



Contents lists available at ScienceDirect

# Tunnelling and Underground Space Technology

journal homepage: [www.elsevier.com/locate/tust](http://www.elsevier.com/locate/tust)

## Risking multi-billion decisions on underground railways: Land value capture, differential rent and financialization in London and Hong Kong

Becky P.Y. Loo<sup>a,\*</sup>, John R. Bryson<sup>b</sup>, Meng Song<sup>c</sup>, Catherine Harris<sup>b</sup><sup>a</sup> Department of Geography, The University of Hong Kong, Pokfulam, Hong Kong, China<sup>b</sup> City-Region Economic and Development Institute, The University of Birmingham, United Kingdom<sup>c</sup> Cardiff Business School, Cardiff University, United Kingdom

### ABSTRACT

Rapid urbanization has brought the needs to minimize negative transport externalities in cities to the forefront. The development of metros is a response to urban sustainability challenges, but the construction of underground infrastructure often requires massive excavation and long construction time, disrupts the economy and people's everyday living, and is highly capital intensive. As such, these multi-billion-dollar investment decisions require political vision and determination, careful traffic analysis, and the ability to raise sufficient funds to cover not only capital construction costs but also future operations and depreciation. Underground infrastructure projects must, therefore, balance the engineering aspects of a proposed project with the development of a resilient and sustainable business model. This paper is the first to develop a comparative longitudinal analysis of the finance and funding models of two underground systems (London Underground and Hong Kong's Mass Transit Railway) with a focus on the development of a conceptual framework for understanding land value capture (LVC) based on differential rents and financialization. The focus is on exploring the supply-side aspects of underground transport infrastructure including finance or capital investment and the relationship with funding or revenue streams and the creation of financially sustainable business models.

### 1. Introduction

Population growth has led to an increase in the intensity and density of urban living (United Nations, Department of Economic and Social Affairs, 2014). This is transforming cities and accentuating the importance of underground transport infrastructure, especially underground railways or metros. The development of metros is a response to road traffic congestion, various transport negative externalities (notably carbon emissions noise and particulate matter), land shortages and the escalating value of urban land (Loo and Banister, 2016; Loo, 2018). The construction of underground infrastructure, however, often requires massive excavation and long construction time, disrupts the economy and people's everyday living, and is highly capital intensive. As such, cities reaching a certain stage of population and income size (Loo and Cheng, 2010; Loo and Li, 2006) are often confronted with the critical but difficult decision to build a metro or to invest in other forms of transport infrastructure. These multi-billion-dollar investment decisions (versus small-scale local infrastructure, see Bryson et al., 2018) require political vision and determination, careful traffic analysis, and the ability to raise sufficient funds to cover not only the capital construction costs but also future operations and depreciation costs for long-term maintenance. Underground infrastructure projects must, therefore, balance the engineering aspects of a proposed project with the development of a resilient and sustainable business model.

With reference to underground railways or metros, what were some of the more successful business models? What lessons can we learnt from these examples? The public financing (upfront capital costs) and funding (revenue) of infrastructure reflects finance and funding conventions that have been established at a particular time and place. These conventions alter as new financing models are created over time. Guided by this historical perspective and the above research questions, this paper develops a comparative longitudinal analysis of the finance and funding models of two underground systems: the London Underground and Hong Kong's Mass Transit Railway (MTR). The focus is on exploring the supply-side aspects of underground transport infrastructure including finance or capital investment and the relationship with funding or revenue streams and the creation of financially sustainable business models. There are a number of on-going debates here including the financialization of urban land by private capital (Torrance, 2009; Theurillat et al., 2016) and alternative approaches to financing infrastructure including *land value capture* (LVC) (Bryson et al., 2017). Our focus is on understanding LVC's contribution to developing financially sustainable underground infrastructure business models that try to develop a balance between revenue flows and capital investment. *LVC is a financial tool designed to monetise the escalation in land values in the catchment area of public infrastructure projects.* Infrastructure projects increase the accessibility and connectivity of land and this is reflected in the value of land around key access points to a

\* Corresponding author.

E-mail addresses: [bpyl@hku.hk](mailto:bpyl@hku.hk) (B.P.Y. Loo), [J.R.Bryson@bham.ac.uk](mailto:J.R.Bryson@bham.ac.uk) (J.R. Bryson), [songm5@cardiff.ac.uk](mailto:songm5@cardiff.ac.uk) (M. Song), [C.E.Harris@bham.ac.uk](mailto:C.E.Harris@bham.ac.uk) (C. Harris).<https://doi.org/10.1016/j.tust.2018.07.011>

Received 22 January 2018; Received in revised form 30 April 2018; Accepted 7 July 2018

Available online 06 August 2018

0886-7798/© 2018 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license

<http://creativecommons.org/licenses/by/4.0/>.

transport network. Thus, underground infrastructure investments have two returns. First, a direct return measured by time saved in travelling between places reflecting the use and policy values of infrastructure projects. Second, indirect impacts that alter the value of land providing benefits to those not directly involved in financing or funding infrastructure investment. LVC tries to capture some of the latter as a contribution to the finance and funding of public sector infrastructure projects. There is an on-going debate on LVC, for example, Du and Mulley (2007) could identify no short-run impacts from a metro extension in Sunderland, UK, while Pagliara and Papa (2011) found that rail development increased land values in Naples in Italy.

Most existing studies focused on above ground rail infrastructure (including light rails) while the role played by LVC in financing and funding underground projects remains largely unknown (see a review Mohammad et al., 2013). Given the diverse geographical contexts, a longitudinal and comparative approach is needed. This paper's research design is a comparative longitudinal case study. The comparative analysis of London Underground and the MTR aims to highlight the impacts of different histories on the funding/financing of these underground systems. The methodology involved identifying and analysing primary and secondary published and unpublished sources including policy documents and reviews. A triangulation approach was used to develop the two case studies. The paper is divided into five sections. After this introduction, the second section reviews the literature on the financing of underground railways to develop a new conceptual approach for exploring LVC developed from the urban rent theory. The third section explores finance and funding and the evolution of the London underground; and the fourth section develops the analysis of the MTR. The final section is a discussion and conclusion that compares and contrasts the financing and funding of these very different underground systems.

## 2. Land value capture, differential rent and financialization of railway infrastructure

A distinctive feature of cities lies in their high infrastructural intensity. Railways, undergrounds, roads, airports and commercial buildings provide the infrastructure for the circulation of people, but also rely on financial infrastructure in which capital is temporarily 'fixed' into the built environment. With a typical life span of 50 years or above, the difficulty is that the returns on transport infrastructure occur over a very long-time period. Moreover, the returns on any infrastructure investment are complex and are not just financial. This explains the role public sector financing plays in infrastructure development. More recently, the application of cost-benefit analysis to mega-transport infrastructure, such as airports, highlighted the wider social and environmental impacts of such investments (Li and Loo, 2016). Kaliampakos et al. (2016) reviewed the costs and benefits of modern undergrounds in different countries including social and environmental externalities. They highlighted that underground solutions resulted in more efficient infrastructure usage, improved urban transportation capacity and increased resilience. Such wider positive benefits may be considered as justifications for the application of public subsidy.

An on-going debate in the social sciences has identified a prevailing trend since the 1970s of 'financialization'. This process has many different definitions, but the term highlights the increasing importance of financial motives, markets and financial intermediaries in shaping economies and decision-making (Epstein, 2005). Much of this debate explores the ways in which various intermediary actors (developers, property consultants and property investors) 'perform the various translations required for anchoring financial capital in the city' (Theurillat, et al., 2016: 1510). This debate has highlighted that:

'The shift of responsibility for essential urban services into the hands of global financial institutions has created infrastructure assets that may be in different cities, countries and continents but that may be

more linked through similar internal rates of return objectives, risk management and refinancing strategies, and ultimately, stable, predictable types of returns for the investors that own the assets' (Torrance, 2009: 818)

This is very much an over-generalisation as the analysis must highlight which urban services are implicated in this process and in which countries. There must also be an analysis of strategies that are intended to mediate some of the adverse impacts of financialization (Bryson et al., 2017). In addition, the debate on financialization has a tendency to focus on financial capital and particular types of financial instrument, whilst ignoring land tenure and some of the earlier literature on urban rent, global finance and property development and investment (Bryson, 1997; Haila, 2016).

Rent is, by its very nature a social relationship; it is both an instrument and a concept and these change over time. The theory of urban rent has its origins in the third volume of Capital (Marx, 1984) and rent in this analysis was paid for the right to use a piece of land with some 'interest on fixed capital' which is 'incorporated in the land, which may constitute an addition to ground-rent' (Marx, 1984: 622). Marx distinguished between two types of rent. First, *absolute rent* results from the ability of landowners to charge rent for land, irrespective of its location or fertility. It is the minimum payment required in return for the use of a unit of land. Secondly, *differential rent* results from differences in the rates of profit obtainable from land that possesses unequal capacities including connectivity (Bryson, 1997: 1445). There are two types of differential rent. *Differential rent I* is a 'function of the advantages offered by the site of a property, and which do not depend on any action by the owner' (Larmarthe, 1976: 100). This includes public sector infrastructural investment that transforms a land plot's relationship to other plots in some way by enhancing accessibility. *Differential rent II* is derived from differences in the production methods applied to a plot of land; this form of rent comes from the advantages contained within the curtilage of a plot, for example the development on a plot of a 20 storey office building compared to 10 storey building. The application of development finance to a plot results in an addition to differential rent II whereas an escalation in differential rent I is directly linked to investments in surrounding plots made by other land owners and public and private sector infrastructure investments, for example in light rail and underground transport.

This is the first paper to identify and develop the relationship between LVC and urban rent theory. We argue that the application of urban rent theory to infrastructure investments provides a conceptual framework for exploring the finance and funding of underground railways based on LVC. The focus is on differential rent I and the effect on the value of adjacent plots. These effects are unearned as they do not reflect any investment by the owners of plots that are adjacent to or within the impact reach of benefits that result from investments that create the differential rent in the first place. It is possible to argue that any uplift in the value of a plot's differential rent I reflects, to some extent, some type of compensation to property owners affected by disruptions associated with major infrastructural investments. It is important that the focus of any analysis of LVC not only explores the relationships between these two types of rent – I and II, but also begins to unravel the complexity of the former. Thus, we argue that differential rent I should be conceptually further divided into two sub-types. First, *differential rent Ia* results from infrastructural investments that enhance connectivity and accessibility. These investments are planned by the public sector and may be financed and funded by the public and/or private sector. It is these impacts that represent LVC uplift. Second, *differential rent Ib* comes from investments in adjacent plots that are often undertaken by the private sector but that influence the value of adjacent plots. This means that the value of a plot is calculated by using the following equation:

Absolute Rent + Differential Rent Ia + Differential Rent Ib  
+ Differential Rent II = Plot Value

In this conceptual framework, differential rent Ia results from infrastructure investments that may be implicated in some type of LVC mechanism. There are two ways in which the uplift in differential rent Ia can be captured by the public sector. First, by *direct* involvement in the property development and investment process. In this approach, some type of development vehicle is established either by the public sector working by itself or in partnership with private sector interests. Second, by an *indirect* process involving some type of taxation on any uplift in the rental value of sites adjacent to and effected by a public sector infrastructural investment. The majority of LVC mechanisms are based on the former mechanism. The latter is technically and politically difficult as differential rent Ia uplifts are unearned, unplanned and perhaps unexpected and this raises issues regarding adjacent land-owners and the politics of taxation of unearned benefits and their measurement.

It is worth noting that the calculation of differential rent II is relatively simple as this reflects the actual or projected rental income from a plot combined with the expected or required yield (Bryson, 1997). This type of rent is not about land values, but the additional value that results from investment on a plot. The value of the land is determined by differential rent Ia & b combined with market forces – supply and demand. The exact amounts of differential rent Ia and Ib are much harder to calculate, and any calculation depends on a set of assumptions regarding relative value over time and the impact and reach of any infrastructural investments combined with the impacts of any investments on other adjacent plots. Cost-benefit analysis facilitates the identification of the wider social and economic benefits of infrastructural investment (Li and Loo, 2016), but only some of these impacts are reflected in differential rent Ia. There is a political question regarding how much of this additional indirect value can be captured by the public sector?

LVC is an old method for financing infrastructure investment. Recently, LVC has become a financing and funding technique that has been explored and (re)applied by cities including London, Hong Kong, Singapore, Atlanta, San Francisco and Kansas City (Transport for London, 2017). In other words, the financing and funding of local infrastructure represents a major upfront capital investment which impacts both on differential rent I and II. These impacts usually benefit private rather than public sector interests and often they are subjected to financialization as global finance is anchored in cities through the application of finance to land as part of a process of land and property speculation and investment. The wider impacts of infrastructural investment have important social, economic and financial consequences. However, there is still a lack of systematic analysis of these different approaches to financing and funding underground transport infrastructure in different contexts. It is to this analysis that we now turn our attention.

### 3. Financing London's underground

The London Underground has an old history of LVC but has only recently returned to exploring the financial model of capturing differential rent Ia and Ib as a mechanism for furthering the development and maintenance of London's transport infrastructure. In the early decades of the nineteenth century, London was transformed from a busy commercial centre into the world's largest city. This transformation was associated with major capital infrastructure investments. The first London underground line, the Metropolitan line, was opened in London between Paddington and Farringdon in 1863. The history of the London underground was dominated by difficulties in accessing finance for capital investment. This was a continual problem. The underground had been built and run by private sector companies who had great difficulties attracting investment and in running the system for profit. Yet,

the *Metropolitan Underground Line* survived as a separate company until the creation of London Transport in 1933. This survival was based on the Line's ability to exploit its land resources around its stations. The Metropolitan promoted housing estates adjacent to the railway under the "Metro-land" brand with nine housing estates constructed near its stations. The Metropolitan obtained two Acts of Parliament during the 1880s which separated its land bank from the railway company. Usually, in the UK railway companies were not permitted to develop surplus land and the land had to be sold on to development interests. The Metropolitan acquired the rights to grant building leases and to sell ground rents, but also to develop its own housing estates (Halliday, 2001: 182). This included extensive developments in London's suburbs. In 1925 a retail development was constructed with 180 flats above Baker Street station with capital costs of £500,000 for an annual rental income of £40,000; a higher return on capital than could be made from running the railway line.

There is an important historic paradox at the centre of the relationship between London's underground and funding (revenue) and private sector finance (capital). The paradox was that London Underground had failed to earn a reasonable rate of return on capital invested by the private sector. Part of the problem was a conflict between people wanting to live in low-density estates in outer London and the population density required to support investment in an underground station. In 1920, it was argued by Albert Ashfield, chairman of the London Passenger Transport Board (LPTB) (1933–1947), that:

'either the circuit covered by a station must be rendered wider or the traffic denser by some means; cheap auxiliary forms of transport such as the motor omnibus may be developed to concentrate traffic on the railway stations ... A measure of coordination among the transport facilities in a district is thus unavoidable for success' (Ashfield, 1924: 4).

This analysis was correct to highlight the disparity between funding and finance but ignored the wider financial and social impacts of investment in railways. The business case for financing an underground ideally should capture some of the values resulting from escalation in the value of land that accrues from increasing connectivity, accessibility and density. Accessibility, thus, not only increases density impacting on the value of differential rent Ia & b and vice versa, but also encourages owners to invest to increase differential rent II. Nonetheless, these values were not then captured for supporting the underground.

In 1933, London Transport was established as a public body with commercial and social responsibilities to regulate London's infrastructure including financing and to develop a more integrated infrastructure system. In the late 1940s the UK's main line railways were nationalised, and their reconstruction was given priority over the maintenance of the Underground and most of the unfinished plans of the pre-war New Works Programme were shelved or postponed with the exception of the development of the Victoria line (opened 1968) and the Jubilee Line (opened 1979). Both the Victoria and Jubilee lines were the first to be subjected to a rigorous economic analysis. In the UK, cost-benefit analysis was initially applied to transport projects with the development of the M1 motorway followed by the Victoria line in 1963 (Foster and Beesley, 1963; Beesley and Foster, 1965). This analysis included time saved by passengers, including road users and the savings from reduced bus services. The initial calculation was that the Victoria line would generate an operating surplus of £250,000/year but that this would not cover the interest charges on capital costs of over £50 million (Halliday, 2001: 182). Nevertheless, between 1950 and 1997 the Underground experienced a period of financial deprivation. Nevertheless, after the Kings Cross fire disaster in 1987 there was an influx of capital which saw stations upgraded, and the busiest stations expanded.

During the 1990s finance and funding remained a continual problem. Consequently, the then Conservative government (1990–1997) sought to employ *Private Finance Initiatives* (PFI) to facilitate the delivery of large-scale capital projects that it could not afford immediately

(Horne, 2004: 78). The Underground would identify the projects and the PFI partner would design, deliver and operate the facility for an agreed time period and with a scale of usage charges (Horne, 2009: 76). This had the advantage of employing private rather than public capital, allowing projects to be delivered sooner and at lower risk of late delivery, though ultimately the costs were likely to be higher than using public financing (Horne, 2009: p.76). The Labour government that came into office in 1997 embraced the concept of private capital on an even larger scale relabelling this as a *Public-Private Partnership* (PPP). The Treasury decided to transfer all London Underground infrastructure and rolling stock to three privately owned companies on 30-year contracts; this left London Underground operational staff employed by the public sector but with privately ‘owned’ assets and privately managed engineering and maintenance staff (Horne, 2004: p.78). The PPP approach increased costs and also complexity. The private sector companies would finance the substantial investment needed to overhaul the ageing underground and in turn would receive performance-related service charges (Horne, 2004: 78).

In 1999, before control was passed to *Transport for London* (TfL), London Underground was divided into two parts so that a public-private partnership (PPP) arrangement could be established; London Underground remained a public company responsible for operations while private companies were responsible for upgrading the railway. TfL was created in 2000 as the integrated body responsible for London's transport system. TfL is constituted as a statutory corporation regulated under local government finance rules. TfL is now financed and funded in four main ways: (1) fares income – this is the largest single source of income; (2) other income, including advertising income, property rental and income from London's road traffic Congestion Charge; (3) grant funding from the Department for Transport (DfT) and Greater London Authority (GLA), and Crossrail funding; (4) borrowing and cash movements. As of 2017, £5 bn is raised from ticketing each year from the underground, bus and rail (Coff, 2017) and £1 bn annually from non-fares including property, retail and advertising (Coff, 2017). TfL has a capital programme (excluding Crossrail) which averages £2 bn annual project expenditure: upgrading roads, buses, Tube trains and infrastructure, i.e. tracks and stations (Coff, 2017). TfL has stated a need to achieve breakeven on their Operating Surplus by 2021/22 (Coff, 2017). They will not increase fares as they are committed to providing affordable transport for all, but there is no central government grant available (Coff, 2017).

In 2010, the experiment with PPP ended when TfL acquired the last remaining PPP contractor, Tube Lines, for £310 million. One of the ways in which TfL is seeking to increase revenue is through LVC using a similar strategy to that developed by the Metropolitan Line in the nineteenth century. The core opportunities for LVC have come from line extensions and station refurbishments. Previous examples of LVC in London include the White City scheme which used land occupied by the White City depot, the former Underground staff and training school and Central power station and the old Wood Lane station platforms and street buildings (Bruce and Croome, 2006: 80). London Underground owns the freehold to the 40-acre White City development site. This £1.5 billion project included new shops, housing, parking space and a transport interchange (Bruce and Croome, 2006: 80). Demolition started in 2003 and the shopping centre opened in 2008 and was the largest covered shopping development in London. In an expansion to this project, more than 30 unused railway arches in White City were transformed into a diverse mix of commercial, leisure and retail space. Transport for London's plan for the arches, near Wood Lane Tube station, incorporated new cycle parking and pedestrian passageways improving connectivity in the neighbourhood. This is a simple case of LVC based on a contractual partnership between TfL and the property developer. One element of this scheme included the construction of a new Hammersmith & City line station with the development partner, Westfield, contributing £170 m to transport improvements. Thus, in this example TfL gained from ‘direct land value capture’ with a share in the

development profit and the uplift in land values and ground rent that results from an increase in differential rent Ia but also benefited from developers investing to enhance differential rent II. Thus, the LVC equation was as follows:

$$\begin{aligned} &TfL \text{ Created Differential Rent Ia} + \text{Developer Created Differential Rent II} \\ &= LVC (\text{Developer Profit Share} + \text{Escalation in Ground Rent}) \end{aligned}$$

In addition, TfL benefited from additional demand from passengers. KPMG and Savills' research for TfL (2017) (using transactions data from the Land Registry and local controls for background price inflation and local place effects) identified that past projects such as the Jubilee line extension (JLE), the Docklands Light Railway (DLR) extension to Woolwich and the upgrade and incorporation of the North London line into the Overground network have produced significant land value uplifts, of 52%, 23% and six per cent respectively, relative to controls. The methodology is difficult and based on assumptions regarding comparative property values. Thus, the Savills' approach applied the ‘difference in difference’ method which explores variations in property prices over time between ‘treatment groups’ and ‘control groups’ (TfL, 2017: 21). The analysis for TfL used control groups of properties within a one to two-kilometre ring of property transactions. A key challenge is the selection of the control properties and differentiating between the direct and indirect impacts of infrastructure improvements from other possible impacts. There is thus a problem with causality and differentiating between differential rent Ia and Ib and controlling for other factors that impact on property values. These other factors include non-financial impacts related to fashion and alterations in the perceived desirability of streets and properties. The TfL analysis identified that for the Jubilee Line Extension (JLE) values within the zones of influence initially grew much faster than the control areas, before falling back in line with the control areas. Over the last two years of construction, value growth within the zones of underground influence accelerated, leading to a transport premium of approximately 30 percent when the JLE opened in November 1999 (TfL, 2017). The values within the JLE zones of influence grew faster than the control areas for the five years after the JLE opened, allowing for some volatility.

The LVC Final Report (TfL, 2017), commissioned jointly by the Mayor of London and TfL, which was published in 2017 and based on research by KPMG and Savills, identified that eight prospective TfL projects costing £36 bn, including Crossrail 2 and the Bakerloo line extension (BLE), could generate a land value uplift of £87 bn. The problem is that existing value capture mechanisms extract only a small fraction of land value gains from transport investment, in an *ad hoc* and poorly targeted manner. These mechanisms include: business rates on commercial premises; Stamp Duty Land Tax (SDLT) on the transfer of land or property (although this accrues to central rather than local government); over-station development; and development taxes such as the Community Infrastructure Levy (CIL) and negotiated developer contributions. Governments in the past have attempted to improve the ability to capture land value uplifts mainly by targeting new developments, and arguably using relatively blunt approaches including high tax rates. Improvements in data, technology and research methods now increasingly enable cities to isolate transport-induced value uplifts (differential rent Ia) in a more intelligent, targeted and potentially more proportionate manner. But, this is a relatively simple process when it involves contractual relationships over specific plots between a public-sector provider of infrastructure and private sector development interests. In this case, LVC can be directly negotiated and agreed based on an allocation of risks, rewards and ownership and access to assets. It is much more difficult to apply LVC to plots that have benefited from metro investments that are not in a contractual relationship with the infrastructural investor. In these cases of indirect LVC, a clear and transparent mechanism for identifying LVC impacts that result from any escalation in differential rent Ia is required.

A number of LVC options have been identified by TfL (2017), but

**Table 1**

Potential future transport for London land value capture projects.

Source: Savills analysis for TfL; value uplift over 30-year period from FY19 to FY48 (base case) (in TfL, 2017). Net present value in financial year 2016/17 prices, £bn.

Scheme	Type	Estimated cost	Value uplift on existing stock	Value uplift on new development	Total land value uplift	Uplift as % of cost
Crossrail 2	New rail line	27.5	47.8	13.1	60.9	221%
Bakerloo line extension	Rail line extension	3.3	11	7.1	18.1	548%
Crossrail 1 extension	Rail line extension	1.8	2.4	1.8	4.2	233%
Old Oak	Regeneration	0.9	1.7	1.2	2.9	322%
DLR Extension	Rail line extension	0.4	0.013	0.4	0.4	103%
Poplar	Regeneration	1.3	0	0.2	0.2	15%
A13	Regeneration/tunnel	0.8	0	0.2	0.2	25%
Camden Town Station	Station upgrade	0.2	0.045	0.003	0.048	24%
Total (rounded)		36	63	24	87	242%

the ‘transport premium charge’ proposed offers the most equitable and, according to TfL’s analysis, most financially significant model for financing transport investment. Such a charge could capture a proportion of the premium paid to landowners by new purchasers or tenants of residential property for access to new transport facilities. This reflects the proposed introduction of a form of indirect capture of the uplifts that can be attributed to differential rent Ia. This would create a novel mechanism to capture transport-induced value uplift that cannot currently be captured by the existing property tax system and has the potential to be an effective mechanism for financing new infrastructure (particularly schemes that could expand the supply of housing). The charge would mean that those who received the greatest benefits from improved transport links – firms and residents around the new or upgraded station – would pay more than others. The charge would be paid by existing and incoming businesses, while current residents would be exempt. According to TfL (2017) this charge could potentially generate between £13 bn and £28 bn of funding across eight sample TfL projects. This charge would go some way to capturing differential rent Ia uplifts, but it does not represent a complete calculation of these unpaid for benefits. Thus, this is a proxy measure and is really a form of land-based hypothecated taxation applied to finance and fund linked infrastructural investments. This approach reflects the difficulties of identifying and measuring the relationship between an infrastructure investment and any resultant differential rent Ia uplifts.

Transport for London’s (TfL) new Elizabeth line, also known as the Crossrail I project is expected to increase rail capacity in the city by 10%. With 118 km of new track and 10 new stations, total construction costs were estimated at almost £15 billion. The Elizabeth line opens in December 2018. Crossrail funding of £216m in 2017/18 financed the project to build the infrastructure for the Elizabeth line. TfL has implemented a variety of LVC mechanisms including betterment charges for commercial properties (the Crossrail Business Rate Supplements), development charges for developers (the Community Infrastructure Levy), land sales and developer contributions in lieu of development charges (as was the case with Canary Wharf station). While there is no clear evidence so far of Crossrail effecting the values of existing residential stock, there is evidence that it has produced uplifts on commercial property (around 1–2.5 per cent per annum relative to controls), and in enabling new residential development (with a 50% increase in density of new housing within 500 m of a Crossrail station compared to areas further away) (TfL, 2017).

A further, example of LVC is the Northern line extension (NLE) to Battersea which will improve transport links and public spaces in the area and is essential to support the transformation of Vauxhall, Nine Elms and Battersea, a designated regeneration area on the South Bank. The extension is set to open in 2020 and up to 25,000 jobs and 20,000 new homes could be created. Journey times from Nine Elms or Battersea to the West End or the City will, in some cases, be less than 15 min. An independent report on the economic impact of the NLE has shown it could generate substantial benefits to the area. The extension is a partially privately funded project based on direct land value capture

from the site developers, SP Setia and Sime Darby, with contributions from other sources such as the new US Embassy. Similarly, TfL intends to fund a significant portion of the Bakerloo line extension into South East London through housing development around stations. A *Tax Increment Financing* (TIF) (Bryson et al., 2017) arrangement was also agreed to provide additional funding for the Northern Line Extension. The Greater London Authority (GLA) took out a loan of up to £1 billion to fund the project, with a repayment guarantee provided by the UK government. Loan repayments are expected to be repaid, in part, through future growth in business rates revenue within the Nine Elms Enterprise Zone. A TIF mechanism is either an alternative to a LVC approach or is complementary.

Savills (in TfL, 2017) using evidence from the academic literature, the London case studies and specific development potential studies estimated, at an order of magnitude, the scale of uplift that might be produced by a sample of potential future TfL LVC projects. This included both the capitalisation of user benefits into land and property values (differential rent Ia), as well as any planning gains arising out of new developments (differential rent II) (Table 1). There is no direct relationship between the estimated cost of an infrastructure enhancement and land value uplift. For instance, Crossrail 2 (a proposed rail route in South East England) and the Bakerloo line extension are clearly premised on capacity and accessibility improvements, which should lead to large land value differential rent Ia uplifts on adjacent plots, and in line with a project such as the JLE. The A13 tunnel or the decking scheme at Poplar will produce relatively modest transport improvements but they release more land for development, which presents the opportunity for value creation in the surrounding area as a result of ‘placemaking’ (TfL, 2017) and enhancement the value of differential rent Ia. An analysis of individual projects reveals some clear differences. Projects such as Crossrail 2 and the BLE produce the majority of their land value uplifts – all differential rent Ia – from the capitalisation of user benefits into residential property prices, with Crossrail 2 (but not the BLE) generating material uplifts also from commercial property (TfL, 2017). In contrast, projects such as the DLR extension, Poplar and the A13 tunnel produce their impacts largely by catalysing new development opportunities.

London Underground’s attempt to apply LVC reflects the long history of this transport infrastructure. Decisions made in the past transferred land and development rights to the private sector undermining the Underground’s ability to develop a sustainable financial model. The development of London Underground’s approach to LVC reflects the accumulation of contractual lock-in brought about by decisions made when the underground lines were planned, developed and nationalised. The consequence is that for this underground a mixed economy of financing and funding is emerging that blends different approaches based on an accumulation of decisions made since 1863. Retrofitting LVC to an existing underground system has meant that, for London, limited LVC will be acquired and any gains will be relatively marginal and predominantly associated with the development of new lines and line extensions. The problem is that the majority of differential rent Ia

uplifts from infrastructural investments have already been realised by private landowners as a consequence of investments made in the distant past. LVC is being applied in a relatively *ad hoc* manner reflecting the contractual position of each line or station. To be effective LVC must be incorporated into the development financial model of an underground rather than retrofitted. This was the position for the Hong Kong metro. We now turn to the analysis of this underground system to explore a metro in which LVC played a central role in the provision of finance and funding from the initial development of the infrastructure.

#### 4. Financing Hong Kong's Mass transit railway

Hong Kong is densely populated with more than 7 million people living in a city of 1,100 square kilometres. In 1967, a study was undertaken by the Hong Kong Government to identify solutions to road congestion. In response, the *Mass Transit Railway* (MTR) was established as a public entity in 1975. MTR was solely owned by the Hong Kong government during the 1980s to 1990s. In 2000, 23% of its shares were sold to private investors with the government retaining 77% (Sharma and Newman, 2017). This restructuring aimed at enhancing the efficiency, competitiveness and profitability of MTR (Wong, 2015). Since then, the company's innovative financing and funding model has led to a profit-making transit operation with a revenue of HK \$45.2 billion in 2016 and a net profit of HK\$9.4 billion (MTR Annual Report, 2016). As of 2017, MTR has 221 km of rail with 155 stations including 89 railway stations and 68 light rail stops. On average, in July 2017 the MTR carried 4.74 million passengers per day and accounted for 43.5% of daily passenger journeys by public transport (MTR Monthly Traffic and Transport Digest, 2017).<sup>1</sup> The operating cost per passenger in Hong Kong was \$0.61 US dollars while revenue per passenger was \$0.96. The MTR is unusual as it does not rely on government subsidies (World Bank, 2001). During 1980–2005, Certero and Murakami (2009) estimated that the Hong Kong government's majority share in MTR generated HK\$140 billion net financial returns. This is based on the difference between earned income of HK\$171.8 billion from land premiums, market capitalisation, shareholder cash dividends and initial public offer proceeds, and the value of government injected equity capital HK\$32.2 billion. The fare box ratio which describes the ratio between fares collected and operational costs in Hong Kong was 1.56. This high fare box ratio is achieved in part by Hong Kong's dense population and part by the efficiency and reliability of the underground system (Wong, 2015). Tang et al. (2018) highlighted the positive impacts of Hong Kong MTR in terms of improvements in urban transport accessibility, enhancing overall societal efficiency via a special institutional arrangement, and stabilising property prices during economic downturns.

In Hong Kong all land in the territory is owned by the government, but development rights are sold to private developers through public auctions. The 'rail-cum-property' model developed to finance and fund the MTR is different from London. At the initial stage of planning a railway line, the MTR conducts a feasibility study to calculate project costs, patronage, revenue and to identify potential property development opportunities that will result from any uplift in differential rent Ia. The government then assesses the proposed lines and routes, and MTR develops a development plan including services to build schools and hospitals (Enoch, 2002). MTR then negotiates development rights (often for a period of 50 years, sometimes 70 years) that allow it to develop properties above railway stations, depots and adjacent land (Hung, 2014; Verougstraete and Zeng, 2014). The government grants these development rights exclusively to MTR, so that MTR does not have to purchase land from the open market. The development rights are granted at a full market value before the establishment of the new

rail line (i.e. the 'before-rail' market price). The MTR receives no other government subsidies (Tiry, 2003). This means that the MTR business model is based on the realization of differential rent Ia & Ib and differential rent II.

MTR prepares a public bidding process to divide the development rights into more manageable projects and allocate them to private property developers who will bear construction and commercial risks (Verougstraete and Zeng, 2014). Under the land leasing conditions, MTR enters into partnerships with property developers selected from a list of qualified bidders based on full market value including the transport premium, or escalation in differential rent Ia, associated with the new line (i.e. the 'after-rail' market price). The price difference between the 'before rail' and 'after rail' is often substantial – differential rent Ia – and can cover all development costs, such as land premiums, construction costs and relevant enabling works and marketing. The full control of the land remains with MTR because it does not sell the development rights to private developers (Suzuki et al., 2015). The developers construct buildings and sell them acquiring uplifts in the value of sites that accrue from differential rent Ia and II. The differential rent equation is as follows:

$$\begin{aligned} & \text{MTR Created Differential Rent Ia} + \text{Developer Created Differential Rent II} \quad \text{Around} \\ & = \text{LVC (MTR Developer Profit Share (Development Gain and Rental Income)} \\ & \quad + \text{Future Profits by MTR Retaining Development Rights)} \end{aligned}$$

20–25% of the developers' profits are acquired by the MTR and any losses are covered by the developers (Enoch, 2002); MTR financing comes from the profit share.

MTR is responsible for aligning multiple shareholder interests in different project phases. It prepares development plans, connects all interfaces between railway stations and properties, enforces technical control standards, deals with land tenders, liaises between the government and property developers, monitors development quality and property sales and manages properties after completion (Suzuki et al., 2015). The 'rail-cum-property' model is based on capturing an MTR share of any uplift from differential rent Ia enabling MTR to plan and integrate different phases of its railway and property development plans to ensure effective implementation, minimize delays and reduce transaction costs (Sharma and Newman, 2017).

When selecting property developers, MTR often negotiates for its share of development profits from the sale or leasing of properties and the sharing of assets in-kind. Through this process, MTR not only benefits from up-front payments generated from development rights but also receives a share of future revenue and development profit (Certero and Murakami, 2009) – including that accruing from differential rent II. The terms of the direct LVC profit allocation model between MTR and private developers is agreed by negotiation. For residential properties, MTR receives an agreed proportion of any profit generated from property sales when a private developer sells units before the contractual deadline. After this deadline, MTR can decide to sell or lease any unsold units. For commercial properties such as shops and offices, MTR obtains profit from leasing to developers or retaining parts of these assets to obtain long-term rental income (Enoch et al., 2005; Verougstraete and Zeng, 2014). Between the establishment of the MTR in 1975 and 1986, three urban lines were completed: Kwun Tong, Tsuen Wan and Island. From these three lines, 18 sites were developed, including 28,000 apartments, 150,500 m<sup>2</sup> of retail and 128,500 m<sup>2</sup> of office space. MTR manages these developments; and the rental and fees from managing these properties was HK\$697 million in 1998 accounting for around 10% of MTR's revenue in that year (Enoch, 2002). By capturing part of the land value and property developed around railway lines via sharing profits with developers, obtaining part of the ownership of new developments and rent from on-site properties, MTR generates revenue from operations, maintenance and new projects (Leong, 2016). This is a very different approach to London Underground as LVC, via contractual agreements with developers based on a direct LVC model, has always been a central element of the MTR's financing/funding strategy. The MTR is directly capitalising on and

<sup>1</sup> Available from: <https://www.gov.hk/en/about/abouthk/factsheets/docs/transport.pdf>.

**Table 2**

MTR operating profit contributions (HK\$bn).

Source: MTR Annual Report, 2016.

	2012	2013	2014	2015	2016	Total	%
Hong Kong Transport Operations	6.5	6.7	7	7.2	7.6	35	40
Hong Kong Station Commercial Businesses	3.3	4.1	4.5	4.8	5	21.7	25
Hong Kong Property Rental and Management Businesses	2.8	3.1	3.4	3.7	3.9	16.9	19
Hong Kong Property Development	3.2	1.4	4.2	2.9	0.3	12	14
Mainland of China and International Railway, Property Rental and Management Subsidiaries	0.6	0.8	0.9	0.7	0.6	3.6	4
Other Businesses	0.1	0.2	0.2	0.1	0.2	0.8	1
Mainland of China Property Development Subsidiary	0	0	-0.1	-0.1	0.4	0.2	0.23
Project Studies and Business Development Expenses	-0.4	-0.5	-0.5	-0.3	-0.4	-2.1	-2
<b>Total Operating Profit</b>	<b>16.1</b>	<b>15.8</b>	<b>19.6</b>	<b>19</b>	<b>17.6</b>	<b>88.1</b>	<b>100</b>

capturing uplifts that accrue from increases in both differential rent Ia and differential rent II, but also any uplifts from differential rent Ib. London Underground is trying to copy this approach to finance the development of new lines and extensions.

MTR obtains revenue from three sources: (1) fare income from the core business of providing public transport services; (2) income from developing and providing other commercial services that are complementary to railway operations (such as kiosks, advertising, exhibitions and consultancy services); and (3) income from property development and management based on the impact of infrastructural investments on differential rent Ia. There are political difficulties with raising fares and this means that MTR is heavily reliant on non-fare revenue. The second and third income sources are critical for MTR's financial sustainable as fare revenue alone does not cover capital depreciation and financing costs (Tang and Lo, 2010a).

During 2012–2016, HK\$35 billion of operating profit came from transportation or 40% of total operating profit (Table 2) and HK \$21.7 billion from commercial businesses in Hong Kong stations. The property rental and management businesses in Hong Kong was the third largest source of operating income, accounting for around 19% of total operating profit (MTR Annual Report, 2016). MTR has the world's highest 'fare box recovery rate' or the percentage of income from ticket sales weighted against operating expenses, typically between 150% and 180% (Wong, 2015). An annual fare adjustment mechanism was introduced in Hong Kong as early as 2007 and this was instrumental in ensuring that MTR fares were in line with local economic conditions, wage levels and the company's productivity, as reflected in a productivity factor after the merger of the MTR and KCRC (Transport and Housing Bureau, Transport Department, 2016). Furthermore, since the 1990s, a co-ordinated approach to transport and land use planning (generally termed transit-oriented development or TOD), with the railways-as-the-backbone transport policy in Hong Kong, has contributed to high levels of metro patronage creating a substantial 'fare box recovery rate' (Loo et al., 2010; Loo et al., 2017).

House price premiums were found to be between 5 and 17% for units built as part of 'rail-cum-property' projects (Cervero and Murakami, 2009). This range highlights the variability in the relationship between infrastructural investment and its impacts on differential rent Ia. This variation is explained by distance decay, or reach, of the impacts of infrastructural investments and the impacts that accrue to the most or least accessible stations in the MTR network. Project with transit-oriented designs reflected by the location of adjacent shops, high quality pedestrian corridors and open space obtain a premium in excess of 30%. Choy et al. (2007) identified that in 1999–2000, on average properties in the Quarry Bay District within 10-minute walk to an MTR station had a HK\$100,000 price premium. According to JLL, the investment management firm, the new Kwun Tong MTR Line extension in 2016 was expected to lead to an 80% and 95% rise in residential property values in Ho Man Tin and Whampoa, respectively

(South China Morning Post, 2016).<sup>2</sup> The Land Registry's record shows that the average sale price of South Horizons flats in Ap Lei Cha increased from HK\$13,320 per square foot in January 2016 to HK\$17,000 in July 2016. In addition, the government's confirmation of the development plan for the Shatin to Central Link increased the average price of residential property by 46% per square foot in Kowloon City district.<sup>3</sup> Apart from increased property values which accrue to private property owners and property developers, part of the LVC can be obtained by the Hong Kong government via properties taxes. Property tax is charged at a standard rate of 15% of the net assessable value of properties, which is determined by rent, service charges and fees paid to the property owner, minus a 20% allowance on the net assessable value for property repairs and maintenance (Hong Kong Government).<sup>4</sup>

Another 'rail-cum-property' example is the Tung Chung Station on the Tung Chung Line. This is a transit-oriented development, consisting predominantly of residential housing with retail, offices and a hotel adjacent to the station. MTR partnered with property developers who paid a land premium and development costs to obtain the property development rights (Suzuki et al., 2015). The two parties worked out a coordinated design for the development of the railway and adjacent properties (Cervero and Murakami, 2009). Not only can MTR enjoy the land premium income (differential rent Ia & Ib), it also benefits from in-kind assets and a share in development profits (differential rent II). In terms of ownership, the residential towers are sold to and owned by individual flat owners, while the shopping malls and retail stores, offices and hotels are owned by the property developers, and the public transport interchanges are owned by the government. MTR manages the residential towers and obtains management income. Developers manage malls, offices, town squares; and hotels are managed by hotel operators. The town square and public transport interchanges are managed by the delegated operator appointed by the government (Murakami, 2012). MTR has developed a LVC model based on differential rent Ia combined with a model based on acquiring profits that accrue from uplifts that result directly from property development and investment (differential rent II) and management fees.

Another project is Maritime Square, which is part of the development of Tsing Yi Station. What is special about this case is that it has been designed to ensure 'seamless' integration between the railway station and the shopping centre enhancing the experience of residents, passengers, visitors and shoppers. Residents living in the apartments above the station enjoy 'weather-free' conditions as they can shop and

<sup>2</sup> Available from: <https://www.okay.com/en/property-news/how-will-the-mtr-south-island-line-affect-the-property-market-in-hong-kong/403#>. WdTe02eQzL8 and <http://www.scmp.com/property/hong-kong-china/article/2039636/mtr-effect-rubs-property-sales-whampoa-and-ho-man-tin>.

<sup>3</sup> Available from: <https://www.okay.com/en/property-news/how-much-will-upcoming-mtr-developments-influence-district-property-prices/572#>. WduajGeQzL8.

<sup>4</sup> Available from: <https://www.gov.hk/en/residents/taxes/property/propertycompute.htm>.

travel without going outside. The benefits of land integration are made possible by master planning undertaken by MTR and incorporated in to 'Development Agreements'. In other words, MTR controlled and supervised the implementation of this master plan ensuring development quality (Tang et al., 2004; Cervero and Murakami, 2008). Property developers paid a land premium and development costs (Hung, 2014).

Apart from the 'rail-cum-property' model, two other models exist to provide mass transport in Hong Kong. One is the *initial subsidy model*, and the other is the *concession model*. Under an initial subsidy model, the government finances part of the initial investment but does not build it. Private investors provide the rest of the finance for construction, and are responsible for the operation and management, on-going investment and asset upgrades. Hong Kong Disneyland Resort Line (DRL) is one example. In 2002, MTR estimated that the construction of the DRL would cost HK\$2 billion. However, the project was unable to achieve an appropriate commercial rate of return and was short of HK \$798 million. Other options such as granting property development rights and equity injection were subject to various restrictions and therefore were not suitable. After the government had reviewed the market environment, patronage and market share estimates, cost estimate and MTR's revenue, it waived HK\$798 million worth of dividends between 2002 and 2004 (Legislative Council, 2015).<sup>5</sup> Another financially unviable project is the West Island Line. The government granted \$12.7 billion towards construction to close the project's financing gap. It involved extending the existing Island Line from Sheung Wan to Kennedy Town with two intermediate stations at Sai Ying Pu and the University of Hong Kong.<sup>6</sup> The MTR has a mixed finance/funding model that includes government subsidy for currently unviable lines combined with LVC, property development/investment gains and user charges. This supports the long history of difficulties with the financing and funding of undergrounds; LVC and property gains work in some places, but more marginal lines require subsidy to close the financial viability gap in the initial investment appraisal.

Under a concession model, the government is responsible for financing, building, owning and leasing existing railway lines to MTR. MTR has to pay rent and is responsible for on-going investment. This reduces the total investment required and improves MTR's investment return. One example is the West Rail in Hong Kong which was directly financed by the government in the form of upfront equity injection. It was built, owned and operated by Kowloon Canton Railway (KCR) who acts as an agent for the government to develop properties on top of the railway station and return a share of the profit to the government. This reflects the creation of a form of special purpose vehicle in which government directly obtains a share of the uplift resulting from differential rent Ia and II. The government bears the risks of obtaining a return on this investment. This line was acquired from KCR by MTR in 2007 under a 50-year lease agreement whereby MTR is in charge of operations, management and on-going investment (Tang and Lo, 2010b; Kam, 2017). The East Rail Line and Ma On Shan Rail Line are also operated under this model.

'Rail Gen 2.0' was introduced in 2016 as an alternative business model to develop MTR with a focus on providing better connections and services. Some of the 'Rail Gen 2.0' projects are financed by a Green Bond designed to improve services and environmental performance. Green bonds are similar to conventional bonds but the exception being that the proceeds from a green bond are invested in projects with environmental outcomes. In its simplest form, a bond issuer raises a fixed amount of capital, and then repays the capital and interest over a

defined time period (United Nations Development Programme)<sup>7</sup>. The proceeds from Green Bonds are used to finance or refinance, in whole or in part, MTR projects that meet eligibility criteria such as low carbon transportation, energy efficiency improvements, sustainable transit stations and real estate property development (MTR Green Bond Report, 2016).<sup>8</sup> This bond utilises a new fast-growing bond investor base providing the same cost effective financing as a traditional bond. MTR issued a debt of US\$600 million as a 10-year Green Bond in November 2016, generating net proceeds of US\$598.05 million. The Green Bonds attracted investors including asset managers, banks, and insurance companies from Asia and Europe. This is one type of financialization, but a type that is controlled and coordinated by MTR. The infrastructural assets continue to be defined by the quality of the urban service that they provide rather than solely based on financial criteria. The bond provides upfront capital investment which is repaid, in part or whole, by savings that result from investments which enhance environmental outcomes. New projects financed from this Bond include the 2.6-kilometre Kwun Tong Line Extension which opened in October 2016. Total investment in the Kwun Tong Line Extension was HK \$6.9 billion, of which HK\$1.3 billion (US\$167.74 million) came from the Green Bond. This project reduced the journey time between Whampoa and Yau Ma Tei stations by 15 min. It is estimated that 19,000 tons of CO<sub>2</sub> emissions would be reduced, apart from other benefits such as reduced road traffic, energy saving and pollution reduction.

The expansion of the MTR is based on different funding models. For instance, the West Island Line, owned by MTR, is based on the initial subsidy model. The government granted MTR HK\$400 million in 2008. The Shatin to Central Line applied the concession model with the government providing the line's capital costs, and MTR is responsible for operations, maintenance, asset renewal and replacement. The South Island Line (East) and Kwun Tong Line Extension used the 'rail-cum-property' model (MTR Annual Report, 2010).

## 5. Discussion and conclusions

Underground transport infrastructure requires a substantial upfront capital investment with fare revenue representing a continual long-term stream of funding that is expected to underwrite development, refurbishment and operational costs. Through the above comparative longitudinal analysis, we have examined some of the more successful business models in London and Hong Kong. Some value lessons about LVC, differential rent and financialization can be drawn. At the conceptual level, the impacts of transport infrastructure investments are complex including direct transport impacts on travel times and the reduction of congestion and indirect impacts related to an escalation in the value of differential rent Ia, but also uplifts in differential rent II from property investments and from differential rent Ib. This paper has developed a new conceptual framework for exploring LVC by applying and developing an approach based on the urban rent theory. The calculation of LVC is a complex task based on understanding the inter-relationships and impacts of three different types of differential rent – Ia & Ib and II. The primary relationship is defined by a new division of differential rent I into two sub-types – Ia directly linked to infrastructural investment and Ib directly linked to investments on adjacent plots usually by the private sector. This new framework provides an approach to guide innovations in the measurement or assessment of LVC. It clearly identifies or allocates the impacts of distinct investments on plot values highlighting the importance of separating the impacts that result from different types of property-related investments and

<sup>5</sup> Available from: <http://www.legco.gov.hk/research-publications/english/essentials-1415ise15-foregoing-dividends-to-finance-infrastructure-projects.htm>.

<sup>6</sup> Hong Kong's Information Services Department (2009). Available from: <http://www.info.gov.hk/gia/general/200905/26/P200905260179.htm>.

<sup>7</sup> Available from: <http://www.undp.org/content/sdfinance/en/home/solutions/green-bonds.html>.

<sup>8</sup> Available from: [https://www.mtr.com.hk/archive/en/community/MTR\\_GreenBondRpt2016\\_Eng.pdf](https://www.mtr.com.hk/archive/en/community/MTR_GreenBondRpt2016_Eng.pdf).



interventions.

The debate on the financialization of infrastructure has argued that 'Infrastructural assets are defined by institutional investors not through physical characteristics, such as a bridge or a road, but through the low-risk and predictable investment return characteristics' (Torrance, 2009: 819).

This is all very well, but there is an important omission in the financialization debate (Bryson et al., 2017). This omission is a very simple question – what is being financialized? Financialization may involve infrastructure directly – a bridge – but much is based on the financialization of the impacts of infrastructural investment – differential rent Ia. The London Underground is an excellent example. TfL is a public-sector organisation or a collective provider of infrastructure, but many of the land-based impacts of this collective provision have been acquired by private actors. Thus, for the London Underground what has been financialised is not the provision of urban services, but some of the impacts of this provision – in other words, uplifts that are part of differential rent Ia and enhanced by investments that impact on differential rent II and Ib. The on-going debate on financialization needs to pay careful attention to what is being financialized and this must include an analysis of all types of differential rent and their impacts. Differential rent is critical as land and land-based effects are a fundamental element in the provision of all types of urban services.

From an investment decision-making perspective, what is apparent from this comparative analysis is that, for London, decisions made in the past have meant that many of the indirect financial benefits from investment in the underground have been captured by private property developers and investors. Thus, public investment in the London Underground is acting as an invisible subsidy to private finance and this reflects a long-term process of the financialization of land. For Hong Kong financialization of indirect benefits is heavily controlled and regulated by the government and MTR throughout. The London Underground is an example of incremental planning with the consequence that the business models supporting this infrastructure are fragmented as they reflect a diversity of different types of contractual relationship. For the MTR there is still a diversity of financing business models, but at the core of each is a concern with monetising any escalation in differential rent Ia and differential rent II that can be linked to MTR investments.

Hence, an important lesson is that a direct approach to LVC through seizing differential rent Ia and differential rent II to the underground development and operations is beneficial. Though the MTR has been developed using a number of distinct financing/funding models, at the centre of these models is a concern with a direct approach to LVC through ownership of freeholds and the sharing of development profits with the private sector. This is an interesting strategy and is one that provides an alternative approach to the financing models explored in the on-going debate regarding financialization and the private and public sectors. Much of the focus of this literature is on the increased importance of private sector financial motives, markets and institutions in shaping economies and decisions. The MTR is an example of an alternative type of financialization; the government and the MTR is developing a direct approach to LVC based on financial motives and markets but designed to create societal gains through the financing and funding of local infrastructure. Thus, the MTR has applied financialization to the provision of rail services in Hong Kong by exploiting, managing, controlling and co-ordinating a direct relationship between differential rent Ia and LVC. The MTR is not only an investor in infrastructure, but also a long-term landowner, property developer, development partner, property manager and property investment. This approach places LVC and financialization at the centre of the provision of rail services in Hong Kong. This is a process in which collective provision continues but as part of a state managed process of financialization based on exploiting the financial gains that result from differential rent Ia & b and II. For the MTR infrastructure assets are defined

by the services provided and that are financed and funded by a mixed financial model based on income streams from providing transport services, short-term development gains and a share in long-term rental gains.

In addition, as demonstrated in the MTR case, placing LVC at the centre of an underground's business model has clear benefits of helping to ensure a balance between fare and non-fare revenue. This is critical for the long-term sustainability of a metro system and can represent a best-practice approach to LVC. Nonetheless, it also means that the sustainability of the underground is highly reliant on property-related transactions and the ability of the metro company to appropriate financial value from uplifts in differential rent Ia that accrue from its investments in increasing the accessibility of plots and in releasing development sites. This point is particularly important as illustrated by the MTR example that some of its development gains come from releasing development sites rather than from any escalation in differential rent Ia from infrastructural investments. This means that the metro company has created a financial/funding model based on LVC – one that captures value from investments that create differential rent II. There is a temporal aspect to this financial/funding model. Differential rent Ia results from an initial infrastructural investment while differential rent II gains can occur at any time as long as the underground retains control of the development rights.

In contrast, the London example shows the underground being initially developed and co-ordinated by and for private sector interests only. The business model was not successful. Subsequent nationalisation not only led to a dependence on taxation and user fees, but was also associated with limited investment. More recently, LVC and TIF based financial mechanisms are being explored, but most of the benefits that have resulted from differential rent Ia are outside the direct control of the London Underground. The current proposals under development by TfL represent an indirect approach to LVC based on attempts to tax unpaid benefits that accrue from differential rent Ia combined with direct LVC in the case of new lines and extensions. The problem is that TfL no longer owns the land directly linked to the existing underground lines as much of this is owned by private actors – financial institutions including pension funds. There is an important distinction to be made here. As a lesson learnt, it is important that the development of new underground lines and extensions does not decouple the tunnels and tracks from the land directly affected by the impacts that infrastructure investment has on enhancing accessibility. This land should be considered to be a critical asset managed to obtain short-term development profit combined with a continual rental stream to support the on-going funding and financing of the provision of infrastructure services.

As demonstrated in the London case, a key lesson is the importance of retaining ownership of land and development rights as continued investments in plots related to the underground provide future streams of revenue to support finance and funding. In contrast, the sale of land that benefits from differential rent Ia impacts will transfer these gains to the private sector, leaving the underground with reduced opportunities to benefit from LVC accruing from all three types of differential rent. This restricts the contribution that LVC makes to the underground's business model, though some of the indirect benefits that accrue from public sector investment in infrastructure are captured by property and land value-based taxes including business rates. It is critical that any new line or extension to existing lines develops a proactive and long-term approach to appropriating the plot-based impacts of public sector infrastructural investments.

The experiences of LVC and financialization in London and Hong Kong not only reflect different histories, institutional and governance structures, but also different approaches to capturing the value of infrastructure investment to support continued investment, development, renewal and operations. While there are other transport and land use policy and planning factors which have contributed to the financial sustainability of the underground railways in London and Hong Kong, securing a sustainable financial model is an essential step in ensuring

that the risks related to multi-billion investment decisions of developing major underground infrastructure, such as metros, are minimized for the long-term benefits of society.

## Acknowledgements

This research has been partially funded as part of the iBUILD Research Centre (Infrastructure Business models, valuation and Innovation for Local Delivery). iBUILD is funded by the Engineering and Physical Sciences Research Council (EPSRC) and the Economic and Social Science Research Council (ESRC) (EP/K012398/1). The usual disclaimers apply.

## References

- Ashfield, A., 1924. London's Traffic Problem Reconsidered, The 19th Century and After Review, August.
- Beesley, M.E., Foster, C.D., 1965. The victoria line: social benefit and finances. *J. R. Stat. Soc. Ser. A (Gen.)* 128: 1, 67–88.
- Bryson, J.R., 1997. Obsolescence and the process of creative reconstruction. *Urban Stud.* 34 (9), 1439–1458.
- Bryson, J.R., Mulhall, R.A., Song, M., Kenny, R., 2017. Urban assets and the financialization fix: land tenure, renewal and path dependency in the city of Birmingham. *Camb. J. Regions, Econ. Soc.*
- Bryson, J.R., Mulhall, R.A., Song, M., Loo, B.P.Y., Dawson, R.J., Rogers, C.D.F., 2018. Alternative-substitute business models and the provision of local infrastructure: Alterity as a solution to financialization and public-sector failure. *Geoforum* 95, 25–34.
- Bruce, J.G., Croome, D.F., 2006. *The Central Line: An Illustrated History*. Capital Transport Publishing, London.
- Cervero, R., Murakami, J., 2008. Rail + Property Development: A Model of Sustainable Transit Finance and Urbanism. Available from: <https://pdfs.semanticscholar.org/ddee/cb08f21dc5f71eba6b2e024d0c0a77d31f01.pdf>. (accessed 28th October 2017).
- Cervero, R., Murakami, J., 2009. Rail and property development in Hong Kong: experiences and extensions. *Urban Stud.* 46 (10), 2019–2043.
- Choy, L., Mam, S., Ho, W., 2007. Modeling Hong Kong real estate prices. *J. Housing Build Environ.* 22 (4), 359–368.
- Coff, T., 2017. Mind the Gap: Financial Sustainability at TfL. LinkedIn. Available online at: <https://www.linkedin.com/pulse/mind-gap-financial-sustainability-tfl-tanya-coff/> (accessed on 5th August 2017).
- Du, H., Mulley, C., 2007. The short-term land value impacts of urban rail transit: quantitative evidence from Sunderland, UK. *Land Use Policy* 24 (1), 223–233.
- Enoch, M.P., 2002. Recouping public transport costs from gains in land values. *Traffic Eng. Control* 43 (9), 336–340.
- Enoch, M., Potter, S., Ison, S., 2005. A strategic approach to financing public transport through property values. *Publ. Money Manage.* 25 (3), 147–154.
- Epstein, G.A., 2005. Financialization and the world economy. In: Epstein, G.A. (Ed.), *Financialization of the World Economy*. Edward Elgar, Cheltenham, pp. 3–16.
- Foster, C.D., Beesley, M.E., 1963. Estimating the Social Benefit of Constructing an Underground Railway in London. *J. R. Stat. Soc. Ser. A (Gen.)* 126: 1, 46–93.
- Green Bond Report, 2016. Available from: [https://www.mtr.com.hk/archive/en/community/MTR\\_GreenBondRpt2016\\_Eng.pdf](https://www.mtr.com.hk/archive/en/community/MTR_GreenBondRpt2016_Eng.pdf). (accessed 30th October 2016).
- Haila, A., 2016. *Urban Land Rent: Singapore as a Property State*. Wiley Blackwell, Chichester.
- Halliday, S., 2001. *Underground to Everywhere: London's Underground Railway in the Life of the Capital*. The History Press, Stroud.
- Horne, M., 2004. *The Victoria Line*. Capital Transport Publishing, London.
- Horne, M., 2009. *The Northern Line*. Capital Transport Publishing, London.
- Hung, W., 2014. Transit oriented development and value capture – Hong Kong. Available from: UNESCAP Regional Expert Group Meeting on Sustainable and Inclusive Transport Development and 2nd Asia BRTS Conference. (accessed 17th August 2017).
- Kaliampakos, D., Benardos, A., Mavrikos, A., 2016. A review on the economics of underground space utilization. *Tunnell. Undergr. Sp. Technol.* 55, 236–244.
- Kam, J., 2017. MTR's Experiences in PPP for Railway Projects. Available from: [https://www.unece.org/fileadmin/DAM/ceci/documents/2017/PPP/Forum/Presentations/Jacob\\_Kam-MTR%E2%80%99s\\_Experiences\\_in\\_PPP\\_for\\_Railway\\_Projects.pdf](https://www.unece.org/fileadmin/DAM/ceci/documents/2017/PPP/Forum/Presentations/Jacob_Kam-MTR%E2%80%99s_Experiences_in_PPP_for_Railway_Projects.pdf). (accessed 21st August 2017).
- Larmarche, F., 1976. Property development and the economic foundations of the urban question. In: Pickvance, C. (Ed.), *Urban Sociology*. Methuen, London, pp. 85–118.
- Leong, L., 2016. The “Rail plus Property” model: Hong Kong's Successful self-financing formula. Available from: <https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/the-rail-plus-property-model>. (accessed 30th October 2017).
- Li, L., Loo, B.P.Y., 2016. Impact analysis of airport infrastructure within a sustainability framework: case studies on Hong Kong International Airport. *Int. J. Sustain. Transp.* 10 (9), 781–793.
- Loo, B.P.Y., 2018. *Unsustainable Transport and Transition in China*. Routledge, London and New York.
- Loo, B.P.Y., Banister, D., 2016. Decoupling Transport from Economic Growth: Extending the Debate to include Environmental and Social Externalities. *J. Transp. Geogr.* 57, 134–144.
- Loo, B.P.Y., Cheng, A.H.T., 2010. Are there useful yardsticks of population size and income level for building metro systems? Some worldwide evidence. *Cities* 27, 299–306.
- Loo, B.P.Y., Chen, C., Chen, E.T.H., 2010. Rail-based transit-oriented development: lessons from New York city and Hong Kong. *Landscape Urban Plann.* 97, 202–212.
- Loo, B.P.Y., Li, D.Y.N., 2006. Developing metro systems in the People's Republic of China: policy and gaps. *Transportation* 33, 115–132.
- Loo, B.P.Y., Cheng, A.H.T., Nichols, S.L., 2017. Transit-oriented development on greenfield versus infill sites: Some lessons from Hong Kong. *Landscape Urban Plann.* 167, 37–48.
- Marx, K., 1984. *Capital*, vol. 3 Lawrence and Wishart, London.
- Mohammad, S., Graham, D., Melo, P., Anderson, R., 2013. A meta-analysis of the impact of rail projects on land and property values. *Transp. Res. Part A* 50, 158–170.
- MTR Annual Report, 2010. Available from: <https://www.mtr.com.hk/archive/corporate/en/investor/2010>. (access 22nd October 2017).
- MTR Annual Report, 2016. Available from: <http://www.mtr.com.hk/archive/corporate/en/investor/annual2016/EMTRAR2016F.pdf>. (accessed 16th October 2017).
- MTR Monthly Traffic and Transport Digest July, 2017. Available from: [http://www.td.gov.hk/filemanager/en/content\\_4858/1707.pdf](http://www.td.gov.hk/filemanager/en/content_4858/1707.pdf). (accessed 28th October 2017).
- Murakami, J., 2012. Value Capture Techniques in Hong Kong and Tokyo: Strategic Transit Finance and Station Area Development. Available from: <http://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/336387-1370897562331/Murakami-web.pdf>. (accessed 17th August 2017).
- Pagliara, F., Papa, E., 2011. Urban rail systems investments: an analysis of the impacts on property values and residents' location. *J. Transp. Geogr.* 19 (2), 200–211.
- Sharma, R., Newman, P., 2017. Urban rail and sustainable development – key lessons from Hong Kong, New York, London and India for emerging cities. *Transp. Res. Procedia* 26, 92–105.
- Suzuki, H., Murakami, J., Hong, Y., Tamayose, B., 2015. Financing Transit-Oriented Development with Land Values – Adapting Land Value Capture in Developing Countries. International Bank for Reconstruction and Development / The World Bank, Washington.
- Tang, S.B., Lo, H.K., 2010a. On the financial viability of mass transit development: the case of Hong Kong. *Transportation* 37 (2), 299–316.
- Tang, S.B., Lo, H.K., 2010b. Assessment of public private partnership models for mass rail transit – an influence diagram approach. *Publ. Transp.* 2 (1–2), 111–134.
- Tang, B.S., Chiang, Y.H., Baldwin, A.N., Yeung, C.W., 2004. Study of the Integrated Rail-Property Development Model in Hong Kong. Available from: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.232.9686&rep=rep1&type=pdf>. (accessed 13rd October 2017).
- Tang, B., 2018. Leveraging property values for metro railway development in Hong Kong – experiences and lessons. In: Squires, G., Heurkens, E., Peiser, R. (Eds.), *Routledge Companion to Real Estate Development*. Routledge, New York, pp. 13–28.
- Theurillat, T., Vera-Büchel, N., Crevoisier, O., 2016. Commentary: from capital landing to urban anchoring: the negotiated city. *Urban Stud.* 53 (7), 1509–1518.
- Tiry, C., 2003. Hong Kong's Future is Guided by Transit Infrastructure. *Japan Railway and Transport Review*, 35. Available from: [http://www.jrtr.net/jrtr35/pdf/f28\\_tir.pdf](http://www.jrtr.net/jrtr35/pdf/f28_tir.pdf).
- Torrance, M., 2009. Reconceptualizing Urban Governance through a new Paradigm for Urban Infrastructure Networks. *J. Econ. Geogr.* 9, 805–822.
- Transport and Housing Bureau, Transport Department, 2016. Public Consultation on the Review of the MTR Fare Adjustment Mechanism. Hong Kong SAR Government, Hong Kong.
- Transport for London, 2017. Land Value Capture: Final Report. TfL, London.
- Transport for London, 2017. Land Value Capture: Final Report, TfL, London.
- Wong, M., 2015. Hong Kong's MTR: Taking a Ride on the World's Most Envied Metro System. Available from: <http://edition.cnn.com/travel/article/hong-kong-mtr-success-story/index.html>. (accessed: 16th October 2017).
- World Bank, 2001. *Cities on the Move – A World Bank Urban Transport Strategy Review*. Available from: [http://siteresources.worldbank.org/INTURBANTRANSPORT/Resources/cities\\_on\\_the\\_move.pdf](http://siteresources.worldbank.org/INTURBANTRANSPORT/Resources/cities_on_the_move.pdf). (accessed: 16th October 2017).
- United Nations, Department of Economic and Social Affairs, 2014. *World Urbanization Prospects: The 2014 Revision*. United Nations, New York.