widely applied and tested methodology.

Also, with the selected hedonic form, any application of modelling methods requires an appreciation of the possible limitations of the models, and appropriate tests for their robustness. Here the main issues discussed in the literature are heteroscedasticity, and multicollinearity. As discussed in Section 3.5.5, it is taken from the literature that problems of heteroscedasticity are most strongly associated with vintage effects in the sample of properties. Because the sample used in the analysis is dominated by recently constructed developments, it is not considered that vintage effects will be important. The potential problem of multicollinearity has been recognised, and dealt with by the standard method of excluded dummy

variables and explicit tests to ensure the models are robust which are described in the following Chapter.

CHAPTER 4 MODELS OF RESIDENTAL PRICES AND RENTS[1]

4.1 Introduction

The review of literature has established that there has been little research on the performance of the formal real estate investment markets in Ghana or indeed, in other African emerging markets with the exception of South Africa. It has also established that the availability of evidence on real estate values and returns is seen as an important factor in the creation of efficient investment markets.

Drawing on real estate transaction records held at the Ghana Land Valuation Board, this Chapter aims to measure the marginal contribution of residential attributes such as number of bedrooms, plot size, location, unexpired term, quality of landscaping and floor area to price and rent. It also seeks to construct indicators of real estate values – price and rent indices – for the past 16 years (1992 to 2007). Achieving these objectives demanded a substantial effort to extract information from paper archives of the Land Valuation Board, and the testing of estimation methods to extract time-series results from the data. This Chapter is intended to provide a basis for the construction of the first Ghanaian "Residential Real Estate Index", a significant contribution to literature. Given the existence of land registration and

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[1] Another version of this Chapter has been accepted as a paper for the *Journal of Real Estate Literature.* The paper was also presented at the 14th European Real Estate Society Conference, June 27-30, 2007 at Cass Business School, London.

valuation systems similar to those of Ghana in other emerging economies, the approach may be more widely applicable.

Formal real estate markets – modern residential, retail and office space leased on well-defined contracts that are registered, and demanding large amounts of development capital – are in an early state of development in many African economies. These nascent investment markets have received little attention from researchers and policy-makers, in contrast to the large volume of work on the foundation stages of real estate markets such as land rights issues and land registration. The role of formal real estate investment markets in the process of economic development therefore remains poorly understood.

This Chapter investigates the applicability of the hedonic approach to the creation of indices of residential real estate capital and rental values from state land registration and valuation systems in Ghana. It lays the foundation that is needed for the next two Chapters which develop full measures of total returns on residential real estate, and compare real estate investments with other assets.

Although it remains small in scale compared with advanced economies, there is a growing stock of income producing residential real estate in Ghana. Transactions in the formal sector of the market are recorded – primarily for the purpose of Stamp Duty collection – by the Ghana Land Valuation Board. These records form the

primary source of data for the empirical price and rent modelling which is the main core of this thesis. Though there is now a substantial, and rapidly growing leased office stock, capital transactions in this sector have been rare. Most retail stock remains in the informal sector, with the small modern stock predominantly held by owner-occupiers. Similarly, industrial real estate stock mostly concentrated along the Spintex Road, the industrial hub of Accra is by and large owner-occupied. The commercial market in Tema follows a similar pattern; characterised by a large industrial stock, but which is again, generally owner-occupied. Due to the small sizes of the commercial investment stocks, and the even smaller volumes of transactions evidence available in the primary data sources used in this research, this study has excluded retail, office and industrial real estate income producing assets.

The size of the formal residential real estate investment market, and the quality of data capture by the Land Valuation Board, are both greatest in the Accra and Tema urban areas. Since the primary data used in this thesis, moreover, required visits to several offices of the Land Valuation Board and other agencies in each location, expanding the data collection to other cities would have been impracticable.

Following this introduction, the Chapter is organised as follows. Section 4.2 gives a short overview of residential market in Ghana. Sections 4.3 and 4.4 explain in detail the data and methodology used. Section 4.5 presents the overall models of transaction prices and rents, and discusses the results. Section 4.6 presents various

statistical tests of model robustness. Section 4.7 provides disaggregated results for individual locations; and Section 4.8 calculates overall price and rental indices from the models. A summary of findings and concluding remarks are provided in Section 4.9.

4.2 The residential market in Ghana

The residential real estate market in Ghana consists of a growing formal and a much larger informal sector. Public agencies such as the Ministry of Water Resources, Works, and Housing, the Social Security and National Insurance Trust (SSNIT), Tema Development Corporation (TDC), State Housing Company (SHC) and the HFC Bank (Ghana) Limited, as well as private developers from the Ghana Real Estate Developers Association (GREDA) have led the development of a formal residential market, for which both real estate sale and leasing transactions are captured by the state land registration and taxation agencies.

After independence in the 1960s two state companies – SHC and TDC – were established to directly deliver housing units. The SHC established in all regional capitals has made a substantial impact on the real estate market in Accra through the development of residential neighbourhoods such as Dansoman, Ringway, Kaneshie, Achimota, Awudome, Teshie-Nungua and Adenta estates. TDC has existed to provide residential accommodation in the rapidly growing Tema metropolis as part

of a major industrialisation drive. It has engaged in various types of real estate development – residential, commercial and industrial – to supplement the development of the biggest port in the country. Its 25 residential communities constitute a huge rental market, which primarily serve the low, middle and upper income strata of residents in Tema.

As the name suggests, SSNIT, one of the key participants in the formal real estate market, is the trustee of the social security scheme in Ghana. The Trust is the main legally authorised institution that manages the state's pension scheme for workers in accordance with the Provisional National Defence Council (PNDC) Law 247 – the Social Security Law – under which the current scheme operates. Besides the standard commercial real estate investments, SSNIT as an institutional investor until recently held a diversified portfolio including a large residential stock of formal rental units in all regional capitals in the country. Its residential rental units have since 2003 been offered on sale, the first option of refusal given to corporate and public employers followed by sitting tenants. Such capital and rental transactions have been contracted at subsidised prices consistent with government housing policy to provide affordable housing to the populace. All transactions in this category have been excluded from the samples used in the analysis in this thesis.

There have been other public policy initiatives to support the development of mortgage lending systems. A World Bank funded pilot project established the

Housing Finance Company (HFC) to operate as a non banking financial institution under the Financial Institutions Non-Banking Law, 1999 (PNDCL 331). The Company's primary objective at inception was to provide mortgage finance for home purchase, home equity, and home improvement and completion (Home Finance Company, 2005). Loans provided by the HFC, however, appear to have had only a marginal impact on the overall market. High variable interest rates charged by the bank as a result of adopting US dollar indexed rates may have made residential mortgage very expensive and unpopular. From 2000 to 2005 (inclusive) the HFC approved only 510 mortgages, 57% of which were granted to non-Ghanaian residents. (Home Finance Company, 2005). As majority of residents and investors could not tap into the residential real estate mortgage market through HFC, the bank has evolved from a non-commercial bank engaged in mortgage financing, investment management and savings mobilisation to HFC Bank (Ghana) Limited, a general commercial bank.

Despite the above policies and activities, the Ghanaian residential real estate market is characterised by acute shortage of accommodation. There is an estimated backlog of 500,000 residential units. Annual residential supply averages 35,000 units, compared with an annual demand estimated at 175,000 units (Ministry of Water Resources, Works and Housing, 2007). Though the shortage of residential stock cuts across all segments of the market, the focus of real estate developers in the

formal sector has been on the middle- and upper-income submarkets where rental values are higher.

The private rented sector delivers a large proportion of the country's residential stock. In Accra, 40.7% of households as at 2000 lived in private rented residential accommodation, whilst a further small group (1.2%) shared premises with relatives on a rent-free basis (Ghana Statistical Service, 2005). There is a sizeable state rent-free sector providing accommodation for civil and public servants, which accounts for 19.9% of households. A fairly large percentage (38.2%) of households in Accra is classified as owner-occupiers. In other urban centres such as Kumasi, Takoradi, Koforidua, Cape Coast and Sunyani a greater proportion of households (42.3%) own their residential accommodation; 34.5% live in rented premises and 23.2% enjoy rent-free houses. On a national scale, 57.4% and 22.1% of the households are owner-occupiers and renters respectively, and 20.5% are rent-free occupiers.

Private sector rented residential has been subject to some state regulation of prices. The Rent Act, 1963 (Act 220) set controlled rents for all residential accommodation. Accordingly, landlords, unable to realise economic rents failed to keep properties in a good condition, and sought to circumvent the law by demanding lump sum advances as premium in lieu of rent reduction (Oteng Kufuor, 1993). Though this practice did not go unchallenged, particularly by sitting tenants, it has been sustained to the present day where initial rent for residential accommodation is

commonly paid for one or more years in advance. The current regulatory framework set by the Rent Control Law, 1986 (PNDC Law 138 with amendments in PNDC Law 163) is much more limited in scope than the 1963 Act, prescribing a ceiling rent ¢1,000.00 (US$11.21) per month only for one and two-roomed residential accommodation. This restriction applies only to very small, low cost apartments. None of the larger family housing units covered by the analysis in this thesis have been subject to rent controls.

Investors in residential real estate, specifically, were also for a time subject to PNDC Law 150 of 1986, which limited the repatriation of rental income or sales proceeds to 35% of the total; the remaining 65% had to be deposited in local currency in a Ghanaian bank. In 1996, it was believed these regulations were being widely circumvented by offshore transactions and was also having a negative impact on real estate investment, resulting in the repeal of the law.

With the exception of remaining rent controls for the lowest end of the market, therefore, there is currently a wholly free market in the types of private rented residential accommodation covered by this research, which is free from both rent controls and any restrictions on repatriation of incomes by non-Ghanaian residents.

Within this framework, the empirical work presented in this Chapter focuses on formal residential investment markets in Accra and Tema. Accra is Ghana's largest

city and the national capital, with an estimated population (at the last Census in 2000) of 1,659,136. Tema with a population of 141,479 is the 6th largest city, the county's largest port and a major industrial centre, and only 18 kilometres from Accra (Ghana Statistical Service, 2002). Together, the two cities (see Figure 4.1) form the dominant commercial and industrial conglomeration in Ghana, accounting for 17% of Ghana's total population of 18.4 million in 2000. The country has a high rate of population growth, averaging 2.6% per year over the ten years to 2007 (World Bank, 2008). On the latest estimates, Accra saw a population increase of 37% from 2000 to 2007, and Tema an increase of 22% (World Gazetteer, 2008).

Figure 4.1: Map of Accra and Tema

In Accra and Tema, real estate markets in leased retail, office and industrial assets are much less developed than in residential, and are largely privately owned. In the

retail sector, there has been upsurge in modern shopping chains – Accra shopping mall, A-Life Supermarkets, C & A Shopping Centre, MaxMart, Koala and Swanzy Arcade – sited at vantage points for residents and commuters, and in competition with the traditional shopping areas in Central Business Districts. The new retail stock, however, remains predominantly owner-occupied, while traditional locations operate in the informal real estate markets.

The small modern office stock – Total House, Trinity House, Pegasus House, Opeibea House, Millennium Tower, Heritage Tower, Trust Tower, Aviation House and Fidelity House – is largely owned by corporate bodies or private individuals. As recent developments gravitate towards the "Independence Avenue Corridor" running from Ridge to the airport, additional office developments such as Silver Star Tower, Una House, Vanguard House and Airport City Scheme have increased the stock.

Much of the residential development in the formal markets of Accra and Tema has been fostered by government policies such as the establishment of the Ghana Real Estate Developers Association (GREDA), which aims to provide an enabling environment for public and private sector co-operation. GREDA draws together representatives of government departments, real estate professional bodies, brokers and major developers to co-ordinate public policy and the private developers to promote the supply of new development.

Private sector members of GREDA are the major suppliers of new residential investments and have contributed extensively towards the development of residential markets in Accra and Tema, particularly, in the form of rapidly expanding gated communities in Accra.

State agencies such as the Tema Development Corporation (TDC), State Housing Company (SHC), and the Social Security and National Insurance Trust (SSNIT) as indicated above have also been prominent developers of residential stock in the formal sector for both sale and rent. The properties sold to private investors by these state bodies are included in the data sample used in this research. For properties retained by state bodies and rented out, neither transactions prices nor rental agreements are covered by the data sample used in the research.

The higher income and longest established residential areas in Accra such as Airport Residential, Cantonments, Labone, Ridge and Roman Ridge were originally developed exclusively for owner-occupation by expatriates and the Ghanaian elite. These neighbourhoods are primarily built on large plots with long secure leaseholds from the state. With an influx of international and local businesses, these areas have in recent years evolved into mixed-used zones. Most recent residential construction has taken the form of sub-division, where "colonial" bungalows on large plots are redeveloped into higher density semi-detached houses and apartments.

Newer middle to upper income residential locations, developed over the last ten years for both owner-occupation and rental residential accommodation, include East Legon Extension, West and North Legon, Ashaley Botwe, Adenta, Baatsona, Okpoigono and Dome in Accra. These neighbourhoods are characterised by high quality and modern houses, but the quality of amenities is lower than in longer established Upmarket locations. They generally lack concrete drainage, tarred roads, community facilities such as recreational centres, police stations and post offices, and have a less reliable supply of utilities.

In Tema, new residential neighbourhoods are somewhat different in character. They cater for the middle and lower end of the income range, typically with small semi-detached units, but are developed on state-provided serviced plots with good basic utilities and tarred roads.

Currently, residential real estate investments in the formal sector are let on varying lease terms. Leases run from two years upward, typically with provisions for rent reviews to market values every three years for longer leases. Rents are usually quoted in US dollars, but payable in local currency (Cedi) because financial regulations preclude payment in other currencies. Sale prices are also commonly quoted in US dollars. Dollar denominated rents offer landlords – many of whom are foreign-based Ghanaians – some protection against currency fluctuations and local

inflation. A convention of paying rents initially for one or more years in advance also offers some protection against inflation.

A large number of expatriates in Ghana live in Accra or Tema. In general, this group of residents earns income in dollar denomination. A substantial number of Ghanaian workers are also paid dollar-denominated incomes – including the majority of the professional staff of multi-national companies. Further groups of local professionals working for banks and other financial institutions can be classified as middle to high income earners who are also able to undertake to pay rents denominated in dollars.

There is no hard evidence on the characteristics of investors in residential real estate in Ghana. Anecdotal evidence suggests Ghanaian residents, principally of businessmen and professionals including medical practitioners, accountants, surveyors, bankers and engineers, predominate. A substantial number of non-resident Ghanaians, typically professionals working in Europe or North America, have also invested to provide residential accommodation in Accra or Tema.

4.3 Data sources

This Section explains the sources of primary data used in the analysis in this Chapter and the following two Chapters, followed by a description of the hedonic modelling methods employed.

4.3.1 Primary data collection

The primary data source is the records of the Ghana Land Valuation Board. The Board, which is one of the country's six land sector agencies, keeps an archive – in the form of hardcopies held in various files and ledgers – covering all real estate sales and letting transactions submitted for Stamp Duty assessment, and also for registration under the deeds and land title registration systems. The Board also holds additional information on sales and letting transactions provided by the private developers who are members of GREDA for general valuation purposes.

Most of the data used is extracted from the "Property Document (PD) Form" specified by Section 13 of the Act 689 (Stamp Duty Act, 2005). A copy of the form is attached as Appendix 4.1. The required fields cover a physical description of each property (location and type), its full address, sale price, rent payable (in the case of lettings), plot size, type of interest transacted, name and address of parties and date of transaction. Copies of the standard forms used to record letting transactions and property management agreements are attached as Appendices 4.2 and 4.3.

In addition to these primary sources, some further information on each property (gross floor areas, quality of landscaping, number of bedrooms, the presence or otherwise of garage and outhouse, detached or semi-detached, and number of storeys) was obtained from filed real estate inspection reports. Valuation technicians within the Board conduct such inspections to ascertain and/or verify sale and letting transactions details as well as report on quality of construction for Stamp Duty purposes, the basis for assessment of duty payable. Approved by the Regional Valuer, these reports are filed as comparables for subsequent rental and capital valuations.

Though the Conveyancing Decree, 1973 (NRCD 175) and Stamp Duty Act, 2005 require full completion of all fields for all transactions, in practice the official records are often incomplete, lacking critical fields such as date of transactions, prices and rents. Other sources – the HFC Bank (Gh.) Limited and the original developers – were used as cross-references for dubious or missing information.

The original process of data assembly and validation was therefore time-consuming and laborious, and required the engagement of two land economy graduates and two valuation technicians for periods up to four months. The manual process required searching through sets of ledgers and files which are stored in different offices, and careful matching of several sources.

Following the primary data extraction from hard copies, all records were scrutinised for missing fields, errors and duplications. At this stage several types of transaction were screened out: all transactions for which the buyer and seller records suggested the transaction was not at arm's length; all cases with missing fields; and all cases where the officially recorded price did not concur with verified figure from either HFC Bank (Gh.) limited or members of GREDA.

The final stage of the data collection process was the transfer of all records into a custom-designed Excel template (attached as Appendix 4.4) for final checking and for analysis within Excel and the econometric software package EViews. At this stage, further transaction records for the relatively small number of flats in the original sample were discarded because their prices would be determined by different attributes from the dominant types of detached and semi-detached houses, and the sample of flats was too small to support separate analysis.

The data capture and validation work was conducted in two stages. In 2006, the first stage collected records for each year from 1992 to 2005; in 2008 the second stage collected new records for 2006 and 2007. Through the whole process, initial records for 6,267 sales transactions over the period 1992 to 2007 were reduced after validation to a usable final sample of 3,250 sales. Usable records were also obtained for 1,130 letting transactions. The sample of lettings transactions is smaller than that

for sales because only leases running for three or more years are generally registered under the Stamp Duty Act.

4.3.2 The property variables used

The full set of property-specific variables available for analysis covered all the primary physical characteristics: type of unit (single family detached or semi-detached), plot size, gross internal floor area, number of bedrooms, number of storeys, and the presence or otherwise of garage and outhouse. Fields for legal and leasing characteristics cover the freehold ownership (coded as state or customary owner), and unexpired term of underlying ground leases. A final field classified the quality of external landscaping as assessed through site inspections by the Land Valuation Board (for variable definitions, see Appendix 4.5).

For the purposes of analysis, four of the physical attributes – number of bedrooms, gross internal area, plot size and unexpired lease term – were treated as continuous variables. Six further property characteristics were treated as discrete variables – number of storeys, presence of garage and outhouse, detached, semi-detached, state versus customary land ownership, and quality of landscaping.

Other standard forms of geographical classification such as postcodes (see Fletcher *et al.*,2000a and Berry *et al.*,2003) are unavailable in Ghana. The application of more advanced techniques such as socio-demographic clustering (see Watkins,

1999; and Bourassa et al., 1999) for location classification are also ruled out by the absence of the necessary information. Jones *et al.* (1999), in reviewing 20 studies that seek to determine the existence of real estate submarkets, conclude that there is little consensus on how submarkets are defined or how, in practice, they should be identified. In the absence of a definitive or consistent definition in the literature of how the influence of location variable should be captured, Conniffe and Duffy (1999) and Fletcher *et al.* (2000a) suggest the use of most readily available data source.

Accordingly, the locational element of the analysis in this research has been dealt with by classifying residential locations into submarkets based on broad neighbourhood characteristics, following an approach similar to Gallimore *et al.* (1996). All property records are classified into five submarkets identified primarily by a residential zoning typology devised by the Ghana Ministry of Local Government (shown in full in Appendix 4.6), allotting to each zone titles which reflect the overall status of each zone.

As Appendix 4.6 demonstrates, the Ministry of Local Government typology is based upon a large set of neighbourhood characteristics including the type of stock (plot sizes, detached or semi-detached units), quality of infrastructure (roads, drainage and utilities), and availability of amenities. In the absence of more elaborate and finely grained classifications of neighbourhood characteristics, the

Ministry of Local Government – through the Town and Country Planning Department – classification constitutes the best available system for differentiating the defining characteristics of residential locations. The five locations are also treated as additional discrete explanatory variables in the models used in this research.

The analysis for Accra is therefore conducted for four submarkets differentiated primarily by the quality of stock and neighbourhood: Upmarket, Gated Market, Emerging Upmarket and Middle Income Market. These names are adopted for the current research in place of the official income-based residential classification such as "high-, middle-, and low-income" residential sub-markets. In Tema, residential locations, referred to as communities, are more homogenous in type, and are classified into a single "Tema" category.

The available data, in summary, provides a fairly full set of variables largely matching the "standard" sets used in hedonic models of residential pricing, as identified in Malpezzi (2003) and Sirmans *et al.* (2005). The most obvious variable from the standard set not used in the analysis is the age of property, because fields for age are not available in any of the primary data sources. This omission is, however, relatively unimportant because the transactions records are dominated by newly or recently developed properties sold by developers to investors. The primary Land Valuation Board records used (Stamp Duty Ledgers) do not give any detail on

some features of properties – such as air conditioning, construction materials, and quality of internal finishes – which may impact on prices. Because stock provided in each sub-market tends to be homogenous in these respects, some aspects of un-measured quality may contribute to price differentiation across locations.

For the rental analysis, a smaller data set was obtained – 1,130 letting transactions – representing 35% of the total observation for sale transactions. Tenancy agreements have common features, the term certain typically between two and five years with renewal clauses, usually at tenants' option. Generally, one or two years' initial rent is paid in advance with subsequent reviews to market rental values. The data fields captured for rental transactions parallel those for sales. The same custom-designed Excel template was used for rental data compilation where rent is substituted for sale price.

All records for property prices and rents are held by the Land Valuation Board denominated in either US$ or local cedis. Some original data therefore contain price and/or rent in US dollars, but these have been converted to local currency (Cedi) at the interbank monthly average exchange rates for each year, which were obtained from the Bank of Ghana.

4.4 Modelling methods

As discussed in Section 3.5.3, the choice of analytical methods is, as in most hedonic modelling, in part dictated by the characteristics of the data available. The repeat sales method is ruled out because, in the current format of the original records, it is not possible to identify properties transacted more than once. In any event, the fairly small number of total transactions available spread over the 16 years suggests that there would be too few repeat sales to support a robust analysis. In addition, the objectives of the analysis include gaining an understanding of the determinants of prices as well as tracking price changes over time, and also explaining the variation in prices across sub-markets.

For these reasons, and as discussed in Chapter 3, the analysis of transaction prices and rental values which follows employs the log-linear specification suggested by Malpezzi (2003) and represented by the general form:

$$P = f(S, N, L, C, T) \qquad [7]$$

where;

P = price; (substituted by R where rental values are being estimated);
S = structural characteristics;
N = neighbourhood characteristics;
L = Location characteristics;
C = contract characteristics that affect rental income; and
T = the time of transaction.

For notational convenience, equation [7] can be re-written by collapsing the vectors S, N, L, C and T into a larger vector X. Adopting a common semi-logarithmic functional form, equation [7] is reduced to:

$$P = e^{x\beta\varepsilon} \qquad [8]$$

So that

$$\ln P = X\beta + \varepsilon \qquad [9]$$

Since β and ε are unknown true parameters, we estimate:

$$\ln P = Xb + e \qquad [10]$$

where b and e are actual estimates.

By the properties of logarithms, the value of an individual characteristic can be estimated, X_1, at a given level of X_1 as:

$$P = e^{xb} \qquad [11]$$

The price of X_1, or any other single attribute, varies with the level of X_1, as well as with the level of other X_i. The price and rent of real estate assets therefore are nonlinear.

As discussed in Section 3.5.1 above, various functional forms of the hedonic models have been used in the literature, with an extensive though inconclusive debate over the merits of different choices. The log-linear form has been employed, again following Malpezzi (2003).

The price and rent models are represented by the equations:

$$\ln P(x_j) = \beta_0 + \sum_{i=1}^{n} \beta_i \ln(x_{ij}) + \sum_{k=1}^{n} \beta_k D_{kj} + \varepsilon_j \qquad [12]$$

$$\ln R(x_j) = \beta_0 + \sum_{i=1}^{n} \beta_i \ln(x_{ij}) + \sum_{k=1}^{n} \beta_k D_{kj} + \varepsilon_j \qquad [13]$$

where $\ln P(x_i)$ and $\ln R(x_i)$ are the natural logarithm of price and rent respectively, β_i and β_K are coefficients, $\ln X_{ij}$ are the natural logarithms of continuous independent variables, D_{kj} are time dummies or other discrete variables, and ε_j represents random errors. The parameters β_i and β_K are computed using ordinary least squares.

To deal with any problems of multicollinearity as discussed in Section 3.5.6, where independent variables are used in the form of dummy variables, one of the dummies is omitted in the estimations, thus forming a base category against which other categories are referenced. In the case of the locational variables, Emerging Upmarket is the omitted dummy. For years, 1992 is taken as the base case, as the start of the target time series. For the main property types, semi-detached is the omitted dummy.

The choice of omitted dummy category is particularly critical for the locational analysis. To ensure that the results are not biased by the selection of the omitted category, the aggregate models are re-estimated with each of the other location dummies in turn excluded. The results show no significant changes with the alternative choices of omitted dummy, and are not reported here.

The residential price and rent modelling has been conducted in three stages. First, hedonic price and rent functions are estimated for the full Accra-Tema sample (Section 4.5).

Second, tests of price model robustness are provided by separately estimating the models for sub-periods within the whole sample, as a check for any evidence of structural breaks, and also for the data stratified by price band (Section 4.6).Tests for multicollinearity between independent selected variables (see Sections 3.5.6 and 3.6 for further discussions) are reported in Section 4.6.3.

Third, in Section 4.7, price and rental models are estimated separately for each of the five locational sub-markets described in Section 4.3.2 above. This is done partly as a test of robustness of the models when the sample is disaggregated, and partly to investigate any variation in the process of price determination in different locations.

Finally, in Section 4.8 the results from the hedonic models are used to construct the aggregate residential price and rental indices for the aggregate market, and to briefly discuss the evolution of prices over time.

Where required, nominal price changes have been converted to real price changes by applying the calculation:

$$RR = ((1 + Nr)/(1 + Ir)) - 1 * 100 \qquad [14]$$

where RR is the real rate; Nr is nominal rate; and Ir is the rate of inflation.

4.5 Aggregate price and rental results

This Section briefly describes the characteristics of the data sets, and then presents the results of the hedonic price and rental modelling, which are used to construct price and rental indices for the years 1992 to 2007. The results from the estimations conducted in the original US$ denomination, are reported in the body of the text. All estimations were also conducted on the original data converted to Cedis (using a Cedi:US$ exchange rate calculated as the average of monthly rates through the year of transaction), in order to calculate Cedi-denominated price and rent indices. The recalculation in Cedis raises no additional modelling issues, and the estimations are not reported here.

4.5.1 Transactions price model

Table 4.1 summarises price data from 3,250 transactions used in the analysis, split by submarket. A full set of descriptive statistics is given in Appendix 4.7. All markets yield at least 100 transaction observations over the period, though there is a high concentration (over 50%) of transactions in the Middle Income Market.

Table 4.1: Transactions price data – summary

Submarket	No. of observations	% of Total observations	% of Detached units	% of State freehold units	Mean unexpired term (years)	Mean GIA (sq. m)	Mean price per square metre (US$)	Minimum price (US$)	Maximum price (US$)	Mean price (US$)	Median price (US$)
Upmarket	242	7.4	99	100	61	310	897.53	80,000	950,000	272,464	242,500
Gated	408	12.6	77	0	69	257	452.33	11,313	792,000	157,538	103,000
Emerging Upmarket	137	4.2	82	17	88	241	331.82	14,766	623,226	96,959	57,187
Middle Income	1,627	50.1	52	10	88	173	257.45	6,055	462,000	40,124	26,500
Tema	836	25.7	61	80	71	183	263.48	8,111	552,000	41,984	29,384
Total	3,250	100									

Table 4.2: Price transactions by year and location

Year	All Locations	Upmarket	Gated	Emerging Upmarket	Middle Income	Tema
1992	69	10		2	21	36
1993	126	10		13	41	62
1994	203	10	11	15	102	65
1995	346	9	8	5	225	99
1996	388	28	32	10	206	112
1997	271	10	7	9	165	80
1998	272	16	13	9	187	47
1999	283	19	11	14	167	72
2000	343	24	52	8	162	97
2001	164	21	45	8	68	22
2002	174	14	33	4	78	45
2003	110	18	34	4	38	16
2004	110	16	42	3	42	7
2005	138	12	48	14	35	29
2006	137	14	38	7	53	25
2007	116	11	34	12	37	22
Total	3,250	242	408	137	1,627	836

The differing characteristics of the stock and overall quality of these submarkets are clearly reflected in a wide variation in transaction prices. The top quality Upmarket area commands premium prices, with an average more than double any of the other markets except the Gated Market. In Upmarket are residential units larger in sizes with average gross internal areas (GIA) of 310 square metres.

The Gated submarket contains a wider spread of stock than the Middle Income and Tema submarkets, the upper end of price range overlaps with the Upmarket neighbourhoods. The Emerging Upmarket locations have a much lower average price than the Gated market, although the price ranges in the two sub-markets are close with similar average size of units.

The Middle Income and Tema submarkets show much lower prices at the bottom end of the range, and a higher weighting of lower priced units, than other submarkets. The low average price level also reflects the smaller size of residential units, around 30% smaller than those in the Gated and Emerging Upmarket locations.

Taken as a whole, the transactions data provides more than 100 observations each year, rising up to 388 observations, with the exception of 1992 with only 69 observations (Table 4.2). There are no observations for the Gated market in 1992 and 1993. The location by year samples are highly variable, with the lowest frequency in the Emerging Upmarket neighbourhoods, but fall below ten in only 18% of the 78 cases.

Table 4.3 : Aggregate hedonic price model – results

Variables	Coefficient	T-Statistic
Constant	-1.6497	-2.2734***
Year Dummies		
1992 (excluded base year)		
1993	-0.0301	-0.6021
1994	0.0102	0.2186
1995	-0.0833	-1.8729**
1996	0.1975	4.4785***
1997	0.3734	8.2156***
1998	0.4409	9.6801***
1999	0.5070	11.2090***
2000	0.4334	9.7309***
2001	0.4499	9.2125***
2002	0.4729	9.6812***
2003	0.5095	9.5775***
2004	0.7023	13.2617***
2005	0.9747	19.0920***
2006	1.1583	22.6043***
2007	1.2583	23.9297***
Location Dummies		
Upmarket	0.6783	15.8976***
Gated Market	0.1957	5.6710***
Emerging Upmarket (excluded)		
Middle Income Market	-0.2645	-8.7070***
Tema Market	-0.2453	-7.3209***
Property Description		
Number of Bedrooms	0.1548	4.4118***
Number of Storeys	0.1922	9.0899***
Garage & Outhouse	0.0994	4.9121***
Detached	0.4738	28.9174***
Semi-detached (excluded)		
Quality of Landscaping	0.1099	7.3934***
Gross Internal Area	0.2386	12.5497***
Plot Size	0.2853	18.2175***
Security of Tenure		
State Freehold	-0.0487	-2.1762***
Unexpired Term	-0.0198	-0.5500
Adjusted R-Squared	0.8827	

Notes: * indicates significance at a 10% level, ** at a 5% level and *** at a 1% level

Table 4.3 presents summary results from the transactions price modelling of the combined Accra-Tema sample. As shown, the model contains 31 independent variables (including the omitted year, property type and location dummy variables). Overall, the model fits the data well. The model explains 88% (adjusted R-squared) of the variances in price. The coefficients on most key independent variables show the expected sign, and are statistically significant.

Thus, the location variables are all strongly significant, and point to a price differentiation between Accra and Tema, and also to the premium prices for Upmarket and Gated neighbourhoods within Accra. The primary property characteristics – location, number of storeys, number of bedrooms, the presence of garage and outhouse, detached, good quality of landscaping and plot size variables – are all strongly significant at the 1% level with the expected signs.

Detached status is, in all markets, an important price determinant. For the Upmarket, gated, Emerging Upmarket and Tema Market, detached units account for between 61% and 99% of all transactions, and in Middle Income Market for 52% (Table 4.1).

In addition, the results provide evidence to show that good landscaping influences residential values. The quality of landscaping variable is also positively signed and strongly significant, in line with findings in Bourassa *et al.* (2005).

The coefficients on the year dummies also suggest substantial variation in prices over time, with all coefficients except those for 1993 and 1994 strongly significant.

The only variables which do not carry the expected signs are the two associated with security of tenure of ground leases – State Freehold and Length of Unexpired Term. Because in Ghana customary land titles tend to be fraught with conflicts and litigation, state freehold might be taken as offering higher security and therefore expected to command a premium price. The results, however, show a negative coefficient on this variable, significant at the 5% level. This result may reflect the impact of the market interventions of state organisations – SHC, SSNIT, and TDC – which take the form of development for sale or rent of "affordable" units in the Middle Income and Tema submarkets. Around 50,000 residential houses have been constructed in Ghana over the past 15 years with government subsidies (CHI International, 2004). These interventions may have reduced values in these neighbourhoods. The finding is consistent with previous work Asabre (2007), which suggests that controlled rents on TDC stock in Tema reduced investment values in that market. It is however inconsistent with Asabre (2004), who finds that transactions involving non-state lands are perceived as risky due to associated litigation and conflicts, and thus sold at discount prices.

Similarly, results from the current research suggest that unexpired term variable is not a significant price determinant, where a price reduction for shorter terms might

be expected. The possible explanation is that purchasers ignore unexpired term as they assume leaseholds will be renewed at low cost, and are therefore equivalent to a perpetual interest. Thus, purchasers tend to equate leasehold transactions to effective freeholds, which is consistent with findings in Antwi (2002) for urban land transactions.

4.5.2 Rental price model

As noted in Section 4.4, the same functional form and set of variables have been used to construct a hedonic model of rental transaction prices, although the sample of rental transactions is limited by the availability of data to a lower total than used for the estimation of capital prices. Table 4.4 below shows the total sample of 1,130 rental transactions, with between 97 (Emerging Upmarket) and 382 (Middle Income) in the individual sub-markets.

Results from the ordinary least square (OLS) estimations (Table 4.5) show the values of coefficients and significance levels of the hedonic rental model. The results suggest that, broadly, the same factors dominate the determination of rental levels as were found for capital prices in the last Section. The model for rental values achieves a slightly higher overall level of explanation of variance, an Adjusted R-squared value of 0.93 than found for the model of capital prices (0.88).

Table 4.4: Rental price data – summary

Submarket	No. of observations	% Total observations	% Detached units	Mean GIA (sq. m)	Mean annual rent per square metre (US$)	Minimum annual price (US$)	Maximum annual rent (US$)	Mean annual rent (US$)	Median annual rent (US$)
Upmarket	173	15.3	100	309	89.10	5,020	64,500	27,492	28,680
Gated	198	17.5	94	287	60.40	900	74,000	17,340	13,050
Emerging Upmarket	97	8.6	80	226	43.20	1,400	60,000	9,753	6,000
Middle Income	382	33.8	53	158	21.60	450	30,100	3,407	2,000
Tema	280	24.8	63	167	18.70	450	30,450	3,112	2,400
Total	1,130	100							

Table 4.5: Aggregate hedonic rental model – results

Variables	Coefficient	T-Statistic
Constant	-10.0496	-8.4035***
Year Dummies		
1992 (excluded base year)		
1993	0.1318	1.6460*
1994	0.2301	2.9630***
1995	0.0893	1.1999
1996	0.4774	6.3099***
1997	0.5650	6.9948***
1998	0.7387	9.2049***
1999	0.9008	11.4380***
2000	0.7920	11.0062***
2001	0.7973	10.2809***
2002	0.8881	11.2492***
2003	0.9876	12.0395***
2004	1.1364	13.3528***
2005	1.2409	15.5488***
2006	1.2847	16.0866***
2007	1.2969	16.4759***
Location Dummies		
Upmarket	0.8185	15.7309***
Gated Market	0.2909	7.1860***
Emerging Upmarket (excluded)		
Middle Income Market	-0.4458	-13.2035***
Tema Market	-0.5081	-13.1584***
Property Description		
Number of Bedrooms	-0.0196	-0.3331
Number of Storeys	0.0895	2.8971***
Garage & Outhouse	0.1768	5.8334***
Detached	0.4471	14.7937***
Quality of Landscaping	0.1051	3.8528***
Gross Internal Area	0.6477	18.0671***
Plot Size	0.1557	6.6432***
Security of Tenure		
State Freehold	-0.0425	-1.2163
Unexpired Term	0.1411	2.5755**
Adjusted R-Squared	0.9331	

Notes: * indicates significance at a 10% level, ** at a 5% level and *** at a 1% level

As found for capital prices, the location coefficients for all submarkets have the expected signs, with rents in Accra strongly differentiated from those in Tema, and are all significant at the 1% level. The time dummies, again with the exception of those for early years (1993 and 1995) are also highly significant, as in the capital price model.

The coefficients for property characteristics also show the expected signs and the same signs as in the capital price model, with the single exception of number of bedrooms. At the 1% significance level, the number of storeys, presence of garage and outhouse, detached, gross internal floor area, and plot size all significantly influence residential rent. The quality of landscaping variable also is positively signed and strongly significant for rent determination. The variable shows coefficient values of 0.1099 and 0.1051 for price and rent analysis respectively.

The number of bedrooms shows a negative coefficient, though it is not statistically significant; in contrast to a weakly significant positive coefficient in the price model (see Tables 4.3 and 4.5). It may be the case that this reflects multicollinearity between number of bedrooms and other broad size factors captured by GIA and plot size (see Sections 3.5.6 and 4.6.3).

Having established overall price and rent indices from data on the total sample, and through the full time period available, further analysis has taken the form of tests for

robustness for both price and rent models by estimating results for different sub-samples of the population of transactions, and then the production of separate models for each submarket, but reported only for price models in the following Sections.

4.6 The robustness of the models

To test for the robustness of the overall model structure across sub-samples of the data, the analysis has been run separately for two sub-periods (the entire period split into two halves), and for transactions grouped into three price bands (lower, median and upper quartiles). This exercise is reported here only for the price estimations. Additional tests for multicollinearity are reported in Section 4.6.3.

4.6.1 Estimations by sub-period

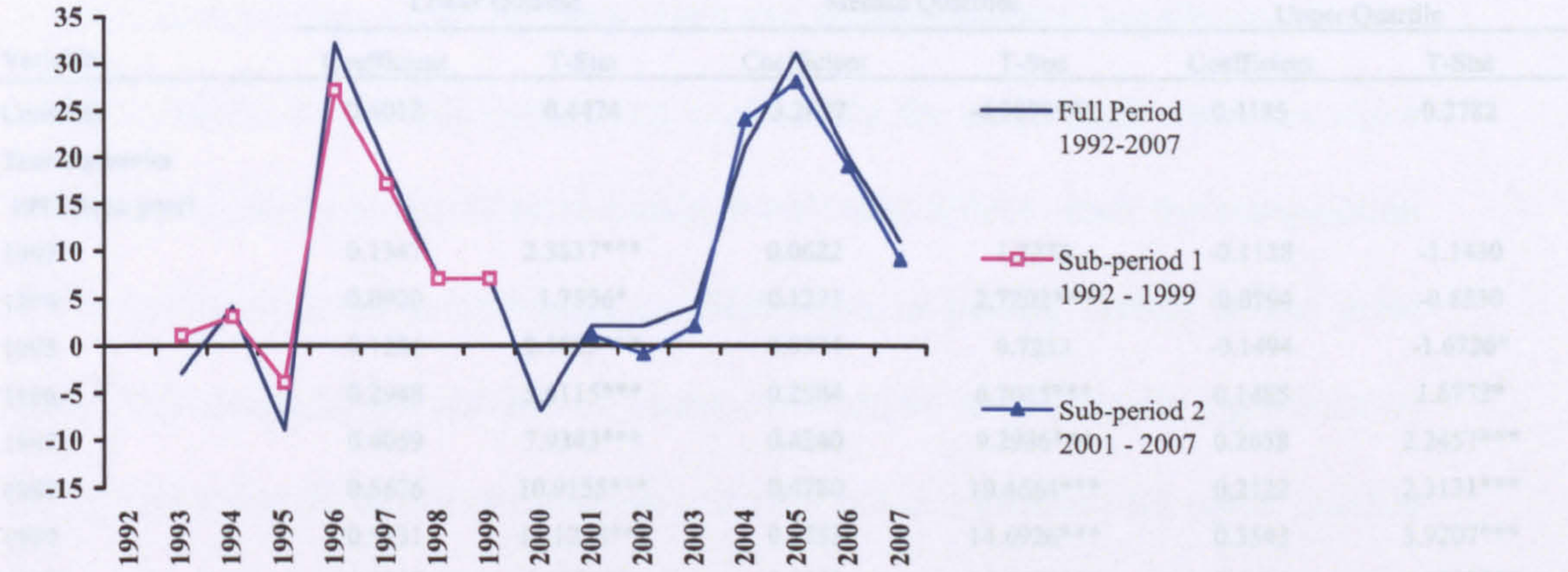
When the full period is split into two eight-year sub-periods (1992-1999 and 2000-2007), the overall Adjusted R-squared remains high for both: 0.82 for the former, and 0.92 for the latter (Table 4.6). The primary discriminating factors of size (measured by gross internal areas and plot size), quality (detached and quality of landscaping) and location (with the exception of the Gated submarket) are strongly significant in both periods. The coefficients on all the independent or explanatory variables except tenure, state security, and presence of garage and outhouse hold the same signs in both periods.

Table 4.6: Hedonic price model results by sub-period

	1992 to 1999		2000 to 2007	
Variables	Coefficient	T-Statistic	Coefficient	T-Statistic
Constant	4.9290	9.9287***	3.1822	7.8097***
Year Dummies				
1992 (Base Year Period 1)				
1993	0.0127	0.2680		
1994	0.0458	1.0399		
1995	0.0084	0.1984		
1996	0.2502	5.9645***		
1997	0.4054	9.4066***		
1998	0.4724	10.9286***		
1999	0.5442	12.6830***		
2000 (Base Year Period 2)				
2001			0.0133	0.4391
2002			-0.0010	-0.0347
2003			0.0192	0.5342
2004			0.2306	6.4531***
2005			0.4782	14.3398***
2006			0.6502	19.4089***
2007			0.7363	20.7233***
Location Dummies				
Upmarket	0.8453	16.3818***	0.2863	4.1078***
Gated Market	0.0392	0.7585	0.2710	5.8272***
Emerging Upmarket (excluded)				
Middle Income Market	-0.4121	-10.9491***	-0.1186	-2.6676***
Tema Market	-0.3354	-8.0901***	-0.2425	-4.8480***
Property Description				
Number of Bedrooms	0.1368	3.1726***	0.0792	1.5066
Number of Storeys	0.2253	8.0853***	0.1607	5.4853***
Garage & Outhouse	-0.0574	-2.1513***	0.2492	8.9773***
Detached	0.4922	26.8177***	0.4173	14.2100***
Semi-detached (excluded)				
Quality of Landscaping	0.0797	4.8348***	0.1912	7.0481***
Gross Internal Area	0.1899	8.2481***	0.3438	11.4325***
Plot Size	0.1956	8.9139***	0.3638	16.5691***
Security of Tenure				
State Freehold	-0.0618	-2.0019**	0.0691	1.9286*
Unexpired Term	-0.0561	0.9026	-0.0890	-2.0069**
Adjusted R-Squared	0.8 152		0.9150	

Notes: * indicates significance at a 10% level, ** at a 5% level and *** at a 1% level

Figure 4.2: Price changes estimated by sub-period models, US$ % pa



Only three explanatory variables – number of bedrooms, tenure and Gated submarket – show a marked change in the statistical significance of coefficients between the two periods. Statistically, therefore, the price model shows no evidence of significant structural breaks over time. An additional illustration of that conclusion is the model produces very similar indicators of year-on-year price changes irrespective of the period used in the estimation (Figure 4.2).

4.6.2 Estimations by price band

The price model has been run on transactions divided into three price bands within each year - the lower quartile, median quartiles falling within the interquartile range, and upper quartile. Again, the model retains a strong overall explanatory power with Adjusted R-squared figures at 0.84 to 0.88 for the different bands (Table 4.7 below).

Table 4.7: Hedonic price model results by price band

	Lower Quartile		Median Quartiles		Upper Quartile	
Variables	Coefficient	T-Stat	Coefficient	T-Stat	Coefficient	T-Stat
Constant	0.4012	0.4474	-3.2697	-4.3878***	0.4185	0.2782
Year Dummies						
1992 (base year)						
1993	0.1347	2.3837***	0.0622	1.2233	-0.1138	-1.1430
1994	0.0920	1.7556*	0.1271	2.7202***	-0.0794	-0.8530
1995	0.1284	2.5025***	0.0324	0.7253	-0.1494	-1.6726*
1996	0.2948	5.9115***	0.2984	6.7015***	0.1485	1.6772*
1997	0.4059	7.9343***	0.4240	9.2986***	0.2058	2.2457***
1998	0.5676	10.9155***	0.4780	10.4664***	0.2122	2.3131***
1999	0.5731	11.1278***	0.6753	14.6926***	0.3543	3.9207***
2000	0.3257	6.4280***	0.6445	14.4634***	0.4416	4.8389***
2001	0.4008	7.2714***	0.6917	14.0391***	0.6521	6.5630***
2002	0.3828	7.0057***	0.7260	14.8163***	0.5440	5.2633***
2003	0.5084	8.2324***	0.8571	15.5204***	0.8755	8.2420***
2004	0.7814	13.2263***	0.9343	17.0539***	1.0710	10.1550***
2005	1.1418	19.6327***	1.3974	26.1916***	1.1732	11.3204***
2006	1.3578	22.8778***	1.6099	30.3542***	1.2243	11.8213***
2007	1.5758	24.8722***	1.6639	30.1945***	1.4564	13.8025***
Location Dummies						
Upmarket	No	Observations	0.4769	4.5557***	0.5068	7.8734***
Gated Market	-0.0865	-1.4434	0.1818	4.6175***	0.0730	1.3861
Emerging Upmarket (excluded)						
Middle Income Market	-0.1870	-3.7184***	-0.1024	-3.1859***	-0.2185	-4.3043***
Tema Market	-0.1641	-3.0240***	-0.1083	-3.0969***	-0.2236	-3.7597***
Property Description						
Number of Bedrooms	0.0946	2.1454***	0.1670	4.7439***	-0.0802	-1.1694
Number of Storeys	0.0870	1.0101	0.1133	4.6205***	0.0524	1.7484*
Garage & Outhouse	-0.1869	-3.2462***	0.0162	0.7514	0.1222	3.9723***
Detached	0.0683	2.5424***	0.3275	22.0404***	-0.1737	-0.8481
Semi-detached (excluded)						
Good Quality Landscaping	0.0760	4.6374***	0.0415	2.8821***	0.1766	2.9759***
Gross Internal Area	0.1530	5.5660***	-0.0003	-0.0143	0.3284	8.8978***
Plot Size	0.1319	4.9868***	0.2488	11.2834***	0.0930	4.1106***
Security of Tenure						
State Freehold	-0.0764	-2.4940***	-0.0211	-0.9217	0.0069	0.1312
Unexpired Term	-0.1485	-2.1234***	-0.0432	-0.9049	0.0096	0.1940
Adjusted R-Squared	0.8450		0.8767		0.8424	

Notes: * indicates significance at a 10% level, ** at a 5% level and *** at a 1% level

Most of the primary explanatory variables – the year dummies, plot size, and quality of landscaping – also show the same signs and strong statistical significance across all price bands. But in this breakdown coefficients for some other variables show substantial differences across price bands, which may reflect either the composition of the samples within price bands, or differences in pricing factors across price bands. For example, the number of bedrooms variable is statistically significant at the 1% level for the lower and median quartiles but insignificant for upper quartile properties. Possibly, the highest priced and largest properties are priced on luxury amenities, such as size of rooms and gardens rather than additional bedrooms. Properties in the upper quartile of the price range are typically large with average gross internal floor areas of 325 square metres, and occupying an average plot of 1,401 square metres (see Appendix 4.9).

Comparatively, the gross internal areas and plot sizes for lower and median-priced band units are relatively smaller. Units in the median quartiles, though with enhanced physical sizes, provide average gross internal areas of 184 square metres with plot size averaged 522 square metres (see Appendix 4.10). Lower-priced units offer average internal floor areas (102 square metres) only one third the size of units in the upper quartile, and typically they sit on an average plot size of 333 square metres (see Appendix 4.11).

The location dummies (Upmarket, Gated Upmarket, Middle Income and Tema Market) share the same signs across all price bands, and are strongly statistically significant except among the lower quartile properties. There are, naturally, thin samples of properties – only 11% of the observations – in the higher priced locations (Gated Market and Emerging Upmarket) which also fall in the lowest price range.

4.6.3 Tests for multicollinearity

As seen in Section 3.5.6, real estate variables such as plot size, GIA, number of storeys, and number of bedrooms are clearly likely to be inter-correlated, and to raise potential problems of multicollinearity in the estimations. Various authors have raised the issue of multicollinearity, as well as problems that arise in its correction (Giliberto, 1985). One issue in estimating a multi-factor index model of the type proposed by Equations [12] and [13] in this thesis is whether actual or orthogonalized variables should be used as explanatory variables. Orthogonalization seeks to ensure that estimated parameters capture effects that are specific to the dependent variable. Using specification analysis, Giliberto (1985) show that such orthogonalization can bias the estimated parameters and in turn, affect statistical inferences (see also, Akella and Chen, 1990).

The current research therefore tests for multicollinearity by running regression tests following the method of Simons *et al.* (1998). In each regression one of the above

characteristics is treated as the dependent variable with each of the others in turn as the independent variable. The results show R-squared values of between 0.20 and 0.58, and suggest that multicollinearity is not a significant problem in the models. The full results of these tests are shown as Appendix 4.8.

4.7 Price and rent Models by sub-market

To look for any variation in the determination of prices across sub-markets, and also to identify differences in price movements over time for different locations, the hedonic rental and capital price models for each sub-market are regressed separately rather than in a single panel as in the last Section.

When run in a single panel, the modelling imposes the same coefficient on each property characteristic across all submarkets. Run separately, the coefficients on property characteristics are allowed to vary across submarkets, and capture any differences in the way prices are determined in different markets.

The results of hedonic models for separately estimated submarkets are reported in Table 4.8 below for prices and Table 4.9 below for rents. The level of explanation achieved for each submarket as indicated by adjusted R-squared remains high, ranging from 0.728 to 0.967 for the transaction price estimate (Table 4.8), and between 0.792 and 0.964 (Table 4.9) for the rental estimate. In both Tables, the

detached variable is excluded in the Upmarket due to the lack of observations for non-detached properties.

For both the price and rent estimations, four variables – detached, landscaping quality, gross internal areas and plot size – in all sub-markets show coefficients with the expected signs. In 16 of the 20 instances (4 variables across 5 sub-markets), the coefficients are significant at the 1% level, and in the remaining 4 instances significant at the 10% level. It appears that these four variables form a core of price determination with a high degree of consistency across sub-markets. The broadly similar coefficients on these variables for both the price estimates and the rental estimations suggest that property characteristics are priced in the same way by occupiers and investors. The only systematic exception is rather higher coefficients on GIA in the rental model than in the transactions price model, which suggests occupiers value simple property size more highly than investors.

Despite the broad consistency in the values and significance of the regression coefficients on this core set of four variables, there are some points of variation across submarkets. The importance of quality relative to unit size, for example, appears to show some systematic differences across neighbourhoods.

Table 4.8: Sub-market hedonic price models - results

Variables/Markets	Upmarket		Gated Market		Emerging Upmarket		Middle Income Market		Tema Market	
	Coefficient	T-Statistics	Coefficient	T-Statistics	Coefficient	T-Statistics	Coefficient	T-Statistics	Coefficient	T-Statistics
Constant	5.132	3.008***	-3.410	-3.282***	-9.866	-2.318***	-4.127	-3.517***	-0.133	-0.124
Property Description										
No. of bedrooms	-0.108	-1.097	0.250	3.865***	-0.030	-0.154	0.242	5.185***	0.145	2.079***
No. of storeys	0.006	0.148	0.127	4.025***	-0.042	-0.406	0.248	6.440***	0.153	3.845***
Garage & outhouse	-0.103	-2.223***	0.044	1.410	0.336	3.10***	-0.031	-1.061	0.061	1.312
Detached	-0.161	-0.724	0.398	7.368***	0.339	2.938***	0.466	23.318***	0.427	14.697***
Semi-detached (excluded)										
Landscape Quality	0.379	3.091***	0.061	1.582*	0.374	4.250***	0.084	4.587***	0.098	3.751***
Gross internal areas	0.189	3.055***	0.857	21.401***	0.278	2.381***	0.101	3.743***	0.156	4.238***
Plot size	0.154	5.932***	0.094	3.262***	0.245	2.505***	0.462	14.104***	0.478	11.219***
Security of Tenure										
State freehold	Excluded	Excluded	-0.056	-0.563	-0.122	-2.976***	-0.049	-1.410		
Unexp. lease term	-0.084	-1.456	-0.194	-1.715*	-0.222	-0.748	-0.159	-1.998**	0.197	2.030***
Adjusted R-Squared	0.728		0.967		0.826		0.809		0.789	

Notes: * indicates significance at a 10% level, ** at a 5% level and *** at a 1% level

Table 4.9 : Sub-market hedonic rental models - results

Variables/Markets	Upmarket		Gated Market		Emerging Upmarket		Middle Income Market		Tema Market	
	Coefficient	T-Statistics	Coefficient	T-Statistics	Coefficient	T-Statistics	Coefficient	T-Statistics	Coefficient	T-Statistics
Constant	-0.682	-0.475	-8.482	-6.331***	-15.759	-4.002***	-18.677	-9.147***	-7.100	-3.104***
Property Description										
No. of bedrooms	-0.069	-0.778	0.006	0.069	-0.426	-0.426	0.141	1.379	0.100	0.829
No. of storeys	0.006	0.165	0.114	2.720***	-0.052	-0.469	0.118	1.571*	0.089	1.294**
Garage & outhouse	-0.091	-2.101**	0.033	0.912	0.326	2.645***	0.046	0.807	0.340	3.586***
Detached	Excluded		0.797	7.178***	0.333	2.662***	0.385	9.294***	0.302	6.150***
Semi-detached (excluded)										
Quality of landscaping	0.313	2.915***	0.116	1.858*	0.213	2.070***	0.119	3.181***	0.057	1.224*
Gross internal areas	0.403	6.554***	0.879	14.901***	0.474	3.180***	0.530	7.779***	0.529	6.756***
Plot size	0.109	3.835***	0.099	1.695*	0.270	2.188***	0.380	5.976***	0.420	6.779***
Security of Tenure										
State freehold	Excluded		Excluded		-0.062	-0.539	0.172	2.006**	0.057	1.139
Unexpired lease term	-0.089	-1.453	0.109	0.714	-0.135	-0.416	0.305	1.892*	0.489	3.368***
Adjusted R-Squared	0.792		0.964		0.857		0.890		0.864	

Notes: * indicates significance at a 10% level, ** at a 5% level and *** at a 1% level

Thus, Landscaping Quality variable carries a higher coefficient in Upmarket and the Emerging Upmarket than other submarkets, indicating a greater importance of environment where the general quality of individual houses is high, and for higher income buyers. In the Middle Income and Tema submarkets, by contrast, Plot Size and Detached status are more important determinants of price than in other submarkets, as is GIA in the Gated submarket. In the latter submarket, where other characteristics of the stock are more homogenous, the results suggest size is a more important price driver.

The other explanatory variables influence prices and rents more selectively across markets. The number of storeys, for example, has a positive and significant coefficient for both prices and rents only in the Gated, Middle Income and Tema markets. And the State Freehold variable is significant only in the Middle Income market – which may reflect the wider mix of land tenures in that area – but it carries a positive coefficient in the rent estimation and a negative coefficient in the price estimation.

The only other variable with inconsistent impacts on prices and rents is number of bedrooms which appears with a strongly significant positive coefficient in the price equations for the Gated, Middle Income and Tema markets, but is statistically insignificant in the rental equations for all markets.

4.8 Residential price and rent Indices

In this Section, the first Ghanaian Residential Indices for the values (price and rent) of residential investment are calculated and constructed from the coefficients on the year dummies in Tables 4.3 and 4.5. The index base figure of 100 for 1992, the excluded year dummy, is multiplied by the exponential of each respective year coefficient to create hedonically adjusted time series measures from 1992 to 2007.

The price index produced from the hedonic model in US dollars (Figure 4.3 below), shows flat or falling prices from 1992 to 1995 followed by a substantial appreciation from the years through 1996 to 1999 then a further flat patch in the early 2000s and a final strong surge in prices in the last four years. The strongest single year rate of dollar price appreciation – 32% – was in 1996. This may in part be explained by the remission of the restrictive law on letting and acquisition of property by foreign companies – PNDC Law 150 – noted in Section 4.2. Over the 15 years covered, the annualised rate of capital appreciation is 8.8% per year.

Figure 4.4 below shows the price index expressed in local currency (Cedi). From 1992 to 2007, the Cedi:US$ exchange rate rose from 437 to 9,358, with a depreciation in the value of the Cedi of up to 100% in individual years. The profile of residential price changes in Cedis is therefore significantly different from that in US$.

Figure 4.3: Residential price index US$, 1992 = 100

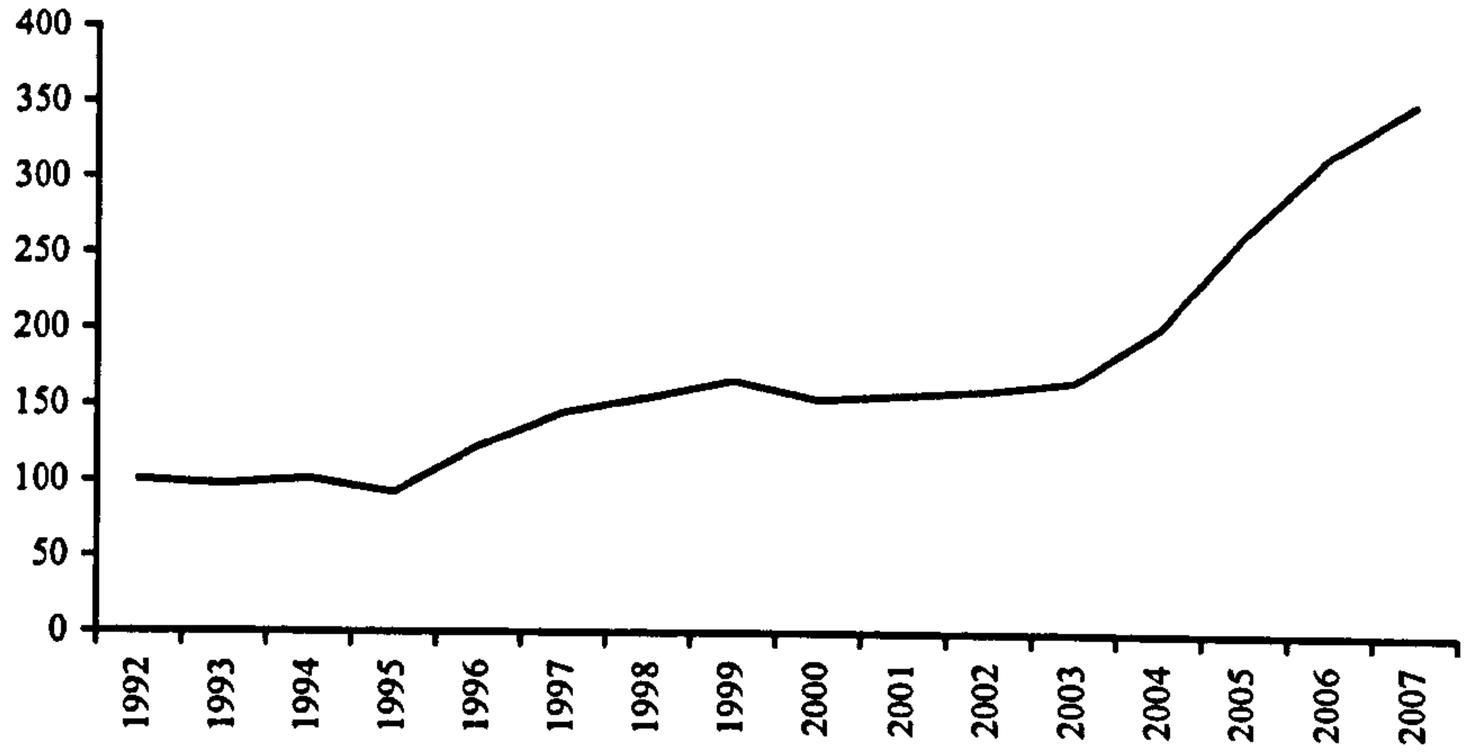


Figure 4.4: Residential price index Cedis, 1992 = 100

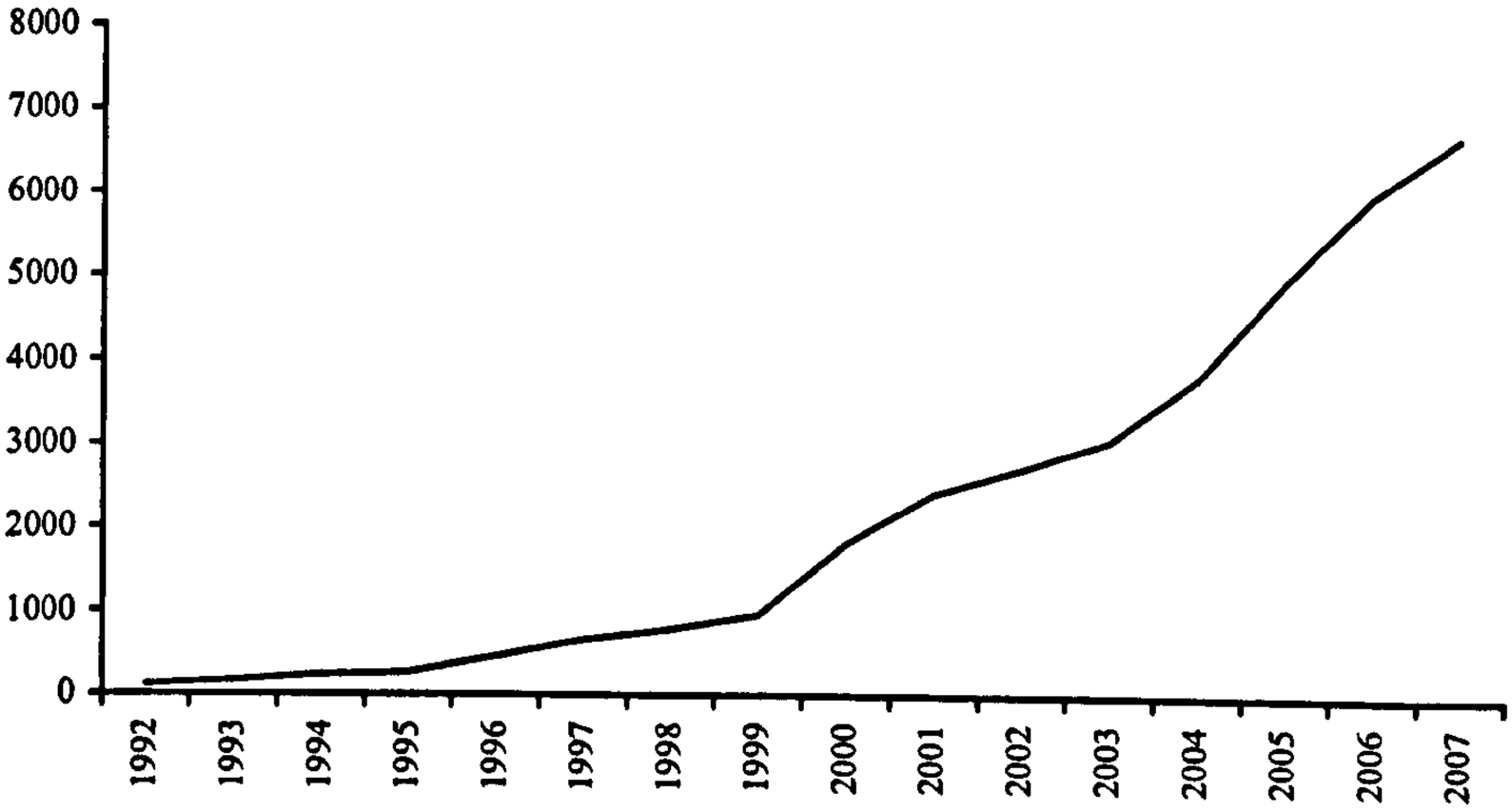


Figure 4.5: Residential rental value index US$, 1992 = 100

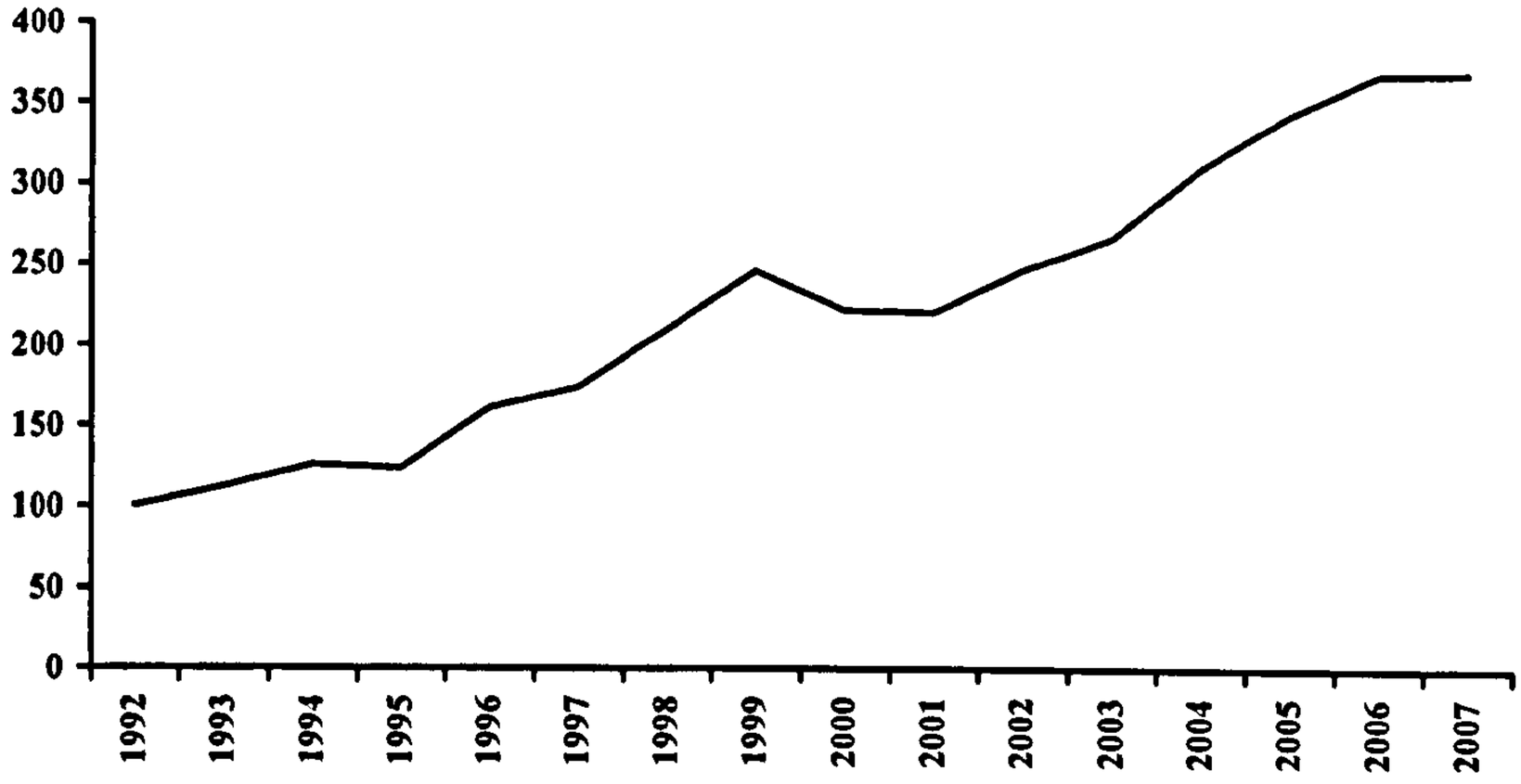
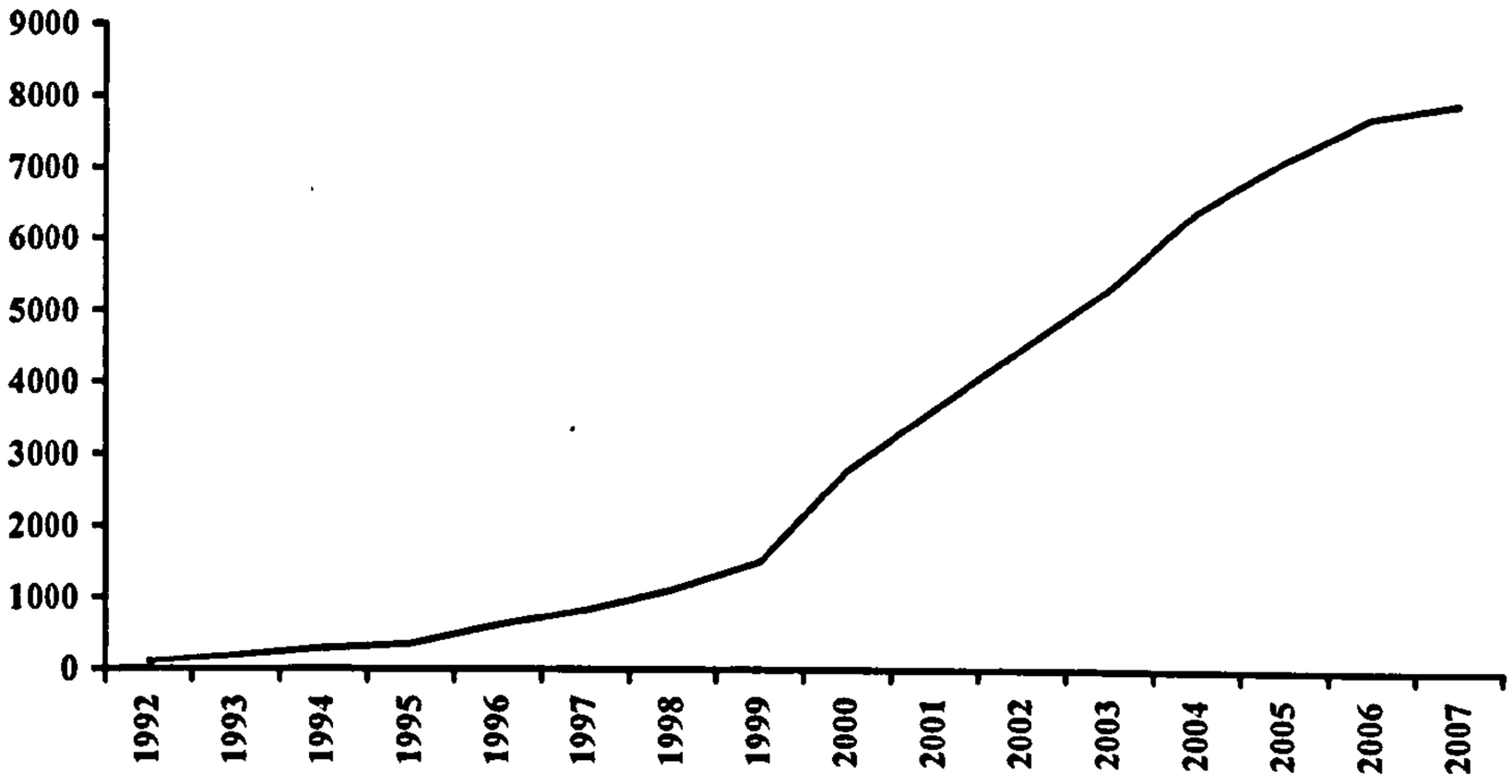


Figure 4.6: Residential rental value index Cedis, 1992 = 100



There has been continuous growth in Cedi residential prices throughout the period, at rates ranging from 13% to 94% per year. Over the whole period, prices have risen by a factor of 75, an annualised rate of 33% per year. The very high nominal rate of capital appreciation should be compared with the high rate of inflation, which has averaged 23% per year over the same period. In real terms, therefore, Cedi denominated house prices have risen at an annualised rate of 8.2% per year.

Figure 4.5 shows the residential rent index denominated in US$. Rental prices rose gradually in the early 1990s, but declined in 1995 and then picked up rapidly from 1996 to peak in 1999. Through 2000 and 2001 rental values fell, followed by a sharp increase in 2002 through to 2006, which levelled off in 2007. Overall, an annualised rental growth of 9.1% has been achieved over the full fifteen years, fractionally higher than the dollar denominated growth in prices of 8.8% per year.

Figure 4.6 shows the rental index denominated in Cedis. As with capital appreciation, in local currency rents have risen every year, with the strongest rise (75%) recorded in 1996 following the repeal of PNDC Law 150. Over the fifteen years covered, annualised rental growth has run at 33.8% per year in nominal terms, and 8.6% per year in real terms.

4.9 Summary and conclusions

This Chapter provides an examination of the residential investment markets in Accra and Tema in Ghana. Through the construction of hedonic models, the price and rent characteristics of the markets, in relation to real estate specific characteristics and market trends have been analysed. Also, versions of the first Ghanaian "Residential Real Estate Indices" have been constructed and tracked.

Characteristics such as the number of storeys, property size and type, quality of landscaping, plot size, security of tenure and location are all found to be significant variables that influence real estate prices and rental values in Ghana. The results demonstrate that hedonic models constructed using the variables available from the Land Valuation Board database achieve high levels of explanation of the variation in transaction prices and rents.

A price index for residential investments derived from the hedonic model suggests that residential values rose substantially from the mid-1990s following the repeal of the PNDC Law 150, and again from 2003 to 2007 with flat or falling values in the first half of the 1990s and in the early 2000s. Annualised over the sixteen years of the price index, the rise in capital values measured in both US dollars and Ghanaian Cedis suggests that investors in residential real estate have achieved appreciable capital growth of 9% and 32.4% respectively.

This Chapter has provided the basis for further examination of the pricing and performance of investments in Ghanaian residential real estate. Extensions of the research in subsequent Chapters will include the addition of estimated net investment yields and rental income returns to create measures of total return. That will in turn provide the basis for an analysis of the performance of real estate investment relative to other assets.

CHAPTER 5 RESIDENTIAL INVESTMENT PERFORMANCE

5.1 Introduction

This Chapter draws upon the price and rental series from Chapter 4 to estimate investment yields and total returns on the residential markets in Accra and Tema. The combined set of market indicators – yields, rental value and price movements – and total returns – income return and capital growth – is then used to compare and contrast the performance of sub-markets within the total sample, and to examine the linkages between market performance and macro-economic conditions in Ghana.

As discussed in the literature review (Section 2.5) previous work on real estate investment yields and returns in Ghana has been limited. Antwi and Omirin (2006) estimate movements in rental values, capital values and yields in the informal residential markets of Accra, and Lagos, Nigeria. For Accra, the results show a real annual price growth of up to 10%, and put residential yields at an estimated 6% for both the informal and formal sectors. Overall, the study concludes that the informal and formal residential markets in Ghana are closely connected in pricing and performance. On a broader scale, Buckley and Mathema (2007) examine the informal housing markets in Accra (Ghana), Dar es Salaam (Tanzania), Addis Ababa (Ethiopia), and Nairobi (Kenya). The research suggests Accra has the lowest

elasticity of housing supply of the markets covered, leading to higher prices and the exclusion of middle-income and low-income earners from the market.

Finally, Asabre (2007) employs both transaction and valuation based data to examine the impacts of rent controls and other interventions on the performance of public housing held by the Tema Development Corporation. The study finds the Corporation's stock has achieved a nominal return of only 3% in 2003. However, the study is restricted to formal housing for the low-income bracket, and excludes the privately owned middle to upper income residential sector covered by the sample used here.

This Chapter therefore adds to the rather scant empirical literature on real estate markets in Ghana. In a further extension of earlier studies, a time series of data that permit an estimation of residential income yields, nominal and real returns are employed at the aggregate and disaggregate levels.

The remaining Sections of this Chapter are organised as follows. Section 5.2 discusses the data and methodology employed to estimate residential income yields and total returns from hedonic models. Sections 5.3 to 5.6 present results on the market indicators in turn – rental yields, rental value growth and market price movements – with an additional analysis of changes in quality mix in each location in Section 5.4. Section 5.7 shows the estimates of income return and capital growth

for investment properties derived from the market indices, and examines aggregate and sub-market investment performance denominated in US$. Section 5.8 briefly notes the differences in relative performance across sub-markets measured in local Cedis. Section 5.9 is a first broad analysis of the linkages between residential performance and economic conditions. A summary of key findings and concluding remarks are reported under Section 5.10.

5.2 Data and methods

All analysis and results in this Chapter are based upon same sample of price and rental transactions employed in the hedonic modelling in Chapter 4. The hedonically adjusted prices and rents resulting from the estimations in Chapter 4 are combined, with appropriate adjustments for costs, depreciation and the structures of leases to represent the net income yields, capital appreciation and total returns which would be achieved by investors holding a portfolio of rented residential units with evenly distributed start and end dates of the underlying leases. These combinations and adjustments have been done in two steps.

First, spot measures of yields for each sub-market and the aggregate market are constructed by dividing the total money of values of hedonically adjusted rent by hedonically adjusted price across all transactions. This simple division gives a measure of prevailing average market rental values divided by prevailing average

prices or capital values – a gross reversionary yield. The gross yield is reduced to a net yield by adjusting downward the market rental value for an estimate of landlords' revenue expenditures. Residential leases in Ghana put the responsibility for routine maintenance and all utilities costs on tenants. This leaves landlords' outgoings limited to management costs estimated at 7% of annual rental income, and property rates which vary with location at up to 1.4% of annual rent, and ground rents at up to 0.3% of annual rent. Total deductions from gross rents have therefore been estimated at 8.7%. No information is available on the prevalence or costs of property insurance, which would fall upon landlords. But anecdotal evidence suggests that it is not a common practice for landlords to insure residential properties.

The second step is to estimate a typical landlord's net income stream from the transactions based rental value data. Typical residential leases in Ghana run for three years. Tenants have an automatic option to renew, though at a new level of market rent. An overall market average income return – the income return to a landlord holding an average portfolio – is therefore represented by a notional portfolio of three average units with evenly spread lease start dates. The net income (adjusted for landlords' costs as explained above) on the portfolio is represented by the evolution of overall market rental value growth and the realisation of rental uplifts on each unit at three years from the start of the lease. Given the very strong demand for housing in Ghana, it is assumed that any voids arising from lease ends

or tenant defaults would be immediately filled by a new letting. Dividing the total estimate of net income by the hedonically adjusted price, or market capital value, for each year provides an estimate of the net income component of total returns on residential investments.

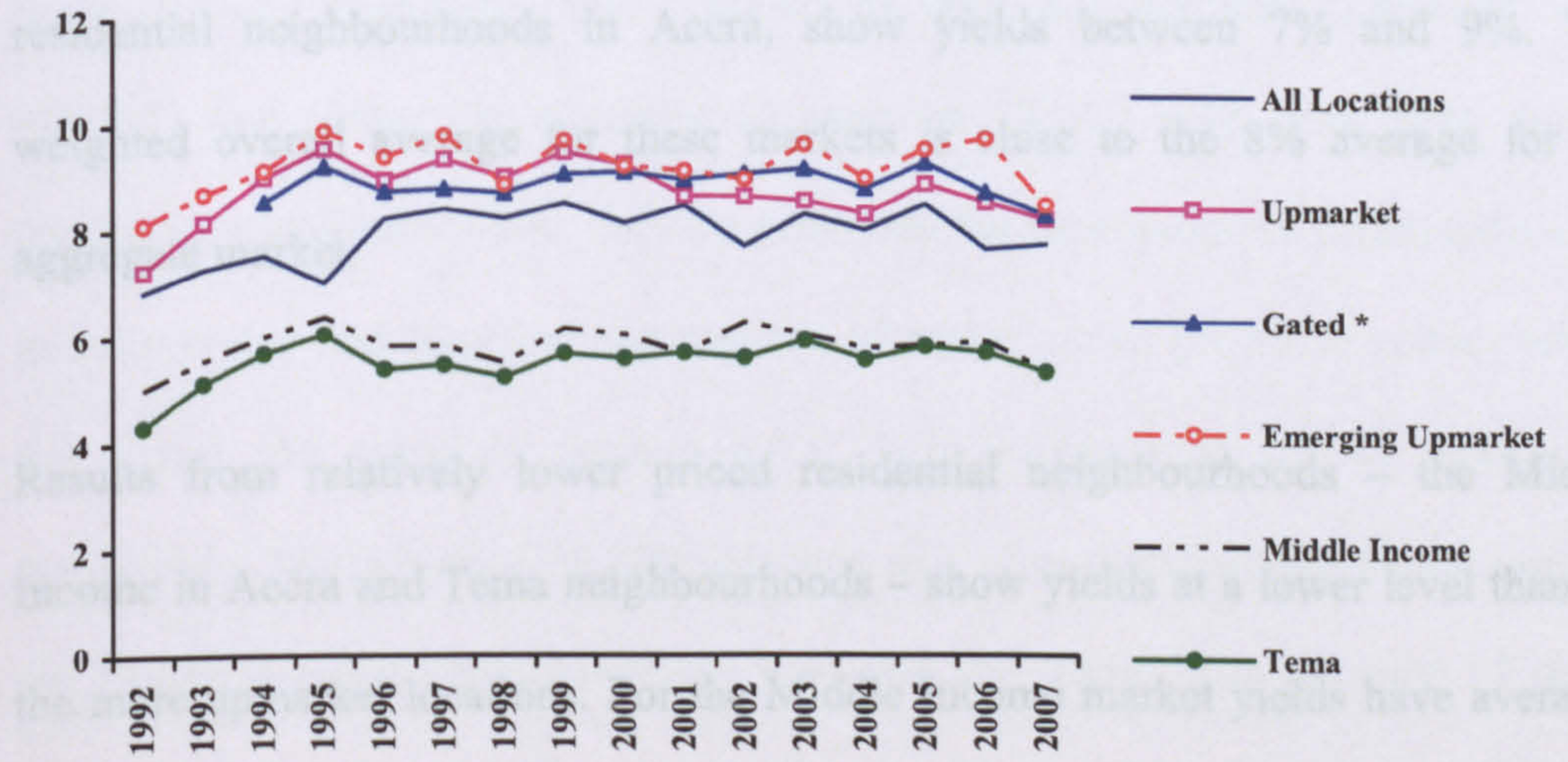
To arrive at the capital appreciation component of total returns, it is necessary to adjust the path of market prices calculated in Chapter 4 for the impacts of depreciation on values. No direct evidence on typical landlords' capital expenditures on residential investment property in Ghana is available. A number of studies across different countries have estimated depreciation rates for residential property in the range of 0.4% to 1.36% per year (see Leigh, 1980; Malpezzi *et al.*, 1987; Shilling *et al.*, 1991; and Weiss, 1994). To allow for the impact of depreciation a round number in the mid range of these estimates at 1% is applied.

The final total returns on residential investment are therefore calculated as the net rates of income return on capital as described above plus the hedonically adjusted price growth each year less an assumed depreciation rate (or capital injections at a rate necessary to offset depreciation) of 1% per year.

5.3 Residential investment yields

As noted in Chapter 4, residential prices and rental values have risen at broadly the same rates. As shown in Figure 5.1, the profile of reversionary yields over time has thus been fairly flat. Across All Locations, the yield has averaged 7.9% over the 16 years of the series, with a range from +0.6 percentage point to -1.0 percentage point around that average. After a step rise in the level of yield in 1996, there is neither pronounced time trend nor sustained shorter-term direction in yield movements, which seemed to show random fluctuations around a stable average of 8.2% from 1996 to 2005. Only the last two years suggest what may be a sustained fall to the end-2007 figure of 7.7%.

Figure 5.1: Residential reversionary yields by location 1992-2007, %



Note: Gated * 1994-2007

For a given rental value, the fall in yields from end-2005 to end-2007 would be equivalent to a boost of capital values of around 10%. But bearing in mind the large year on year percentage changes in both rental values and capital values, and the fact that the samples for the rental and capital value samples cannot be precisely matched, it is not possible to apply any fundamental explanation to short-term shifts in the levels of yield. The overall estimate of yield given here is above the 6% figure quoted by Antwi and Omirin (2006). The difference is likely to result from the fact that the research was limited to lower and middle income markets, which in the current research tend to show lower yields, as discussed below.

Yield levels show a substantial and sustained differentiation across submarkets. The Upmarket, Gated Market and Emerging Upmarket locations, the higher quality residential neighbourhoods in Accra, show yields between 7% and 9%. The weighted overall average for these markets is close to the 8% average for the aggregate market.

Results from relatively lower priced residential neighbourhoods – the Middle Income in Accra and Tema neighbourhoods – show yields at a lower level than for the more upmarket locations. For the Middle Income market yields have averaged 5.91% over 16 years, and for Tema they have averaged 5.65%, with no evident time trend in either market. Yields in these neighbourhoods have consistently run 2 to 3 percentage points lower than those in the more upmarket Accra neighbourhoods.

The significantly lower level of yields in the lower quality markets is contrary to the normal expectation that higher quality stock would be subject to lower investment risk (due to higher tenant quality) and also to an expectation of higher long run rental growth, due to relatively restricted supply of the most accessible locations and highest quality amenities, and high income elasticity of demand for higher quality housing. Both factors would normally be expected to set lower yields on higher quality residential units (see for example, Fraser, 1993; Hoesli and McGregor, 2000).

The counter-intuitive differentiation of yields across submarkets of different quality may be explained in two ways. First, government intervention in the Middle Income and Tema locations in the form of direct provision of affordable housing through the State Housing Company (SHC), Social Security and National Insurance Trust (SSNIT) and Tema Development Corporation (TDC) may have kept current residential rental values low, but also generated the expectation of future reductions in intervention and therefore expectations of higher rental growth at some point in the future. As noted in Section 4.5.1, CHI International (2004) reports the government has delivered 50,000 detached and semi-detached residential units in the Middle Income neighbourhoods in Accra and Tema over the past 15 years. Annual rental values for these submarkets are the lowest in the formal residential market. As seen in Appendices 5.5 and 5.6, the average annual residential rents in the Middle Income neighbourhoods in Accra and in Tema are US$3,407.00 and

US$3,112.00 respectively, around one-third of the overall market average. Second, where rental values in the private rented sector are depressed by the availability of public sector stock at below-market rents, the depressing effect on capital values may be mitigated by the potential gains on sales to owner occupiers.

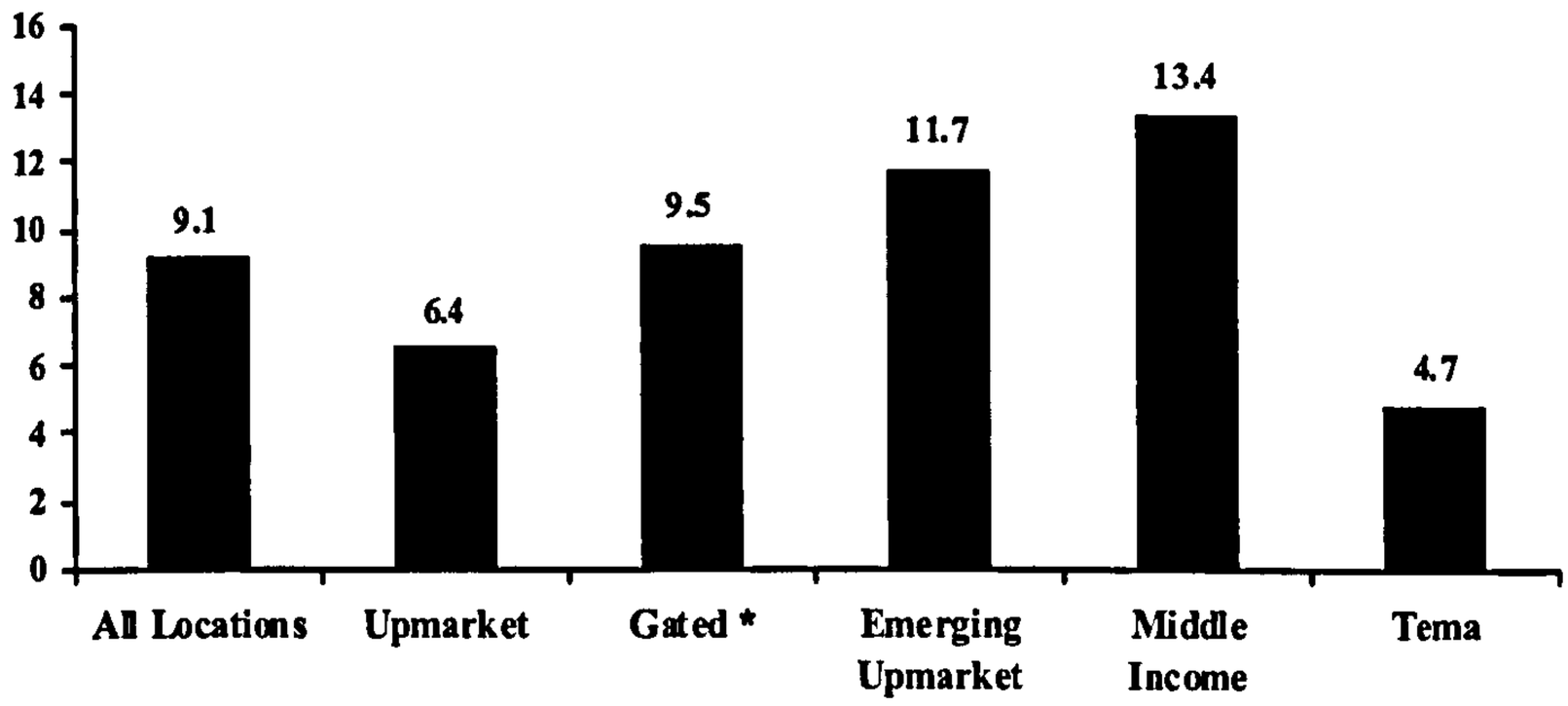
5.4 Residential rental values

The usefulness of rental income yield as an indicator of value performance depends on both the level of rents and the prospects for rental growth. This Section firstly presents an analysis of rental changes over time across all sub-markets. In addition, a comparison of the hedonically adjusted measures of rental levels with the unadjusted average rental levels is used to examine changes in quality mix in each location over time in Section 5.5. Hedonically adjusted rental levels are derived from the aggregate and disaggregate hedonic residential rent models and rental indices. "Unadjusted" rent indices are simply the average from rental transactions reported each year. In a similar manner, hedonically adjusted price levels have been analysed against unadjusted price levels but results are not reported here.

There appears to be a strong differentiation across sub-markets in long term rental value growth (Figure 5.2). The Upmarket and Tema neighbourhoods have seen growth rates well below the average for All Locations, with above average rates for the Gated, Emerging Upmarket and Middle Income groups. All locations, however,

show standard deviations in annual rental growth rates which are well above their means, running from 15% in the Upmarket group to 37% for the Emerging Upmarket group. Given the limitation to 15 observations and high levels of variance, none of the differences across locations in mean annual growth are statistically significant from the average for All Locations at the 10% level. Indeed, there are no statistically significant differences between the means for any pair of location groups.

Figure 5.2: Annualised rental growth by location 1992-2007, US$ % pa



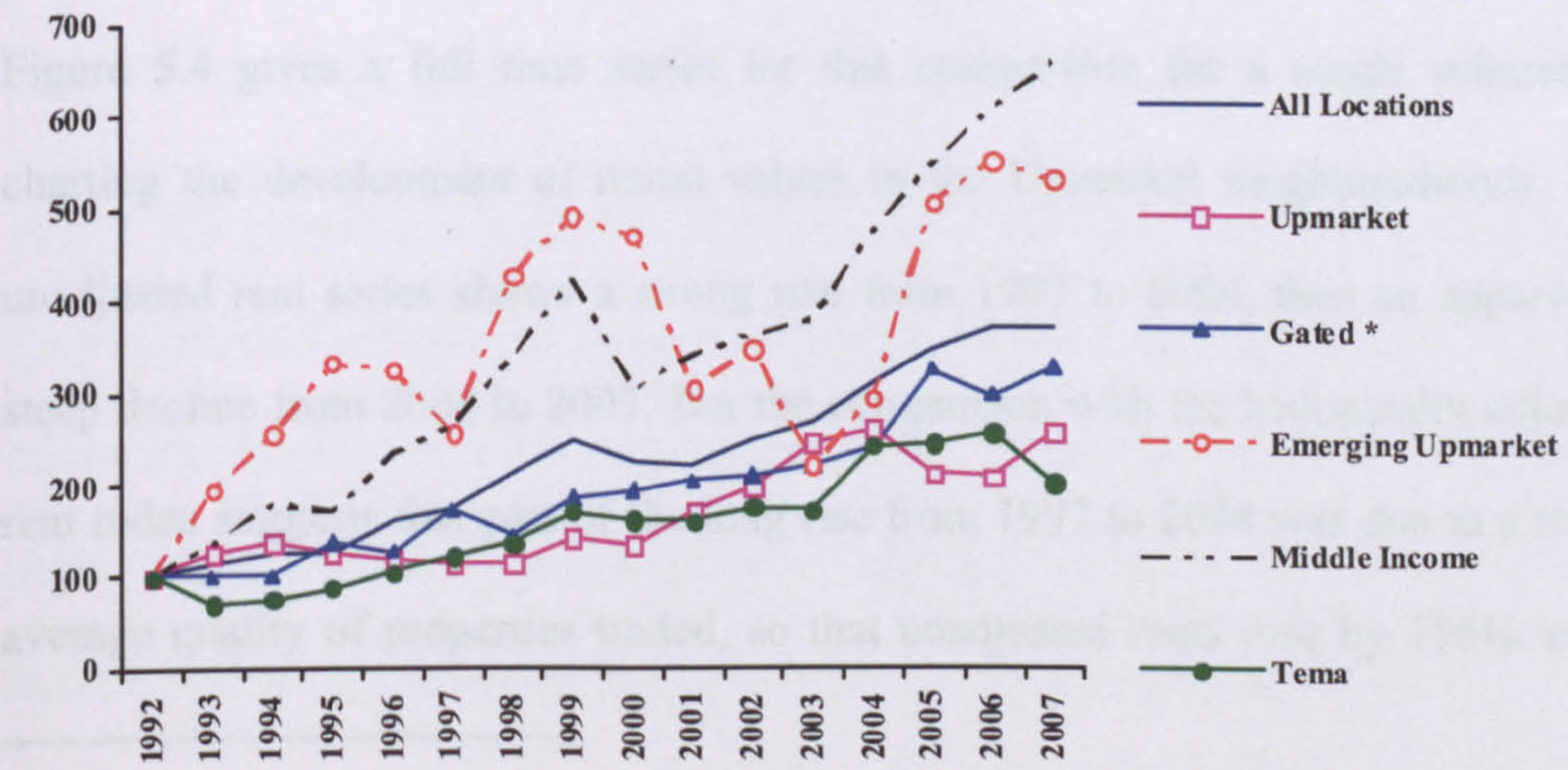
Note: Gated * 1994 = 100

Any explanation of differences in rental value growth rates across locations must, therefore, be qualified by absence of strong statistical significance imposed by the limited number of annual observations.

Figure 5.3 shows the evolution of rental values over time in each location. The Emerging Upmarket and Middle Income groups have seen much high volatility in

levels of rents, and higher average growth, than the other groups. In the case of the Emerging Upmarket locations, some of the high volatility may be attributable to the relatively small sample size of observations (97, or 9% of the total). This is not, however, the case for Middle Income locations, which have the largest sample of rental observations (382 or 34% of the total). In other locations, the progression of rental growth has been relatively stable. On the measure of annual growth rates, the highest correlation between any pair of locations is only 0.43 for Emerging Upmarket and Middle Income market, and several pairs are negatively correlated. It does not appear that rental trends in individual locations have been very strongly integrated with the overall market.

Figure 5.3: Rental value indices by location, US$ 1992 = 100



Note: Gated * 1994 = 100

5.5 Quality changes by sub-market[2]

To cast further light on any changes in the characteristics of sub-markets, the hedonically adjusted rental trends discussed in the last Section are compared with unadjusted rental levels calculated as the simple averages for each year. The unadjusted rental figures are simple averages of the transactions for each year, and therefore combine the impacts of general market price levels over time with any changes in the quality mix of properties traded. The hedonically adjusted figures represent only movements in the general price level, and correct for changes in quality. Over time, a higher growth in adjusted rents than in unadjusted average, therefore, suggests a downward shift in the quality of properties traded and vice versa.

Figure 5.4 gives a full time series for this comparison for a single submarket, charting the development of rental values in the Upmarket neighbourhoods. The unadjusted rent series shows a strong rise from 1997 to 2004, then an apparently steep decline from 2004 to 2007. But the comparison with the hedonically adjusted rent index suggests that part of the long rise from 1997 to 2004 was due to a rising average quality of properties traded, so that unadjusted rents rose by 156% while

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[2] Another version of this Section was presented in a paper presented at the 8th Annual Conference of the African Real Estate Society, August 13-15, 2008, Johannesburg, South Africa. The paper has been accepted for the *Journal of African Real Estate Research*.

after adjustment for quality mix the hedonic rent index rose by 130%. After 2004 the unadjusted rent index suggests a massive 36% fall in rents, while the hedonic measure shows only a cumulative 2% fall. The implication is that recent trading in this area has shifted sharply towards smaller, lower quality units.

Figure 5.4: Unadjusted vs. adjusted rent indices for Upmarket, US$ 1992 = 100

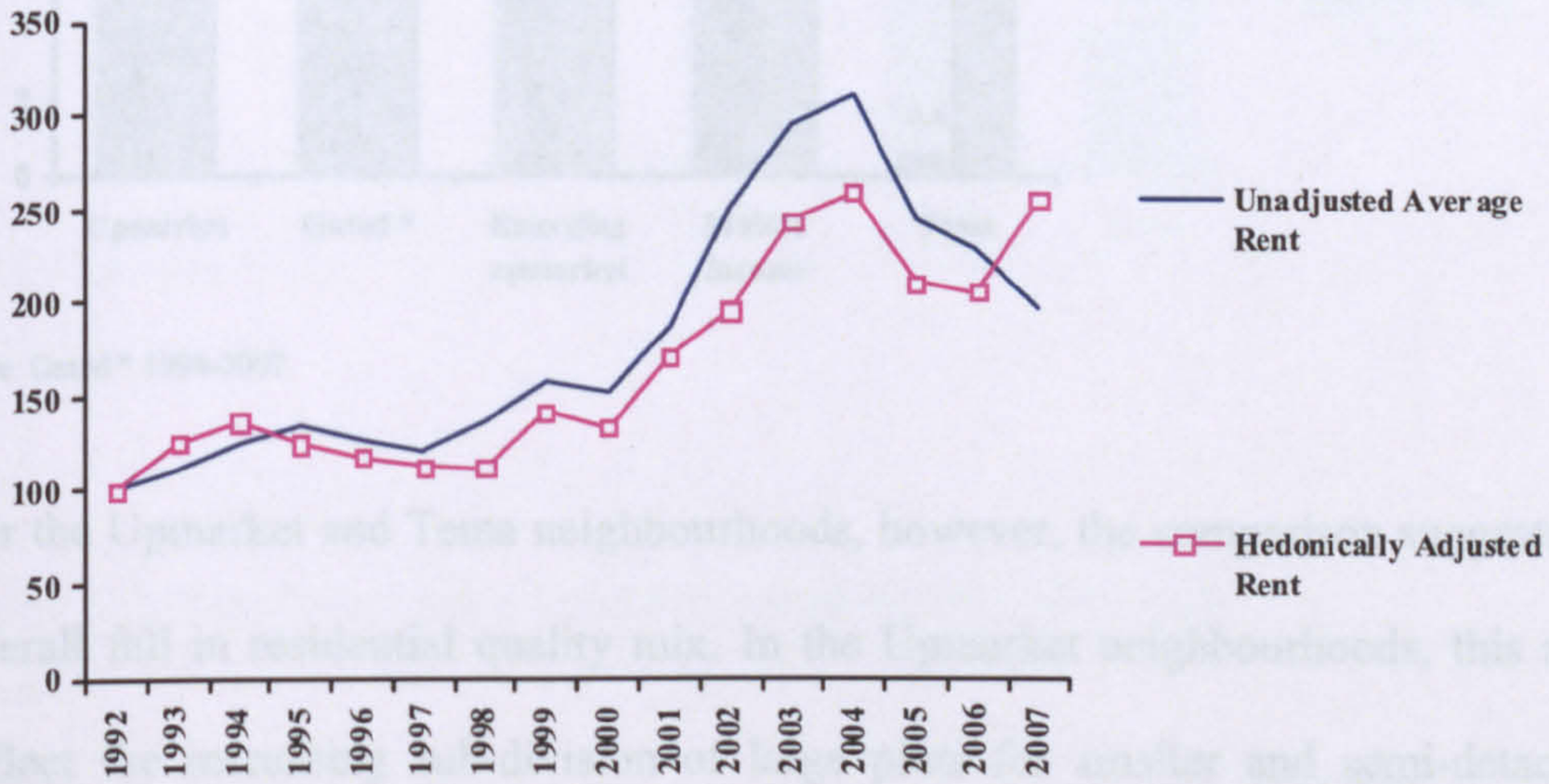
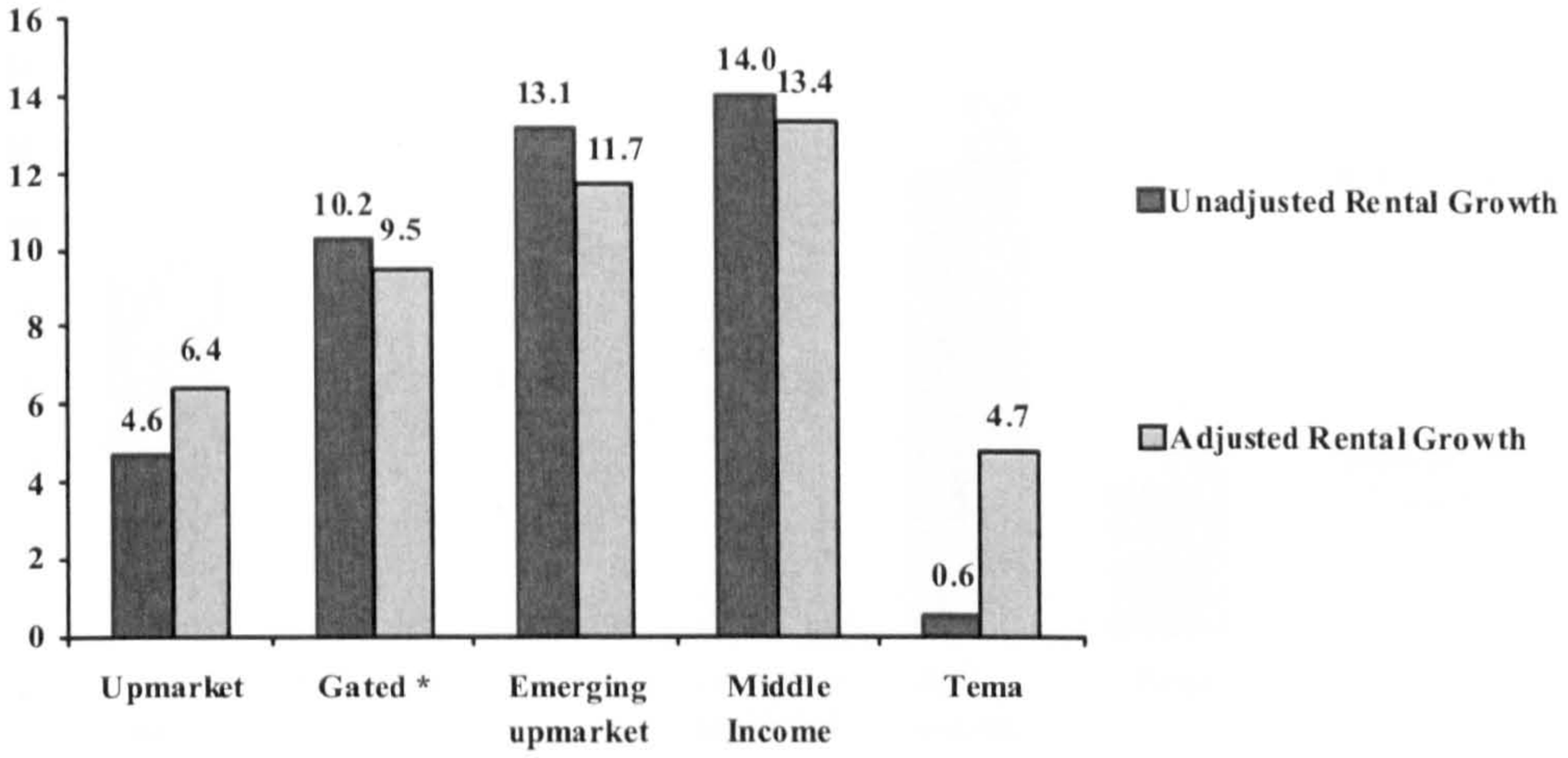


Figure 5.5 provides a long term comparison of unadjusted and adjusted rental growth rates for all submarkets over the whole period of the analysis. The full time series of adjusted and unadjusted rents are not shown, but in all these cases the shifts indicated by the annualised rates of change have been fairly consistent over time. In the Gated, Emerging Upmarket and Middle Income submarkets, the quality mix appears to have been improving with adjusted rental growth rates significantly below the unadjusted figures. The Gated, Emerging Upmarket and Middle Income neighbourhoods in Accra therefore appear to have seen an improving quality mix.

Figure 5.5: Unadjusted vs. adjusted annualised rental growth 1992–2007, US$ % pa



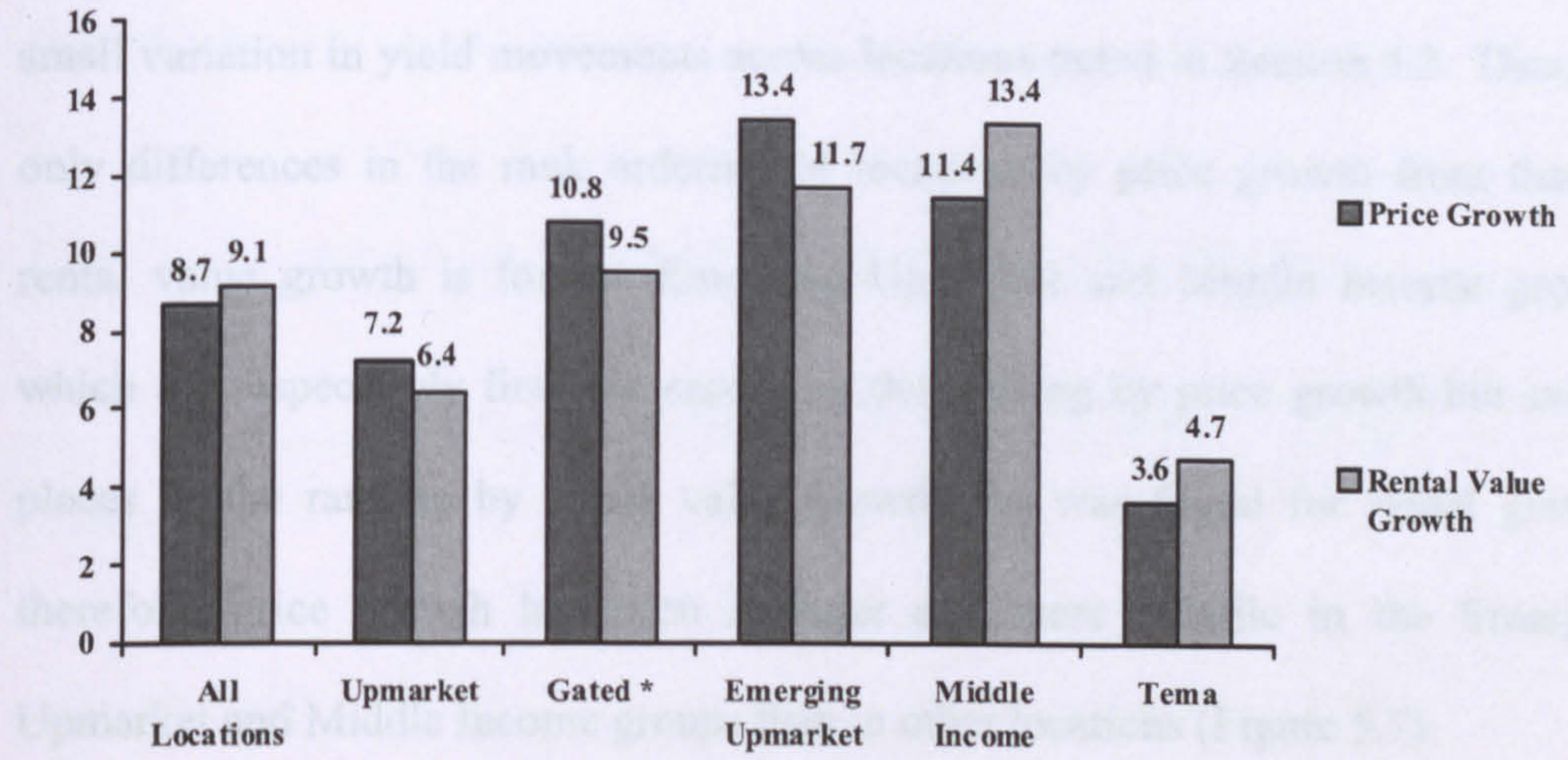
Note: Gated * 1994-2007

For the Upmarket and Tema neighbourhoods, however, the comparison suggests an overall fall in residential quality mix. In the Upmarket neighbourhoods, this may reflect the increasing sub-division of large plots for smaller and semi-detached residential units. The reduction in quality in Tema on the other hand is likely to reflect the delivery of large volumes of housing for middle- and lower- income groups by the Tema Development Corporation.

5.6 Residential transactions prices

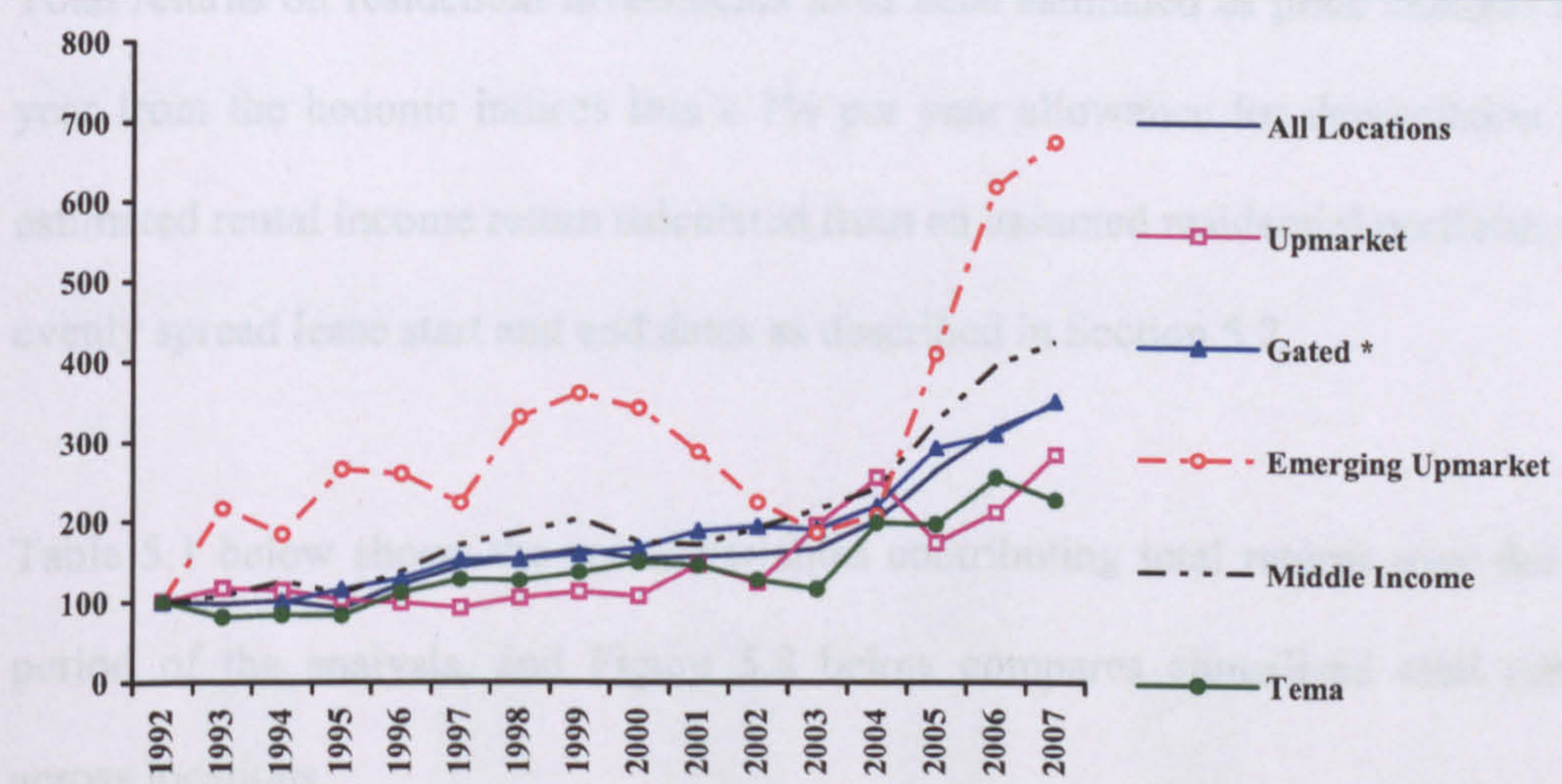
Figures 5.6 and 5.7 plot the growth in transactions prices for residential investments across locations, in dollar denomination. For comparison, the annualised price growth across locations is compared with the rental value growth rates discussed in the last Section.

Figure 5.6: Annualised price and rental growth by location 1992-2007, US$ % pa



Note: Gated * 1994-2007

Figure 5.7: Residential price indices by location, US$ 1992=100



Note: Gated * 1994 = 100

Long term price growth runs from 3.6% per year in Tema to 13.4% per year in Emerging Upmarket neighbourhoods. The broad pattern across locations in rates of

price growth is close to that for rates of rental value growth – a product of the fairly small variation in yield movements across locations noted in Section 5.3. Thus, the only differences in the rank ordering of locations by price growth from that by rental value growth is for the Emerging Upmarket and Middle Income groups, which are respectively first and second in the ranking by price growth but switch places in the ranking by rental value growth. As was found for rental growth, therefore, price growth has been stronger and more volatile in the Emerging Upmarket and Middle Income groups than in other locations (Figure 5.7).

5.7 Market performance in US dollars

Total returns on residential investments have been estimated as price changes each year from the hedonic indices less a 1% per year allowance for depreciation plus estimated rental income return calculated from an assumed residential portfolio with evenly spread lease start and end dates as described in Section 5.2.

Table 5.1 below shows the set of variables contributing total returns over the full period of the analysis, and Figure 5.8 below compares annualised total returns across locations.

Income returns, reflecting an assumed leasing pattern of evenly spread leases, across all locations run 10% to 15% below the level of average reversionary yields, which

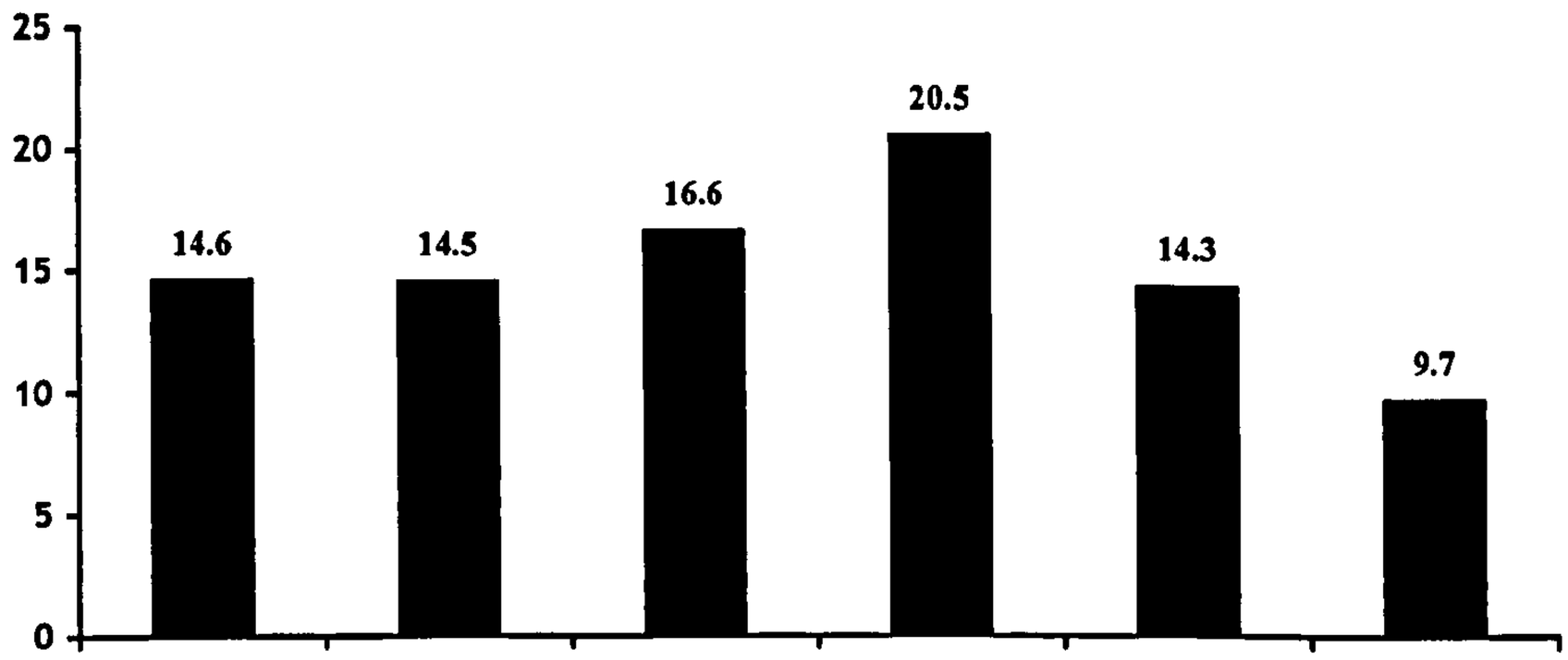
reflect the substantial rates of rental value growth which would make the typical portfolio strongly reversionary.

Table 5.1: Investment performance by location 1992-2007, US$ % pa

	All Locations	Upmarket	Gated *	Emerging upmarket	Middle Income	Tema
Average Yield %	7.9	8.7	8.9	8.2	5.9	5.7
			Annualised % per year			
Rental Value Growth	9.1	6.4	9.5	11.7	13.4	4.7
Price Growth	8.8	7.3	10.2	13.7	10.2	5.6
Income Return	6.7	7.8	7.4	7.0	4.9	5.0
Capital Growth	7.7	6.3	9.2	12.6	9.2	4.6
Total Return	14.6	14.5	16.6	20.5	14.3	9.7
Risk (SD of Return)	11.6	21.9	8.4	39.6	12.2	22.0

Note: Gated * 1994-2007

Figure 5.8: Annualised total returns by location 1992-2007, US$ % pa

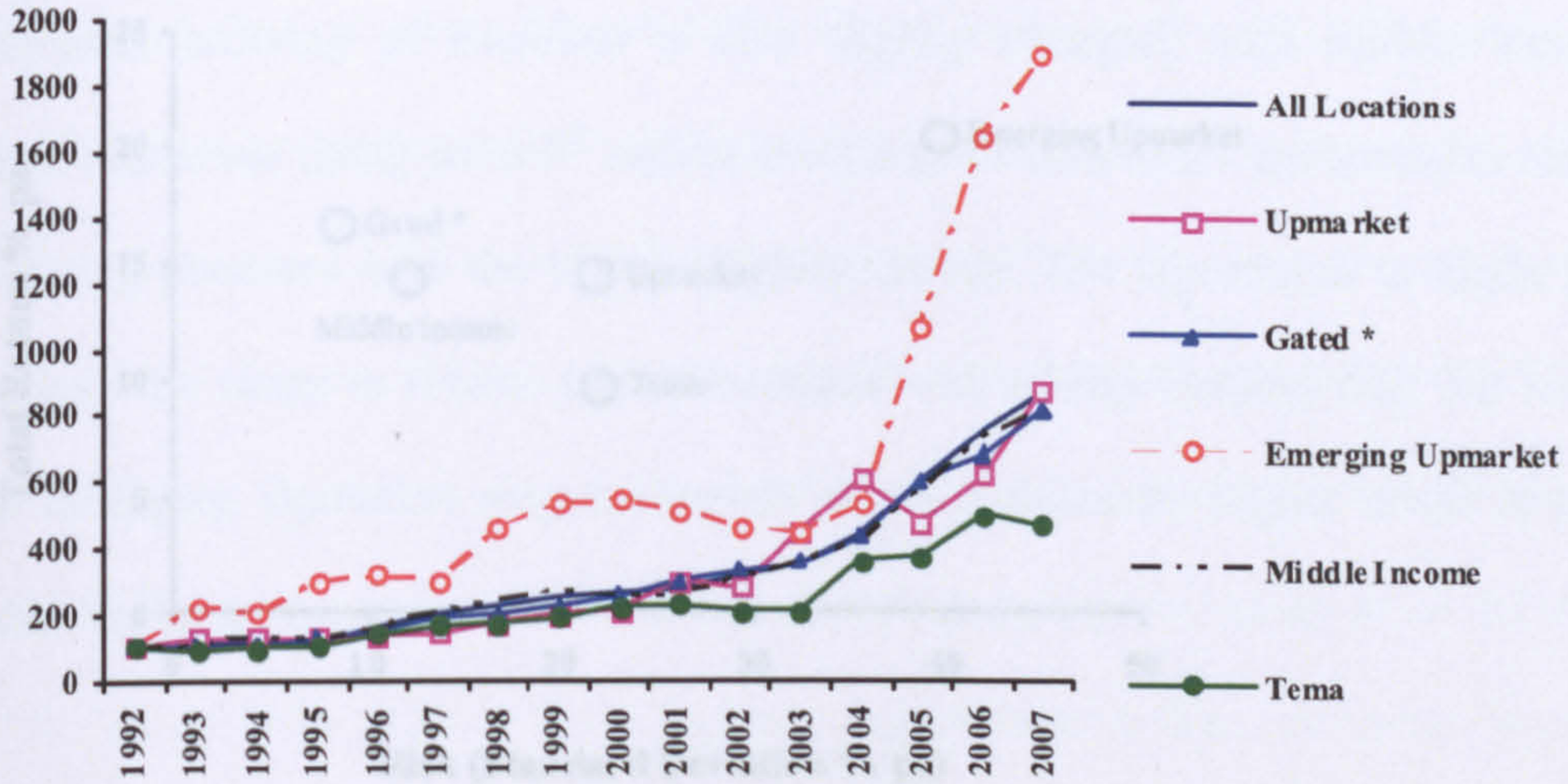


Note: Gated * 1992-2007

Long term rates of return range from 9.7% per year in Tema to 20.5% per year in the Emerging Upmarket group. As with measures of rental growth and price changes, and despite the substantial spread in returns, none of the differences between locations in average rates of return are statistically significant at the 10% level. The variation in returns mainly reflects the variation in rates of capital growth, which in turn have been driven mostly by variation in the growth of rental values, across locations as described in the last two Sections. The profile of total returns, and rank ordering by returns across locations, are slightly different from those for rates of price growth and capital growth because relatively low income return for the Middle Income group partially offsets above average rates of capital growth, and high income return for the Upmarket group partially offsets low capital growth. Tema remains, however, the weakest market ranked by all performance measures.

Most sub-markets show a broadly similar profile in total returns over time (Figure 5.9 below). For the Upmarket, Gated and Middle Income groups, returns have tracked fairly closely together through 15 years. The most notable exception is the Emerging Upmarket neighbourhoods, which showed higher rates of return through most of the 1990s and a very strong surge in returns since 2004. Tema neighbourhoods have shown a relative weakening of returns since 2000.

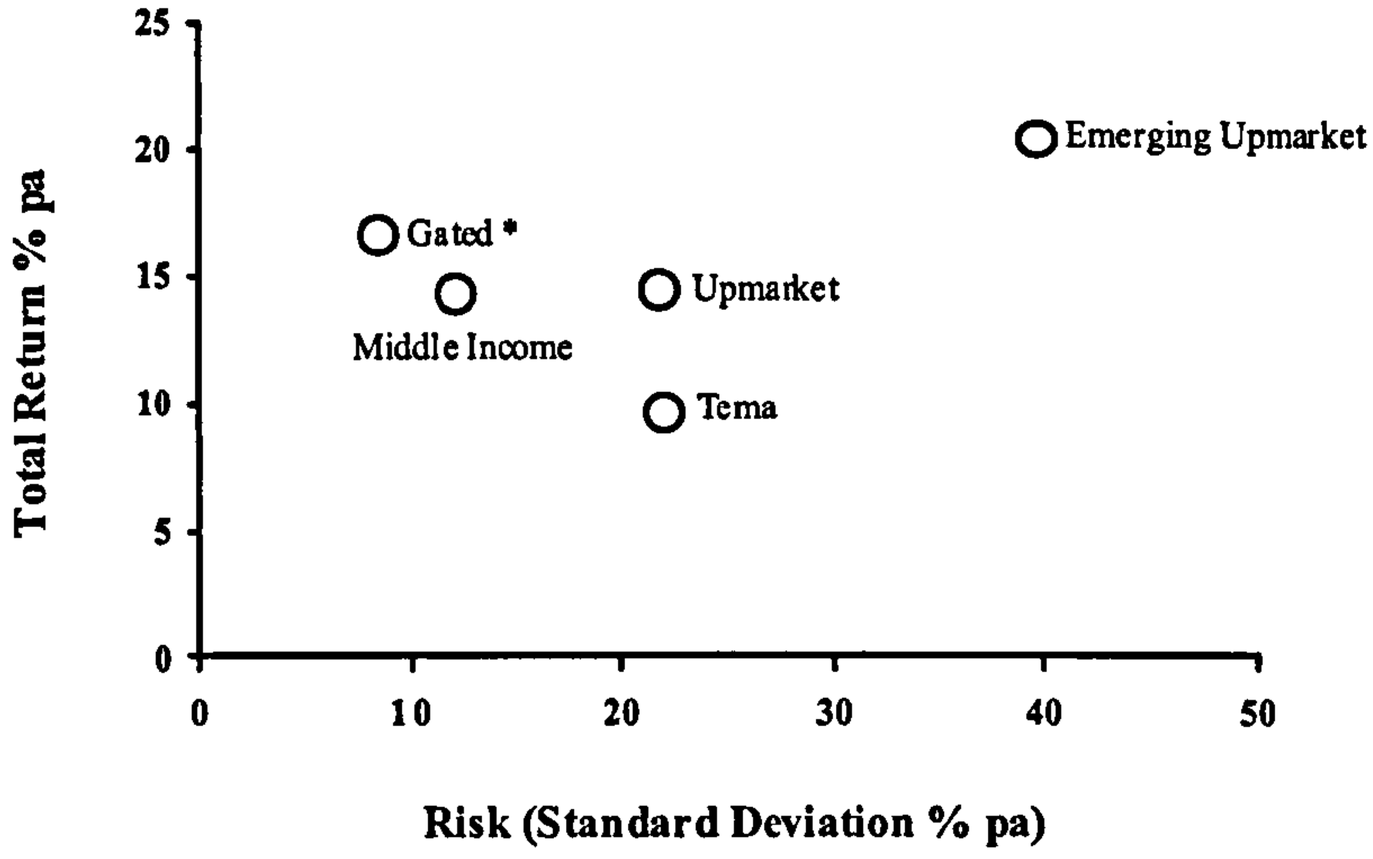
Figure 5.9: Indices of total return by location, US$ 1992 = 100



Note: Gated 1994 = 100

The results show no consistent trade-off between rates of return and risk across submarkets with the exception of the Emerging Upmarket (Figure 5.10). For All Locations, as seen in Table 5.1, the standard deviation at 11.6% per year is slightly below the mean annual return of 14.6%. The Upmarket, Gated, and Middle Income groups show a spread of risk from 8.4% per year to 21.9% per year for broadly comparable returns (14.3% per year to 16.6% per year). The Tema market shows relatively high risk for a below-average rate of return. Again, only the Emerging Upmarket neighbourhoods show the combination of high return and high risk normally expected.

Figure 5.10: Returns and risk by location 1992-1997, US$ % pa



5.8 Market performance in Cedis

This Section converts the key measures presented in the last Section into Cedis, in order to evaluate the overall performance of the residential investment market, and variation in that performance across sub-markets, from the perspective of local occupiers and investors. The conversion to Cedis affects only slightly the relative performance across sub-markets discussed in the last Section, due to differences in the co-variances between rates of growth and return each year and movements in exchange rates. That topic is therefore briefly recapitulated here (Table 5.2 below).

Measured in Cedis, returns across locations have a rather flatter profile than measured in US$: all locations except Emerging Upmarket fall into a range of returns from 32.2% per year (Tema) to 37.6% per year (Middle Income), while the

Emerging Upmarket neighbourhoods still show distinctively higher returns (44.6%). The rank ordering of locations is also slightly changed, with Middle Income neighbourhoods rising from 4th ranked measured in US$ to 2nd measured in Cedis, changing positions with the Gated neighbourhoods. The conversion to Cedis also narrows the range in returns across locations with widely varying risk, but leaves the Emerging Upmarket neighbourhoods showing distinctly higher levels of both return and risk.

Table 5.2: Investment performance by location 1992-2007, Cedis % pa

	All Locations	Upmarket	Gated *	Emerging upmarket	Middle Income	Tema
Average Yield %	7.9	8.7	8.9	9.2	5.8	5.5
			Annualised % per year			
Rental Growth	33.8	30.5	30.5	36.8	39.0	28.5
Price Growth	33.4	31.6	31.3	39.4	35.2	29.5
Income Return	4.6	5.4	5.4	5.4	3.3	3.4
Capital Growth	32.4	30.5	30.3	38.4	34.2	28.5
Total Return	37.2	36.5	35.9	44.6	37.6	32.2
Risk SD of Return	22.9	31.7	27.6	56.2	22.3	35.9

5.9 The drivers of market performance

It is outside the objectives of this thesis to undertake formal modelling which seeks to explain or predict residential values in Accra and Tema, though the construction

of the time series of performance measures opens up the possibility of that work being conducted by others. This Section, however, provides an initial examination of the correspondence between residential investment performance and broad macro-economic indicators for the Ghanaian economy, and in particular looks at the interaction between exchange rate movements and the performance of the formal residential market which, as noted in Section 4.2, is customarily denominated in US dollars. The macro-economic data used, comprising a set of measures of inflation, economic growth, interest rates and the Cedi:US$ exchange rate are shown in Appendix 1.1. Since the purpose of the exercise is to look for linkages between local factors and residential investment performance, the analysis begins using Cedi denominated measures. Since this thesis finds exchange rate movements to have had a strong impact on Cedi denominated performance, some of the analysis uses measures denominated in US$.

A starting point for the discussion is to establish the primary drivers of variation in residential investment returns. As demonstrated in Figure 5.9, the variation in total returns over time falls into two periods. From 1993 to 2001, Cedi denominated rates of return were highly volatile, around a high mean value of 48.5% per year. From 2002 onward, annual returns have been much more stable, around a mean of 24.4% per year. A linear trend fitted through the rates of return shows nominal rates of return trending downward at 5.7% per annum, though given the volatility in returns the fitted trend has a very low explanatory power (R squared of only 0.16).

The apparent downward trend in nominal rates of return is primarily explained by Ghana's rate of inflation, which shows the same pattern of large variation around a high mean from 1993 to 2001, and narrower variation around a lower mean from 2002 onward. Real rates of return, therefore, have been highly variable but show only a weak trend (Table 5.3 below). A linear trend fitted through the real annual rates of return suggests an underlying rate of decline in real returns of -1.6% per year. Due to the small number of observations, of course, the downward slope of the fitted trend line is statistically insignificant (p value of the slope coefficient is 0.85). The stable underlying rate of real total return can therefore be taken from a trend fitted through the index of total returns, which suggests a long run real rate of 11.3% per year. Although the step down in the rate of inflation may account for most of the apparent downward trend in rates of return, there is only a weak relationship between variation in annual rates of return and inflation rates. Over 15 years, the contemporaneous correlation between nominal return and the rate of inflation is positive at 0.26, but the correlation coefficient is statistically insignificant (p value is 0.35).

As Table 5.3 below demonstrates, the annual variation in nominal total returns is not associated with variation in income return, which has been relatively stable. Because capital values have varied widely against relatively stable rental incomes, rises and falls in capital value produce inverse though relatively small movements in

annual income returns. Income return and total return are, thus, quite strongly negatively correlated (-0.76).

Table 5.3: Residential performance and the Ghana economy 1992-2007, Cedis % pa

	Correlation with Rental Value Growth		P Values of Correlation Coefficient	
	Nominal	Real	Nominal	Real
Real GDP Growth % pa	-0.69	-0.48	0.00	0.07
Real GDP per Capita Growth % pa	-0.69	-0.48	0.00	0.07
Inflation Rate % pa	0.36	-0.15	0.18	0.60
Interest Rate for Construction (%)	0.52	0.28	0.04	0.30
Yield on 91-Day Treasury Bills (%)	0.64	0.31	0.01	0.26
Cedi:US$ Depreciation %	-0.87	-0.76	0.00	0.00
	Correlation with Total Return		P Values of Correlation Coefficient	
	Nominal	Real	Nominal	Real
Real GDP Growth % pa	-0.47	-0.17	0.08	0.55
Real GDP per Capita Growth % pa	-0.47	-0.17	0.08	0.55
Inflation Rate % pa	0.26	-0.31	0.35	0.26
Interest Rate for Construction (%)	0.43	0.12	0.11	0.68
Yield on 91-Day Treasury Bills (%)	0.48	0.05	0.07	0.85
Cedi:US$ Depreciation %	-0.82	-0.63	0.00	0.01

The primary driver of annual variation in returns is therefore changes in capital value. Capital growth and total return are very strongly correlated at close to unity. Given the relative stability in yields over time, the bulk of variation in capital values has in turn been produced by annual variation in rates of rental value growth. The correlation between nominal rental value growth and capital growth rates is 0.88,

and the correlation between nominal rental value growth and total returns is 0.87 (both correlations are significant at the 1% level).

Major influences on the overall investment performance will, therefore, work primarily through impacts on rental value growth which is the primary driver of total returns. Table 5.3, accordingly, shows contemporaneous correlations between annual rates of rental growth and total returns, in both real and nominal terms, and a basic set of economic indicators.

The results are at first sight counter-intuitive. Both rental value growth and total returns show negative correlations with GDP growth and growth in GDP per capita, in both nominal and real terms. All coefficients except that between GDP growth rates and real returns are significant at the 10% level or better. Both measures of real estate performance show a positive correlation with interest rates indicated by the rate of interest on construction loans or the yield on Treasury Bills, though only the relationships with nominal rental value growth are strongly significant. Standard house price models would normally show positive relationships with real incomes (proxied in this case by the GDP variables) and a negative relationship with interest rates (Pasha and Butts, 1996). The rate of inflation is positively correlated with nominal rental value growth and total return, but weakly correlated with real rental value growth and total return. This would be consistent with residential investment acting as a weak inflation hedge in the short term – protecting returns against only

part of any rise in short-term inflation – but none of the coefficients are statistically significant.

Table 5.4: Residential performance and the Ghana economy 1992-2007, US$ % pa

	Correlation with Rental Value Growth		P Values of Correlation Coefficient	
	Nominal	Deflated by Ghanaian CPI	Nominal	Deflated by Ghanaian CPI
Real GDP Growth % pa	0.11	0.48	0.69	0.07
Real GDP per Capita Growth % pa	0.09	0.46	0.74	0.08
Inflation Rate % pa	-0.10	-0.78	0.73	0.00
Interest Rate for Construction (%)	0.03	-0.39	0.92	0.15
Yield on Treasury Bills (%)	0.12	-0.48	0.67	0.07
Cedi:US$ Depreciation %	0.39	0.55	0.16	0.03

	Correlation with Total Return		P Values of Correlation Coefficient	
	Nominal	Deflated by Ghanaian CPI	Nominal	Deflated by Ghanaian CPI
Real GDP Growth % pa	0.51	0.70	0.05	0.00
Real GDP per Capita Growth % pa	0.50	0.69	0.06	0.00
Inflation Rate % pa	-0.27	-0.78	0.33	0.00
Interest Rate for Construction (%)	-0.21	-0.52	0.44	0.05
Yield on 91-Day Treasury Bills (%)	-0.25	-0.66	0.37	0.01
Cedi:US$ Depreciation %	0.47	0.57	0.08	0.03

By far the strongest linkage demonstrated in Table 5.3 is large negative correlations between residential performance and movements in the Cedi:US$ exchange rate, which take broadly comparable values and are strongly statistically significant for rental values and total returns in both nominal and real terms. In other words, depreciation in the value of the Cedi tends to be associated with rises in rental values and returns. The linkage was strongly evident in 2000, when the Cedi

depreciated by 106% against the dollar (its heaviest fall in the fifteen years) and the rate of inflation doubled (see Appendix 1.1).

In view of the strong impact of exchange rate movements on the market, Table 5.4 repeats the correlation analysis using US$ denominated measures of rental value growth and total returns. Again the Table shows correlations against both nominal US$ denominated measures and against the US$ denominated measures deflated by the Ghanaian rate of inflation.

The dollar conversion goes some way to restoring the expected relationships between economic growth, interest rates and residential performance. GDP growth shows a positive correlation with total returns, and interest rates a negative correlation. The linkages between economic variables and nominal rental value growth, however, remain weak. More surprisingly, the expected relationships with economic growth and interested rates appear much stronger, with increased correlation coefficients and stronger statistical significance, if the dollar denominated performance measures are deflated by Ghanaian price inflation.

Overall, these results imply that the rented residential sector is dominated by both occupiers and investors who price the market in terms of dollars in an economy where goods and services are generally priced in Cedis, and at least some incomes of occupiers are priced in Cedis. Thus, rental values, capital values and total returns measured in dollars rise above the local inflation rate when incomes (proxied by

GDP) are rising, and they fall relative to the inflation rate with an erosion of real incomes by higher inflation. Reductions in interest rates have the expected impact on residential values and returns, increasing investor demand while having a weaker positive effect on occupier demand. Finally, even when deflated by local inflation rates, the dollar values of residential rents and investment are lifted by a depreciation of the Cedi, which increases the values in local currency of dollar denominated incomes.

5.10 Summary and conclusions

This Chapter has applied the results of the hedonic modelling from Chapter 4 to generate estimates of reversionary income yields, income returns, capital appreciation and total returns for residential investments. These measures are used to determine the overall residential investment performance, the variation in performance across sub-markets and in an initial examination of the linkages between residential investment performance and the Ghanaian economy. From the Ghanaian perspective, at the aggregate level, residential reversionary rental yields have been stable over the period of analysis when set against large variations in rates of inflation and interest rates. It appears that higher priced and higher quality locations (Upmarket, Gated and Emerging Upmarket neighbourhoods) have been held on yields which have been consistently above those in lower priced and lower status neighbourhoods (Middle Income in Accra and Tema). Relatively low yields

on lower quality neighbourhoods may be explained by the delivery of subsidised accommodation by state agencies, which may have depressed the market rents achievable on private rented stock, as noted in Asabre (2007). Under these conditions the price value of rental properties may be raised by the possibility of realising capital gains through sales into owner-occupation.

Indications of changes in the quality of stock within each sub-market can be taken from a comparison of hedonically adjusted rents and unadjusted average rents per square metre over time. This comparison suggests that there has been a pronounced downward shift in quality mix in the highest quality neighbourhoods (Upmarket) in Accra, probably through the increased sub-division of large plots to provide smaller semi-detached units. Tema neighbourhoods also show a downward shift in quality mix, perhaps due to public policy pressures to provide accommodation for lower income households.

Overall, residential total returns measured in Cedis have run at annualised rate of 37.2% per year, made up of a relatively stable income return averaging 4.6% per year and highly volatile capital growth at an annualised rate of 32.4% per year. In real terms, Cedi denominated returns adjusted for inflation have run at an annualised rate of 11.3% per year, with capital growth at 7.4% per year. Measured in US$, annualised total returns from 1992 to 2007 have been 14.6% per year, with capital growth of 7.7% per year and average income return of 6.7% per year.

Across sub-markets, in US$ denomination, annualised returns have been at 14.5% for Upmarket neighbourhoods, 14.3% for Middle Income neighbourhoods and 16.7% in Gated communities. The Emerging Upmarket neighbourhoods have achieved a much higher rate of return at 20.6% per year, while Tema shows a much lower return of 9.7% per year. Though these are at first sight large differences, however, the high volatility in returns and limitation of the sample to 15 annual observations means that none of the differences in average rates of return across sub-markets are statistically significant at the 10% level, irrespective of whether they are measured in US$ or Cedis.

Also, across the sub-markets, differences in long-run returns have been in large part driven by variation in rates of rental value growth. Because yields and income returns have been fairly stable over time, year on year variations in capital growth and total returns in each sub-market have been almost wholly the product of annual variation in rental value growth.

A preliminary investigation of linkages between aggregate performance and key economic variables has been undertaken. When analysed in Cedis, these linkages at first sight appear perverse, showing negative correlations with growth in GDP and positive correlations with rates of interest. In Ghana's case, the expected relationship is clearly complicated by the standard practice of quoting private sector residential prices and rents in US$, payable in Cedis. Both rental value growth and

total return, measured in nominal or real Cedis, show a high and statistically significant negative correlation with the rate of depreciation in the Cedi:US$ exchange rate. Residential market returns expressed in US$, therefore, do show the expected positive relationship with GDP growth and negative relationship with interest rates, though the effects are much weaker and statistically insignificant on rental values.

CHAPTER 6 RESIDENTIAL INVESTMENT AND OTHER ASSETS

6.1 Introduction

Access to market information and the ability of investors to interpret performance indicators are important to both individual and corporate investors. In Ghana, sources of information on residential investments have been limited to the Land Valuation Board, newspapers and occasional reports from real estate brokers. But the absence of credible data of historic real estate returns has made it impossible to compare investment performance (risk and returns profile) across asset classes.

The last Chapter provided the first evidence that real estate investment in Ghana has offered what appear, in isolation, to be reasonable rates of capital appreciation and total return to investors. In both US dollar denomination and in Cedis, rates of return have run well above rates of inflation, both overall and in all sub-markets.

A full case for real estate investment, however, requires a comparison with alternative Ghanaian assets. This Chapter employs time series data from 1992 to 2007 to comparatively examine the performance of residential real estate market against other investments in Ghana. To achieve this objective, the Chapter firstly measures investment performance of equities traded on the Ghana Stock Exchange (GSE) and of fixed income investments represented by Treasury Bills. There are no

measures of historic performance for longer term Ghanaian Government bonds over the full period covered by the residential investment measures.

The performance of residential real estate investment is taken directly from the yields and total returns set out in Chapter 5. For equities, data on returns have been constructed for the period 1992 to 2007 by combining equity price and dividend data for all equities listed on the Ghana Stock Exchange. There is no original source for full total returns on the GSE. Treasury Bills rates have been taken direct from Bank of Ghana statistics.

Subsequent Sections of this Chapter are structured as follows. Section 6.2 presents an overview of the GSE, with a brief review of related studies on the stock market in Ghana in Section 6.3. Section 6.4 compares investment yields across the three asset classes. Section 6.5 gives the full comparison of investment returns, and locates the realised returns and risks on residential investment in the context of competing asset classes.

6.2 The Ghana stock market

The establishment of a stock market in Ghana was seen as a significant component of economic development as far back as 1968. However, due to unstable political and economic environment as well as lack of political will, the establishment of a

functional stock market was long delayed. It was not until November 1990, when under the Stock Exchange Act, 1971 (Act 384), the first trading of the Ghana Stock Exchange (GSE) was conducted (Ghana Stock Exchange, 2006).

Using the index of stock market capitalisation to GDP ratio, Yartey (2006) describes the GSE as not very important in the first 4 years of its establishment. The stock market capitalisation as a proportion of GDP, however, climbed to 35% in 1994, very close to the world average of 38.2%. The GSE itself calculates and publishes the GSE All-shares Index, covering all listed equities. The base for the GSE Index is December 1993 – unfortunately one year later than the base of the performance calculated for Ghanaian residential investments.

To give a full comparison of local equity market with residential investment an alternative source of Stock Market performance has been used, the Databank Index produced by the information company Databank Group (Databank Group, 2008). This service tracks the market's performance from 1990, covering all stocks listed on the GSE, and showing annual figures on price changes and estimates of dividend yield. As at December 2007, there were 32 GSE listed companies, with a total market capitalisation of ¢12,368.60 billion (US$1.32 billion).

6.3 Review of related studies

Numerous studies (see for example, Coyne *et al.,* 1980; Webb and Sirmans, 1980; Burns and Epley, 1982; and Kaplan, 1985) have examined the performance of real estate assets in comparison with alternative asset classes such as stocks and bonds in developed economies. But Liu *et al.* (1995) argue the findings in most of these studies are not comparable with one another due to differences in focus. The research classifies these studies into two categories. First, studies which had focused on evaluating the returns or risk and return profile of one real estate type against stocks. Second, others which compared diversified real estate portfolios to stocks or many investment alternatives.

With the exception of the oldest stock markets in South Africa and Egypt which have existed several decades, most emerging stock markets in Africa including those in Ghana, Malawi, Uganda, Swaziland and Zambia were established within the past two decades. Senbet and Otchere (2008) contend that the rapid development in equity markets is accounted for by African's new commitment to financial sector policy reform, and the region's improved economic performance.

Studies on Ghana Stock Exchange have been scanty, and primarily focused on the Stock Market's development and its linkages with economic growth. The restricted research, however, provides a consistent picture of the market's performance. From

a corporate finance perspective, Yartey (2006) finds the stock market in Ghana to be the most important source of long-term finance for listed companies. By providing funding for corporate growth, the study argues the stock market development has been important for economic development. But by global standards, the Ghana Stock Exchange is described as illiquid. Trading volumes have run at most at just 1.4% of GDP in 1994 when compared with the world average for the 1990s of 31%.

Yartey and Adjasi (2007) in appraising the economic importance of stock markets in Africa address the low liquidity of the stock market in Ghana. Broadly, the study suggests African stock exchanges face the challenge of integration and need better technical and institutional development. It finds the GSE in the same position as most stock markets in Africa. The market is small with few listed companies, characterised by low market capitalisation. The base of only 32 listed companies in Ghana contrasts with much higher figures in other African markets in countries such as Egypt (792), Nigeria (207), South Africa (403) and Zimbabwe (79). Nonetheless, market capitalisation in Ghana amounts to 31% of GDP, above the average (27%) for the continent, excluding South Africa and Zimbabwe, though lower than in other emerging economies such as Malaysia where the capitalisation ratio is 161%. Consistent with Yartey (2006), the study also reveals that the stock market in Ghana is a significant source of company capital, financing 12% of total asset growth of listed companies between 1995 and 2002.

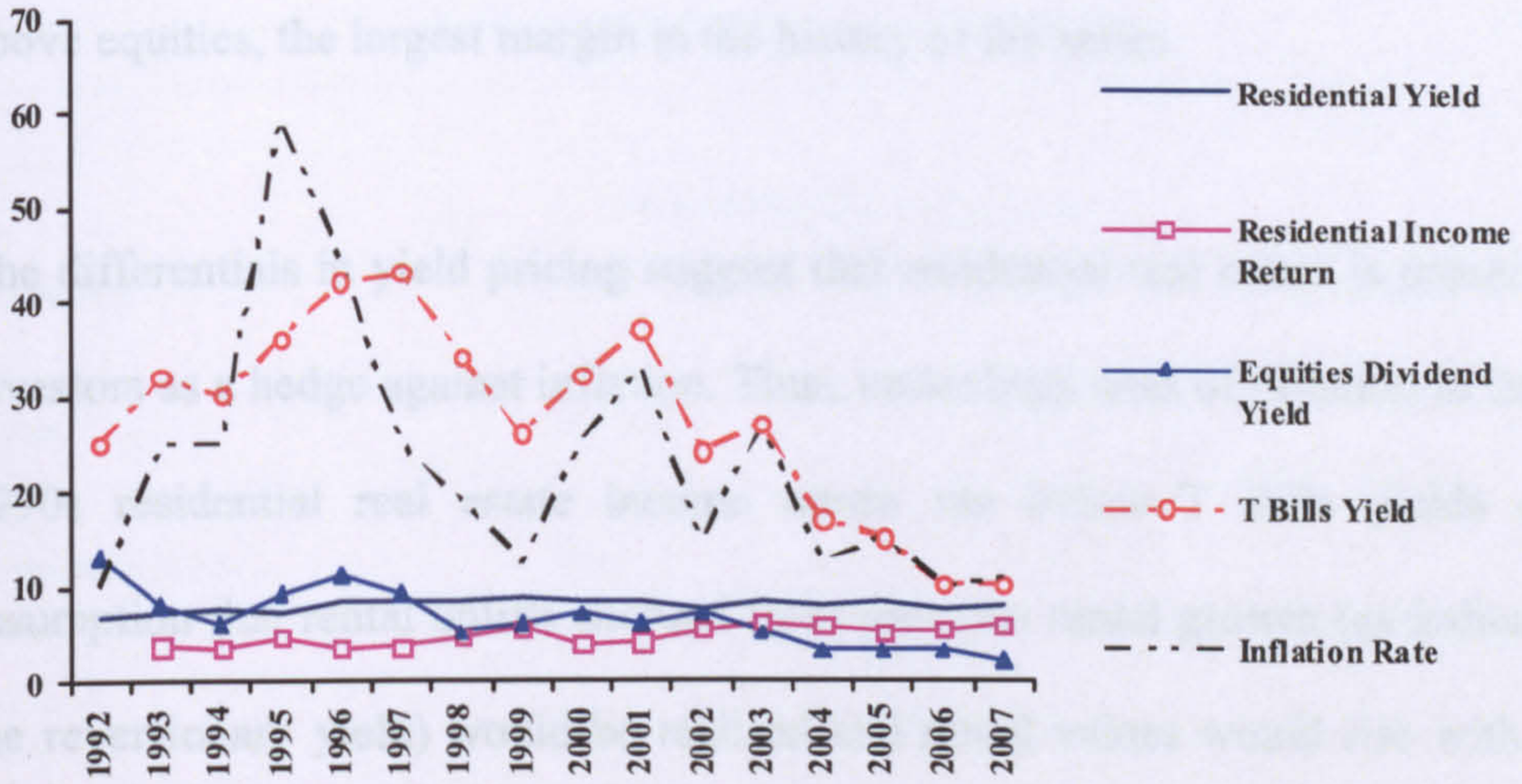
In a recent policy-oriented study on African stock markets, Senbet and Otchere (2008) also describe the markets in Africa as thin and illiquid with the exception of South Africa and a few countries in North Africa. The study provides performance measures in local currency to show that the mean annual stock return in Ghana between 1990 and 2006 was 44%, higher than the average (38%) for African stocks. The GSE has also outperformed stock markets in emerging economies outside Africa such as Mexico in Latin America and Malaysia in Asia.

6.4 Investment yields

Figure 6.1 below presents yields for residential real estate, equities and Treasury Bills as well as residential income returns from 1992 to 2007. Treasury Bills or T Bills are promissory notes issued by the Bank of Ghana on short term basis, usually 91 days. Treasury Bills returns are the redemption yields on these instruments averaged over four quarters each year, as published by the Bank of Ghana.

Stock market dividend yields were high from 1992 to 1997, when yields ran at up to 13%. From 1998 to 2002, with a decline in the rate of inflation, yields settled at lower, more stable, rates between 6% and 7%. The last four years have seen a sharp dip in dividend yields, falling to 2% by the end of 2007. Over the period 1992 to 2007 dividend yields have averaged 6%.

Figure 6.1: Residential, equity and T Bills yields 1992 – 2007, %



Sources: GSE, Bank of Ghana, Databank Group and own estimation

Yields on Ghanaian Treasury Bills have also reflected the downtrend in the rate of inflation, falling from a peak of 43% in 1997 to 10% in 2006 and 2007. At these levels, T Bills yields are in line with the current rates of inflation.

Residential yields show a different trend over time from those on other assets, remaining relatively flat despite the change in the rate of inflation. The reversionary residential yields were close to or below equities dividend yields up to 1997, but have run well above equities yields for the last five years. The residential yield measure, as described in Chapter 5, is elevated by the high level of reversions produced by high rates of nominal rental value growth, especially in the 1990s. Residential income returns therefore provide a more appropriate comparison with equity dividend and T Bills yields. Rates of income return were well below equity

dividend yields up to 2002, but by end-2007 had risen to 3.8 percentage points above equities, the largest margin in the history of the series.

The differentials in yield pricing suggest that residential real estate is perceived by investors as a hedge against inflation. Thus, under high rates of inflation in the early 1990s residential real estate income return ran below T Bills yields on the assumption that rental uplifts accrued from previous rental growth (as indicated by the reversionary yield) would be realised and rental values would rise with future inflation. While this would reflect perceptions of residential values relative to inflation common in many countries, it is more surprising that the yield comparison suggests residential real estate was seen as offering better inflation protection than Ghanaian equities.

6.5 Total returns

Figures 6.2 and 6.3 compare the total returns across Ghanaian asset classes set against the rate of inflation, and Table 6.1 summarises performance over the fifteen years to 2007. Full annual series for all asset classes are given in Appendices 6.1 and 6.2.

Table 6.1: Ghanaian investments annualised total returns 1992 – 2007, Cedis % pa

	Residential Real Estate	Equities	T Bills
	Nominal Total Return % per year		
Annualised	37.2	42.7	27.2
Mean	38.9	51.1	27.7
Standard Deviation	22.9	52.1	10.3

Figure 6.2: Annual total returns by asset class 1992-2007, Cedis, % pa

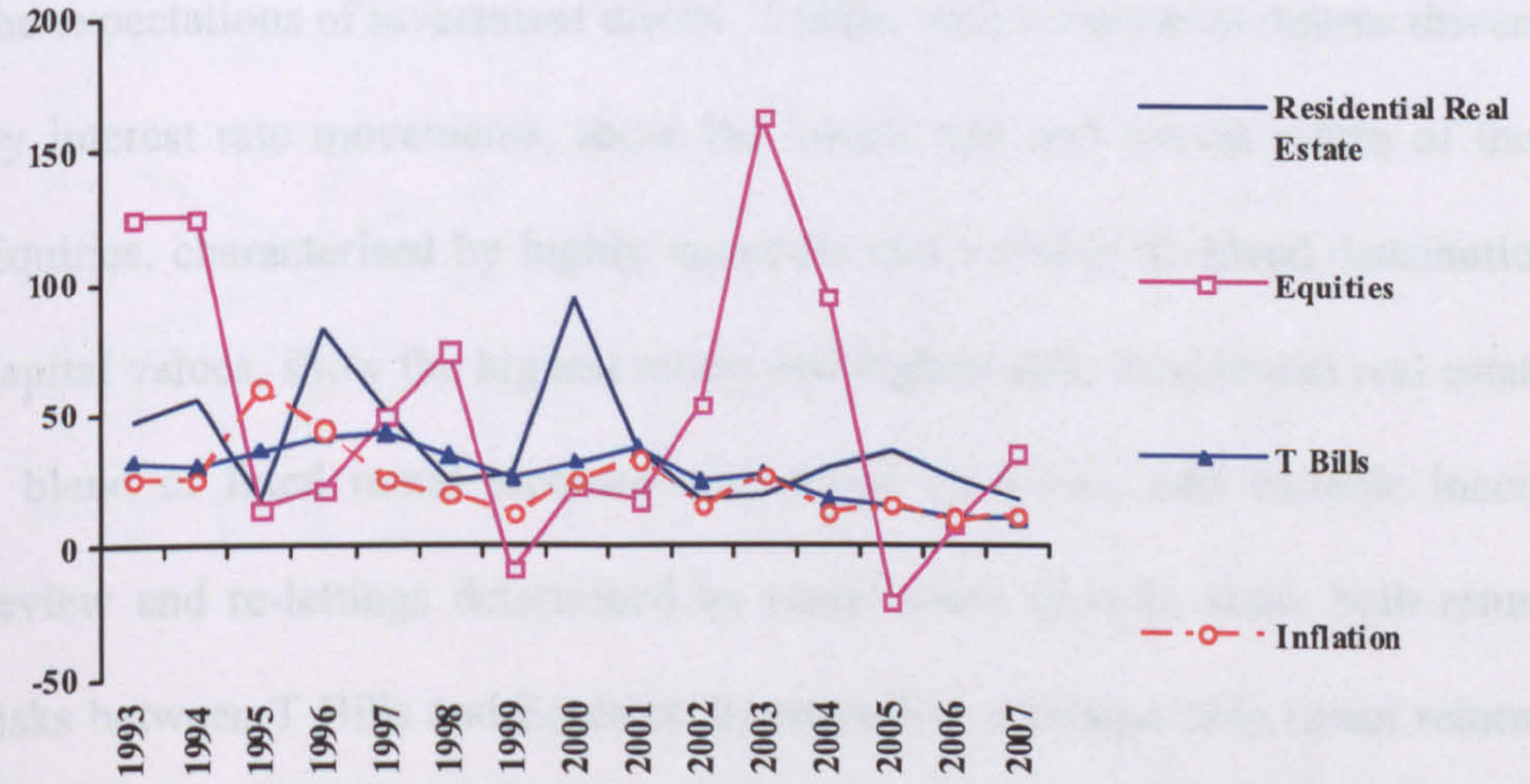
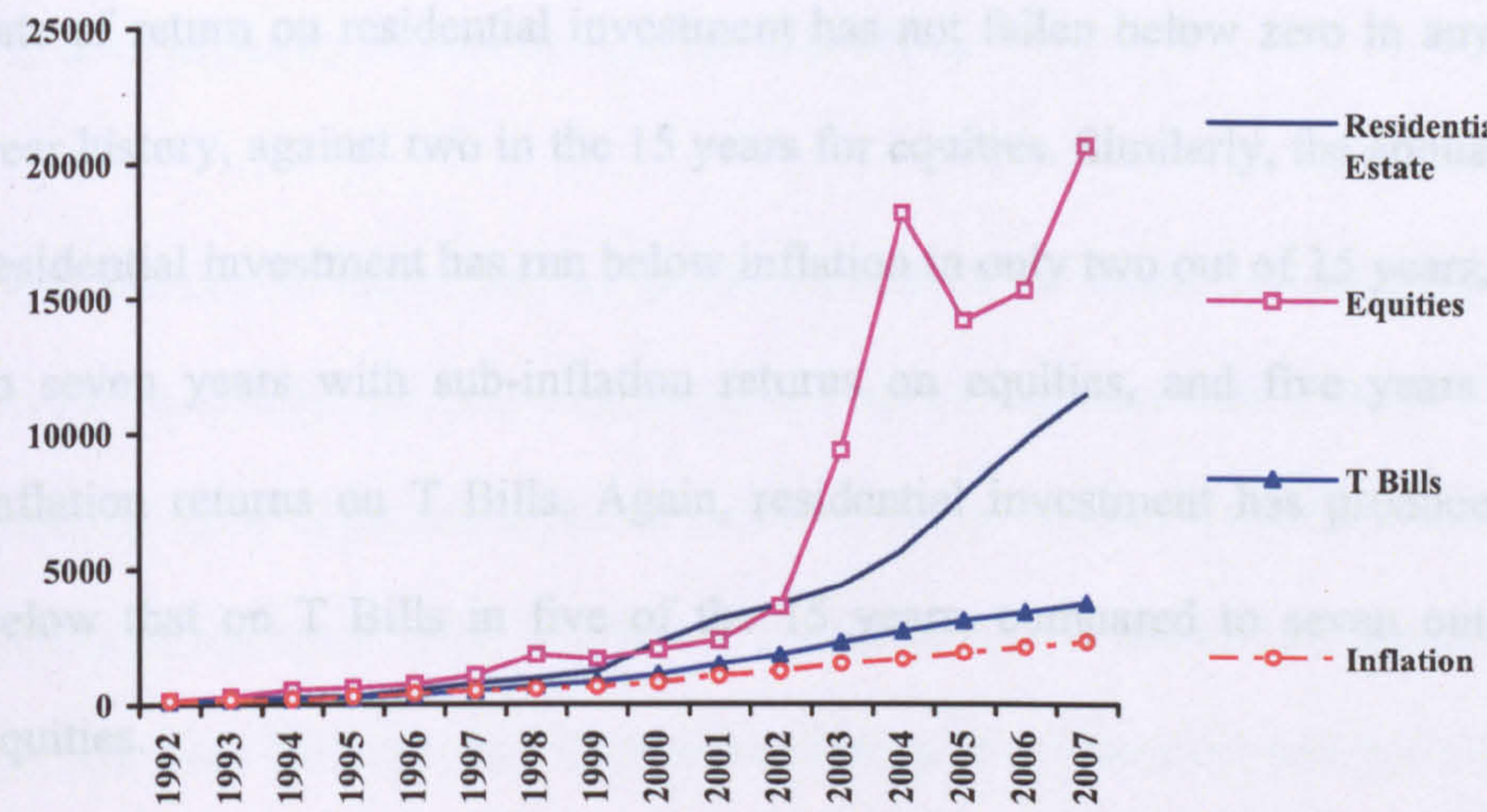


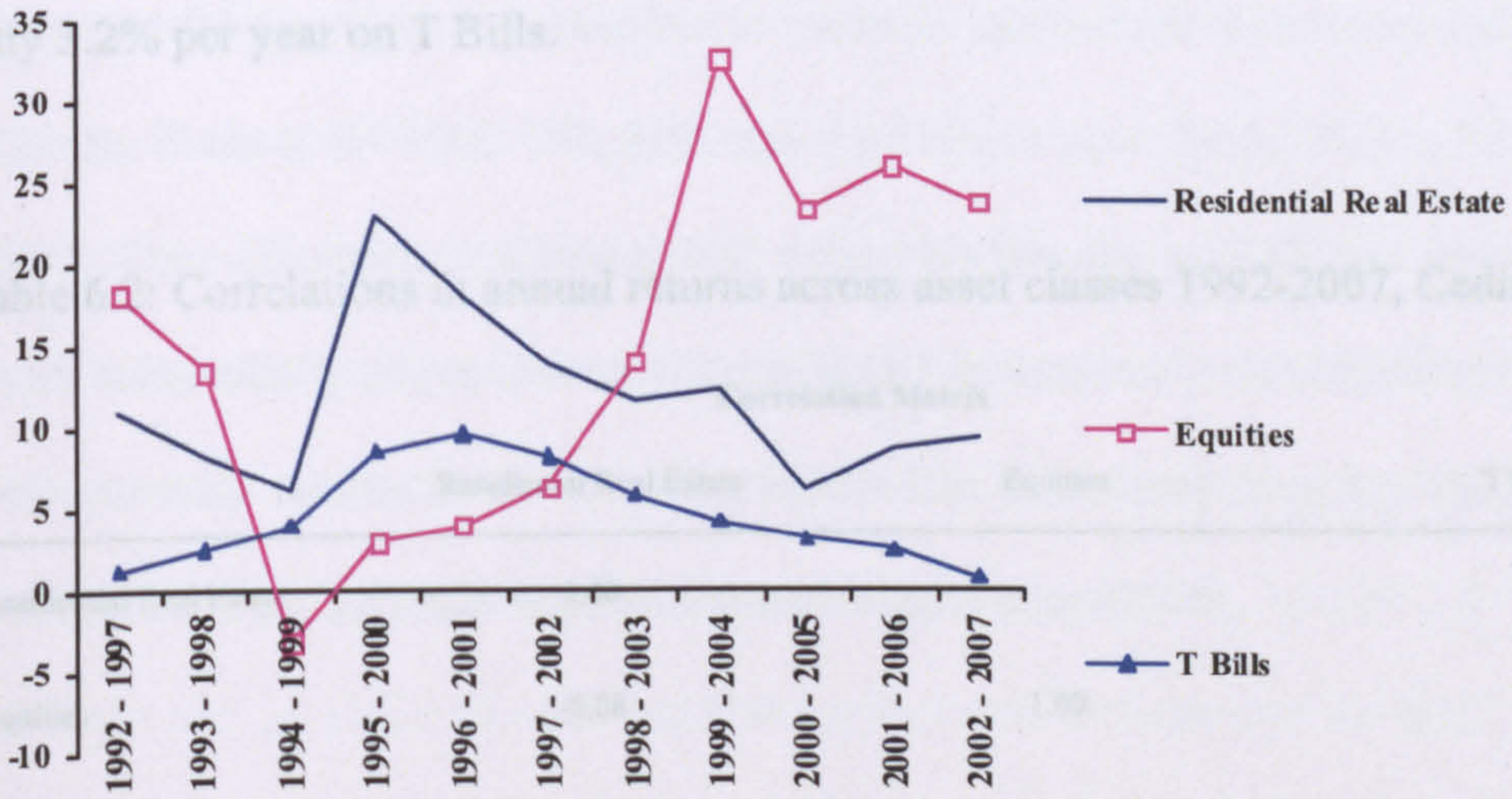
Figure 6.3: Total return indices by asset class, Cedis 1992 = 100



Over the full period, both returns and risks across the asset classes fall in line with the expectations of investment theory. T Bills, with variation in returns driven solely by interest rate movements, show the lowest risk and lowest return of the three. Equities, characterised by highly uncertain and variable dividend distributions and capital values, show the highest return and highest risk. Residential real estate, with a blend of fixed rental incomes determined by leases, and variable incomes on review and re-lettings determined by rental value growth, show both returns and risks between T Bills and Equities. Expressed as a Sharpe ratio (asset return less T Bills return divided by standard deviation of the asset), the risk adjusted excess returns on residential real estate at 0.49 is marginally above that on equities at 0.45. Against other asset classes in Ghana, therefore, residential real estate has offered a competitive return, commensurate with its risk.

Residential investment has also provided more consistent returns than equities. The rate of return on residential investment has not fallen below zero in any of the 15 year history, against two in the 15 years for equities. Similarly, the annual return on residential investment has run below inflation in only two out of 15 years, compared to seven years with sub-inflation returns on equities, and five years with sub-inflation returns on T Bills. Again, residential investment has produced a return below that on T Bills in five of the 15 years, compared to seven out of 15 for equities.

Figure 6.4: Five year rolling real returns by asset class, Cedis % pa



The relative stability of returns on property, and consistent performance above T Bills and inflation is brought out more clearly by calculating rolling real returns over five years (Figure 6.4). On a five year holding period, residential real estate has delivered a steady return premium over T Bills, and a minimum real return of 6%

per year. Residential real estate has also avoided any protracted downturn such as that seen in equity returns through the late 1990s.

Thus, residential real estate has produced returns for medium-term investors which have consistently run above inflation and above the return on T Bills. Equities, by contrast, have delivered a return below inflation in one out of the eleven 5-year rolling period since 1992, and below T Bills in four of the eleven periods. Adjusted for Ghanaian inflation, the Cedi denominated real return on residential real estate over 15 years has been 11.3% per year compared to 15% per year on equities, and only 3.2% per year on T Bills.

Table 6.2: Correlations in annual returns across asset classes 1992-2007, Cedis

Correlation Matrix

	Residential Real Estate	Equities	T Bill
Residential Real Estate	1.00		
Equities	-0.08	1.00	
T Bills	0.48	0.12	1.00

Finally, residential real estate has also offered Ghanaian investors the strong diversification benefits normally associated with the asset class (Table 6.2). The

correlation between residential real estate and equities is not statistically different from zero, and the correlation with T Bills is a moderate 0.48.

Against an international investment background, as shown in Section 5.7 (see Table 5.1) Ghanaian residential real estate has achieved a return denominated in US$ of 14.6% per year from 1992 to 2007. From the viewpoint of a US based investor, this may be compared with returns on US real estate over the same period of 11.2% per year, and on US residential real estate of 12.2% per year (NCREIF, 2008). In local currencies, the unweighted average annualised return on residential real estate in the five countries for which it is possible to measure total returns over the same period (Canada, France, Sweden, UK, US) was 11.9% per year (IPD, 2008b; NCREIF, 2008). Thus Ghanaian residential real estate investment in US$ has provided a return substantially above that on US residential investment – indeed above that the local currency returns in all countries where data exist apart from the UK, where over the same period residential investment returns were 16.9%.

Measured by standard deviation, the risk of US$ dominated Ghanaian residential investment has been 11.6% per year, against only 3.0% per year for US residential real estate as recorded by NCREIF. As discussed in Section 2.6, the volatility of the NCREIF US residential index is likely to be understated due to valuation smoothing. Geltner (1993) estimates a corrected standard deviation for the NCREIF returns at up to two times that shown by the Index. Similarly the standard deviation

averaged across the five countries where the data exist was low at 4.2% per year. US-based investors into Ghanaian residential real estate have therefore received a return premium over the alternative of residential investment in the US of the order of 2.4% per year, with a risk penalty in added standard deviation from 8.6 percentage points per year to 5.6 percentage points per year, depending on the extent of desmoothing of the US data thought to be appropriate.

On a risk-adjusted basis, US-based investors in Ghanaian residential real estate have seen a Sharpe Ratio (over US Treasury Bills) of 0.33. This compares with a Sharpe Ratio of 1.04 for US residential investment with no upward adjustment of volatility for smoothing, and 0.52 for US residential investment with an estimate of volatility doubled to correct for smoothing. The choice of Ghanaian residential investment over the US alternative has, therefore, appeared to provide US domiciled investors a slightly inferior risk adjusted return, although the size of the margin between the two is uncertain given problems in estimating true volatility for the US results. Since the Sharpe Ratio on US long dated government bonds over the same period has been 0.39, and that on US equities has been 0.38, however, both US and Ghanaian real estate investment have offered risk adjusted returns comfortably above those on the other major asset classes.

As the superior real estate risk adjusted returns in the US suggest, the period from 1992 to 1997 covered by the Ghana residential real estate index has been

characterised by strong real estate performance and, since 2001, relatively weak returns on equity investments in the wake of the global stock market declines in the early 2000s. Indeed, exceptionally high rates of appreciation in house prices across many countries from the mid-1990s up to the mid-2000s were seen as "the biggest financial bubble in history" by The Economist magazine (The Economist, 2005) – a diagnosis relying primarily on simple indicators such as deviations in prices from long run trends and high house price to household income ratios.

Professional opinion in the middle-2000s remained divided on whether historically high rates of real house price growth were a bubble or a rational reflection of fundamentals such as reduced inflation, low interest rates credit availability or, in some countries, restrictions on housing development. Thus, for the UK where the real appreciation in house prices was amongst the most marked, Cameron *et al* (2006) concluded that there was no evidence of a departure from fundamental values over the period 1997-2003. For the US, similarly, top policy makers were persuaded that increased house prices were sustainable (Greenspan, 2003). On the other hand, Shiller (2007) represents the perhaps equally widespread view that unprecedented real house price inflation was at least in part a classic speculative bubble driven by unsupportable expectations for future price increases.

At the time of writing, in late 2008, it may appear that those who believed that prices were an unsustainable bubble have conclusively won the debate. As

discussed in a recent report from the International Monetary Fund, the rise in house prices has, in many countries, been sharply reversed through 2007 and 2008. Indeed, the fall in house prices is generally considered to have been a primary trigger of the banking crisis which began in 2007, and which continues to have a severe impact on the global economy through credit losses in the banking system, falls in construction volumes and other housing-related sectors of the economy, and adverse wealth effects on household consumption (IMF, 2008).

The ultimate explanation of these extreme swings in house prices, and their ramifications for the financial system and the economy, are issues beyond the scope of this thesis. The fact that the period currently covered by the Ghana residential investment index was globally a period exceptional gains in house prices and real estate values should be taken as a qualification to the solid returns observed in Ghana from 1992 to 2007, and also supports the case for maintaining the production of index values to track movements in the market through a global economic downturn.

6.6 Summary and conclusions

This Chapter compares the performance of residential investment against other Ghanaian asset classes represented by equities and Treasury Bills. Residential real estate investment shows a good historic performance track record with returns and

risks in the "expected" space between Treasury Bills and equities. Induced by a favourable investment climate, residential and equities have over the period shown an upward increase in total nominal returns, particularly from the period commencing 2000.

The residential investment market also proves to be a good diversifier for the two other asset classes. Historic residential investment returns have shown a different pattern to equities and Treasury Bills, and falls in line with international evidence that real estate provides useful diversification of risk within a portfolio of investment assets. Taken as a whole, with the diversification and long term return benefits offered by residential investment, the evidence provided in this Chapter suggests residential real estate market plays a significant role in its own right in national economy and also as a competitive investment asset class.

CHAPTER 7 FINDINGS AND RECOMMENDATIONS

The primary goal of this research – to construct and test robust models of changes in value for Ghanaian residential investments over a period long enough to be useful for analysis – has been completed, together with the supporting work on background literature and methods of residential real estate index construction. The results of the work, in the form of the first ever time-series indicators for any form of real estate investment in Ghana and research applications of those indices to the analysis of residential investment markets, constitute an original and unique advance in knowledge of Ghana's real estate. Given the lack of comparable measures for other African economies, both the methodology and the findings of the research also make an original contribution to the general understanding of real estate in emerging economies.

In Chapter 1, the key role of real estate in the process of economic development is defined from four perspectives. First, it emphasises that the accumulation of wealth could be associated with the expansion of real estate stock as well as the rise in its capital value. Second, it acknowledges that real estate values are the primary source of collateral for bank lending for not only commercial real estate investments but also for residential markets. Third, it notes that, based on the Asian crisis of the late 1990s, incorrect pricing and real estate markets instability are potential risk for

economic growth because these factors could adversely impact on banking and financial systems. Fourth, it explains that real estate markets are a major potential source of revenue for central and local governments particularly, in emerging economies such as Ghana, which are characterised by cash-based informal markets.

This importance of real estate values and investment notwithstanding, formal real estate investment markets in emerging economies have received very little attention from researchers. Chapter 2 reviews previous studies to show that there has been virtually no analysis of formal residential investment markets in emerging economies which tracks price and rent changes over time or compares the investment performance of real estate with other asset classes. Whilst evidence on real estate markets performance abounds in the literature for developed countries, such indication for emerging economies is very limited. Published literature on Ghana has treated real estate in the same manner, with the main focus on either land administration systems or the operation of informal real estate markets.

The development of the real estate markets progresses slowly in Ghana and other sub-Saharan African countries, partially due to weak and inefficient land administration systems. Both academic and industry researchers have concentrated on emerging markets through the development of equity market and housing mortgage lending systems. There remains, therefore, a substantial gap in

understanding of the performance of emergent formal real estate investment markets and the development of an appropriate policy and financial infrastructure to support those markets.

To make a choice on a suitable method to construct the first Ghanaian real estate investment performance indices, Chapter 3 investigates the methods most commonly used for the analysis of residential real estate pricing. The discussion of methodologies in the literature, and the nature of the dataset available for analysis in Ghana both indicated hedonic modelling based on transactions dataset as the most useful approach. The technique has been applied with a careful understanding of its potential weaknesses, and the use of appropriate model specifications and statistical tests for the correct model form.

Chapter 4 describes the laborious process of data compilation from primary paper records which produces for the first time transactions dataset on residential prices and rentals in Accra and Tema. This dataset underlies the subsequent empirical analysis which constitutes the core of the current research and its contribution to original study. After careful validation checks and the omission of all doubtful and incomplete records, a total of 3,250 property sales transactions, and 1,130 rental transactions, were available for analysis over the period 1992 to 2007.

The hedonic price and rent models developed in Chapter 4 form the building blocks for the construction of investment performance indices, but also cast new light on the determinants of residential values in Ghana. Hedonic models are constructed for the aggregated Accra-Tema market, and for each of the five residential neighbourhood groups identified by location and the quality of the residential stock. The results advance understanding of the residential market, demonstrating that five real key property attributes – location, gross internal floor areas, quality of landscaping, detached or semi-detached type, and plot size – predominate in the explanation of both rental and transactions prices across all submarkets. From the models, time series indices for transaction price and rent are extracted by the method of determining coefficients on year dummy variables from 1992 to 2007 in the hedonic estimation. These constitute the first Ghanaian residential real estate market indices, and the basis for complete measures of investment performance in subsequent analysis. Various tests for the robustness of the models – including estimations by sub-period and separately estimated models for each sub-market – demonstrate they are robust to structural breaks and aggregation problems, and free from significant multicollinearity.

Chapter 5 applies the results of the hedonic modelling to generate estimates of reversionary income yields, income returns, capital appreciation and total returns for residential investments. Estimates of income return and capital growth are derived

from the market price and rental indices with appropriate adjustments for landlords' irrecoverable costs and depreciation. These measures are used to determine the overall residential investment performance, the variation in performance across sub-markets and in an initial examination of the linkages between residential investment performance and the Ghanaian economy.

Finally, Chapter 6 completes the analysis by comparing residential investment returns with those delivered by Ghanaian stock market and fixed income investments. This gives, again for the first time, a basis for investors to assess the case for residential investment relative to alternative investments in Ghana.

Following this introduction, the remaining part of the concluding Chapter is organised in four Sections. Section 7.1 summarises key findings of this thesis, mainly from the original empirical work presented in Chapters 4, 5 and 6. Section 7.2 discusses the policy implications for the development of residential real estate markets in Ghana. Section 7.3 covers areas for further research opened up by this thesis, and Section 7.4 gives concluding remarks.

7.1 Key findings

The first critical objective of the research was to establish the feasibility of collecting sufficient information from the historic records of government agencies

to construct reliable measures of changes in prices and rents over time. This proved to be a time consuming task, and more laborious than envisaged at the outset of the work. A large number of potential transactions observations, moreover, had to be deleted from the sample due to missing or doubtful information. Nonetheless, the final samples represent the most accurate historical record available for residential real estate markets in Ghana. Tests of the hedonic models based on the data collected give a plausible account of price determination, and are statistically robust. As noted in Section 7.2, this element of the research could form the basis for annually updated measures of residential performance in Ghana, and an extension of the measures to other urban centres of the country. The approach, moreover, may be extended to other African countries with land administration systems similar to Ghana.

The second objective of the research, and the ultimate test of the sample data, lies in the ability to generate robust hedonic models, using variables and model specifications widely used in the literature and extensively tested in developed economies. Chapter 4 demonstrates that aggregate hedonic models embodying a standard set of attributes covering location, property size and quality are well specified and achieve high levels of statistical explanation of variance in residential values (with Adjusted R-squared values in the range of between 0.728 and 0.967). At the aggregate level, and with only minor exceptions in the disaggregated models for sub-markets, the model results show that a set of five primary property

characteristics – location, detached or semi-detached units, quality of landscaping, plot size and gross internal floor areas – are the predominant price and rent determinants, showing the expected signs and a high level of statistical significance on the regression coefficients. The price and rent models also capture strong annual movements, showing strongly significant coefficients for the majority of year dummies.

When disaggregated by sub-markets, the hedonic models confirm the impression from simple averages of markets which are strongly differentiated in price by location and stock quality. Overall, the location variables are highly significant across submarkets and point to price and rent differentiation between submarkets within Accra, as well as a differentiation between Accra and Tema.

The empirical results therefore document the emerging formal residential market in Ghana, and point out some differentiation in the process of price formation in different submarkets. Nonetheless, as would be expected, the separately estimated hedonic models for each of the five sub-markets showed fairly similar core determinants of prices across sub-markets, but with some variation in the details. Thus, four property attributes – detached / semi-detached units, quality of landscaping, gross internal floor areas and plot size – predominate in the explanation of residential prices and rents in all submarkets. In the higher quality locations, however, prices tend to be determined less by unit size and more on

landscape quality. In lower income neighbourhoods with more homogenous stock quality, property size is a strong influence on prices.

Generally, the hedonic modelling showed the expected signs and strong statistical significance on the location, physical size and quality attributes of properties, yielding results in line with ex-ante expectations. For those explanatory variables indicating security of tenure, however, some results were contrary to prior expectation. Thus, underlying land leases from freeholders which are state controlled would be expected to show a positive impact on residential values against land leases granted from customary owners where land titles are frequently subject to conflicts and extended litigation. In fact, the results tend to show negative or statistically insignificant impacts of land leases from state freeholders impacts on values. This is likely to reflect an association between state freeholds and the delivery of lower quality or subsidised "affordable" housing by state agencies such as the State Housing Company and Tema Development Corporation. It may also be the case that private developers have built only on those sites in customary ownership which have undisputed titles.

A second indicator of security of tenure – the unexpired term on underlying ground leases – might be expected to show a positive impact from longer unexpired terms. Here, however, the results suggest that length of unexpired term has no influence on values. It is likely that purchasers are likely to ignore this factor as it is generally

assumed that leaseholds will be automatically renewed at low costs. This finding is consistent with a previous study on the topic (see Antwi, 2002).

The third objective to the research was to construct the first indices for residential investment markets – indeed the first systematic market indicators for any aspect of the country's housing market. Price and rent indices constructed from the hedonic modelling results show strong market movements over the period measured. In terms of US$, market rental values have risen at an Annualised rate of 9.1% per year, and residential prices have risen by 8.8% per year, from 1992 to 2007. Denominated in Ghanaian Cedis, rental values have risen by 33.8% per year, and capital prices by 33.4% per year. Very high rates of growth in the Cedi denominated measures must be considered against the high rate of Ghanaian inflation, which has run at 23.2% per year over the same period. Adjusted for inflation, however, in Cedis, rental values have risen by 8.6% per year and capital prices by 8.2% per year.

The fourth objective of the research was to explore applications of the new residential price indices in the analysis of market dynamics. On this point, the profile of price and rent movement over time shows some broad relationships with conditions in the Ghanaian economy. During the 1990s, annual rates of inflation were high and very volatile, accompanied by large fluctuations in interest rates and continuous large soar in the Cedi:US$ exchange rate. This period of instability culminated in a doubling of the exchange rate, its largest movement during the

period, in 2000 with knock-on effects on inflation and interest rates the following year.

Since 2002, however, macro-economic conditions have been more benign, with acceleration in GDP growth, falling inflation (albeit to a recent rate still at 10% per year), reduced interest rates and a stabilisation in the exchange rate. In parallel, Cedi denominated price and rental growth rates from 1992 to 2001 were extremely volatile in nominal terms, with a range from 20% to 90% per year. Since 2002, year by year variations in Cedi denominated prices have been relatively small, around a lower nominal average (2% to 32%). In real terms, however, average rates of price and rental growth have been considerably lower since 2002 than in the earlier period.

Market trends measured in US$ similarly show reduced volatility since 2002. Although Cedi denominated average growth rates have been lower in this period, the stabilisation of the exchange rate means that average price and rental growth denominated in US$ has been more in line with rates seen during the 1990s. Measured in US$, moreover, the profile of market changes also suggests some impact of Government policies towards external investors in real estate. Thus, both prices and rents showed peak rates of increase following the repeal of PNDC Law 150 in 1996, which imposed restrictive terms on the distribution of real estate

incomes from external companies and diplomatic missions in the acquisition or rental of real estate assets.

Overall, therefore, Chapter 4 achieves the first four primary objectives of the research in demonstrating the feasibility of primary data collection, the robustness of house price and rental models based on that data, the principles of construction of Ghanaian price and rent indices, and the insights into the determination of prices and influences on market performance which can be drawn from such indices.

The remainder of the thesis considered further applications of the rental and price indices developed from hedonic models. Chapter 5 extends the coverage of market measures to produce a full set of real estate investment performance indicators – yields, income returns, capital growth and total returns. This extension provides a additional contribution to the fourth objective of the research, examining the performance of sub-markets and the overall market from the perspective of investors in residential real estate.

A first step in the production of performance measures is investment yields. At the aggregate level, residential reversionary rental yields have been stable over the period of analysis when set against large variations in rates of inflation and interest rates. Thus, reversionary yields have averaged 7.9% from 1992 to 2007 with a range from 6.8% to 8.5%. The levels of yield show no significant correlation with any

macro-economic variables with the exception of a weak positive relationship with the interest rate on construction loans. Stable yields set against large variations in inflation suggest that residential real estate is perceived by investors as a strong hedge against inflation.

A comparison of reversionary rental yields across sub-markets shows a marked distinction between residential locations which is at first sight counter-intuitive. It appears that higher priced and higher quality locations – Upmarket, Gated and Emerging Upmarket neighbourhoods – have been held on yields which have been consistently above those in lower priced and lower status neighbourhoods – Middle Income in Accra and Tema – by a margin of around 2 percentage points. Relatively low yields on lower quality neighbourhoods may be explained by two factors. First, these markets have seen a higher delivery of subsidised accommodation by state agencies, which may have depressed the market rents achievable on private rented stock, as noted in Asabre (2007). If investors assume that the depression of rents will not be sustained in the long run – that these locations will benefit at some point from high rental growth as prices move to the market level – the low yields would be consistent with higher expected income growth. Furthermore, under these conditions the price value of rental properties may be raised by the possibility of realising capital gains through sales into owner-occupation.

Indications of changes in the quality of stock within each sub-market can be taken from a comparison of hedonically adjusted rents and unadjusted average rents per square metre over time. A relative increase in hedonically adjusted rents relative to unadjusted rents indicates a fall in quality, and vice versa. This component of the analysis suggests that there has been a pronounced downward shift in quality mix in the highest quality neighbourhoods (Upmarket) in Accra, probably through the increased sub-division of large plots to provide smaller semi-detached units. Tema neighbourhoods also show a downward shift in quality mix, perhaps due to public policy pressures to provide accommodation for lower income households. The Middle Income and Emerging Upmarket neighbourhoods in Accra show a rise in quality mix over time, possibly reflecting an improving status and availability of amenities as these relatively new residential areas mature. Only Gated communities have seen a fairly stable mix of quality, perhaps reflecting the dominance of these neighbourhoods by only two developers in this market who have preserved a distinct market niche. This analysis also confirms the advantages of hedonic methods over simple average methods in tracking underlying market prices and rental values, especially in the comparison across sub-markets.

The full analysis of investment returns demonstrates that overall total returns measured in Cedis have run at annualised rate of 37.2% per year, made up of a relatively stable income return averaging 4.6% per year and highly volatile capital growth at an annualised rate of 32.4% per year. In real terms, Cedi denominated

returns have run at an annualised rate of 11.3% per year, with capital growth at 7.4% per year. Measured in US$, annualised total returns from 1992 to 2007 have been 14.6% per year, with capital growth of 7.7% per year and an average income return of 6.7% per year.

The analysis of the realised total returns across sub-markets demonstrates that, in US$ denomination, returns have been at broadly similar long-run rates in three largest Accra sub-markets, running at an annualised 14.5% for Upmarket neighbourhoods, 14.3% for Middle Income neighbourhoods and 16.7% in Gated communities. The Emerging Upmarket neighbourhoods have achieved a much higher rate of return at 20.6% per year, while Tema shows a much lower return of 9.7% per year. Though these are at first sight large differences, the high volatility in returns and limitation of the sample to 15 annual observations means that none of the differences in average rates of return across sub-markets are statistically significant at the 10% level, irrespective of whether they are measured in US$ or Cedis.

Across the sub-markets, differences in long-run returns have been in large part driven by variation in rates of rental value growth from 1992 to 2007. The sub-market with highest rental value growth – Accra Middle Income – has however seen total returns diluted by a low rate of income return and a small rise in yields relative to other markets. Low returns in Tema reflect low rental value growth, low capital

growth and low income return. Yields and income returns have been fairly stable over time and year on year variations in capital growth and total returns in each sub-market have been almost wholly the product of annual variation in rental value growth. Within each sub-market, rates of rental value growth and total return in US dollars correlate at between 0.78 and 0.91.

A final element of the fourth objective of the research is to contribute to an understanding of the dynamics of the performance of the Ghanaian residential market in relation to macro-economic drivers. Though formal modelling of the time series behaviour of the residential investment market is beyond the objectives of the research, and would indeed be limited by the small number of annual observations, a preliminary investigation of linkages between aggregate performance and key economic variables has been undertaken. When analysed in Cedis, these linkages at first sight appear perverse. Annual variation in both real and nominal total returns – driven primarily by annual variation in rates of rental value growth – show a negative contemporaneous correlation with indicators of general prosperity (growth in GDP and GDP per capita), and a positive correlation with prevailing rates of interest. Models of residential values would generally show the opposite signs on these two primary explanatory variables.

In Ghana's case, the expected relationship is clearly complicated by the standard practice of quoting private sector residential prices and rents in US$, payable in

Cedis. Rent and price changes are therefore strongly impacted by exchange rate movements. Both rental value growth and total return, measured in nominal or real Cedis, therefore show a high and statistically significant negative correlation with the rate of depreciation in the Cedi:US$ exchange rate. Residential market returns expressed in US$, therefore, do show the expected positive relationship with GDP growth and negative relationship with interest rates, though the effects are much weaker (and statistically insignificant) on rental values.

For both rental values and total returns, however, the expected positive relationship with GDP growth and negative relationship with interest rates emerge very strongly when US$ values are deflated by the Ghanaian rate of inflation. It appears the variation of prices and rental values over time is a rather complex result of the real purchasing power of local incomes denominated both in Cedis and in US$. This is a topic on which further research, with added information on the mix of tenants and landlords whose incomes are denominated in Cedis versus US$, is required to yield a full understanding of the determination of prices.

The fifth objective of the research was to set the returns achieved on Ghanaian residential real estate against those on other asset classes. The results for residential investments considered alone show what appear to be attractive overall rates of return expressed in US$ (14.6% per year), nominal Cedis (37.2% per year) and real Cedis (11.3% per year). To test further the attractiveness of real estate investment to

local investors, Chapter 6 compared residential returns against those on other Ghanaian investments for which measures of returns are available from 1992 to 2007 – equities listed on the Ghanaian Stock Exchange, and Treasury Bills. Over this period, residential investments have shown an average gross reversionary yield of 7.9% and income return of 4.6% (measured in nominal Cedis), against an average equity dividend yield of 6% and Treasury Bills yield of 27%. As noted above, residential yields and income returns have remained almost flat through the period, against substantial falls in equities dividend and Treasury Bills yields – an indicator that residential investment has been regarded as a strong inflation hedge, undoubtedly in part due to the denomination of rents and prices in US$.

Denominated in Cedis, annualised total returns on residential investment from 1992 (37.2% per year) have set between those on Treasury Bills (27.2%) and equities (42.7%). In real terms, equities have produced returns at 15.7% per year, residential real estate at 11.3% per year, and Treasury Bills a low real return of 3.2% per year. These differences in rates of return appear to offer plausible rewards for risk in the pricing of Ghanaian investments. Thus, the risk of residential real estate returns (a standard deviation of 22.9%) stands well below equities (52.1%) and above that in Treasury Bills yields (10.3%). Expressed as a Sharpe ratio – mean asset returns less mean Treasury Bills return divided by the standard deviation of the asset – residential real estate has shown a risk adjusted excess return of 0.49, slightly above that for equities at 0.45. In terms of risk and return, therefore, residential

investments have delivered levels between those fixed income and equity investments, the result normally expected from the combination of fixed and variable incomes generated by real estate leasing structures.

Residential investment has also delivered the third characteristic generally associated with investments in real estate: a low correlation with other asset classes, and therefore valuable diversification benefits in a mixed asset portfolio. Thus, residential returns show only a moderate correlation (0.50) with Treasury Bills returns, and a negative correlation (-0.10), which is statistically not significantly distinguishable from a zero correlation, with equities.

In all, the results produced demonstrate the primary objectives of this thesis have been achieved: first in proving the feasibility of collecting a usable dataset from Land Valuation Board archives; second in constructing well-specified models of underlying rental and price movements from which the first indices of Ghanaian residential investment performance can be constructed; and third illustrating the potential research applications and policy implications of such indices in the form of analyses of sub-market trends, and the benefits of residential real estate investment to multi-asset investors.

7.2 Implications for public policy and further research

The research documented in this thesis is an original contribution which, it is hoped, will act as a foundation for two main forms of further development: one in the continuation and expansion of data collection and analysis by public agencies in Ghana; the other in further research to refine the analysis given here. These two topics are addressed in the following Sections, followed by concluding remarks in Section 7.3.

7.2.1 Public policy and real estate information

The original motivation for this research was to devise measures of the investment performance of real estate in Ghana where none have previously existed. As noted in Chapter 2, the availability of market indicators – yields, rental values, prices, total returns – is widely seen as an important part of the information infrastructure needed to support the development of real estate investment markets. This research contends that it would be valuable to all those concerned with the evolution of such markets in Ghana – developers, investors and policy makers – to maintain, extend and enhance the production of the indicators presented for the first time in this thesis.

An annual updating of the times series created by this research would be a fairly straightforward task, requiring only the collection of new transactions evidence

from Accra and Tema each year, and the re-estimation of the models described in Chapter 4. An annual exercise of this type, following the methods established in this research, could readily be carried out.

The value of market measures, however, would clearly be greatly enhanced by the extension of data collection and construction of models to cover other cities where there are substantial formal real estate markets, and reliable records are held by state agencies, especially if this extended coverage also included the compilation of historic series for other cities where records are available. Recurrent data collection and analysis on a wider scale would require a larger scale input from the Land Valuation Board to facilitate data collection (ideally in electronic form, along the lines of the Excel template created to capture the data used in this research), and perhaps also develop skills among internal staff to carry out the full analysis – the re-estimation of models and calculation of the relevant indicators. Consideration should also be given to improving the reliability of data collected, and adding further information (such as building specification) to the fields collected with a view to improving the power of the analysis. Looking further forward, the coverage of the data collection and analysis could be expanded to include formal markets in retail, office and industrial property as they emerge in Ghana.

The benefits of producing real estate market information in the future may be enhanced by having a forum for the discussion and dissemination, and to encourage

further research. A Real Estate Research Forum could be set up, perhaps under the aegis of existing public-private bodies such as the Land Valuation Board, Ghana Real Estate Developers Association and the HFC Bank, to oversee the further development of research and ensure the work done is aligned with the interests of both policy makers and participants in the market.

Finally on this point, given the importance of reliable measures of market performance to the operation of efficient investment and lending markets, and ultimately to enhance the credibility of Ghanaian real estate for global investors, capital investment in an information infrastructure of this type would yield multiple benefits. Experience in other countries has amply demonstrated that real estate information services can generate substantial revenues, which could ultimately be earned by the government of Ghana by direct sales of information, or licensing access to its data by commercial providers.

7.2.2 Further research

Though this thesis has achieved its main goals of creating the first robust Ghanaian residential price and rent models and a set of market indicators based upon those models, the scope of the research has inevitably been governed by the limited primary data, and the time available to explore applications of the market indicators.

The most important limitation is that the current research has covered only investments in income producing residential real estate. At the outset, it was hoped that it would also be possible to provide a similar analysis of investments in non-residential real estate, based on the much smaller but nonetheless expanding stock of office, retail and industrial space. In the event, it was quickly apparent that insufficient transactions evidence for these sectors is held by state agencies. Preliminary indicators of rents, yields and values for commercial real estate could, however, be collected by direct surveys of owners. Such measures would begin to provide a basis of comparison across types of real estate, and pave the way towards the production of fuller performance data as these markets expand.

A second area for further research is in the investigation of hedonic modelling of the residential market. Chapter 4 presents overall models, which are well specified and robust, but still limited by the set of explanatory variables available, plus the limits of time and resources available to pursue specific issues of price determination. On this point, there is no doubt that some improvements in the models could be achieved by the collection of additional primary data on attributes such as property specification (for example, air conditioning and quality of finishes) noted in the last Section.

Outside of individual property attributes, the analysis of locational influences and the segmentation of sub-markets has been conducted on the basis of a pre-existing

neighbourhood classification. Though this classification does reflect the dominant sub-division of markets, an analysis conducted with a fuller set of neighbourhood characteristics (travel times, the main employment sectors and shopping centres, the quantity and quality of major amenities such as schools and parks) would undoubtedly flesh out the picture of price determination and sub-market differentiation given here.

Additional areas for further research lie in the application of the results. The initial exploration of applications presented in Chapters 5 and 6 is not intended to be definitive. It does, however, provide pointers to useful extensions of the analysis on several topics. One issue of general interest is the modelling of residential price changes over time. The initial analysis in Chapter 5 suggests that the drivers of dollar denominated house prices is, inevitably, a complex process in an economy which has been exposed to high domestic inflation and large movements in exchange rates. There is clearly scope for further interesting research into the market dynamics of residential prices under these conditions. The basis for this type of research could be improved by surveys to determine the balance between occupiers whose incomes are denominated in US$ and Cedis, and also the balance of domestic versus overseas and expatriate investors in the market. These are points on which there is currently only anecdotal evidence. Similarly, research into residential price dynamics and issues of public policy would also be illuminated by the collection of additional information on the sources of finance, and the costs of

debt used by investors in the market. Any more formal modelling of residential prices would also be improved by the systematic collection of data on housing supply, in particular rates of new development for the formal sector, which does not currently exist.

A fourth area for further research is associated with issues of land management and public policy in Ghana. The hedonic modelling results in Chapter 4 indicate the distinctions between types of land ownership (fully titled state ownership versus customary owners) and security of ground leases are not important influences on residential prices. Taken at face value, this in turn indicates that the problems of land titling widely discussed in the literature are not a significant factor in the market. Additional research, however, is required to develop a full understanding of this topic, and to determine whether a shortage of land with clear title is or is not a constraint on the growth of the formal residential stock. It may be the case, for example, that developers only build on land in customary ownership where titles are relatively well-secured and undisputed.

A second public policy issue for further studies is the relationship between interventions in the market by state agencies and the operation of the private rented sector. In accord with some previous studies, the results in Chapter 5 indicate a differentiation in yields across sub-markets which may be due to varying degrees of state provision of housing at subsidised rents. Again further research is needed to

clarify the scale of housing supplied at sub-market rents, and the impact of that factor on the behaviour of private sector renters and landlords.

This list of potential extensions or refinements of the current research is not intended to be exhaustive. It is hoped that this thesis sufficiently demonstrates the general point that the creation and maintenance of credible measures of real estate investment performance is a critical foundation for research of value to academics, to policy makers, and to all participants in the market.

7.3 Concluding remarks

This research was motivated by the author's own experience working as a valuer for the Ghana Land Valuation Board and a belief that improved information has a critical role to play in the maturing of real estate investment markets in Ghana and similar economies. That belief has been reinforced by the examination of previous research which both emphasise the importance of real estate in the economy, and the evident lack of information on emerging formal real estate markets in Africa.

It is common when conducting original research that the extent of the work required was underestimated, and some of the initial vision of the scope of the study had to be sacrificed to fulfilling the core objectives. Thus, it was hoped at the outset that the analysis could also cover non-residential real estate, and explore more fully

applications of the results to, for example, the understanding of market dynamics. These extended ambitions, however, were overtaken by the time and sources needed to extract primary information from several separate sets of archives, and to screen the raw data for duplications, errors and omissions. Nonetheless, the core tasks of the current research have been completed, in the form of hedonic models which provide a good level of explanation of residential price and rental variations in a form consistent with previous research on many residential markets. It has also been demonstrated that market indices derived from these models give a plausible account of trends over time, and suggest that investor returns have been achieved which are consistent with fundamental theory on the behaviour of real estate markets, and in line with the results typically found in other countries.

In conclusion, this research claims to have demonstrated the feasibility and the value of producing measures of real estate investment performance sufficiently to encourage the maintenance, extension and applications of the methodology in Ghana as suggested in this Chapter. This claim reinforces that the example of Ghana can also be transferred to other African countries.

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Appendix 1.1: Ghana macroeconomic indicators (1992 – 2007)

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Real GDP Growth (%)	6.2	4.9	3.3	4	4.6	4.2	4.7	4.4	3.7	4.2	4.5	5.2	5.8	5.8	6.2	6.3
GDP per capita (US$)	449	387	344	398	416	404	427	430	270	281	318	384	436	513	594	690
Inflation (%)	10.0	25.0	24.9	59.5	46.6	27.9	19.2	12.4	25.2	32.9	14.8	26.7	12.6	15.1	10.9	10.5
Cedi:Dollar exchange rate	437	649	957	1,200	1,637	2,050	2,314	2,647	5,456	7,171	7,932	8,697	9,005	9,049	9,176	9,358
Interest rate for construction (%)	26.1	33.3	32.7	36.8	42.6	44.8	42.8	35.6	42.4	46.8	36.4	35	30.33	28	25.4	24.3
Yield on Treasury Bills (%)	25.4	32	29.5	35.9	41.7	42.8	34.3	26.4	32.4	37.1	23.6	26.8	16.6	14.8	9.9	9.7
Prime Bank rate (%)	30	35	33	41.5	45	45	43.2	28.3	27	27	26.6	18.7	17.1	11.4	14.3	12.7
Base rate (%)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	29.8	36.4	42.6	30.3	30.3	26.6	23.8	21.2	19.4
Ghana Stock Exchange Share Price Index		133	298	317	361	512	868	736	858	956	1395	3553	6799	4769	5006	6600
Databank Share Price Index	87	188	409	428	471	663	1,121	951	1,097	1,222	1,784	4,578	8,755	6,553	6,875	9,100
Population (Million)	15.0	15.4	15.8	16.2	16.6	17.1	17.5	18.0	18.4	18.9	19.4	19.9	20.4	20.9	21.4	22.0

Sources: IMF, Statistics Ghana, Bank of Ghana

Appendix 4.1: P.D. Form in Section 13, Stamp Act, 2005 (Act 689)[3]

Stamp Duty Act, 2005

LVB No:.....

DOCUMENT No.....

PARTICULARS OF LAND TRANSACTIONS AS REQUIRED UNDER SECTION 13

(This form duly completed must accompany each instrument relating to the creation or transfer of any estate or interest in land submitted to the Commissioner of Stamps for assessment of the Stamp Duty payable thereon)

Name of Instrument (*a*).....

Date of Instrument.....

Name and address of Grantor or Transferor.....

.....

.....

Name and address of Grantee or Transferee.....

.....

.....

Short description and situation of the Land (*b*).....

.....

.....

Area of the Land.....

.....

Estate or Interest Created or Transferred (*c*).....

.....

Consideration Fee.....

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[3] Copied from Schedule 2 of the Stamp Act, 2005 (Act 689).

(a) State whether the instrument is a Conveyance, Deed of Gift, Mortgage, Lease, Concession, Assignment, etc.

(b) State whether any buildings are erected on the land. The plan to be attached to this form must contain sufficient detail to enable the boundaries of the land to be identified on the Government Survey Maps, and the scale to which the plan is drawn.

(c) When the transaction is the Assignment or grant of a Lease or the transfer of an estate or interest subject to a lease, state the date of the commencement of the term, the length or nature of the term and the rent reserved.

Consideration: (i) Capital Payment.....

(ii) Any Mortgage debt covenant to be paid.....

.....

(iii) Any Mortgage debt leased.....

.....

.....

(iv) Any term of years surrendered.....

.....

(v) Terms and conditions of renewal (for leases only).....

.....

Signature of Grantee/Transferee or Agent.....

Address.....

.....

.....

Appendix 4.2: Conventional residential tenancy agreement

TENANCY AGREEMENT

THIS TENANCY AGREEMENT is made this day of Two Thousand and Eight (2008) BETWEEN .....whose postal address is Post Office Box Accra, in the Republic of Ghana (hereinafter called "THE LANDLORD" which expression shall where the context so requires or admits include his successors and assigns) of the one part AND ..... (hereinafter called "THE TENANT" which expression shall where the context so admits or requires include her successors and assigns) of the other part.

WHEREBY IT IS AGREED as follows:

1 The Landlord lets and the Tenant takes from the.....day of ..... Two Thousand and Eight (2008) ALL that premises (one storey 3 bedroom (say 350 sq m, plot size=0.45 acres) situate at Obenesu Crescent, East Cantonments Residential Area in the city of Accra and known as PLOT NO..... (hereinafter referred to as the PREMISES) TOGETHER with the rights easements and appurtenances thereto belonging or usually held or occupied therewith or reputed to belong thereto.

a) THE TENANCY shall be for a term of TWO (2) years commencing from the 1st day of .....Two Thousand and Eight (2008) to the ..... (2009) for a monthly RENT OF TWO THOUSAND FOUR HUNDRED UNITED STATES OF AMERICA DOLLARS (US$2,400.00).

b) THE RENT for the period..... to .....shall be the Cedi Equivalent of TWENTY EIGHT THOUSAND EIGHT HUNDRED UNITED STATES OF AMERICA DOLLARS (US$28,800.00) PER YEAR at the prevailing

INTER-BANK RATE (on the date of actual payment) and thereafter payable yearly in advance.

c) THE Tenant must return the inventory of items supplied by the Landlord such as the keys and accessories in the building at the termination of this agreement in good and or in working condition as will be received and confirmed by the Tenant as same, or be replaced if unable to do so. After handover of ALL the above, the Tenant shall be responsible for the Maintenance and Repairs during the term of this agreement.

2. THE TENANT HEREBY COVENANTS WITH THE LANDLORD as follows:

a. To pay the said rent at the time and in the manner hereinbefore expressed without prior demand by the Landlord and without any deductions whatsoever.

b. To pay for and discharge all bills in respect of water, electricity and telephone services consumed on the demised premises.

c. To keep the interior of the premises and the windows and door locks and all interior fittings fixtures and conveniences belonging thereto in good and tenantable decorative repair (reasonable wear and tear and damage by accidental fire storm tempest and earthquake excepted); and to bear the expenses thereof;

e. To maintain and provide periodic servicing of installed air conditioners.

f. Not without the previous written consent of the Landlord to make or suffer to be made any alteration or improvements in the demised premises or addition thereto.

g. Not to allow in or about the demised premises anything which may be or become insanitary or a danger to health and in particular not to allow any permanent stagnant water or other breeding place for mosquitoes in or on the premises or any part thereof.

h. To permit the Landlord and/or its agents, surveyors and others authorized by them respectively at all reasonable times to enter upon and view the state and condition of the demised premises and to carry out its obligations hereunder.

i. Not to store or bring upon the demised premises any articles of a specially combustible inflammable or dangerous nature.

j. Not to do or suffer on the demised premises or any part thereof any act matter or thing whatsoever which may be or tend to the annoyance nuisance damage or disturbance of the Landlord or other Tenants or occupiers of any adjoining or neighbouring property.

k. To use the premises hereby for RESIDENTIAL PURPOSES ONLY.

l. Not without the prior consent in writing of the Landlord to assign, underlet, mortgage or otherwise part with possession of the demised premises or any part thereof.

2. To yield up the demised premises with the fixtures and fittings and additions thereto (Tenant's fixtures only excepted) at the expiration or sooner determination of the said term in tenantable repair and condition in accordance with the several covenants hereinbefore contained.

3. THE LANDLORD HEREBY COVENANTS WITH THE TENANT as follows:

a. To pay all rates taxes assessments and other outgoings that shall become payable for or in respect of the said premises except those payable by the Tenant under Clause 2 hereof.

b. To keep the main structure including the external walls and the main timbers of the premises in good and tenantable state of repair and condition including painting of the external areas of the premises at least once in every three years.

c. The Tenant paying the rent hereby reserved and observing and performing the several covenants and stipulations herein on its part contained shall peaceably hold and enjoy the demised premises during the said term without any disturbance or interruptions by the Landlord or its successors in title and assigns or any person or persons claiming through or under or in trust for the Landlord.

4. PROVIDED ALWAYS AND IT IS HEREBY AGREED as follows:

a. If the rent hereby reserved or any part thereof shall remain unpaid for three calendar months after becoming due and payable whether legally demanded or not or if any of the covenants agreements conditions and stipulations herein contained shall on the part of the Tenant expressed to be observed or performed after one calendar month's notice shall have been served upon the Tenant requiring the observance or performance THEN it shall be lawful for the Landlord or any person or persons duly authorised by the landlord in that behalf or anytime thereafter to re-enter upon the said premises or any part thereof in the name of the whole and thereupon this tenancy shall absolutely determine BUT without prejudice to any right of action of the Landlord in respect of any breach of the Tenant's covenants herein contained.

b. In the event of destruction or damage to the Premises or any part thereof by fire, tempest/tornado or earth quake or through no fault of the tenant or occupiers so as to become
unfit for habitation and use then the Landlord shall allow the Tenant an abatement of all the rent or a fair and just proportion thereof according to the nature and extent of the destruction or damage sustained until the premises or the part thereof so destroyed shall have been rebuilt or reinstated and made fit for habitation and use.

c. That the Landlord may upon the written request of the Tenant made not less than Three (3) calendar months prior to the expiry of the term hereby created and if there shall not at the time be any existing breach or non-observance of any of the covenants on the part of the Tenant herein before contained at the expense of the Tenant grant to the Tenant a further term and on such conditions and at such rent as the parties may agree upon.

d. The lease shall be determined by either party giving three (3) months notice to that effect.

e. In the event of an emergency requiring the tenant to leave the house prior to full completion of the tenancy, a period of three months notice will serve to release the tenant from the contract. The amount of rent paid will be calculated on a proportion basis up to the date the notice expires and the landlord shall refund the difference in US Dollars to the tenant.

f. In the event of an earlier determination of the tenancy by the Tenant upon the 3 months required notice, the Landlord agrees to refund the balance of the rent advance paid to the Tenant provided that the Landlord secures a tenant at the end of the three (3) months notice.

g. No variations or amendments of this lease shall be valid unless committed to writing and signed by or on behalf of the parties.

h. If any dispute shall arise as to the terms of this agreement same shall be solved through consultations based on mutual faith and goodwill between the two parties. Any dispute not solved between both parties and arising from this agreement shall be referred to be settled by Arbitration under the Arbitration Act 1961 (Act 38) or any third party agreed upon by both Landlord and Tenant.

i. Any notice required to be served under this agreement shall be sufficiently served by personal delivery on either party or by registered post to the party's address herein stated.

IN WITNESS WHEREOF the Parties herein have hereunto set their Seals the day and year first above written.

Signed, Sealed and Delivered by the within-named
LANDLORD

In the presence of:-

Signed, Sealed and Delivered by the within-named
TENANT

In the presence of:-
WITNESS:
NAME:
ADDRESS:
SIGNATURE/DATE:

Appendix 4.3: Conventional residential management agreement

THIS AGREEMENT made the 13th day of July Two Thousand and Seven (2007) **BETWEEN** .....a Real Estate Management Company incorporated under the laws of the Republic of Ghana and having its office in Accra and whose postal address is (hereinafter referred to as the '' MANAGEMENT AGENT'') of the one part

AND .....whose postal address is (hereinafter referred to as '' THE CLIENT'').

Whereas the Client is desirous of appointing the Management Agent to let and manage the Client's property located at and known as No.

And whereas the Client has agreed with the Management Agent to appoint the Management Agent in the aforesaid areas of practice.

NOW THIS AGREEMENT WITNESSETH as follows:-

The Client hereby appoints the Management Agent as its Consultant and the Management Agent hereby accepts same from the .....until this agreement is terminated as hereinafter provided.

The Management Agent shall provide the following services in respect of the Client's aforesaid properties:

- Management of the Properties
- Negotiating and letting of the subject properties
- Any other duties that may be directed by the Client.

3. The Management Agent's remuneration shall be as follows:-

Letting of property – 10% on one year's rent accruing to the property let.

Property Management Services for property let: 7% of annual rent

Other Services: this shall be negotiated as and when jobs are assigned to the Management Agent.

Any alteration of or amendment to this Agreement shall not be valid unless agreed in writing by both parties.

The validity, construction and performance to this Agreement shall be governed by the laws of the Republic of Ghana.

Any dispute or differences between the parties hereto shall be referred to a single Arbitrator if the parties can agree on one, or failing agreement to two arbitrators, one to be appointed by each party and in either case subject to the provisions of the Arbitration Act 1961 (Act 38).

Either party may terminate this agreement by notice in writing to the other party stating its intention to determine same at the expiration of six months from the date of such notice. Besides the Client reserves the right to determine this agreement forthwith in the event of any neglect of duty on the part of the Management Agent. Upon the determination of this agreement and payment of a proper proportion of the said fee up to such determination and payment of all disbursements and out-of-pocket expenses incurred up to the date thereof the Management Agent shall deliver all deeds documents and papers in its possession relating to the business of the Client and shall continue to afford the Client all reasonable assistance in concluding pending matters at the date of such determination without making any charge therefore.

Any notice to be served on the parties herein shall be sufficiently served or delivered if sent by registered post, fax or e-mail to the last known place of business in Ghana or served on any of the parties' offices or authorised agents.

The terms of this Agreement shall extend to and be binding upon the parties hereto and their successors in office.

IN WITNESS WHEREOF the within-named parties have signed sealed and delivered the day and year first above written.

THE COMMON SEAL OF
was affixed to this Deed and same was delivered
in the presence of:-

NAME: NAME:

STATUS: DIRECTOR STATUS: COMPANY SECRETARY

SIGNATURE: SIGNATURE:

ADDRESS: ADDRESS:

SIGNED AND DELIVERED BY THE WITHIN
NAMED
in the presence of:-

NAME:

ADDRESS:

SGNATURE: DATE:

Appendix 4.4: Fields and Coding for Excel Data Collection Template

Fields	Codes
Location Classification	Accra Residential Neighbourhood Groups 1 to 4, Tema Neighbourhoods 5
Number of Storeys	From 1 to 3 (flats excluded)
Number of Bedrooms	Numeric, From 1 to 5
Garage/Outhouse	Neither 1, Garage Only 2, Both 3
Detached/Semi-Detached	Detached 1, Semi-Detached 2
Security Of Tenure	State as Freehold 1, Customary Freehold 2
Landscaping	Not Known 0, Good Quality 1, Average 2, Below Average 3
Gross Internal Area	Numeric, Square Metres
Plot Size	Numeric, Square Metres
Date Of Sale	Date, Month / Year
Dollar Price/Rent	Numeric, US$
Cedi Price/Rent	Numeric, Cedis (converted at average Cedi:$ rate for year)
Unexpired Term	Numeric, Years
Dollar Price/Rent Pms	Numeric, US$ (Calculated from Price and Area)
Cedi Price/Rent Pms	Numeric, Cedis (Calculated from Price and Area)
Remarks	

Appendix 4.5: Definition of hedonic variables

Variable	Definition
Dependent Variable	
Price	Natural logarithm of sale price of unfurnished real estate
Independent Variables	
Location (submarket) and amenities	Dummy variable for quality of neighbourhood: of accessibility, availability of utilities
Storey	Dummy variable for whether real estate has single, two, three or more storey
Bedrooms	Natural logarithm of number of bedroom(s)
Garage	Dummy variable indicating whether the real estate has a garage
Outhouse	Dummy variable indicating whether the real estate has an outhouse
Garage/outhouse	Dummy variable indicating whether the real estate has both garage and outhouse
Detached	Dummy variable for detached real estate
Semi-detached	Dummy variable for semi-detached real estate
State Freehold	Dummy variable indicating whether the paramount interest in the subject land is held by the government or a stool (customary holder)
Landscaping	Dummy variable for quality of landscaping relative to other properties in the vicinity
Gross internal floor area	Natural logarithm of gross internal floor area in square metres
Plot size	Natural logarithm of plot size in square metres
Tenure (Unexpired lease term)	Natural logarithm of unexpired lease term

Appendix 4.6: Residential submarket or location classification

Market Classification	Neighbourhood Characteristics
Upmarket comprising: Airport Residential Cantonments East Legon Labone Ridge Roman Ridge Switchback Road	Low density buildings Predominantly of detached types Plot sizes of no less than 600 squared metres Spacious environment free from intrusion by incompatible land uses Community facilities such as schools, clinics and corner shops adequately provided Roads and concrete drains; and public utility services adequately provided State owns freehold interest in land
Gated Market comprising: East Airport (Golden gate) East Legon Extension (Trasacco Villas)	Gated community with high density buildings Spacious environment free from intrusion by incompatible land uses Access roads and concrete drains available; and public utility services adequately provided Customary freeholders in land
Emerging Upmarket comprising: Abelemkpe Dzorwulo East Legon Extension North Legon West Legon	Predominantly detached with varied plot sizes Spacious environment, no intrusion by incompatible land uses Adequate community facilities such as schools, clinics and corner shops adequately provided Surfaced roads and concrete drains with basic public utility services Both state and customary freeholds in land
Middle-income market comprising: Achimota, Adenta Baatsona Dansoman Dome Okpoigono Kaneshie Teshie/Nungua Estates	Variety of buildings at net site densities of between 15 and 45 units per hectare A mixture of house types (detached, semi- detached, etc) Small scale retail development in selected areas Adequate level of infrastructural and social amenities State and customary freeholders

Market Classification	Neighbourhood Characteristics
Tema comprising: Communities 4, 5, 18 – 22 Sakumono	A mixture of house types (detached, semi- detached, etc) Small scale retail development permitted in selected areas Adequate infrastructural and social amenities State freehold in Tema Township, Customary freehold elsewhere

Source: Ministry of Local Government (1990).

Appendix 4.7: Descriptive statistics for transactions price data

	Location Classification	*Number of Storeys*	*No. of Bedrooms*	*GIA*	*Plot Size*	*Price (US$)*	*Price (Cedis)*	*Unexpired Term*
Mean	4	1	3	199	695	75,039	455,963,022	79
Standard Error	0.02	0.01	0.01	2	16	1,859	16,576,152	0.27
Median	4.00	1.00	3.00	162	478	35,200	101,351,473	78.00
Mode	4.00	1.00	3.00	60	300	65,000	354,633,500	70.00
Standard Deviation	1.19	0.36	0.81	128	898	106,002	944,986,040	15.6
Sample Variance	1.4	0.13	0.66	16,305	805,990	1.12E+10	8.93E+17	243.31
Kurtosis	0.05	1.58	1.18	2	24	14	18	0.39
Skewness	-1.02	1.89	0.8	1	5	3	4	-0.61
Range	4	1	6	1,013	7,754	943,945	8.55E+09	91
Minimum	1	1	2	45	100	6,055	3,933,810	8
Maximum	5	2	8	1,058	7,854	950,000	8.55E+09	99
Sum	12158	3759	9578	646,599	2,259,754	2.44E+08	1.48E+12	257462
Count	3,250	3,250	3,250	3,250	3,250	3,250	3,250	3250

Appendix 4.8: R-squared values from Multicollinearity tests

Dependent/Explanatory Variable	GIA	No. of bedrooms	Plot size	No. of storeys
GIA		0.580	0.438	0.257
No. of bedrooms	0.580		0.292	0.198
Plot size	0.438	0.292		0.217
No. of storeys	0.257	0.198	0.217	

Appendix 4.9: Descriptive statistics for upper quartile observations

	Price	*No. of bedrooms*	*Gross Internal Area*	*Plot size*	*Tenure*	*No. of storeys*	*Garage/ Outhouse*	*Detached*	*Semi-detached*	*State security*	*Landscape Quality*
Mean	178324	4	325	1401	74	1.5	1.5	2	1.003676	1	2
Standard Error	5570	0.03	4.90	53.78	0.63	0.02	0.02	0	0.00212	0.02	0.007739 74
Median	113933	4	300	820	70	1	1	2	1	1	2
Mode	200000	3	458	930	70	1	1	2	1	1	2
Standard Deviation	159112	0.80	140.04	1536.23	17.95	0.4997	0.50023	0.1	0.060559	0.50	0.221091 09
Sample Variance	2.5E+10	0.64	19610	2359993	322.24	0.2497	0.25023	0.0	0.003667	0.25	0.048881 27
Kurtosis	3.0E+00	1.89	0.70	4.28	0.59	-1.995	-2.00	268.7	268.6544	-1.97	14.57936 01
Skewness	1.7E+00	0.76	0.78	2.24	-0.71	0.10	0.03	-16.4	16.43155	0.19	-4.067386 4
Range	918346	6	997	7649	91	1	1	1	1	1	1
Minimum	31654	2	61	205	8	1	1	1	1	1	1
Maximum	950000	8	1058	7854	99	2	2	2	2	2	2
Sum	1.5E+08	2916	265001	1143395	60279	1204	1217	1629	819	1186	1590
Count	816	816	816	816	816	816	816	816	816	816	816

Appendix 4.10: Descriptive statistics for median quartile observations

	Price	*No. of bedrooms*	*Gross Internal Area*	*Plot size*	*Tenure*	*No. of storeys*	*Garage/ Outhouse*	*Detached*	*Semi-detached*	*State security*	*Landscape Quality*
Mean	50409	3	184	522	81	1	1	2	1	1	2
Standard Error	1173	0	2	7	0	0	0	0	0	0	0
Median	32723	3	162	479	82	1	1	2	1	1	2
Mode	65000	3	120	300	70	1	1	2	1	1	2
Standard Deviation	47194	1	93	275	15	0	0	0	0	0	0
Sample Variance	2.E+09	0	8638	75516	210	0	0	0	0	0	0
Kurtosis	7	1	2	37	0	9	4	-1	-1	-1	-2
Skewness	3	1	1	4	0	3	2	-1	1	1	-1
Range	314983	4	605	3736	80	1	1	1	1	1	1
Minimum	12267	2	45	110	19	1	1	1	1	1	1
Maximum	327250	6	650	3846	99	2	2	2	2	2	2
Sum	8.E+07	4772	3.E+05	8.E+05	1.E+05	1737	1803	2757	2097	2102	2670
Count	1618	1618	1618	1618	1618	1618	1618	1618	1618	1618	1618

Appendix 4.11: Descriptive statistics for lower quartile observations

	Price	*No. of bedrooms*	*Gross Internal Area*	*Plot size*	*Tenure*	*No. of storeys*	*Garage/ Outhouse*	*Detached*	*Semi-detached*	*State security*	*Landscape Quality*
Mean	20590	2	102	333	82	1	1	1	2	1	1
Standard Error	501	0	2	4	0	0	0	0	0	0	0
Median	16091	2	87	300	89	1	1	1	2	1	1
Mode	15000	2	60	300	70	1	1	1	2	1	1
Standard Deviation	14322	0	51	115	14	0	0	0	0	0	0
Sample Variance	2.E+08	0	2586	1.E+04	191	0	0	0	0	0	0
Kurtosis	7	1	7	2	-2	159	54	6	6	-1	-2
Skewness	3	1	2	1	0	13	7	3	-3	1	1
Range	79595	3	306	750	39	1	1	1	1	1	1
Minimum	6055	2	56	100	60	1	1	1	1	1	1
Maximum	85650	5	362	850	99	2	2	2	2	2	2
Sum	2.E+07	2.E+03	8.E+04	3.E+05	7.E+04	821	830	894	2.E+03	1050	1117
Count	816	816	816	816	816	816	816	816	816	816	816

Appendix 5.1: Descriptive Statistics for aggregate residential rental market

	Classification	*Number of Storeys*	*No. of Bedrooms*	*Garage/Outhouse*	*Detached/ Semi-detached*	*Security of Tenure*	*Landscape Quality*	*Gross Internal Area*	*Plot Size*	*Price dollars*	*Unexpired Term*	*Annual Rental Value*
Mean	3	1	3	1	1	2	1	212	986	113484	74	10007
Standard Error	0.04	0.01	0.03	0.04	0.01	0.01	0.02	3.73	38.80	3918.79	0.48	372.07
Median	4	1	3	1	1	2	1	190	538.50	63425	70	4505
Mode	4	1	3	0	1	2	1	60	930	300000	70	1000
Standard Deviation	1.41	0.43	0.88	1.22	0.45	0.48	0.60	125.35	1304.33	131732	16.10	12507.16
Sample Variance	1.99	0.19	0.77	1.50	0.20	0.23	0.36	15713.79	1701270	1.7E+10	259.13	1.56E+08
Kurtosis	-1.20	1.38	1.38	-1.22	-1.03	-1.73	1.65	1.96	9.12	4.9E+00	0.27	3.85E+00
Skewness	-0.44	1.52	0.53	0.64	0.99	-0.52	1.67	1.31	3.04	2.1E+00	-0.45	1.96E+00
Range	4	3	7	3	1	1.1	2	717	7754	847099	91	73550
Minimum	1	1	1	0	1	1	1	45	100	7901	8	450
Maximum	5	4	8	3	2	2.1	3	762	7854	855000	99	74000
Sum	3788	1389	3435	1259	1445	1837	1496	239115	1113625	1.3E+08	84101	11308390
Count	1130	1130	1130	1130	1130	1130	1130	1130	1130	1130	1129	1130

Appendix 5.2: Descriptive Statistics for Upmarket Location

	Number of Storeys	*No. of Bedrooms*	*Garage/ Outhouse*	*Detached/ Semi-detached*	*Security of Tenure*	*Landscape Quality*	*Gross Internal Area*	*Plot Size*	*Price dollars*	*Unexpired Term*	*Annual Rental Value*
Mean	1.59	3	2	1	1	1	309	3173	281944	60	27492
Standard Error	0.04	0.06	0.07	0	0	0.01	7.013	161.37	10343	1.50	960.08
Median	2	3	3	1	1	1	295	3500	280000	55	28680
Mode	2	3	3	1	1	1	285	775	300000	42	30000
Standard Deviation	0.52	0.82	0.88	0	0	0.17	92.24	2122.50	136044	19.75	12628
Sample Variance	0.27	0.67	0.77	0	0	0.03	8508	4505007	18508011 658	390.07	15946296 5
Kurtosis	-1.40	1.14	0.43			30.54	2.017	-1.03	1.25	-1.10	-0.30
Skewness	-0.11	0.37	-1.31			5.67	0.978	0.27	0.77	0.18	0.38
Range	2	5	3	0	0	1	587	7649	806875	87	59480
Minimum	1	1	0	1	1	1	63	205	48125	8	5020
Maximum	3	6	3	1	1	2	650	7854	855000	95	64500
Sum	275	603	423	173	173	178	53406	548884	48776344	10340	4756070
Count	173	173	173	173	173	173	173	173	173	173	173

Appendix 5.3: Descriptive Statistics Gated Market Location

	Number of Storeys	*No. of Bedrooms*	*Garage/ Outhouse*	*Detached /Semi-detached*	*Security of Tenure*	*Landscape Quality*	*Gross Internal Area*	*Plot Size*	*Price dollars*	*Unexpired Term*	*Annual Rental Value*
Mean	1	3	2	1	2	1	287	804	180507	69	17340
Standard Error	0.03	0.05	0.09	0.02	0	0.03	10.34	19.22	11252.05	0.66	996.12
Median	1	3	1	1	2	1	248	833.5	122525	67	13050
Mode	1	3	3	1	2	1	220	930	105500	70	12000
Standard Deviation	0.49	0.76	1.27	0.23	0	0.45	145.56	270.49	158330	9.26	14016.62
Sample Variance	0.24	0.57	1.60	0.05	0	0.20	21186.83	73166.25	2.5E+10	85.75	1.96E+08
Kurtosis	-1.79	0.70	-1.69	13.43		11.67	0.83	1.03	3.2E+00	2.97	3.37
Skewness	0.48	-0.36	-0.10	3.91		3.58	1.04	-0.41	1.8E+00	1.98	1.75
Range	1	4	3	1	0	2	717	1300	777875	38	73100
Minimum	1	1	0	1	2	1	45	100	14125	60	900
Maximum	2	5	3	2	2	3	762	1400	792000	98	74000
Sum	274	681	331	209	396	223	56837	159147.5	3.6E+07	13748	3433270
Count	198	198	198	198	198	198	198	198	198	198	198

Appendix 5.4: Descriptive Statistics Emerging Upmarket Location

	Number of Storeys	*No. of Bedrooms*	*Garage/ Outhouse*	*Detached/ Semi-detached*	*Security of Tenure*	*Landscape Quality*	*Gross Internal Area*	*Plot Size*	*Price dollars*	*Unexpired Term*	*Annual Rental Value*
Mean	1	3	1	1	2	1	226	668	96715.4	88	9753
Standard Error	0.05	0.11	0.12	0.04	0.04	0.06	15.01	80.75	11003.6	1.01	998.4
Median	1	3	1	1	2	1	193	508	55714.4	91	6000
Mode	1	4	0	1	2	1	60	490	65000	95	4000
Standard Deviation	0.45	1.12	1.19	0.40	0.36	0.56	147.83	795.26	108373	9.99	9832.9
Sample Variance	0.20	1.25	1.42	0.16	0.13	0.31	21854	632442	1.2E+10	99.85	96686341
Kurtosis	-1.01	0.74	-1.06	0.43	1.80	1.05	0.39	70.12	10.2882	0.97	9.6
Skewness	1.00	0.62	0.70	1.56	-1.94	1.40	1.04	7.80	2.89061	-1.23	2.7
Range	1	6	3	1	1.1	2	590	7620	598460	43	58600
Minimum	1	1	0	1	1	1	60	215	14766	56	1400
Maximum	2	7	3	2	2.1	3	650	7835	613226	99	60000
Sum	124	314	109	116	179.1	130	21904	64760	9381393	8496	946003
Count	97	97	97	97	97	97	97	97	97	97	97

Appendix 5.5: Descriptive Statistics for Middle Income Location

	No of Storeys	*No. of Bedrooms*	*Garage/ Outhouse*	*Detached /Semi-detached*	*Security of Tenure*	*Landscape Quality*	*Gross Internal Area*	*Plot Size*	*Price dollars*	*Unexpired Term*	*Annual Rental Value*
Mean	1	3	1	1	2	2	158	491	52691.9	84	3407
Standard Error	0.01	0.04	0.1	0.03	0.015511	0.04	4.67	16.42	2902.26	0.67	187.5439
Median	1	3	0.0	1	2	1	133	417	30038.6	90	2000
Mode	1	3	0.0	1	2	1	60	300	63000	96	1000
Standard Deviation	0.23	0.79	1.009539	0.4999691	0.303169	0.69	91.19	320.9	56724.1	13.101260 1	3666
Sample Variance	0.05	0.63	1.01917	0.2499691	0.091912	0.48	8315.4	1E+05	3.2E+09	171.64301	13435977
Kurtosis	13.44	5.15	0.80936	-1.9994141	4.989306	-0.28	6.82	74.08	11.8664	-0.843432	12
Skewness	3.92	1.06	1.430375	0.11	-2.63879	1.00	2.11	6.49	2.80577	-0.7480162	3
Range	1	7	3	1	1	2	655	4456	454099	54	29650
Minimum	1	1	0	1	1	1	60	189	7901	45	450
Maximum	2	8	3	2	2	3	715	4645	462000	99	30100
Sum	403	1065	262	563	725	577	60310	2E+05	2E+07	32058	1301569
Count	382	382	382	382	382	382	382	382	382	381	382

Appendix 5.6: Descriptive Statistics for Tema residential market

	Number of Storeys	*No. of Bedrooms*	*Garage/ Outhouse*	*Detached/ Semi-detached*	*Security of Tenure*	*Landscape Quality*	*Gross Internal Area*	*Plot Size*	*Price dollars*	*Unexpired Term*	*Annual Rental Value*
Mean	1	3	0.48	1	1	1	167	547	50753	69	3112
Standard Error	0.02	0.05	0.05	0.028927 6	0.03	0.04	5.53	22.74	3153	0.64	182
Median	1	3	0	1	1	1	138	465.5	36634	70	2400
Mode	1	3	0	1	1	1	60	400	68000	70	3500
Standard Deviation	0.35	0.77	0.77	0.484051 9	0.46	0.62	92.57	380.57	52764.93 7	10.68	3044.575 6
Sample Variance	0.13	0.59	0.59	0.234306 2	0.21	0.38	8569.46	144832	3E+09	114.09	9269440
Kurtosis	17.14	0.75	3.83	-1.7261	-1.24	0.74	6.55	27.82	4E+01	10.34	30
Skewness	3.57	0.49	1.96	0.535051 8	0.88	1.36	2.00	4.45	5E+00	-1.26	4
Range	3	5	3	1	1	2	675	3746	541500	79	30000
Minimum	1	1	0	1	1	1	45	100	10500	19	450
Maximum	4	6	3	2	2	3	720	3846	552000	98	30450
Sum	313	772	134	384	364	388	46658.02	153121	14210956	19459	871478
Count	280	280	280	280	280	280	280	280	280	280	280

Appendix 6.1a: Residential real estate performance indicators

	Price Index – Cedis						Price pms - Cedis					
	All	Upmarket	Gated	Emerging	Middle	Tema	All	Upmarket	Gated	Emerging	Middle	Tema
1992	100	100		100	100	100	92,759	193,254		71,747	51,868	60,551
1993	144	172		322	159	121	102,606	241,721		109,977	87,615	75,693
1994	221	248	100	403	274	184	156,282	361,410	257,950	181,572	119,459	133,559
1995	253	279	145	733	304	229	141,924	368,896	283,000	214,273	126,255	137,801
1996	456	363	222	976	521	418	401,572	933,787	541,739	401,320	290,147	302,939
1997	681	429	329	1053	811	603	541,683	1,445,842	926,159	512,345	464,609	442,968
1998	823	548	375	1768	998	673	679,749	1,612,437	1,001,893	687,394	545,969	470,335
1999	1006	671	445	2216	1247	831	899,020	2,159,515	1,272,317	888,783	663,766	690,119
2000	1925	1328	961	4315	2219	1885	1,760,773	4,285,255	2,104,490	1,695,639	1,118,185	1,321,757
2001	2573	2405	1413	4766	2845	2391	3,097,562	6,909,285	2,808,948	2,506,803	1,516,562	1,580,339
2002	2912	2240	1610	4097	3515	2299	2,875,072	7,981,786	3,150,369	2,530,369	1,888,553	1,950,851
2003	3312	3886	1735	3724	4315	2281	4,609,700	10,216,038	3,724,878	2,912,578	2,280,413	2,458,496
2004	4158	5266	2078	4310	5075	4073	5,408,458	11,995,033	4,741,702	2,322,588	2,621,100	3,772,627
2005	5487	3604	2787	8554	6849	4050	5,976,300	15,307,416	5,309,428	5,305,526	4,345,711	4,089,673
2006	6685	4474	2997	13101	8493	5353	6,439,285	16,558,085	6,186,825	4,942,587	4,646,402	4,259,708
2007	7535	6139	3447	14641	9243	4830	7,005,665	12,300,758	6,930,641	7,320,001	5,152,493	4,817,067
Year	**Price Index – US Dollars**						**Price pms - Dollars**					
	All	Upmarket	Gated	Emerging	Middle	Tema	All	Upmarket	Gated	Emerging	Middle	Tema
1992	100	100		100	100	100	212.22	442.14		164.15	118.67	138.53
1993	97	116		217	107	81	158.10	372.46		169.46	135.00	116.63
1994	101	113	100	184	125	84	163.35	377.76	269.62	189.78	124.86	139.60
1995	92	102	116	267	111	83	118.23	307.31	235.76	178.50	105.18	114.80
1996	122	97	130	261	139	112	245.27	570.34	330.89	245.12	177.22	185.03
1997	145	92	154	224	173	129	264.20	705.19	451.72	249.89	226.61	216.05
1998	155	104	155	334	188	127	293.74	696.77	432.94	297.04	235.93	203.24
1999	166	111	161	366	206	137	339.60	815.74	480.61	335.73	250.73	260.69
2000	154	106	168	346	178	151	322.73	785.43	385.73	310.79	204.95	242.26
2001	157	147	188	291	173	146	431.97	963.53	391.72	349.58	211.49	220.39
2002	160	123	194	226	194	127	362.45	1,006.24	397.16	319.00	238.08	245.94
2003	166	195	191	187	217	115	530.00	1,174.60	428.27	334.88	262.19	282.67
2004	202	256	221	209	246	198	600.63	1,332.10	526.58	257.93	291.08	418.97
2005	265	174	295	413	331	196	660.45	1,691.78	586.76	586.32	480.25	451.96
2006	318	213	312	624	405	255	701.76	1,804.53	674.25	538.65	506.37	464.23
2007	352	287	352	684	432	226	748.67	1,314.53	740.65	782.26	550.63	514.78

Appendix 6.1b: Residential real estate performance indicators

	Rental pmspa – Cedis						Yields - Cedis						Nominal Total Returns -Cedis					
	All	Upmarket	Gated	Emerging	Middle	Tema	All	Upmarket	Gated	Emerging	Middle	Tema	All	Upmarket	Gated	Emerging	Middle	Tema
1992	11,214	17,117		7,149	3,729	3,894	7%	7%		8%	5%	4%						
1993	12,601	25,937		10,744	6,510	5,735	7%	8%		9%	6%	5%	47%	74%		223%	60%	22%
1994	16,148	40,494	22,853	20,016	8,893	9,032	8%	9%	9%	9%	6%	6%	56%	47%		28%	74%	54%
1995	13,984	43,480	27,025	26,078	11,032	11,183	7%	10%	9%	10%	6%	6%	18%	17%	49%	84%	13%	26%
1996	50,473	95,283	59,041	47,639	19,377	19,977	8%	9%	9%	9%	6%	5%	83%	35%	56%	37%	73%	84%
1997	69,391	128,853	84,456	62,503	29,111	24,601	8%	9%	9%	10%	6%	5%	52%	23%	51%	13%	57%	46%
1998	103,949	168,883	110,282	78,738	42,384	36,333	8%	9%	9%	9%	6%	5%	24%	33%	18%	72%	25%	14%
1999	147,057	277,321	131,335	136,186	65,173	60,379	9%	9%	9%	10%	6%	6%	27%	28%	24%	30%	27%	26%
2000	224,842	441,261	252,064	217,079	109,079	100,195	8%	9%	9%	9%	6%	6%	94%	101%	119%	97%	80%	128%
2001	404,844	703,116	321,965	305,040	127,185	115,750	8%	9%	9%	9%	6%	6%	37%	83%	50%	15%	30%	28%
2002	330,671	886,929	400,179	324,656	180,914	169,269	8%	9%	9%	9%	6%	6%	17%	-2%	18%	-7%	26%	-1%
2003	583,351	1,077,127	456,276	386,608	224,279	195,172	8%	9%	9%	10%	6%	6%	19%	77%	14%	1%	26%	4%
2004	679,833	1,300,635	568,490	339,818	279,235	251,840	8%	8%	9%	9%	6%	6%	30%	39%	26%	24%	21%	81%
2005	656,660	1,270,501	599,054	560,479	317,493	274,313	8%	9%	9%	10%	6%	6%	36%	-24%	39%	102%	38%	2%
2006	546,584	1,398,876	687,002	554,687	320,715	264,382	8%	9%	9%	10%	6%	6%	26%	31%	13%	56%	27%	35%
2007	620,110	1,091,037	667,531	584,698	282,803	253,933	8%	8%	8%	8%	5%	5%	18%	42%	21%	16%	12%	-5%
	Rental pmspa – Dollar						Yields - Dollars						Total Returns – Dollar					
	All	Upmarket	Gated	Emerging	Middle	Tema	All	Upmarket	Gated	Emerging	Middle	Tema	All	Upmarket	Gated	Emerging	Middle	Tema
1992	25.73	39.84		13.60	8.80	8.86	7%	7%		7%	5%	4%						
1993	19.71	41.89		14.66	10.59	8.98	7%	8%		8%	6%	5%	2%	20%		118%	10%	-15%
1994	45.42	43.37	24.71	18.16	9.72	9.54	8%	9%	9%	8%	6%	6%	10%	4%		-11%	21%	8%
1995	11.77	32.13	29.14	16.70	8.10	13.67	7%	9%	9%	8%	6%	8%	-2%	-2%	21%	49%	-7%	3%
1996	30.62	58.79	36.41	24.56	12.19	12.21	8%	9%	9%	8%	6%	5%	37%	4%	18%	4%	29%	37%
1997	33.55	63.60	41.92	25.87	14.80	12.00	8%	9%	9%	9%	6%	6%	24%	4%	24%	-6%	28%	19%
1998	44.62	72.35	48.07	29.65	18.95	15.73	8%	9%	9%	8%	6%	5%	12%	21%	7%	54%	12%	3%
1999	54.84	104.57	50.13	43.49	25.72	22.68	8%	10%	9%	8%	6%	6%	13%	14%	11%	15%	13%	12%
2000	41.15	81.82	46.43	33.55	20.70	18.55	8%	9%	9%	8%	6%	6%	0%	4%	12%	1%	-8%	14%
2001	56.48	98.66	45.13	37.51	18.55	16.20	8%	9%	9%	8%	6%	6%	9%	43%	19%	-7%	3%	1%
2002	41.37	109.25	49.80	35.48	23.37	21.73	8%	9%	9%	8%	6%	6%	10%	-8%	10%	-11%	17%	-8%
2003	67.08	123.98	52.71	38.76	26.82	22.00	8%	9%	9%	9%	6%	6%	10%	63%	6%	-6%	16%	-4%
2004	75.34	143.55	63.34	32.74	32.28	27.09	8%	8%	9%	8%	6%	5%	27%	35%	23%	20%	17%	75%
2005	72.36	141.03	67.21	54.29	36.71	31.39	8%	9%	9%	9%	6%	6%	36%	-24%	39%	101%	37%	2%
2006	58.07	140.79	73.84	52.76	35.91	29.78	8%	8%	9%	9%	6%	6%	25%	30%	12%	54%	25%	33%
2007	66.02	117.92	71.53	53 59	31.00	28.03	8%	8%	8%	8%	5%	5%	15%	40%	19%	14%	10%	-7%

Appendix 6.1c: Residential real estate performance indicators

	Nominal Returns Index -Cedis						Real Returns -Cedis					
	All	Upmarket	Gated	Emerging	Middle	Tema	All	Upmarket	Gated	Emerging	Middle	Tema
1992	100	100		100	100	100						
1993	147	174		323	160	122	17%	39%		158%	28%	-2%
1994	229	255	100	412	279	189	25%	17%		2%	40%	24%
1995	269	298	149	758	315	239	-26%	-27%	-7%	15%	-29%	-21%
1996	492	403	232	1038	546	438	27%	-6%	8%	-5%	20%	27%
1997	747	497	352	1175	859	640	22%	-1%	21%	-9%	26%	17%
1998	929	660	416	2021	1076	729	4%	11%	-1%	44%	5%	-4%
1999	1176	842	515	2620	1372	920	13%	13%	10%	15%	13%	12%
2000	2284	1689	1126	5172	2465	2096	55%	60%	75%	58%	44%	82%
2001	3120	3097	1687	5940	3213	2693	3%	38%	13%	-14%	-2%	-3%
2002	3665	3036	1995	5553	4050	2677	2%	-15%	3%	-19%	10%	-13%
2003	4353	5373	2268	5589	5093	2773	-6%	40%	-10%	-21%	-1%	-18%
2004	5672	7477	2850	6913	6153	5016	16%	24%	12%	10%	7%	61%
2005	7715	5709	3961	13951	8474	5140	18%	-34%	21%	75%	20%	-11%
2006	9735	7494	4484	21781	10741	6934	15%	19%	3%	42%	15%	22%
2007	11439	10670	5417	25352	12045	6555	6%	29%	9%	5%	1%	-15%
	Returns Index - Dollar						Real Returns Index -Cedis					
	All	Upmarket	Gated	Emerging	Middle	Tema	All	Upmarket	Gated	Emerging	Middle	Tema
1992	100	100		100	100	100						
1993	102	120		218	110	85	100	100		100	100	100
1994	112	125	100	195	133	91	117	139		258	128	98
1995	110	122	121	290	124	95	146	164	100	264	179	121
1996	151	128	143	301	160	130	108	120	93	305	127	96
1997	187	132	178	282	204	154	137	112	101	289	152	122
1998	209	159	191	434	229	159	167	111	122	262	192	143
1999	236	182	211	498	259	178	174	123	121	378	201	136
2000	237	189	237	502	238	202	196	140	134	436	228	153
2001	258	271	281	466	245	204	304	225	234	687	328	279
2002	283	249	309	415	286	188	312	310	263	594	321	269
2003	312	406	328	391	332	182	319	264	271	484	353	233
2004	396	549	402	470	390	318	299	369	243	384	350	191
2005	537	419	557	943	535	325	346	457	272	422	376	306
2006	669	544	623	1449	671	433	409	303	328	740	449	273
2007	772	761	740	1649	739	402	469	361	337	1049	517	334

Appendix 6.2a: Ghana Stock Exchange and Treasury Bills performance indicators

	Dividend Yields (%)	Databank Index (Price)	All Shares Index (Price)	Databank Index 1992=100	T bill rate (%)	T bill Values	T bill Index
1990		100					
1991		91					
1992	13%	87		100	25.4	1.254	100
1993	8%	188	100*	216	32	1.320	132
1994	6%	408	298	470	30	1.295	171
1995	9%	427	317	492	36	1.359	232
1996	11%	471	361	542	42	1.417	329
1997	9%	663	512	763	43	1.428	470
1998	5%	1121	868	1290	34	1.343	631
1999	6%	951	736	1095	26	1.264	797
2000	7%	1097	858	1263	32	1.324	1056
2001	6%	1222	956	1407	37	1.371	1448
2002	7%	1784	1395	2053	24	1.236	1790
2003	5%	4577	3553	5269	27	1.268	2270
2004	3%	8754	6799	10077	17	1.166	2645
2005	3%	6553	4769	7542	15	1.148	3038
2006	3%	6875	5006	7914	10	1.099	3340
2007	2%	9100	6600	10475	10	1.097	3664

*Average capitalisation for the period from 12 November 1990 to 31 December 1993

Appendix 6.2b: Ghana Stock Exchange and Treasury Bills performance indicators

	Equities Total Nominal Returns		Equities Total Real Returns	
Year/Performance Indicators	Index	T bill Total Nominal Returns Index	Index	T bill Total Real Returns Index
1992	100	100	100.00	100.00
1993	224	132	179.56	105.60
1994	502	171	321.66	109.49
1995	570	232	229.00	93.27
1996	693	329	189.73	90.14
1997	1034	470	221.47	100.62
1998	1801	631	323.60	113.36
1999	1631	797	260.72	127.44
2000	1987	1056	253.72	134.80
2001	2334	1448	224.25	139.09
2002	3569	1790	298.65	149.77
2003	9334	2270	616.50	149.90
2004	18085	2645	1060.86	155.18
2005	14022	3038	714.61	154.84
2006	15113	3340	694.52	153.51
2007	20380	3664	847.27	152.34

Source: Author's estimation

Journal Publications and Conference Papers

Refereed Journal Publications

Anim-Odame, W., T. Key, S. Stevenson (2009) Measures of Real Estate Values from Land Registration and Valuation Systems in Emerging Economies: the case of Ghana. *Journal of Real Estate Literature* (forthcoming)

Anim-Odame, W., T. Key, S. Stevenson (2009) Residential Real Estate Market Development in Ghana, *Journal of African Real Estate Research* (forthcoming)

Conference Papers

Measures of Real Estate Values from Land Registration and Valuation Systems in Emerging Economies: the case of Ghana. Paper presented at the 14th European Real Estate Society conference, Cass Business School, London, June 27-30, 2007. Accepted for the Journal of Real Estate Literature.

Residential investment and market dynamics: evidence from Ghana. Paper presented at the 24th Annual American Real Estate Society Conference, April 16-19, 2008 Florida, USA.

Residential Real Estate Market Development in Ghana. Paper presented at the 8th African Real Estate Society Conference, August 13–15, 2008, Johannesburg, South Africa. Accepted for the Journal of African Real Estate Research.