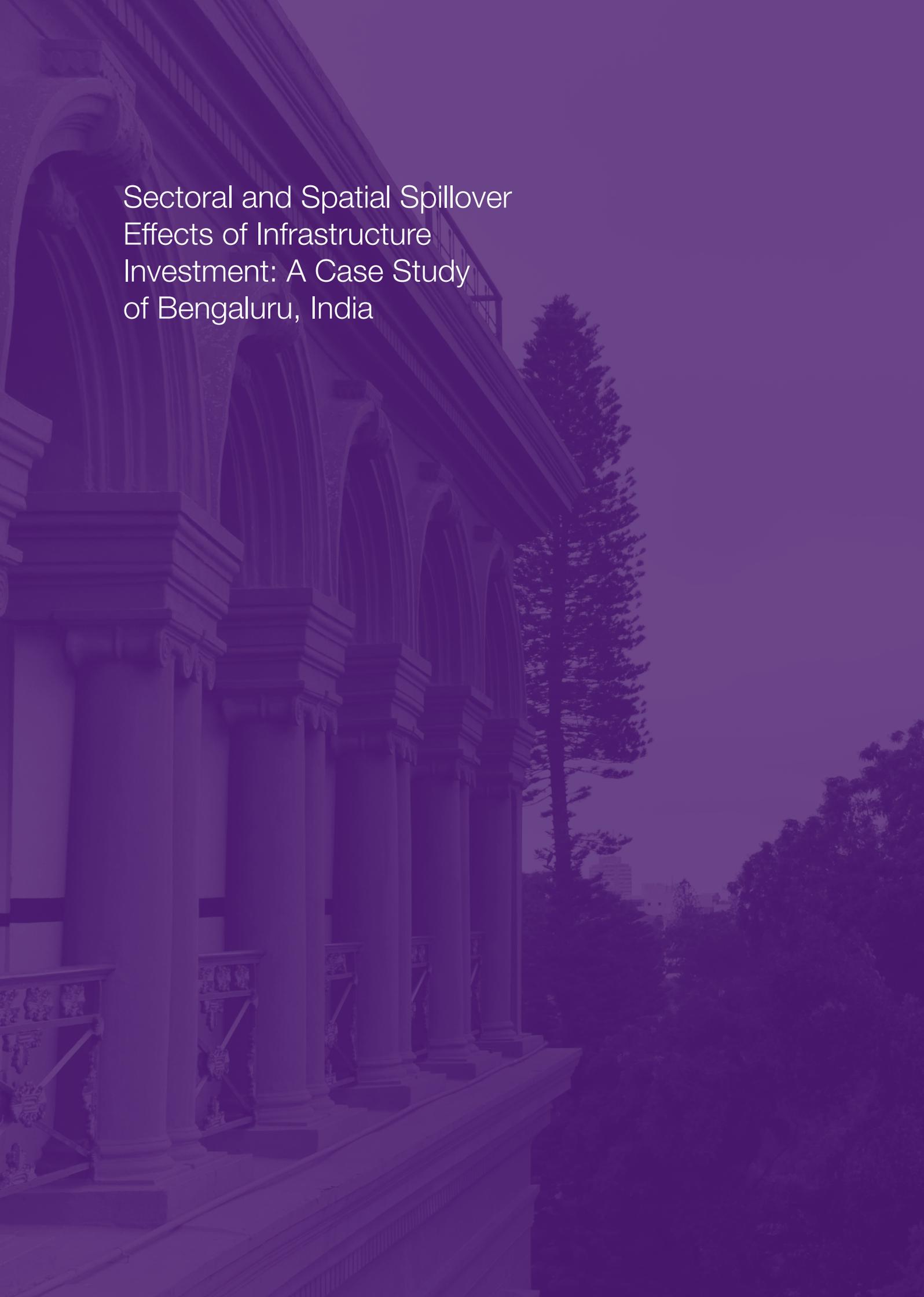


Report **July 2013**

RICS Research

Sectoral and Spatial Spillover Effects
of Infrastructure Investment:
A Case Study of Bengaluru, India





Sectoral and Spatial Spillover
Effects of Infrastructure
Investment: A Case Study
of Bengaluru, India



A report for Royal Institution of Chartered Surveyors

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Purpose and scope

According to an estimate by the Ministry of Urban Development, India, the urban population in India is expected to reach a total of 575 million by 2030 from an estimated 325 million in 2005 (UN Population Database, India Infrastructure Report 2009). In view of such a staggering size of the urban population, spending in infrastructure should be backed by comprehensive policy framework. India has experienced huge growth in infrastructure spending flowing through various channels e.g. railways, highways, power generation, airports etc. An important aspect for the economic policy formulation in a developing country is the understanding of the relative significance of the informal sector.

There are quite a few studies which explored the subject in the developed countries. However, evidences from the emerging economies are quite limited. In this study, we try to ascertain the effect of infrastructure spending on the local and regional economies, using the case of Bengaluru (Bangalore), India. Specifically, our analysis covers the following research themes. *Sectoral Spillover Effects* as infrastructure investment may stimulate investment in other sectors, for example, an improved infrastructure may provide potential stimulus to commercial and residential building activities through availability of employment, housing and improved labour mobility. The direction, size and speed of the spillover effects would depend on specific sectoral attributes and dynamics. *Spatial Spillover Effects*: The effects of infrastructure investment may follow a spatial distribution, for example, the impacts may spread over the micro-markets of a metro area and extent of such impacts would depend on local market structure, constraints and dynamics.

Methodology

Starting from a simple theoretical framework, we formulate testable hypotheses and use both primary and secondary information in our data analysis. A detailed market report, covering micro-markets in Bengaluru, has been put together to track the changes in the market structure and understand dynamics of the property sector focusing on key infrastructure projects. Moreover, an econometric model based on panel data framework has been formulated to ascertain changes in cap rate, a key property sector performance indicator.



Key findings

- Consistent with our theoretical hypotheses, we find that infrastructure projects in Bengaluru has opened up the land and helped alleviate mobility constraints for economic inputs. As a result, a number of property sector developments are being observed across the local markets. Many commercial and residential projects have been started. This has not only affected the emerging micro-markets but also influenced property sector returns in mature and established local areas.
- However, these effects are observed with significant lags. The length of lag in the market adjustment appears to depend on local market structure and severity of market constraints like presence and strength of informal sector. As expected, office and residential sectors are responding to the infrastructure investments quicker than the industrial sector. Moreover, office sector activities have spurred residential developments across many locations supporting sectoral spillover effects.
- Many locations have been experiencing consistently high absorption and substantial supply during last few years, when a number of infrastructure projects were completed in late-2000s.
- The most noticeable effect of the infrastructure investment is seen on land value across the city. Presence of speculative land holding is also evident. While investor presence is prominent, the end-user activity in commercial and especially residential sectors is driving compression in cap rate in many areas.
- Despite steady uptick in supply across all property sub-sectors, increasing demand for both commercial and residential space due to strong growth in Bengaluru IT and knowledge industry has outpaced supply and led to significant demand-supply mismatch, and thereby exerting an upward pressure on capital values.
- Further analysis of commercial property yields (capitalization rates) suggests distinct spatial spillover patterns. Locations such as Whitefield and Electronic city witnessed shortening of yields prior to 2005 due to preference of these locations by IT industry (major driver of economy in Bengaluru) over central business district and secondary business district. However, after 2005, the relocation of international airport and delays in other infrastructure development projects impacted property yields in these locations.
- Results from cap rate modeling confirm that investors have generally been 'backward looking'. With rise in rent relative to historical average, yields shorten.
- Macroeconomic factors such as general risk spread in the economy have also affected yields at the local level. A rise in risk spread increases local commercial property cap rates.

Contrary to the perception that liquidity has been driving cap rates, its effect in Bengaluru has not been found to be statistically significant. The measure of liquidity in this report is change in M2/GDP. M2/GDP is inverse of velocity of money in the economy. A rise in M2/GDP indicates a reduction in velocity and portfolio theory of money demand suggests that this will lead to rise in asset prices.

Concluding remarks

The main contribution of the project is the analysis of the relationship between infrastructure investment and built environment within an emerging economy set-up. The findings reveal importance of accessibility in property sector performance. These findings are especially important for the policy makers as this shows importance of local area heterogeneity in expected outcome of infrastructure investment. There are significant bottlenecks (such as regulatory framework, government controls and other institutional constraints) that add to lagged effects. Unless such bottlenecks are mitigated or removed the desired policy outcome may not be achieved. As a result, the growth of real estate sector is thwarted by the infrastructure bottlenecks and to some extent this is reflected in softening of commercial property cap rates in locations like Whitefield and Electronic City, which have been affected by shifting of airport to a location 50 Km away and delays in transport connectivity projects.

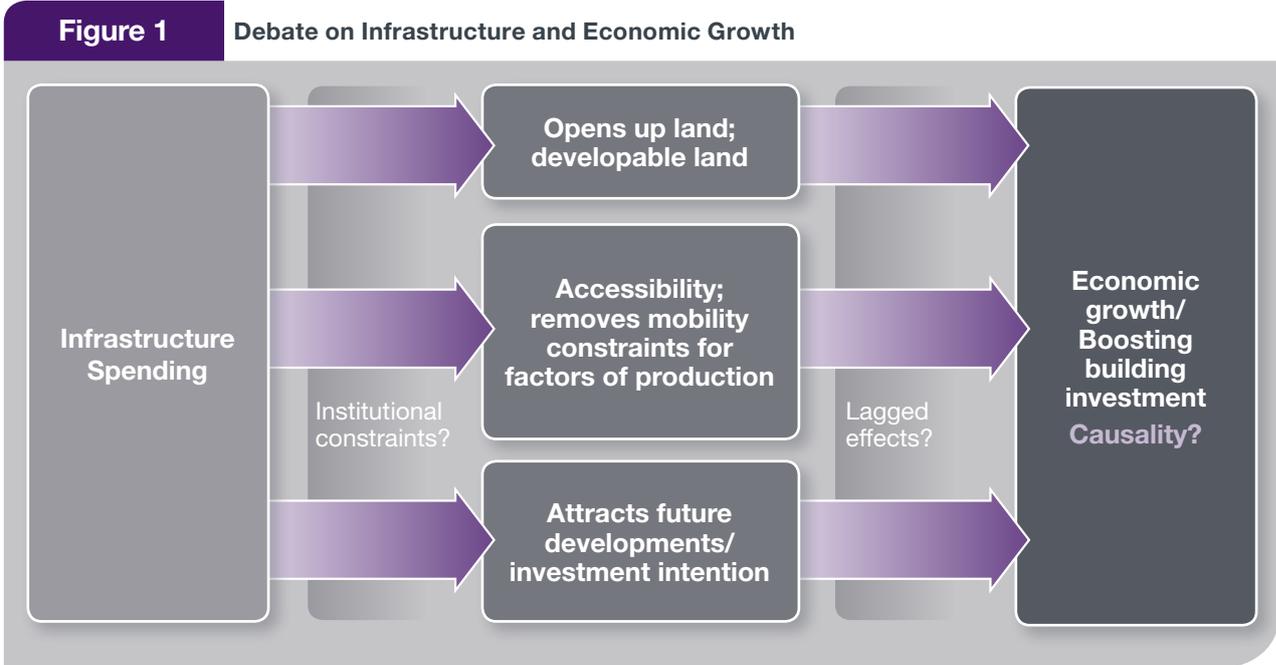
1.0 Introduction

Physical infrastructure spending in India has increased substantially over the last five years and has averaged at about 7% of GDP annually. Projections by the Planning Commission indicate that the trends will only grow in future with expected average annual spend of over 9% of GDP. Large infrastructure projects involve huge commitments of public resources and has a profound influence on urban development. Last decade saw a big push in infrastructure spending across India through various channels e.g. railways, highways, power generation, airports etc. The volume is increasing and pace is accelerating as policies across public agencies recognize the importance of a robust infrastructure in maintaining the Country's long-run growth trajectory. There is a growing awareness across the public agencies of the importance of an extensive infrastructure network in achieving the long-run growth objectives. Majumder (2007) estimated the required investment of about 6% of GDP over a period of 14 years will sustain the trend growth in India.

According to the Ministry of Urban Development, India, the urban population in India is expected to reach a staggering total of 575 million by 2030 from an estimated 325 million in 2005 (UN Population Database, India Infrastructure Report 2009). For government policy framework, it is imperative to understand the impact of these public infrastructure spending. While it is not a new academic research area, it is of utmost importance in an emerging economic environment with rapid urbanization, like in India. Though sufficient literature exists to point out

that the objective of these projects is to improve the competitiveness of national economies and attract capital investments, their impact on urban landscape, local and regional economy and society are less well understood. Evidence of the association, though mixed, has been established with both aggregated and disaggregated data from a cross-section of countries – mostly in developed countries. The conclusions are varied and depend on the geography and the time period studied.

Cities in the developing world also aspire to become a 'world city' or a 'global city' as their economies link up with the international markets. In order to attract capital, states intervene through space based interventions, usually mega infrastructure projects, in urban regions (Brenner, 1998). Brenner (1998, pp. 20) also states that "the immutable link between processes of urban-regional restructuring and state re-scaling is institutionally embodied in the growing role of various newly created para-state agencies, quangos and public-private partnerships in planning and coordinating investment within these local mega-projects (e.g. the London Docklands Development Corporation, the London Pride Partnership, London First, Frankfurt's Economic Development Corporation, the Schiphol Airport business park and the IJ-Banks waterfront development agency in Amsterdam). Some examples of such infrastructure in India are the development of new airports as in Bengaluru or express highways connecting urban locations such as the NICE corridor connecting Mysore and Bengaluru.



Source: The figure is taken from Nanda (2012)

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The use of public infrastructure spending as fiscal stimulus is based on the economic principle of demand ‘multiplier’ effect i.e. economic development can be boosted through job creation in the economy.

Public capital may also incite growth in private capital spending by removing bottlenecks and raise the economic productivity. In simple terms, infrastructure spending: (a) creates jobs; (b) removes mobility constraints and facilitates movement of factors of production i.e. capital and labor; (c) opens up land for further development; (d) boosts industrial development in small towns and villages; and (e) creates opportunities for future growth. While job creation and the effect on mobility constraints are short-run effects, effect on productivity and future development are long-term effects. However, the extent and severity of institutional constraints can influence this feedback process significantly (Nanda, 2012). Regions and countries do vary in their institutional backgrounds resulting in varying receptiveness for public spending. Regional heterogeneity in terms of institutional constraints may influence the channels through which the effect of infrastructure spending is spread and leads to economic development.

An important aspect of regional analysis of the relationship between public investment and growth is the possibility of spillover effects of investment from one geographic area to other areas and one sector to other sectors. For example, infrastructure improvement in one area may as well stimulate better accessibility and thus productivity in dynamic sense, in neighbouring areas. The contiguous areas tend to share the benefits of public investment. Also, infrastructure investment may spur activities in other sectors like property markets. The impacts may entail changes in property market values, land use and development pattern, and regulatory framework.

The most-studied aspect of infrastructure investment is the impact on productivity of economic inputs of labour and capital. McDonald and McMillen (2010) summarize the debate in three strands. First, while the magnitude of the productivity effect is small (1% increase in the stock of infrastructure may generate only about 0.04 to 0.08% increase productivity). Second, the magnitude of productivity effect varies over time as the economy matures e.g. the US has experienced downward trend from the 1970s through the 1990s and into the 2000s. Third, public infrastructure may lead to significant spillover effects on other regions, especially neighbouring regions. This is particularly the case for ‘network’ infrastructures like highways, airports, water ports etc. However, the size and direction of the spillover effect depend on various factors. Accordingly, the success of infrastructure

investment (in terms of achieving a target economic growth) is mixed. The main reasons behind the limited success are lagged effects, institutional constraints, infrastructure endowment and regional diversionary effects. This is further explored in this report.

Moreover, some argue that the role of infrastructure is changing from simply being the precondition for production and consumption to being at the very core of globalization of economic activities (Flyvbjerg et al., 2003). This is causing facilitating infrastructure to be built as megaprojects despite lack of complete understanding of their spatial spillover effects. In this context, the present paper analyses the territorial reorganization that has followed two large ‘network’ infrastructure projects (Airport development – BIAL and NICE corridor) in Bengaluru. The lens for analysis in this paper is impact on land and property market. This paper poses two strands of research questions:

Sectoral spillover effects: Impact of two infrastructure investment projects on property sectors (commercial and residential building activity), its direction, size and speed. The paper also analyses sectoral attributes and dynamics that influence these impacts.

Spatial spillover effects: Impact of two infrastructure projects on other micro-markets in Bengaluru and the extent of such impacts. The paper also discusses local market structure and dynamics that generate spatial spillover effects.

The rest of the report is organised as follows. The following section situates our research theme in the existing literature. Section 3 describes the Bengaluru market area and recent trends in key property sector parameters. Section 4 explains our empirical framework and then the section 5 describes the data and model estimation. The results and analysis are presented in section 6 along with some concluding remarks in the last section.

2.0 Literature Review



It is rather straightforward to rationalise that infrastructure investment should impact economic activity. The question then revolves around size and direction of such effects. Using aggregate time series analysis in a couple of seminal studies, Aschauer (1989a, 1989b) concludes that public building investment has statistically significant impact on economic growth. This finding is very important, especially from policy making point of view as large volume of public resources are spent on infrastructure projects. Moreover, the effect size found in early studies was quite large. Munnell (1992, p. 191) notes that these effects imply that “a 1 percent increase in the stock of public capital would increase output by .34 percent. Given the size of the public capital stock and output, these figures imply a marginal productivity of public capital of roughly 60 percent; that is, a \$1 increase in the public capital stock would raise output by \$.60.” While it generated a great deal of interest in the area, the positive link has been either supported or challenged by other subsequent studies. A number of studies have supported Aschauer’s findings.¹ The bone of contention seemed to have revolved around the data issues, econometric estimation issues and presence of other mitigating factors. Quite aptly, Munnell (1992, p. 191) suggested that “in my view, the implied impact of public infrastructure investment on private sector output emerging from the aggregate time series studies is too large to be credible.” Using US data, Lynde and Richmond (1991) find a positive marginal

product of public capital. Using Swedish data, Berndt and Hansson (1992) find that increases in public infrastructure capital, *ceteris paribus*, may reduce private sector costs. Canning and Fay (1993) present evidence from panel data analysis of 96 countries that transportation infrastructure yields “normal” rates of return in developed countries, extraordinarily high rates of return in industrializing countries, and moderate rates of return in underdeveloped countries. They conclude that the short run impact of infrastructure is very limited but the long run effect comprises higher growth rate and output.

A number of studies focused on the effect of infrastructure on productivity. Following figure (1), infrastructure investment can reduce (or remove) mobility constraints of factors of production, and thereby, it can entail positive effect on productivity of labour and capital. Using Mexican manufacturing industries as the case study, Shah (1992) provides such evidence of economic significance of public infrastructure investment on private sector profitability. Other studies have also confirmed such effects using data from different countries (e.g. Nadiri and Mamuneas, 1994 for the US manufacturing industries; Seitz, 1994 and Seitz and Licht, 1995 for the West German manufacturing industries) However, quite a few studies have also found no statistical significance for such relationships (Tatom, 1991; Evans and Karras, 1993). Quite clearly, a consensus appears to have not yet emerged in the literature using aggregate national data.

¹ See Gramlich (1994), Munnell (1992) for a survey of the literature. Also, some of the literature review discussed here draws on a more recent survey presented in Ball and Nanda (2013).



A quite natural question arises from the analysis of national aggregate data: what is the process by which investment at the national level trickles down to regional economies and spurs variation in regional economic growth? Regional analysis is fraught with an array of effects like network and spillover/leakage effects that are hard to quantify due to presence of significant unobserved heterogeneity at various geographic levels. A group of studies used regional or state level panel data to understand these relationships.² Costa et al. (1987) argue that labour and public capital are complementary inputs across US states, and that public capital exhibits diminishing returns. Using data from 28 US metropolitan areas, Duffy-Deno and Eberts (1991) find positive and statistically significant effects of public infrastructure on regional economic development. They use per capita personal income as proxy for regional economic development. The choice of proxy is important in this question as the problem of endogenous feedback may crop up frequently with such proxies. Similarly, other studies find comparable evidences (Munnell and Cook, 1990; Garcia-Milà and McGuire, 1992). However, many studies have also presented contradicting or non-supporting evidences of a positive relation. As Pereira and Andraz (2008) point out that studies controlling for state-level unobserved heterogeneity tend to find that public capital variables are not significant.³ The evidences come from a cross-section of countries: for example, Evans and Karras (1994) for US, Ezcurra et al. (2005) for Spain.

Ball and Nanda (2013) use long-term regional construction data to investigate whether increased infrastructure investment in the English regions leads to subsequent rises in housebuilding and new commercial property, using time series modeling. The results are a mixed bag and are not consistent across regions to suggest any robust conclusion about the direct effect of infrastructure on building activity, which may be due to geographical differences and to network and diversionary effects. This raises the question on the productivity effects found in many US studies. The possible explanation could lie in decentralized structure of the US political system. The study by Cadot et al. (2006) in France, which is perhaps more centralized than the US, has not found significant evidence of the productivity effects. At the same time, beyond the skepticism around the productivity effects, McDonald and Thorson (1997) argue that road construction may have significant effect on agricultural land values, probably due to heightened anticipation of conversion from agricultural use to residential development. This means, that many property sector indicators (e.g. cap rate) would reflect these effects.

The possibility of spillover effects or leakage from investment from one region to other regions is an important aspect of the regional analysis. Haughwout (1998) provides a model and presents a quantitative example showing that increases in public goods may not always result in higher equilibrium output at the regional level. Haughwout (2002) uses a sample of large U.S. cities to suggest that public capital provides significant marginal benefits and aggregate city willingness to pay for large increases in public capital is less than their cost.

Pereira and Andraz (2004, 2006) provide evidence of the significant regional spillover effect using US and Portugal data respectively. Pereira and Andraz (2008) suggest that consideration of spillover effect should be an integral part of the analysis of regional impact of public capital formation. They use US state-level annual data from 1977 to 1999 and find that public investment in highways affects private sector variables positively at the aggregate level as well as in most states. More importantly, they find that the spillover effects of public investment in highways are at least 80% of the total effects for all private sector variables and have a clear geographical pattern in that the effects are more prominent in western states and the corridor between the Great Lakes and the Gulf Coast.⁴ Studying Spanish regions, Pereira and Roca-Sagales (2002) also find considerable spillover effects. However, the extent of effect may crucially depend on infrastructure endowment of the regions. Shirley and Winston (2004) show that the rate of return from highway infrastructure spending decreased over time in the US – from about 17-25% in 1970s to 4.9-7% in 1980s and to about 1% in 1990s. As McDonald and McMillen (2010) comment that this reduction could be attributed to the increasing stock of infrastructure i.e. diminishing marginal returns. Therefore, positive feedback effect of infrastructure spending may not be guaranteed across regions. However, in a developing country, the positive effect can be achieved.

A number of studies have explored the productivity effect of airports – another significant type of ‘network’ infrastructure. Generally, these studies find significant positive effects. Cohen and Morrison Paul (2003) find significant cost-saving effect of airport investments in states with large airport hubs e.g. O’Hare Airport in Chicago. They estimate that, on average, a 1% increase in airport infrastructure stocks in a state with at least one large airport hub corresponds to a 0.113% fall in manufacturing costs within that state. These savings could be attributed to increased effectiveness (marginal products) of non-production workers, production workers and materials, from the enhanced traffic flow and reliability of the transport network. Moreover, they also find that in large hub states, airport expansion in linked states appears to have a comparable cost impact on manufacturing firms to own-state airport investment. For states without hubs, own-state airport investment is also cost saving, though smaller than hub states, primarily due to enhanced business travel for non-production workers.

The relationship between the infrastructure investment and the property sector revolves around the fact that the ‘network’ infrastructures like roadways and airports open up the land for future development. As Ball and Nanda (2013) note that the property sector perspective is based on possibility that economic activities across various sectors have to be accommodated in buildings and transmitted through the property sector. Therefore, expanded local business activity stimulated by infrastructure investment is likely to lead to more

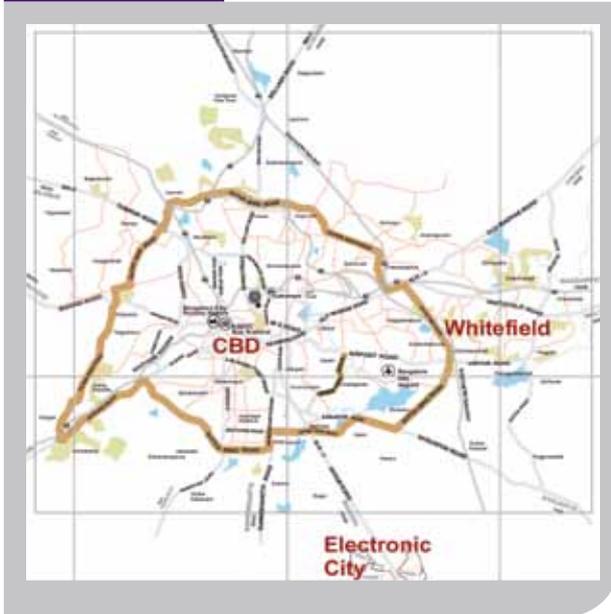
commercial building to accommodate it, especially in service-dominated economies. Related to this, the housing sector is also stimulated due to increased labour market activity and alteration in travel-to-work patterns. Interestingly, Cohen and Morrison Paul (2007) present evidence of significant positive effects of public infrastructure on US property prices and effect size depends on distance from the investment with the effect being less for more distant properties. In the UK, Adair et al. (2005) find such positive effect on prices across urban regeneration areas. The results show that rental growth was similar in regeneration locations compared to the prime market. However, they find a major yield shift for property in regeneration areas in the short to medium term. Such pricing effect is less convincing in housing sector due to intrinsic connection with the labour market. It can be argued that housing markets could react readily because housing prices reflect the present value of the future rent increases. Haughwout (1997) present evidence that 10% increase in central city infrastructure can lead to 0.61% appreciation in suburban house values. Without considering the tax effects, it means, the cost of 10% increase in infrastructure would be approximately \$1 billion, while the increase in housing value would be approximately \$3 billion. However, Gibbons and Machin (2008) argue that the impact of transport improvements on house prices is not clear as it depends on the context and local area dynamics.

Overall, there is no denying the fact that infrastructure investment may lead to considerable economic benefits. However, extent of such benefits depends on regional dynamics, infrastructure endowment and economic contexts. Any policy analysis should consider these in evaluating impact of infrastructure investment. With these thoughts, we now turn to our case study Bengaluru, India focusing on two ‘network’ infrastructure projects (a highway project and an airport) in a developing country set-up. In the next section, we provide an account of recent market trends in Bengaluru real estate space market.

4 Also see Boarnet (1998), Holtz-Eakin and Schwartz (1995).

3.0 The Bengaluru Real Estate Space Market and Key Infrastructure Projects⁵

Figure 2 Bengaluru Metropolitan Area



Source: JLL India

Bengaluru, the capital city and the largest city of the Karnataka State is now popularly known as the 'Silicon Valley of India'. The city is now regarded as a high tech city with offices and development centres of major software companies including IBM, Hewlett-Packard, Texas Instruments, Oracle, Novell, Fujitsu, and Digital Equipment. During a short span of four to five years, Bengaluru has experienced rapid growth and international recognition in the field of information technology (IT) and software development.

The growth of information technology has attracted other Information Technology Enabled Services (ITES) and consulting companies to establish their base in the city in the past decade. Though the global slowdown of 2008 has hurt the IT exports, the successive years have recorded significant recovery in the export growth and it is expected to strengthen further. After establishing itself as an IT and Business Process Outsourcing (BPO) hub, Bengaluru has successfully attracted the Biotech industry as well. The city also attracts people from all over the world for its excellent schools and universities, such as the Indian Institute of Science, National Institute of Mental Health and Neuro-Sciences, the Indian Space Research Organization, Indian Institute of Management and Indian Institute of Aero-physics.

The demographic profile of Bengaluru has changed rapidly over the last decade due to the large in-migration of people into the city following the IT boom from various parts of the state and country, cutting across different income groups and cultural backgrounds. Bengaluru is India's fourth largest Fast Moving Consumer Goods (FMCG) and clothing and footwear market, and the third-largest hub for high net worth individuals (HNWI/ HNIs), after Mumbai and Delhi. IT professionals form about 5% of the total population of Urban Bengaluru (550,000 IT Professionals – approximately 1/3rd of total IT professionals in the Country).

Bengaluru real estate market can be divided into four main areas – Central business district (CBD); Secondary business district (SBD), Electronic city and Whitefield (see Figure 2).

Strong growth in services sector and steady increase in population has put pressure on the infrastructure in Bengaluru. As a result, a slew of infrastructure projects have been undertaken over the last decade. Especially last few years have seen completion and commencement of some major infrastructure projects. Table 1 presents a list of major completed and upcoming infrastructure projects in the city. In this study, our focus lies on two major projects – NICE-Corridor and Bengaluru International Airport (BIAL).

Table 1 Major Recently Completed and Upcoming Infrastructure Initiatives in Bengaluru

Bengaluru International Airport (BIA)	Operations of Terminal 1 (T1) commenced in May 2008. Expansion of T1 is scheduled to become operational in 2011 at an estimated cost of USD 214 million.
Elevated Expressway to Bengaluru International Airport	The 22.12 km long elevated six-lane expressway project is part of the Hyderabad-Bengaluru section under Phase VII of the National Highway Development Project. Estimated to be built at a cost of INR 680 Crores on a BOT basis, the construction is expected to be completed by 2013.
Peripheral Ring Road (PRR)	The Peripheral Ring Road project is in two phases: Phase I - 65 km stretch connecting Hosur Road and Tumkur Road running through the north-eastern quadrant of Bengaluru cutting across Bellary Road; and Phase 2: 51 km stretch connecting Hosur Road and Tumkur Road covering the south-western quadrant. Completion of the project is expected by mid-2013.
Metro-Rail Corridor	East-West Corridor of 18.1 km in length starting at Byappanahalli and terminating at Mysore Road. Other proposed corridors include North-South Corridor of 4.9 km starting at Yeshwantpur and terminating at Jayanagar and the Extended Phase I along the North-South corridor.
Bengaluru-Electronics City Elevated Toll Expressway	Inaugurated in January 2010, the Bengaluru Elevated Toll Expressway is a 9.985 kilometers long elevated, tolled and access-controlled expressway on Hosur Road in Bengaluru.
Bengaluru-Mysore Infrastructure Corridor	Phase I started in the year 1999 with distinct project phases (as stand-alone development projects) are expected to be commissioned over a period of 13 years. Certain stretches are already operational.
High-Speed Rail Link (HSRL)	The proposed HSRL will have a length of about 34 km from the Bengaluru city centre to the International Airport passing through Cubbon Road (City Center check-in station), Hebbal (Check-in station), Yelahanka (pick-up station) and BIA Terminal Station at an estimated cost of INR 6689 Crores.
Intermediate Ring Road (IRR)	Stretch of 185 km including the overlap on STRR and Nelamangala bypass connecting many industrial and residential establishments located on the outer periphery of Bengaluru.
Satellite Town Ring Road	Stretch of 367 km connecting the BMRDA New Townships: Nandagudi, Solur, Bidadi, Satahanur, Ramanaaram. Survey is completed.
Mono Rail (Under Integrated Mass Transport System)	The 60 Km feeder network for Metro is being planned with Phase I from Majestic to Agara lake (15 Km).
Signal Free Outer Ring Road	The construction of 31 km stretch from Hebbal Flyover to Central Silk Board is under implementation at a cost of nearly INR 240 Crores.

Note: INR and USD exchange rate is about 1 USD=54.88 INR as of 04.04.2013, Bloomberg. 1 crore = 10 million

Source: JLL India

3.1 NICE-Corridor and Surroundings

The Bengaluru Mysore Infrastructure Corridor Project (BMICP), popularly known as the NICE road (Nandi Infrastructure Corridor Enterprises), is connecting Tumkur to Hosur. With five intersections lying between the Hosur and Tumkur junctions, the NICE road has triggered tremendous development in the locations like Kanakapura Road, Magadi Road, Peenya, Bannerghatta Road and Mysore Road. These locations lacked good connectivity before NICE road were built. Some key areas of development are:

Kanakapura Road

The Kanakapura Road area has seen strong growth in real estate developments over the last few years and especially after the NICE corridor from the Kanakapura junction became operational. The presence of the NICE corridor meant that a resident in Kanakapura would have easy access to Hosur and Electronic city on one side and Mysore road, Magadi Road and Tumkur on the other. As a result, the area has become a popular destination for housing developments. Over the past few years, the Kanakapura Road has gained prominence in the luxury villa category. Numerous luxury apartments have been completed and many are in the pipeline. The primary growth driver has been proximity to the work places like Bannerghatta Road and Electronic city and also closer to well-known IT company campuses like Wipro and Infosys. This micro-market is likely to be one of the most attractive residential locations in the next few years; however, there were no major office and retail developments witnessed in the vicinity.

This location has been marked by consistent high absorption and substantial supply during 2010. Capital values for high end residential projects are currently in the range of INR 3,500 – 5,500 per sq ft. Mid segment capital values are in the range of INR 2,800 – 3,400 per sq ft. while the low end segment has capital values between INR 2,000 – 2,500 per sq ft. currently. As one of the largest sub-markets in Bengaluru, the areas under this geography offers a wide range of residential housing options to the buyers. Since the NICE road became operational, many developers have launched projects on Kanakapura Road, with the prospect of much more to happen in the coming years. Kanakapura Road micro-market is expected to further gather momentum with the completion of proposed and ongoing infrastructure projects like Metro rail. There is a limited supply of commercial and retail supply along this micro-market. The potential remains substantial however, due to the large residential supply in the pipeline coupled with the infrastructure initiatives towards this location.

Tumkur Road

Tumkur Road, close to NICE corridor and surroundings, has traditionally been the major industrial hub of the city and consists of many small and medium scale industries. At present, this location is surrounded by vacant land parcels and is predominantly an industrial area with heavy presence of warehousing and industrial activities. Large public sector units and many small scale industrial units are located as the area is promoted as one of the large industrial hubs in the city. The commercial base in the surroundings has been predominantly government offices, training institutes, small industries and warehouses. Many government offices have their own residential colonies such as HMT colony, Air Force Camp, ITI Training Institute colony etc. The area also lacks as a cultural hub due to the poor socio-economic status of residents.

Capital values for high end residential projects are currently in the range of INR 3,800 – 5,500 per sq ft. Mid segment capital values are in the range of INR 2,500 – 3,000 per sq ft while the low end segment has capital values between INR 2,000 – 2,500 per sq ft currently.

Tumkur Road micro market and its surroundings are growing at a slower pace as compared to other micro-markets of the city. This is mainly because of concentration of the industrial sector. In the recent years, there have been large contiguous land parcels which are being unlocked for real estate developments. The land values are comparatively low in this part of the city. However, existing and proposed infrastructure facilities such as NICE Road, PRR and Metro Rail Terminal at Tumkur Road are expected to improve the overall connectivity of this region and also drive appreciation in land value.

Mysore Road

Compared to other parts of the city, the Mysore Road sub-market has had a slower pace of real estate activity as there were no strong fundamental economic drivers for the area, and a major portion of the sub-market features dense and old developments on small parcels of land. The residential sector is dominated by low- and mid-end apartments, while the high-end residential market is in the very early stages of development. Major portion of the West has highly dense old developments with small parcels of land and comparatively poor accessibility. The development of Global Tech Village, an IT Special Economic Zone (SEZ) by Tanglin developers along Mysore Road resulted in launch of many residential apartments in the micro-market.

Capital values for high end residential projects are currently in the range of INR 3,000 – 4,000 per sq ft. The mid segment capital values are in the range of INR 2,500 – 3,000 per sq ft while the low end segment has capital values between INR 1,900 – 2,300 per sq ft currently.

3.2 Locations closer to Bengaluru International Airport (BIAL)

Presently, North Bengaluru is undergoing significant transformation due to rapid commercialization. Most of the industrial developments along the major roads are getting transformed as commercial developments. A mix of residential and commercial developments dominates real estate space in North Bengaluru.

Commercial

Land parcels along Bellary Road are experiencing changes in terms of usage, and large-scale city level industrial and office uses are coming up with pockets of industrial activity along the Bellary road and including the Larsen & Turbo, SLV industries, Kirloskar and other IT establishments. Few "Grade A" commercial developments are concentrated near Hebbel flyover, with few sporadically located, standalone commercial developments along Bellary Road.

The notable commercial projects in North Bengaluru are: Kirloskar Business Park with built up area of about 260,000 sq ft and the Manyata Embassy Business Park, which covers an area of about 300 acres, out of which only 100 acres has been developed. The rest of the area i.e. about 200 acres of land parcel will be utilized in future for commercial development. The prevailing rentals for the commercial properties are in the range of INR 45-50 per sq. ft per month. In addition to these developments, prominent developers have acquired land parcels in Devanahalli for integrated developments. It is expected that developers might come up with a commercial developments covering a total approximate BUA area of 20 million sq.ft.

Residential

The North Bengaluru is predominantly residential marked by high density residential developments and mostly in the form of independent houses and plotted developments. The primary reason for this is height restrictions due to proximity to the international airport and presence of other aviation-related institutions such as Jakkur Flying Club and Air Force Base. The presence of world-class hospitals, international schools and the proposed new connectivity to the Bengaluru International Airport are driving demand for residential apartments in North Bengaluru. However, the Bellary Road sub-market has seen widespread construction activity by developers over the past year, leading to oversupply in some areas and across product categories.

The projects close to Hebbel flyover witnessed significant absorption activity due to the strong investment sentiment towards this micro-market and also because of their affordability. The sub-market currently faces some oversupply, although developers are mostly based out of Bengaluru and are using a portion of their land banks, acquired few years ago when Bengaluru International Airport was proposed, for residential projects.

The current capital values for high end residential projects are in the range of INR 3,500 – 7,500 per sq ft, while those for mid segment housing are between INR 2,500 to INR 3,000 per sq ft. Low end housing projects are in the range of INR 1,900- 2,000 per sq ft currently. Capital values in the Bellary Road sub-market across all segments rose during 2009 and 2010 and may remain stable in near term due to oversupply situation.

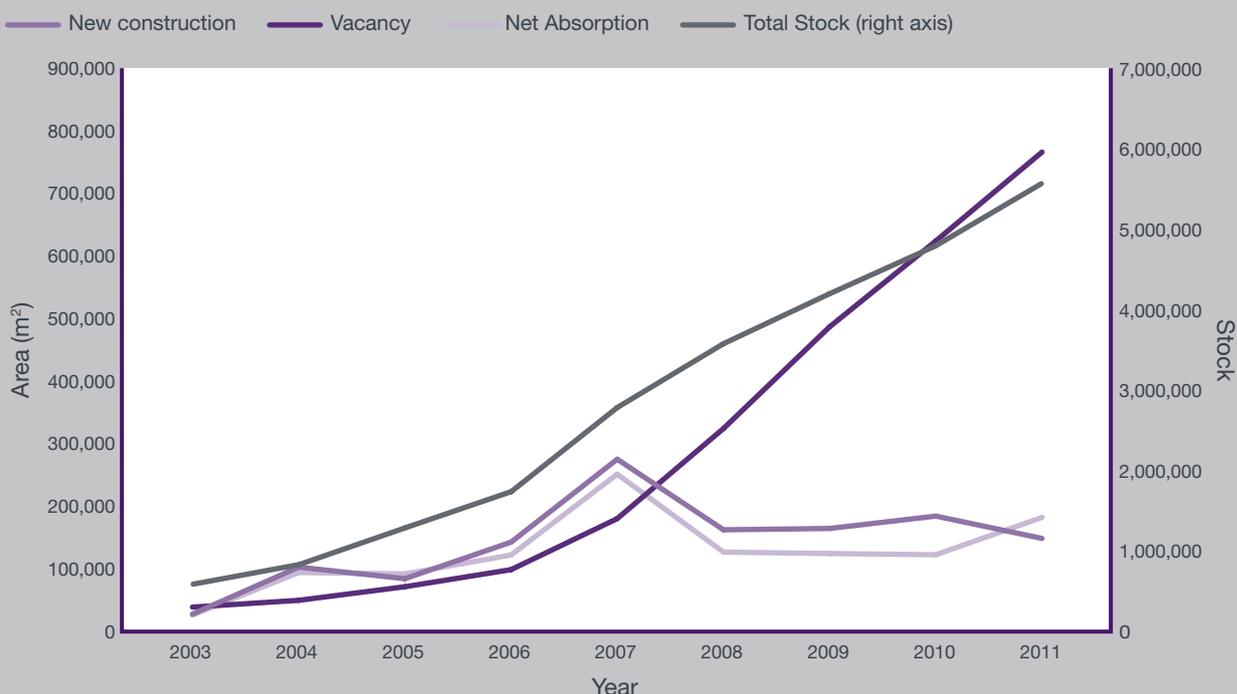
Retail

In North Bengaluru, the retail sector is rather weak. There are only a few malls - Esteem mall on the Bellary Road, Big bazaar on Hennur Main Road and Hebbal Outer Ring Road. However, there are some major retail developments coming up in ORR (Outer Ring Road), Vidyanarayapura, Sahakaranagar and Yelahanka Newtown. Presently, the precinct is undergoing rapid transformation and this transformation along Bellary Road has resulted in commercial and retail developments. Traditional retail market has been the preferred retail destination for almost all types of retail activities. This is mainly due to lack of organized retail spaces like shopping malls and hypermarkets. The existing developments are inadequate both in terms of quality and quantity, to meet the increasing demand.

The high street retail has started along the Hennur Road, Yelahanka New Town and in Sahakarnagar. The general pattern of high street development observed in the North Bengaluru is of mixed use standalone buildings with retail (shops) on the ground floor and commercial (office spaces) on the upper floors. The rentals at the ground floor ranges from INR 30-40 per sqft per month and at the first floor the rentals are from INR 25-35 per sqft per month.

In the retail sector, Esteem Mall is the only mall which has come up near the Hebbel Flyover, covering a total built-up area of about 70,000 sq. ft. The average rentals in the Esteem mall are in the range of INR 50-65 per sq. ft. per month. RMZ Corp, Mantri Developers, Karle Group and Kirloskar Group are planning to develop shopping malls in North Bengaluru and those are anticipated to be operational by the end of 2014. Properties in North Bengaluru would continue to rise in their capital values in long run with the proposed apparel park, self-contained townships, and various large hospitality industry projects. The revamp of important junctions like Bellary Road, Mekhri Circle and ORR (Outer Ring Road) would only add to the capital gain potential of North Bengaluru. Also, with a significant office supply in the pipeline in this part of the city, the demand for housing is likely to sustain in the near term with a rise in affluent employee base.

Figure 3 Commercial Property Sector Supply in Bengaluru



Note: Figures are averages over four quarters for the year

Source: JLL India

In general, it is evident that many projects across all property sectors have already started and are coming up in areas where significant infrastructure investment has been made and are being planned for. The recovery process from the 2008 recession is robust as shown in Figure 3. One of the main constraints in some areas is presence of highly concentrated areas occupied by traditional small to medium scale industries. Such presence of informal sector may significantly increase the lag length of the transmission channel through which infrastructure investment flows into the built environment activities. As discussed above, we find significant heterogeneity across micro-markets in terms of presence of this informal sector. For example, property market activities across Kanakapura Road, Magadi Road, Peenya, Bannerghatta Road and Mysore Road may have resulted from spatial spillover effect of a number of physical infrastructure projects in surrounding areas. Tumkur Road and Mysore Road micro markets are growing at a slower pace as compared to other micro-markets of the city. Such spatial variation in impact of

infrastructure investments is largely driven by location of the projects and size of the infrastructure endowment in local areas. Interestingly, we also find that office sector activities seem to generate significant impetus to residential sector activity, as increased labour force across IT and other office-based industries leads to uptick in housing demand. The primary growth driver behind residential developments in Kanakapura Road has been proximity to the work places like Bannerghatta Road and Electronic city and also closer to well-known IT company campuses like Wipro and Infosys. This shows evidence of sectoral spillover effect of infrastructure investments.

Therefore, it is quite expected that the property sector developments may take different trajectories in different micro-markets. Such heterogeneous economic outcomes may be reflected by the key property sector performance indicator – cap rate. Therefore, in the next section, we turn to formal modeling of cap rate changes across four major areas of the Bengaluru real estate market.

As previously mentioned, McDonald and Thorson (1997) suggest that road construction may have significant effect on agricultural land values which may be reflected by the property market indicators. Therefore, we attempt to model a key property sector performance indicator – capitalisation rate – in this context. From a theoretical standpoint, for a correctly priced property, capitalisation rate (cap rate) can be approximated as:

$$(1) K = RFN + RP - g + d$$

Where, the cap rate, K , is a function of nominal risk free rate (RFN), risk premium (RP), expected average rental growth for continuously new property in perpetuity (g) and the expected average rate of depreciation in perpetuity (Ball, Lizieri and MacGregor, 2002). There is a long literature on modelling cap rate. Early works (see Sivitanides et al., 2002; Hendershott and MacGregor, 2005a, 2005b for example) modelled cap rates as an adjustment around equilibrium values, which in turn are determined by property fundamentals such as risk free interest rates, rent levels and rental growth. Chichernea et al. (2008) followed this tradition. Chervachidze, Costello and Wheaton (2009) expanded the literature by incorporating debt availability into the model. The motivation for incorporating debt availability into cap rate model draws from macroeconomic literature concerning the role of debt availability in generating asset demand and asset bubbles (ibid). Following Archer and Ling (1997), this study included a metric for general risk premium over the risk free rate. The authors estimated a single step-adjustment model with the following specification:

$$(2) \text{Log}(K) = \alpha + \beta_1 \text{Log}(K) + \beta_2 \text{Log}(\text{Rentratio}) + \beta_3 \text{GsecYield} + \beta_4 \text{Liquidity} + \beta_5 \text{RiskSpread} + \beta_6 \text{Qtr1} + \beta_7 \text{Qtr2} + \beta_8 \text{Qtr3} + \beta_9 \text{Location dummies}$$

Where K is the lagged cap rate. Rentratio is the ratio of real rent index for a given location in a given quarter to the historical average of real rent for this location. GsecYield is the real treasury-bond yield. RiskSpread is the spread between corporate bond index and treasury-bond yield on similar tenure bonds. Liquidity is the ratio of total net borrowing and lending to nominal GDP.

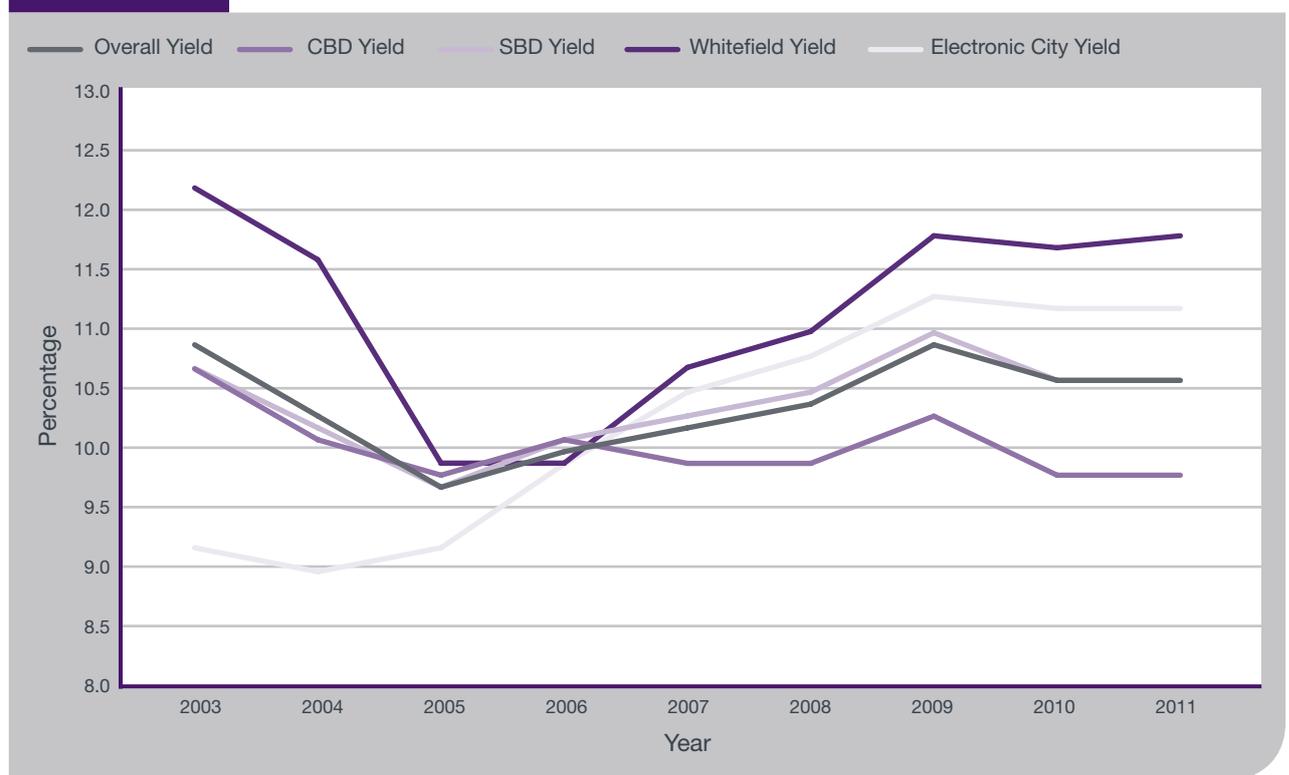
Chervachidze et al. (2009) include Rentratio to capture the role of investors' expectations. If investors are forward looking, high rental levels (compared to historical means) will indicate to investors that the market is at the peak of the cycle and a downward adjustment is in offing, thus causing investors to expect lower cash flows in the future. This would impact cap rates positively. If, however, investors are backward looking, they will project current rent growth into future and will expect higher cash flows in future. This will have negative effect on cap rates (ibid). RiskSpread proxies the general risk aversion in the economy and the premium that investors desire for this risk. If the desired risk premium in economy increases, it will increase the cap rate. Liquidity is a measure of liquidity in the economy. If liquidity is higher in the economy, it will cause asset price inflation.

This will imply that cap rates will fall. The measure of Liquidity that Chervachidze et al. (2009) use in their model is the ratio of debt in the economy scaled by GDP. They argue that easy availability of debt encourages property transactions and can inflate prices. Precisely reverse would happen if debt is scarce. To avoid simultaneity problems, they use total debt flow in the economy rather than debt flow in property sector as a measure of debt.

In this report, we use a single equation model as Chervachidze et al. (2009) proposed, however, with following extensions: First, our study models cap rate within a large city (Bengaluru) by constructing a panel data based on four sub-markets in the city. These sub-markets are used by property agents in reporting information for commercial property in Bengaluru. Second, the measure of liquidity in our models is the ratio of money supply (M2) in the economy scaled by GDP. The argument for using this definition of liquidity instead of debt is that in India, while the debt availability is important, equity has played a very important role in asset price inflation. An appropriate measure of liquidity, therefore, is changes in money supply in the economy scaled to GDP. This measure is inverse of income velocity of money. According to portfolio approach to money demand, when wealth increases relative to current income, the income velocity of money falls ceteris paribus (Santoni, 1987). A corollary is that if income velocity of money falls (or, inverse of income velocity of money increases), cap rates or yields on asset will decline and asset values will increase. Theoretical model of asset pricing suggests that capital flows play a role in asset pricing. However, concerns have also been raised with regard to simultaneity between capital flows and asset returns. Here, we avoid the issue of simultaneity as the measure of capital flows is money supply scaled by the GDP at the overall economy level. Third, we also include a variable that proxies the overall shift in demand for space at a macroeconomic level. Bengaluru being an IT city, we include growth in stock index for IT companies traded on Bombay Stock Exchange (BSE). A positive change in the index would lead to higher property cash flows (rentals), which will have negative effect on cap rate. Precisely reverse would happen if index falls. This interpretation of movements in IT index and its impact on cap rate calls for some caution as not only sectoral fundamentals but market risk also plays a role in determining IT index returns.

As argued in previous sections, much of the effect of infrastructure investment is expected to transmit through the property sector. Given the market analysis of the real estate sector in Bengaluru in section 3, we examine the impact of large ‘network’ infrastructure projects on key property sector parameter. The data used for cap rate in this paper is the Jones Lang LaSalle (JLL) commercial property cap rate series from 2003:Q1 to 2012:Q1 for four locations as shown in Figure 2 (Central business district, CBD; Secondary business district, SBD, Electronic City and Whitefield).

Figure 4 Commercial Property Sector Cap rates in Bengaluru



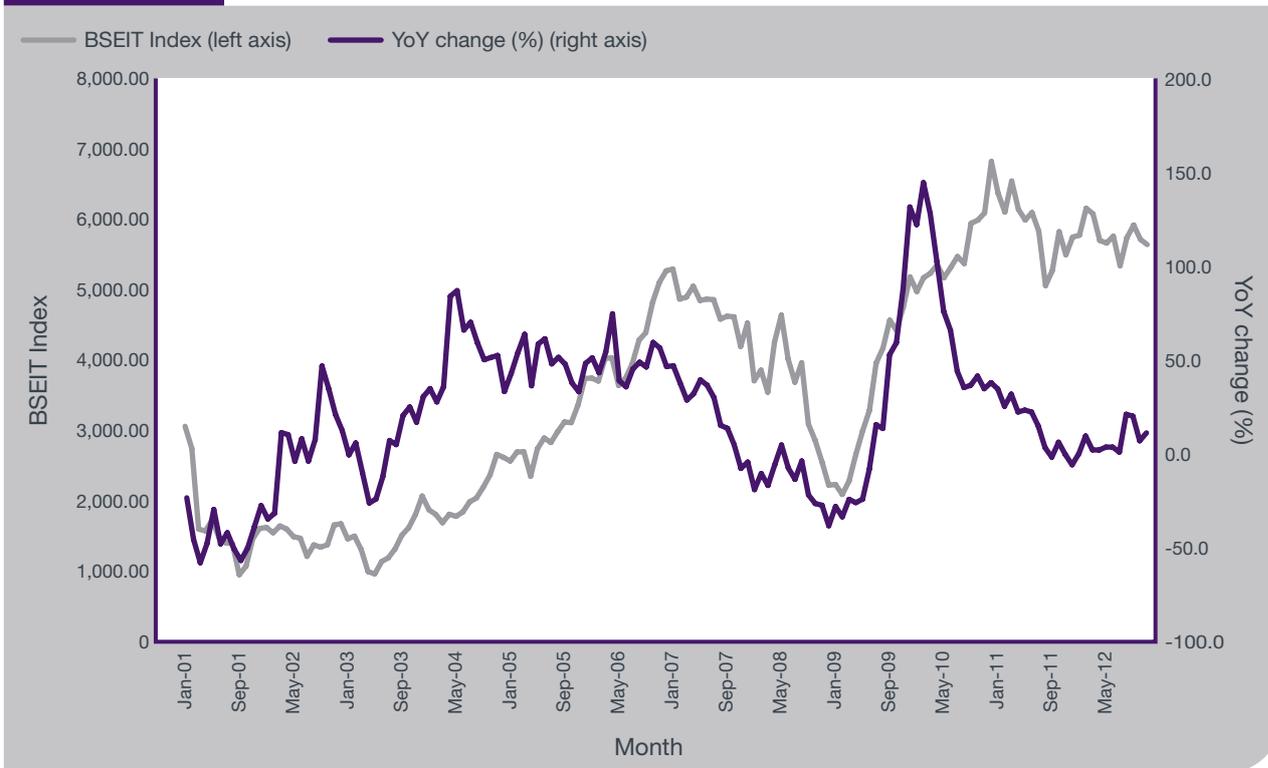
Source: JLL India

As shown in Figure 4, prior to 2005: Q4, cap rates in CBD, SBD and Whitefield followed a different trend than Electronic City. While the cap rates were hardening in CBD, SBD and Whitefield, these were softening in Electronic City. Electronic City has been home to IT major Infosys for a long time but areas like Whitefield also started to emerge as IT hubs after IT parks were developed there. Interestingly cap rates in these locations converged in 2005: Q4 and following that have tracked similar trends. After 2006, cap rates have softened in all locations compared to previous years. CBD and SBD, which were less preferred in earlier period in comparison to Electronic City are back in favour with lower cap rates than newly developed IT dominated locations such as Electronic City and Whitefield.

The office markets in Bengaluru are closely related to the IT sector. Post 2006, the performance of IT sector (as measured by BSE IT stock index) declined arguably due to global financial crisis (GFC) and associated reduction in demand for IT services from the US and Europe (Figure 5). Even though domestic real economy weathered through the GFC quite well, weak market conditions and uncertainty further impacted IT sector negatively.

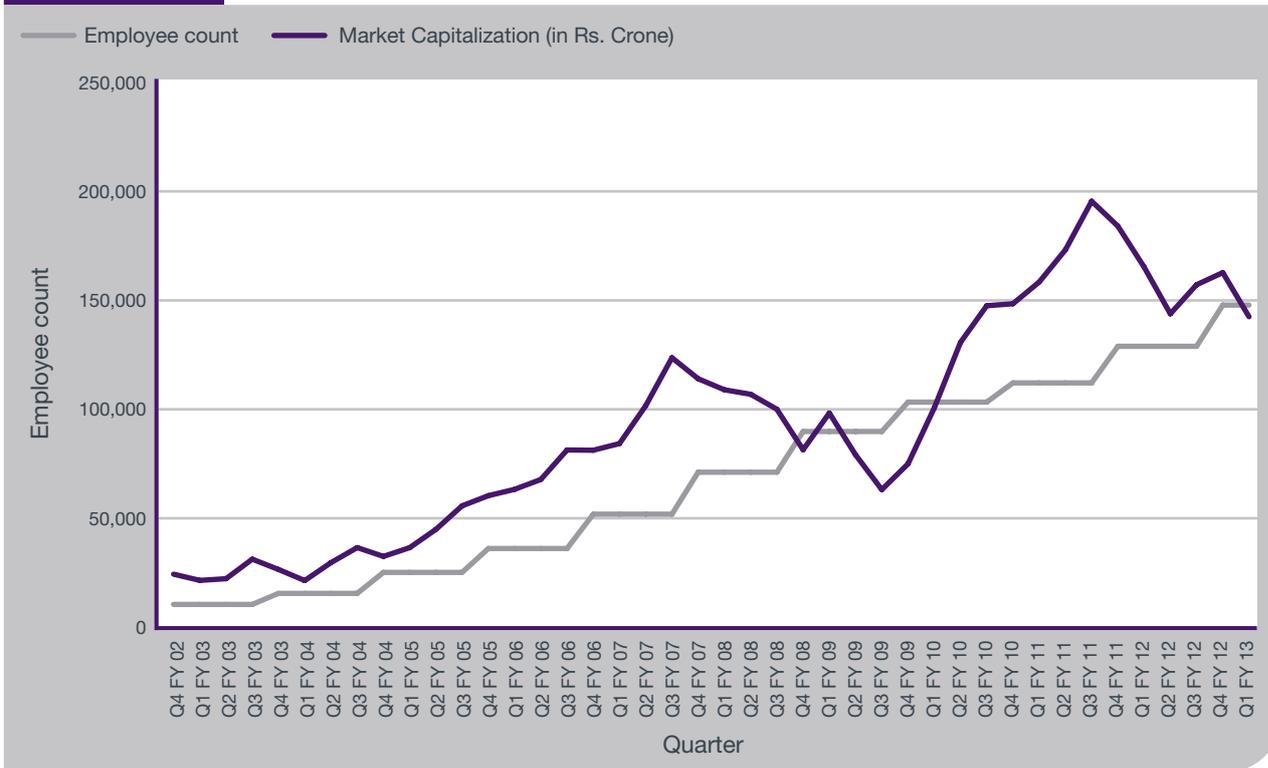
This can be seen in the performance of IT major (headquartered in Electronic city) Infosys (see Figure 6). Even though global employee count at Infosys continued to increase, their market capitalization did have a negative impact from 2007 to 2009. Uncertainty in market conditions may have impacted the demand for space.

Figure 5 Stock Market Performance of the Indian IT Sector



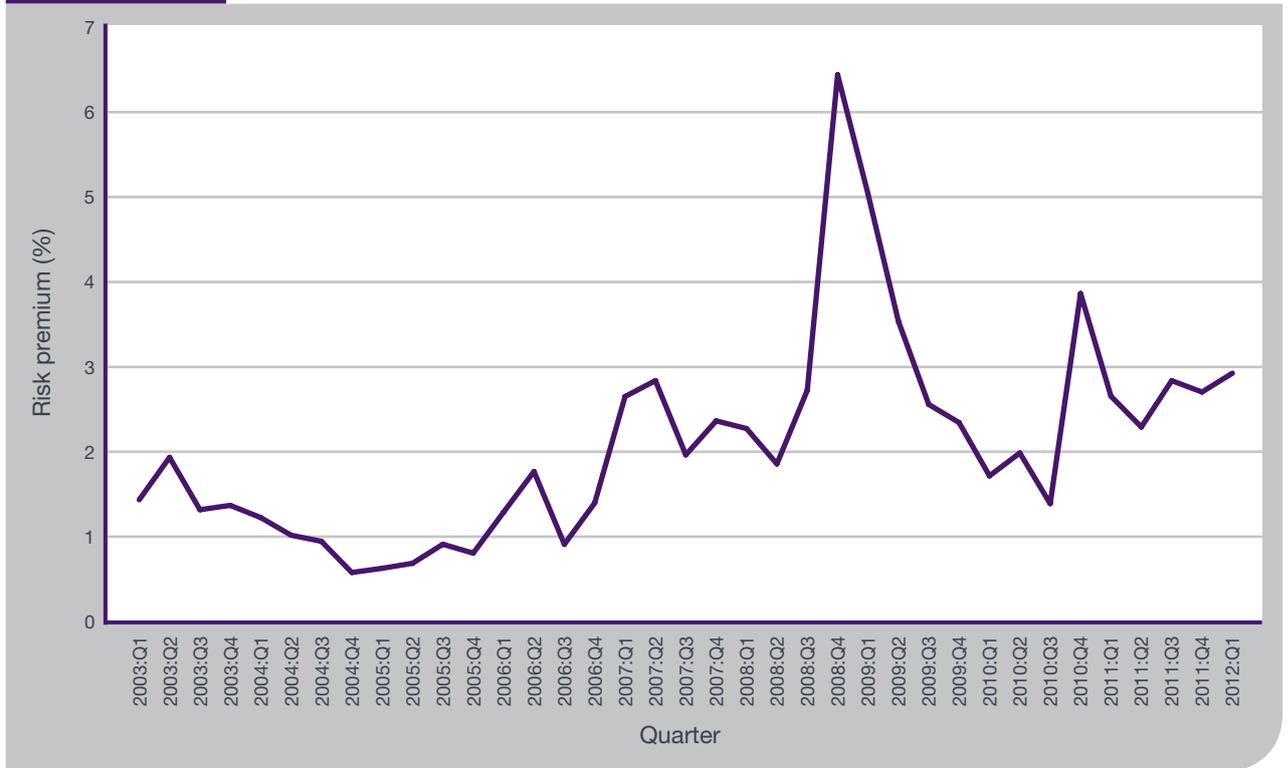
Source: Bombay Stock Exchange⁶

Figure 6 Infosys Limited Market Cap and Employee Count



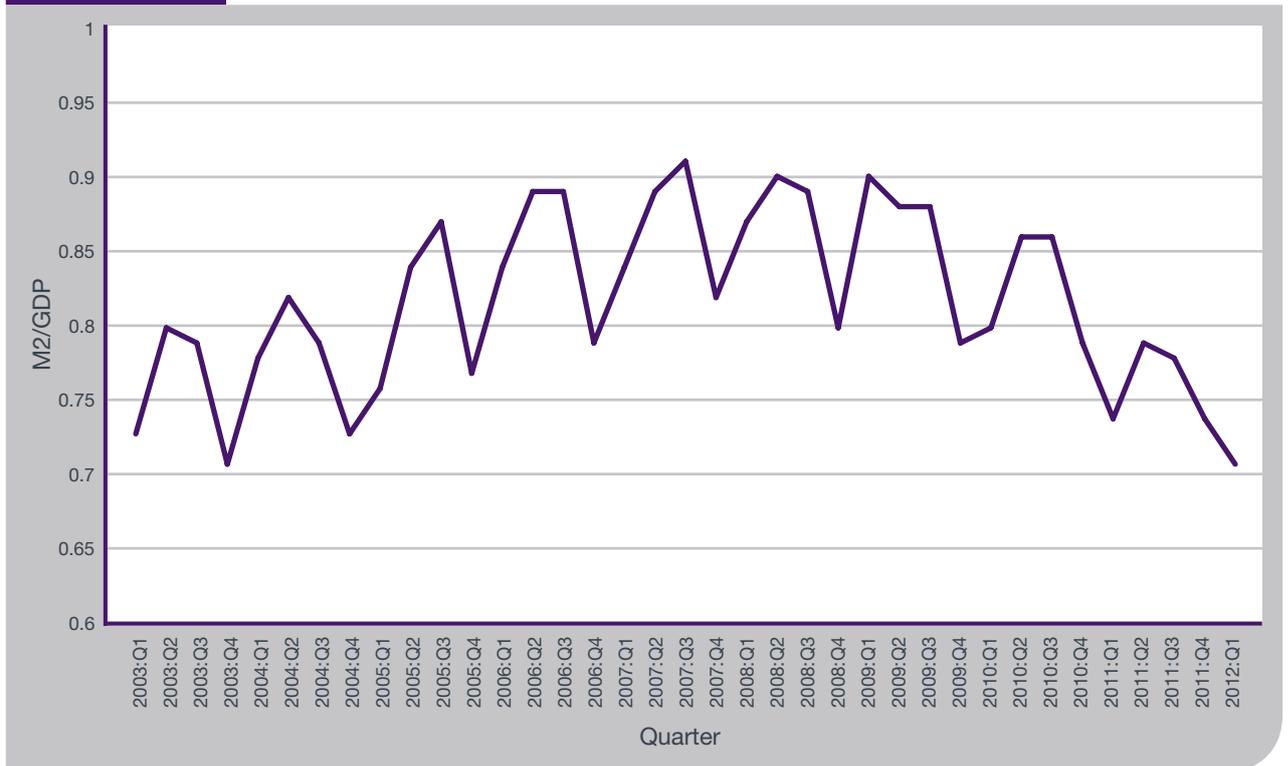
Source: Infosys Limited Annual Reports⁷

Figure 7 Risk spread



Source: Authors based on data from Reserve Bank of India

Figure 8 Liquidity trends



Source: Authors based on data from Reserve Bank of India

Based on literature discussed earlier, two macroeconomic factors that determine cap rate are risk premium and liquidity. As a measure of risk premium, Chervachidze et al. (2009) used premium for corporate AAA bond over 10 year Treasury Bond rate for the US in their model. However, for India we were unable to find a series on corporate bond yield for the period of our model on cap rate. One of the reasons is that 10 year corporate bonds are not common in India. Even for shorter tenure bonds, the data is not available. In this report we measure risk premium for Commercial paper (whose tenure is shorter than 270 days) over similarly tenured Government securities. Figure 7 presents risk premium during 2003:Q1 to 2012: Q1. The macroeconomic risk premium has increased from 2006:Q1. The quarters of 2008:Q4 and 2009:Q1 shown huge spike in risk spread.

The measure of liquidity in this report is change in M2/ GDP. As discussed earlier, M2/GDP is inverse of velocity of money in the economy. A rise in M2/GDP indicates a reduction in velocity and portfolio theory of money demand suggests that this will lead to rise in asset prices. Figure 8 presents the trend of M2/GDP during 2003:Q1 to 2012:Q1. Despite the seasonality that the data shows, there is clear trend that M2/GDP increased until mid-2007 before falling again. This trend overlaps with the reverse trend that cap rates in Bengaluru saw during this period.

We employ fixed effect panel econometric method to estimate the model. The advantage of this method is that it allows us to use both time series and cross sectional variations in the data, which increases the efficiency of the OLS estimates. A potential bias in estimating equation (2) is the possibility of correlation between unobserved heterogeneity at the local area level and the observables, which would violate standard assumptions of OLS estimation. Therefore, the disturbance term in equation (2) is specified as a two-way error component model:

$$(3) \quad \varepsilon_{it} = \mu_{it} + \lambda_{it} + v_{it}$$

Where μ_{it} denotes an area-specific fixed effect and λ_{it} a quarter-specific effect. In this fixed effect specification, heterogeneity is assumed to be constant over time and correlated with independent variables. The constant effect is removed by mean-differencing the data which will control for the unobserved heterogeneity.

As discussed by Chervachidze et al. (2009), this estimation strategy is consistent with theoretical expectations that market-specific unobserved characteristics will lead to permanent differences in capitalization rate trends across markets, and fixed effect methods allows us to estimate these unobservables.



Table 2 Estimation results

Dependent variable: Log (cap rate)			
Variables	Unstandardized Coefficients		t-ratio
	Coefficient	Standard Error	
Intercept	0.555	0.108	5.130
Log (RentRatio)	-0.042	0.021	-2.012
GSecYield	0.004	0.003	1.241
Log (Lagged cap rate)	0.737	0.048	15.260
Annual growth in BSE IT index	-0.007	0.009	-0.758
RiskSpread	0.013	0.003	4.099
Dummy for quarter 1 (1:Yes; 0:No)	0.011	0.007	1.591
Dummy for quarter 2 (1: Yes; 0:No)	0.000	0.007	-0.062
Dummy for quarter 3 (1:Yes; 0:No)	0.011	0.008	1.380
Dummy for CBD (1:Yes; 0:No)	-0.008	0.007	-1.140
Dummy for SBD (1:Yes; 0:No)	0.007	0.007	0.905
Dummy for Whitefield (1:Yes; 0:No)	0.024	0.008	3.007
Liquidity	-0.001	0.001	-0.797

R-squared (adjusted): 0.83

Note: Quarter 4 is omitted variable for time fixed effects and Electronic city is omitted variable for location fixed effects.

Table 2 presents the estimation results. All major variables have expected signs and except “Growth in BSE IT index” are significant. The model explains 83% of variation.

Location variables except for Whitefield are insignificant. This indicates that Whitefield generates statistically significant difference in average cap rate compared to other locations. Two infrastructure related factors explain this behaviour. First the development of a number of IT parks in Whitefield in 1990s, which housed a number of IT companies. Whitefield was in close proximity of old airport in comparison with its rival IT location, electronic city. This attracted a number of IT companies and is reflected in cap rate prior to 2006. Second factor that affected this location adversely was to shift the international airport to Devanahalli, about 50 Km from Whitefield in 2004. The airport became operative in May 2008. In the early periods poor connectivity with Whitefield (which to some extent is still a problem) impacted demand for commercial properties in this location. Electronic city is equally far from the new airport. This has affected the demand for properties in this location as well. Devanahalli itself is emerging as a location for IT and other services.

Quarterly dummies (or fixed effects) are not significant. The negative and significant coefficient for *RentRatio* confirms that investors are backward looking and base their cap rate expectations on past rental performances. Risk premium is significant and positive indicating that macroeconomic risk plays an expected role in cap rate determination. Liquidity variable, though has expected sign, is insignificant. Other variables, growth in *BSE IT Index* and *GSecYield*, though have expected signs but are statistically insignificant.

7.0 Concluding Remarks

Much of the economic benefit of infrastructure projects are generally channelized through the built environment. The transmission channel is fraught with significant economic frictions such as institutional constraints. In this report, we examine such effects by focusing on major infrastructure projects in Bengaluru, India. Due to lack of depth in the data available, we rely on both primary and secondary information about the market. Despite data limitation, our findings indicate many interesting aspects of the effects of infrastructure on the property sector.

The main contribution of this project lies in better understanding of the relationship of infrastructure investment and building activities in a fast-growing emerging economy. Many studies have been focused on developed countries; however, the dynamics in developing countries are much less explored in the literature. The developing country set-up provides us with a unique opportunity to study the relationship within an environment with significant presence of informal sectors and low infrastructure endowment. Therefore, some of the standard findings from developed country case studies may not be tenable in our case study. Our analysis confirms that thesis.

Despite significant challenges in terms data availability and quality, we are able to provide a reasonable account of the study market and perform sound analysis. Consistent with our theoretical hypotheses, we find that infrastructure projects in Bengaluru have opened up the land and helped alleviate mobility constraints for economic inputs. As a result, a number of property sector developments are being observed across the local markets like Kanakapura Road, Magadi Road, Peenya, Bannerghatta Road and Mysore Road, which appear to have resulted from spatial spillover effect of a number of physical infrastructure projects. Many commercial and residential projects have been started. This has not only affected the emerging micro-markets but also influenced property sector returns in mature and established local areas. However, these effects are observed with significant and varying lags. The length of lag in the market adjustment appears to depend on local market structure and severity of market constraints like presence and strength of the informal sector. For example, Tumkur Road and Mysore Road micro markets are growing at a slower pace as compared to other micro-markets of the city. Such spatial variation in impact of infrastructure investments is heavily influenced by location of the project and size of the infrastructure endowment in local areas.

Furthermore, we also find that some property sector respond more quickly to infrastructure stimulus than others. As expected, office and residential sectors are responding to the infrastructure investments more readily than the industrial sector. This could be due to presence traditional industries along some major corridors in the city. Interestingly, we find that developments in office sector seem to trigger residential sector activity, as increased labour force creates demand for residential buildings. Such sectoral spillover effect is evident in Kanakapura Road area. The primary growth driver behind residential developments in Kanakapura Road has been proximity to the work places like Bannerghatta Road and Electronic city and also closer to well-known IT company campuses like Wipro and Infosys.

Many locations have been experiencing consistently high absorption and substantial supply during last few years, when a number of infrastructure projects were completed in late-2000s. The most noticeable effect of the infrastructure investment is seen on land value across the city. Presence of speculative land holding is also evident. This can potentially affect developments in next few years. Big developers with a significant land bank may hold key to property market activities. While investor presence is prominent, the end-user activity in commercial and especially residential sectors is also driving noticeable compression in cap rate in many areas. Despite steady uptick in supply across all property sub-sectors, increasing demand for both commercial and residential space due to strong growth in Bengaluru IT and knowledge industry has led to significant demand-supply mismatch. However, our econometric model of cap rate suggests that macroeconomic and distinct local trends have determined the trajectory of cap rates in Bengaluru. The analysis of commercial property yields (capitalization rates) indicates distinct spatial spillover effects, which appear to depend on location, type and size of the infrastructure projects.

These findings reveal importance of accessibility in property sector performance and are especially important for the policy makers as this shows importance of local area heterogeneity in expected outcome of infrastructure investment. There are significant bottlenecks that add to lagged effects. Unless such bottlenecks are mitigated or removed, the desired policy outcomes may not be realised. As a result, the growth of real estate sector is thwarted by the infrastructure bottlenecks and to some extent this is reflected in softening of commercial property cap rates in locations like Whitefield and Electronic City, which have been affected by shifting of airport to a location 50 Km away and significant delays in transport connectivity projects.

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