To Tax or not to Tax: The case of London Crossrail

STAREBEI Project – “Land value finance as a tool to diminish municipality bond risk”: Report II
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Abstract

Land Value Finance is a policy fiscal tool through which it is possible to finance transport infrastructure in an efficient, transparent, and equitable way. Due to the persistent effects of the 2008 economic crisis on public sector budgets, large-scale infrastructure investments such as London’s Crossrail typically suffer from substantial funding shortfalls; thus, there is the need to find innovative tools to finance urban transport investment. The present research analyses how Land Value Finance can be used to raise complementary financial resources in order to reduce this shortfall. Two specific strategies are examined. Strategy one considers a modification to the fiscal scheme known as the Business Rate Supplement (BRS) by linking it more directly to the land value benefits generated by Crossrail. The second strategy uses a discounted cash flow analysis to examine the gains which could be achieved through the issue of a municipal bond backed by BRS additional revenues. The two strategies are tested by collecting BRS data and real estate values of London boroughs for 2009, 2010 and 2011. The results indicate that the two proposed strategies are able to raise the necessary funds. However, the scenario analysis shows that above a certain threshold, an increase in the BRS rate undermines the strategy’s validity by inducing business flight and consequently shrinking the tax base. The paper concludes by observing that Land Value Finance is a valid tool for raising financial resources for transport infrastructure, but it needs to be carefully tailored to the context and fiscal regime under consideration.

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Section 1. Introduction

London Crossrail is a new urban infrastructure project comprising a high frequency railway corridor and two tunnels to connect West London through the city to East London. When the infrastructure is fully operational in 2018 it is expected to add 10% extra capacity to the London railway system, thus reducing congestion on the Underground, Dockland’s Light Railway, and National Rail services (Steer Davies Gleave 2005). Moreover, according to the Mayor’s Transport Strategy (2010), the implementation of this transport infrastructure (21 km of new tunnels and 10 new stations) will support London’s sustainable development initiative, improve transport connectivity and accessibility, and contribute to urban renewal (Mayor of London, 2010). The final estimated cost of the infrastructure is £14.8 billion and is financed mainly by London Authority (Greater London Authority and Transport for London), London developers and London businesses. In particular, Greater London Authority (GLA) is raising 30% of the total cost (£4.1 billion) through a Supplementary Business Rate (BRS). BRS is an earmarked additional tax paid only by businesses located within the GLA in the aim to recapture part of the real estate value generated by the implementation of Crossrail. The tax is a 2 Pence levy per pound of the non-domestic rateable values set inside the Greater London Authority. The revenues accruing from BRS are paid into a ring-fenced account to be used only for Crossrail expenditure needs. Specifically, BRS is an earmarked fiscal method based on Land Value Finance (LVF) that pledges its revenue to repay the capital costs of the infrastructure. LVF is a fiscal mechanism formulated especially to recapture the windfall gains accruing to the private sector through public sector infrastructure developments (i.e. new transport infrastructure, urban regeneration, or other service provision) (Medda, 2012).

Since the current economic climate is still a challenging one, and central government grants and funding have been noticeably curtailed, municipalities are keen to identify new local fiscal and financial tools that can unlock the potential of urban investments, satisfy local authorities’ budget expenditure needs and boost economic growth (Wagenvoort, et al., 2010). The LVF methodology is characterised by different positive economic features: it does not distort decisions of economic agents; LVF encourages harmonious city expansion; it cannot be transferred to third parties and it tends to curtail speculation (Cocconcelli & Medda, 2013). There are numerous cases in the literature that confirm the benefits of using LVF to finance public infrastructure investments in urban areas (an extensive literature review can be found in (Smith & Gihring, 2013). Although much work appears in the literature on how to use LVF to finance infrastructural projects in urban areas, to the best of our knowledge there are no studies that analyse the viability of this mechanism to secure bond issues during crisis periods, or examine LVF’s impact on the performance of broad-based business activity in cities. This research uses the actual London Crossrail as a case study to demonstrate how Land Value Finance can be used to raise complementary fiscal and financial resources for the construction of a transport infrastructure during periods of economic turmoil.
We begin our analysis by assuming a funding shortfall of 20% from the initial total central government provision due to the economic crisis. Given this initial financial shock, the study proposes two strategies to address the hypothetical reduction in central government grants. The analysis is articulated through three steps: in Strategy 1, we evaluate if London authorities are able to raise additional funds by implementing a progressive BRS tax rate to bridge a funding gap (£1.02 billion) left open by a reduction of central government grants (Strategy 1); in Strategy 2, we assess whether additional BRS revenues, generated by Strategy 1, can be pledged to the repayment of a municipal bond (Strategy 2); and as a final step, the analysis provides a fiscal burden test to evaluate whether the increase in BRS tax rate leads to a drop in the tax base which consequently offsets the benefits achieved in Strategies 1 and 2.

In Strategy 1 we consider a modification to the BRS tax rate, by making the additional tax rate progressive according to the benefits generated by Crossrail. In Strategy 2, through a discounted cash flow analysis, we examine the gains which could be achieved if a municipal bond backed by BRS additional revenues were to be issued. We collect BRS data and real estate values of GLA Boroughs for years 2009, 2010 and 2011 (Greater London Authority and Crossrail Ltd sources). The results indicate that both of the proposed strategies are able to raise the necessary funds. In particular, in Strategy 2, when a 1% fiscal rate is added to the present BRS fiscal burden and a proposed municipal bond is issued, GLA can save, on average across 6 different scenarios, £90 million, or reduce the implementation of the BRS by two years. There is one caveat, however, the fiscal burden increase can impact negatively on the tax base and reduce the attractiveness of the location. In order to address this caveat, we assume that the rise in tax rate reduces London business attractiveness and thus the BRS tax base. Through a multi-scenario tax base reduction analysis, we calculate the thresholds where the additional BRS costs offset the benefits achieved in Strategy 2. The analysis outcomes show that, above a reduction of 4% in real estate values, an increase in the BRS rate largely undermines the strategy’s validity and leads to a distortion in the market, thereby inducing business flight and consequently shrinking the tax base. We conclude by observing that Land Value Finance is an appropriate tool for raising financial sources for transport infrastructure, but it needs to be tailored to the context and fiscal regime in the city under consideration.

The paper is organised as follows: Section 2 provides the context for the work and reviews the literature; Section 3 describes the Crossrail project and the BRS; Section 4 analyses the empirical data of Crossrail financing mechanisms and provides two strategies for financing Crossrail through a bond issue; Section 5 concludes the work.
Section 2. Literature Review

This study explores how Land Value Finance (LVF) can unlock additional funds for the construction of large urban transport infrastructures with greater benefits and less costs than traditional financing methods. Until recently, European finance of transport infrastructure has relied to a large extent on debt provided by commercial banks, central government grants, or public financial institutions (Wagenvoort, et al., 2010). But the economic downturn has undermined the foundation of this mechanism, thus affecting the bankability and the viability of urban projects (Kappeler & Namoz, 2010). In response to funding shortfalls, local authority decision makers have been considering the possibility of raising funds through sub-sovereign bonds that can help to finance needed projects. The most mature sub-sovereign bond market is the United States municipal bond market; and their available experience can provide useful lessons on how to create a European municipal bond market (Feldstein & Fabozzi, 2008). US municipalities have a long history of issuing tax-exempt general obligation (GO) bonds in order to raise capital for local budget expenditures (O’Hara & SIFMA, 2012). GO bonds are secured by the full faith and credit worthiness of the municipality and are issued prior to the construction of public improvements. The credit risk connected with the development of the infrastructure was therefore borne entirely by the municipality itself (Feldstein & Fabozzi, 2008).

Nevertheless, the increasing importance of Public Private Partnership (PPP) and other forms of PPP to deliver public projects requires a new financial structure for municipal bonds that relies on the project profitability itself (Brusewitz, 2004); this particular category of municipal bond is known as Revenue Bonds (RV). Although issued by public bodies, the performance of these bonds is connected to the project, on its capacity to generate revenue, and to be able to repay the cost of the investment (O’Hara & SIFMA, 2012). Therefore, Revenue Bonds are characterised by a lower credit profile compared to GO Bonds, which makes RBs more expensive for raising the capital needed (Securities and Exchange Commission, 2011). Revenue Bonds have relied for many years on Credit Insurance to reduce borrowing costs, attract more investors, and send a positive signal to the market (Quigley & Rubinfeld, 1991). However, the financial crisis starting in 2007 knocked the Monoline industry to such an extent that it could no longer provide the needed guaranties to back the municipal bonds (Martell & Kravchuk, 2012). Thereafter, it became inconvenient for municipalities to purchase insurance that did not curtail the interest rate, so the Monoline market for municipal bonds dissolved, exposing the need for innovative ways to guarantee and provide collateral and credit enhancements to the issues of municipal bonds. Earmarked fiscal revenue thus represents a viable solution.

Public transport infrastructures financed by issuing Revenue Bonds often have positive spillover effects on the local economy, raising the number of people employed, or affecting real estate values in the areas
under development (Fujita & Thisse, 2002). Indeed, improvements to local public transport infrastructure, i.e. new journeys, lower travel time, and increased comfort – result in higher values of accessibility (Iacono, et al., 2009).

Accessibility can also be regarded as a spatial interaction measure defined by the potential economic, social, cultural, and political facilities that could be reached by different agents (Reggiani & Martin, 2010). Higher accessibility boosts the attractiveness of a location, resulting in higher demand for land and thereby increasing real estate values (Ahlfeldt, 2011). According to Alonso (1964), any accessibility enhancement is capitalised in land values and surging land and real estate prices in the areas affected by transport improvements (Alonso, 1964). The public authority can recapture these positive economic spillovers and commit the funds to finance the capital cost of the transport infrastructure (Doherty, 2004). A system suggested in the economics literature to recapture these windfall gains and reinvest them for financing public transport infrastructure is known as Land Value Finance (LVF) (Medda 2012). LVF is structured so that the transport investment is repaid by recapturing some or all of the land value increase resulting from greater accessibility.

The present work supports the use of an innovative mechanism for financing urban public transport through LVF revenues pledged to the repayment of municipal bond issue. This research emphasises the catalyst role of LVF to leverage funds and unlock the urban value potential for financing public transport improvements. Under this framework, the bond repayment is linked to the fiscal revenues deriving from captured positive externalities to the real estate values in the location affected by the transport improvement. Importantly, this ring-fencing method generates a positive feedback loop which is able to self-finance further development (Figure 1).
In order to test the viability of the LVF model shown in Figure 1, the authors examine the Crossrail financing mechanism. London Crossrail is partly financed through a Land Value Finance mechanism called the Business Rate Supplement (BRS) (Roukouni & Medda, 2012). After a brief review of the Crossrail transit infrastructure project, we will quantify the amount of money that can be raised and saved through the implementation of the LVF fiscal tool by then pledging the revenue to the repayment of the LVF-backed municipal bond.

**Section 3. The Crossrail case study**

The public transport network in London is already highly congested; the (GLA, 2009) estimates that, by 2031, nearly 1.3 million additional people and 750,000 new jobs will exist in the capital. Public transport is vital to the economic success of London metropolitan area therefore various challenges need to be tackled to provide a sustainable growth environment to the entire city.

The answer of London authorities to improve the public transport, reduce congestion, and provide a new means of transport for reducing car dependency, is the Crossrail project. Crossrail is intended to integrate the mainline railway through the construction of two new tunnels (13 miles-21 Km); trains will run from Maidenhead and Heathrow Airport (West London) through the City to Shenfield and Abbey Wood (East London) (Figure 2). Construction started in 2009 and the entire project is expected to be delivered in 2018, with full service operations to begin in 2019. The company responsible for the development of the infrastructure is Crossrail Ltd., (2001), a joint venture company between Transport for London (TfL) and the Department for Transport (DfT).
The implementation of the transport infrastructure supports the objectives listed in the (GLA, 2010): Crossrail is expected to:

- Provide the condition for sustainable economic development and population growth;
- Improve transport connectivity and accessibility;
- Engage in urban renewal (10 stations newly built, renewed or refurnished) and regeneration of local areas (Isle of Dogs, Woolwich and Abbey Wood).

When it becomes operational, Crossrail will provide a high-frequency, high-capacity and accessible service for over 200 million people, increasing London rail capacity by 10% (GLA, 2009). Demand forecasts indicate that by 2026, Crossrail will carry over 200,000 passengers per day during the morning peak period (07:00 to 10:00 hours). The introduction of this new Underground line will relieve congestion across the London Underground network; according to estimates, the Crossrail extra capacity will reduce congestion by between 20, to over 60% on other Underground lines (in particular, Bakerloo, Central, District, and Jubilee lines) (Steer Davies Gleave, 2005). Crossrail benefits are not merely linked to the performance of the Underground system, they will also provide wider socio-economic spillovers to the entire London area by:

1. Boosting the level of employment in London: over 14,000 people are expected to work in the Crossrail construction and over 1,000 net jobs created;
2. Reducing pressures on road traffic;
3. Yielding environmental benefits (less pollution and lower noise levels);
4. Improving road safety.

In 2008 the Labour government estimated the Crossrail bill at £16 billion with a delivery date of 2017. The existing coalition government reviewed the costs of the infrastructure and cut the budget to £14.8 billion, with a more cost-effective infrastructure delivery date (2018) (HM Treasury, 2010). Costs of the
infrastructure are shared among Transport for London (TfL) and Greater London Authority (GLA), the Department for Transport (DfT), London Businesses, and fare and tax payers. In particular, the central government contributes, via the DfT, £4.5 billion in grant funding; London authorities, in particular TfL and GLA, provide £7.1 billion (Table 1).

**Table 1. Crossrail fund sources**

<table>
<thead>
<tr>
<th>Crossrail Financing</th>
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<tr>
<td>Estimated capital cost</td>
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**Sources of Funds**

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<td>Total</td>
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**Department for Transport and BAA Grants**

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<tr>
<th></th>
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<tbody>
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**Other**

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**Total Sources**

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<td>Total Sources</td>
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*Data Source: Crossrail Ltd.*

The infrastructure costs are to be borne mainly by London authorities and London tax payer residents. Whereas TfL and GLA are mainly responsible for raising funds for the construction of the infrastructure; they bear over 50% of the total costs (see Figure 3). Business activities located in London contribute directly to finance the cost of the infrastructure through the Construction Infrastructure Levy (CIL), Section 106, and the Business Rate Supplement (BRS). The BRS, which is germane to our study, is the largest GLA element of contribution for financing the infrastructure.
In the United Kingdom the BRS enables local authorities to levy locally a supplement to the standard Business Rate. The Business Rate Supplement Act emphasises the role of tax as local, additional, and transparent (Business Rate Supplements Act, 2009). With the Act, the government confers power to the GLA and specific local authorities to impose a levy on business taxpayers to help finance local projects that promote economic development. In accordance with the BRS Act, the Major of London imposed a 2 Pence per Pound of rateable value across London businesses which have a rateable value above £55,000. Local authorities are responsible for issuing the BRS bill, which is calculated as the rateable value multiplied by the BRS. For at least the first five years (from 2010 to 2015) the BRS will not be raised but, if needed, the Major (via the GLA) can decide to change the supplement, as it is responsible (in partnership with the 32 London boroughs) for collecting fiscal revenues. To emphasise the local role of the tax, BRS fiscal revenues stay in London, are paid to a Crossrail ring-fenced account, and are to be used only to cover Crossrail costs.\(^2\) Moreover, the BRS is a temporary tax and is to be enforced only until the infrastructure cost is fully covered. According to GLA estimates, the BRS is likely to run between 24 and 31 years, with an expected end date of 2037-38. Over this time, BRS will raise £4.1 billion, of which £3.5 billion are allocated to secure borrowing of GLA, and 0.6 billion are used to directly finance construction costs.

The total £7.8 billion investment in Crossrail by GLA and Transport for London is raised from different channels: through bank loan, (a £1 billion loan from the EIB to TfL), through capital markets by means of

\(^2\) In order to improve transparency, the BRS Act requires the creation of a BRS ring-fenced account. The GLA then transfers BRS revenues to the ring-fenced account managed by TfL to be used strictly for Crossrail project costs.
municipal bond issue (£600 million bond issued by GLA with the assistance of Lloyds Corporate Markets), and through Public Body banks (£800 million loan awarded by the Public Works Loan Board to GLA). The Public Works Loan Board (PWLB) is a statutory body operating within the United Kingdom Debt Management Office, an Executive Agency of HM Treasury; their main activity is to lend money from the National Loans Fund to local authorities and other prescribed bodies, and to collect principal and interest repayments. PWLB fixed and variable interest rate loans are determined by the UK Debt Management Office through the methodology set by HM Treasury (Section 5 of the National Loans Act, 1968). This methodology is designed to ensure that the PWLB does not lend at rates lower than those at which the government can borrow, and generally to ensure compliance with the policies of HM Treasury. It is estimated that the lower financing costs compared to PWLB rates will save the business rate payer around £65 million over the lifetime of the BRS.

Having examined the background for financing the Crossrail project, we will next analyse whether additional BRS revenues can be used to locally finance a further share of the infrastructure cost. Given the economic and fiscal crisis experienced recently across Europe, we demonstrate through a scenario application a reduction in central government resources (for example, 20%), which forces the local authorities to raise more local funds to finance Crossrail. By implementing two strategies, we show how it is possible for London local authority to create a positive feedback loop, where the progressive additional BRS revenues are used to compensate for the central government grant reduction, and in order to secure capital market borrowing by means of municipal bonds. The two proposed strategies may enable sustainable economic and financial growth, deliver the Crossrail urban transport project, and benefit the entire community by spreading the cost of the infrastructure according to the benefits generated.

Section 4. London Crossrail case study: the Additional BRS progressive Strategies

This section provides a step-forward scenario analysis of the London Crossrail case study. We assume that, due to the economic and financial crisis, the central government disbursement is reduced by 20% (minus £1.02 billion). The Crossrail project now has a funding gap that must be filled, and the GLA is responsible for raising needed funds. For the purpose of the analysis, BRS data and real estate values of GLA boroughs are collected for years 2009, 2010 and 2011 (Greater London Authority and Crossrail Ltd. sources), and a dataset with interest rates for PWLB and the UK Treasury has been made available from PWLB and HM Treasury office.
Given our assumptions and available data, we propose two strategies to address a hypothetical reduction in central government grants. The study is articulated through three steps:

- Evaluate if London authorities are able to raise additional funds by implementing a progressive BRS tax rate to bridge a funding gap (£1.02 billion) caused by a reduction of central government grants (Strategy 1).
- Assess whether additional BRS revenues generated by Strategy 1, can be pledged to the repayment of a municipal bond (Strategy 2).
- Fiscal Burden Test if the increase in BRS tax rate leads to a drop in the tax base which offsets the benefits achieved in Strategies 1 and 2.

The next two sub-sections address our research questions stated above:

- Sub-Section 4.1: Strategy 1 evaluates the effectiveness of two possible BRS progressive schemes.
- Sub-Section 4.2: Strategy 2 assesses the interest rate savings achieved through a municipal bond issue backed by BRS proceeds, and back-tests the existence of a fiscal threshold which may undermine the validity of the scheme discussed in section 4.1.

### 4.1 Strategy 1: the Additional BRS progressive scheme

We assume that the GLA is responsible for raising additional revenue by modifying the existing BRS tax scheme. The actual BRS is a flat rate tax: all taxpayers contribute to the same extent and any tax rate discrimination is made according to the benefits received from the new infrastructure. The present work suggests an innovative fiscal scheme that charges taxpayers in accordance with the benefits received by the project: the closer the business activity is to Crossrail infrastructures, the more it contributes to the repayment of the investment. In this way, the proposed additional BRS is an increase in the existing BRS tax rate such that the bundled scheme becomes progressive.

Since the public bodies in charge of collecting the BRS revenues are London boroughs, the tax rate discrimination is created using the GLA administrative borough divisions. The administrative area of Greater London Authority contains 32 London boroughs. In order to make BRS progressive, London boroughs are divided into three groups: Group A is comprised of boroughs with at least one Crossrail station within their borders; Group B contains the boroughs that share at least one edge with boroughs in Group A; and Group C boroughs have none of the characteristics stated above and receive limited benefits from Crossrail development. Figure 4 summarises the tax rate discrimination across the London boroughs.
Figure 4. Tax rate borough contributions: a visualisation.

Data Source: Crossrail Ltd. Elaboration: QASER Lab.

According to the framework of this research, boroughs in Group A pay more than Group B boroughs; whereas Group C boroughs (with neither station nor border adjacent to Group A boroughs) pay no additional charge. Six scenarios to raise the additional money needed for the completion of the infrastructure are then examined (see Table 2); the different additional BRS tax rates are levied on the rateable value estimated in 2010 by the Greater London Authority Commission for BRS (all data, divided per borough, are available on the GLA website).

Table 2. Six Scenarios for the additional BRS Contributions: the Borough Rates

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.01</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>0.01</td>
<td>0.005</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>0.0075</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>0.0075</td>
<td>0.0025</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
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<td>-</td>
</tr>
<tr>
<td>6</td>
<td>0.005</td>
<td>0.001</td>
<td>-</td>
</tr>
</tbody>
</table>
Table 2 lists the 6 possible scenarios and for each Group of boroughs displays the additional BRS charge. Two schemes are also suggested. In Scenarios 1, 3 and 5 the additional BRS charges are borne only by Group A boroughs (scheme one), whereas in Scenarios 2, 4 and 6 the additional BRS charges are shared between Group A and Group B boroughs (scheme two). According to the Scenarios listed in Table 2, we carry out a data analysis to quantify the amount of proceeds GLA is able to collect per year with the additional BRS schemes.

Table 3 presents the estimations regarding fiscal revenues obtained in the case where only boroughs in Group A contribute to fill the funding gap (scheme one).

### Table 3. BRS revenues per year: Scheme 1

<table>
<thead>
<tr>
<th>Scheme one</th>
<th>Scenario 1</th>
<th>Scenario 3</th>
<th>Scenario 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAX RATE</td>
<td>0.01</td>
<td>0.0075</td>
<td>0.005</td>
</tr>
<tr>
<td>Total</td>
<td>87.538</td>
<td>65.6535</td>
<td>43.769</td>
</tr>
</tbody>
</table>

Data Source: GLA website. Elaboration: QASER Lab.

Among the scenarios under scrutiny, Scenario 1 provides more revenue with a contribution of £87 million per year. This amount doubles the fund raised by Scenario 5, which seeks to affect the London taxpayers who pay less. In Scenario 5, with an additional half cent to BRS, GLA is able to raise £43 million per year. Scenario 3 pursues a more balanced fiscal solution and is able to raise £65 million per year.

Scheme two, depicted in Table 4, splits the Crossrail funding gap between boroughs in Groups A and B and shows the total amounts collected in Scenarios 2, 4 and 6. Scheme two aims to deliver a more sustainable and shared financing process throughout the entire city; here, the costs are borne by a wider class of businesses located in central London, and the scheme assumes that benefits generated by the Crossrail extension are not limited merely to boroughs with at least one station within its borders.

### Table 4. BRS revenues per year: Scheme 2

<table>
<thead>
<tr>
<th>Scheme two</th>
<th>Scenario 2</th>
<th>Scenario 4</th>
<th>Scenario 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAX RATE</td>
<td>0.01</td>
<td>0.005</td>
<td>0.0075</td>
</tr>
<tr>
<td>Total</td>
<td>87.538</td>
<td>13.1415</td>
<td>65.6535</td>
</tr>
<tr>
<td>Total Groups A+B</td>
<td>102.126</td>
<td>72.9475</td>
<td>46.3973</td>
</tr>
</tbody>
</table>

Data Source: GLA website. Elaboration: QASER Lab.

According to the Scenarios in Table 4, the GLA has the opportunity to raise more revenues across a wider area per year; Scenario 2 provides the largest amount of proceeds and raises £87 million in Group A and £13 million in Group B. Scenario 4 is again the balanced solution and brings to the GLA budget £65 million (Group A) plus £7 million (Group B), which results in an overall inflow per year above £70 million. Scenario
6 is the most prudent; it recaptures a total of £46 million per year split into £43 million borne by Group A and £2.5 million in Group B. As Figure 5 shows, boroughs in Group A still contribute the majority of the additional funds raised, on average 85% of the overall proceeds, but a noteworthy contribution comes from boroughs in Group B, which bear on average the 15% of additional fiscal revenue needed.

Figure 5. Scheme 2: the contribution of boroughs in Groups A and B to the additional BRS proceeds

Data Source: GLA website. Elaboration: QASER Lab.

The two schemes analysed in our BRS progressive Strategy 1 provide the funds that GLA and TfL require to bridge the funding gap left open by the central government grant reduction. In the first scheme the GLA raises between £87 and £43 million per year, and with the second scheme total proceeds range between £46 and £102 million per year.

Given the six BRS progressive scenarios, we next estimate the time needed by each strategy to provide sufficient funding for Crossrail. This part of the work provides a discounted cash flow analysis to exactly determine the horizontal period of additional BRS application required to raise £1.02 billion. In doing so, the estimations are carried out using the interest rate of 6.29%, the same as the current GLA calculation to discount BRS future revenues. Figure 6 displays the analysis results: on the vertical axis the discounted additional BRS proceeds are shown; the horizontal axis indicates number of years. The red dashed line shows the funds still needed; when the scenario approaches this line it becomes a viable option. The proposed modified progressive scheme has been verified to generate a minimum financial return of £1.02 billion in four of the six scenarios examined (Figure 6).
As Figure 6 depicts, two of our scenarios are not feasible at this stage. According to these BRS rates, Scenarios 5 and 6 do not raise the necessary proceeds to complete the infrastructure. Among the feasible solutions, Scenario 2 is the first to reach the threshold of the funds needed (dashed red line in Figure 6); it raises £1.02 billion in 13 years by levying an additional pence/cent for Boroughs in Group A and half a cent for Boroughs in Group B. This solution is the most cumbersome among the six proposed and achieves the goal by imposing a large increase in the BRS rate. Scenario 1 generates the revenues needed over 18 years and charges only businesses in boroughs that have a Crossrail station within their borders. This solution is the least progressive, however, and aims to recapture more value in particular from the real estate in close proximity to new stations. Only the specified central locations bear the additional cost of the infrastructure, and it is assumed that no extra benefits spread to outer London Boroughs.

The more balanced scenarios, namely 3 and 4, are still able to raise the funds needed to complete the infrastructure, but both need an extended life-time to reach the threshold. Scenario 3 collects £1.02 billion over 40 years, but Scenario 4 collects the same amount in only 27 years. The two scenarios (3 and 4) differ in how they charge businesses: Scenario 3 charges only stations in Group A whereas Scenario 4 spreads the cost across both Groups A and B boroughs. Nevertheless, Scenario 4 is the most feasible: it provides a good compromise of tax rate increase shared among London taxpayers and creates a more progressive structure.
to recover the funding needed. Moreover, Scenario 4 increases the progressiveness of the tax rate by charging Group A and B boroughs according to the benefits received from the infrastructure. Scenario 4 delivers the most equitable, sustainable, and feasible solution.

The additional BRS proceeds gathered in Strategy 1 are used to repay the cost of the additional debt borne by the London Authorities to balance the government grant contraction. In the next sub-section, Strategy 2 estimates the savings that London Authority achieves in the case of a municipal bond issue backed by additional BRS revenues.

4.2 Strategy 2: Municipal Bond potential savings

To engage in a 27-year fiscal project to pay for an infrastructure that must be delivered in a reasonable amount of time emphasises the need to overcome a temporal dimension that can be tackled by borrowing money. We will next examine how a municipal bond issue, backed by the BRS schemes proposed in the above study, decreases the interest rate costs, saves taxpayers money, and is more cost-effective than raising funds using other sources (commercial bank or public bank). The additional tax rates created by the two schemes are structured in order to raise enough proceeds to back the issue of a Municipal Bond or bank loan, and repay the principal amount and the interest at maturity. The data available at this stage of the analysis are the rateable value of businesses in London, the tax rates levied for the additional BRS, and the proceeds collected with the additional BRS scheme.

To fulfil the research goals, we calculate the interest rate at which money can be borrowed by the Greater London Authority (GLA). The work assumes that GLA has a risk-averse profile and pursues two options for raising the amount of money to deliver Crossrail: 1.) request a loan through a public body (Public Work Loan Board, PWLB), or 2.) borrow money through capital markets by issuing municipal bonds. The differences between the two interest rate options are the savings that can be realistically achieved by the GLA. Figure 7 depicts the spread between the PWLB interest rate and the HM Treasury bonds across different maturities. On the left-hand side we depict the methodology used to calculate the spreads: it is the difference between the rate of the PWLB (upward arrow) and the Treasury bonds (downward arrow). This interest rate spread can be regarded as a proxy variable of the extra cost paid by the GLA for raising debt through bank loans instead of capital markets. The cost can be very small, almost close to zero if the city has a very high credit quality (similar to the sovereign issuer), or the cost could be very close to the spread if the city decides to borrow from the PWLB, because its credit rating discourages raising money through capital markets. As Figure 7 indicates, the difference is large, particularly among short maturities, but decreases substantially for long-term maturities.
Figure 7. Spread between PWLB and Treasury Interest rates

Borrowing costs: ceiling vs ground:

Data source: PWLB and Bank of England; Elaboration: QASER Lab.

The feature of a decreasing spread with increasing maturity can be explained by the long-term lender role exercised by PWLB. The PWLB is a body which specialises in financing long lived infrastructures with investment periods ranging between 20 and 50 years. We assume that the GLA decides to borrow needed money immediately for the construction of the Crossrail and then pledges the BRS revenue to the repayment over a 30 year period of maturity. For the purpose of the analysis, this work cautiously selects the 30-year maturity, although this decision may lead to a bias in the experiment; shorter maturities may positively affect our result, although they raise the problem of debt rolling over, and the capacity for London Authority to refinance its debt position.

Given the total amount of additional BRS proceeds, the maturity of the borrowing, and the interest rate, the following data estimation provides a discounted cash flow analysis to quantify the possible savings if the GLA issues a municipal bond instead of borrowing money from PWLB. The data analysis is split into two streams: the first analysis focuses on municipal bond issues backed by additional BRS revenues generated by Group A only; the second analysis assumes that the municipal bond issue is backed by revenues collected from Groups A and B.

In the first scheme analysis only boroughs with a station within their borders contribute to the additional cost of the infrastructure; therefore, the pay-as-you-benefit mechanism is at maximum level. The second scheme analysis quantifies the savings in Scenarios 2, 4 and 6 where both Group A and Group B repay the gap left from the central government grant reduction. The second scheme consists of a more balanced
distribution of fiscal burden across the boroughs and accounts for the possibility that Crossrail benefits spread widely across the London area. Both analyses use discounted cash flow of yearly additional BRS revenues to evaluate benefits and savings achieved by means of municipal bond issue.

Under the first proposed scheme, the additional BRS raises between £87 million and £43 million per year. By means of the results presented above in Table 3, the work estimates the municipal bond issue and the potential interest rates saving that are achieved in the case where PWLB interest rates are reduced. The estimation shows that Scenarios 1, 3 and 5 provide enough capital to enable the construction of the Crossrail extension in case of a central government grant reduction. Table 5 displays the results of the discounted cash flow analysis and the savings achieved under the different scenarios. The top of the table reports the amount that can be borrowed by issuing municipal bonds and the associated interest rate; whereas the bottom of the table shows the savings that can be achieved by reducing the PWLB interest rates.

Table 5. Total savings per scenario and Basis Points

<table>
<thead>
<tr>
<th>Interest Rates</th>
<th>0.05</th>
<th>0.049</th>
<th>0.048</th>
<th>0.047</th>
<th>0.046</th>
<th>0.045</th>
<th>0.044</th>
<th>0.043</th>
<th>0.042</th>
<th>0.041</th>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Scenario 1</td>
<td>1489.638</td>
<td>1509.951</td>
<td>1530.71</td>
<td>1551.927</td>
<td>1573.616</td>
<td>1595.788</td>
<td>1618.457</td>
<td>1641.637</td>
<td>1665.342</td>
<td>1689.587</td>
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<tr>
<td>Scenario 3</td>
<td>1117.228</td>
<td>1132.463</td>
<td>1148.032</td>
<td>1163.945</td>
<td>1180.212</td>
<td>1196.841</td>
<td>1213.843</td>
<td>1231.228</td>
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<td>1267.19</td>
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<tr>
<td>Scenario 5</td>
<td>744.818</td>
<td>754.9754</td>
<td>765.3549</td>
<td>775.9636</td>
<td>786.8078</td>
<td>797.8938</td>
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<td>820.8184</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>BP Savings</td>
<td>0</td>
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<td>20</td>
<td>30</td>
<td>40</td>
<td>50</td>
<td>60</td>
<td>70</td>
<td>80</td>
<td>90</td>
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<tr>
<td>Scenario 1</td>
<td>-</td>
<td>20.31302</td>
<td>41.07215</td>
<td>62.28958</td>
<td>83.97784</td>
<td>106.1499</td>
<td>128.8191</td>
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<td>Scenario 3</td>
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<td>15.23476</td>
<td>30.80411</td>
<td>46.71718</td>
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<td>41.98892</td>
<td>53.07495</td>
<td>64.09554</td>
<td>75.99958</td>
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<td>99.9746</td>
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Elaboration: QASER Lab.

The results show that the GLA can raise sufficient proceeds for the completion of the infrastructure by issuing bonds under all the scenarios and across different interest rates. In particular, according to this estimation, the GLA can raise between £1.69 billion and £0.8 billion to fill an eventual hole due to central government cuts. In Table 5 results are set out from the worst to the most optimistic case. The case highlighted in red indicates that no savings are achieved and there is no difference between borrowing money through municipal bonds or the PWLB. The most optimistic scenario (90 BP savings achieved) is outlined in green and assumes no difference between London and the HM Treasury credit-worthiness. The intermediate solution is shown in yellow and provides an average possible solution between the extreme possibilities. The scenario saving estimations emphasise the important role of interest rates in debt repayment. In particular, a decrease of 40 BP delivers £80 million savings, equivalent to 1 year of additional BRS. Conversely, the most optimistic scenario provides nearly £200 million savings to taxpayers, equivalent to a reduction of 2 years of the BRS.
The first analysis is followed by a second scenario analysis where the boroughs contributing to the construction cost belong to Group A and Group B. Under the second analysis, the GLA is able to raise the sufficient funds in less time, which enables us to remove additional BRS few years early.

Scenario 2 maximises revenue, raising over £100 million per year, followed by Scenario 3, raising £72 million per year, and Scenario 6, raising £46 million. Due to this collection scheme, the GLA is able to issue a bond and the proposed solutions are reported at the top of Table 6.

Table 6. Scenarios 2, 4 and 6. Total savings per scenario and Basic Points

<table>
<thead>
<tr>
<th>Borrowing</th>
<th>Interest Rates</th>
<th>0.05</th>
<th>0.049</th>
<th>0.048</th>
<th>0.047</th>
<th>0.046</th>
<th>0.045</th>
<th>0.044</th>
<th>0.043</th>
<th>0.042</th>
<th>0.041</th>
</tr>
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<tr>
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<td>1713.27</td>
<td>1736.63</td>
<td>1760.505</td>
<td>1784.908</td>
<td>1809.852</td>
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<td>1888.085</td>
<td>1915.349</td>
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<tr>
<td>Scenario 4</td>
<td>1234.85</td>
<td>1251.693</td>
<td>1268.902</td>
<td>1286.49</td>
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<td>1322.849</td>
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<td>1360.856</td>
<td>1380.597</td>
<td>1400.605</td>
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<tr>
<td>Scenario 6</td>
<td>789.54</td>
<td>800.3111</td>
<td>811.314</td>
<td>822.5598</td>
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</table>

<table>
<thead>
<tr>
<th>BP Savings</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
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<tbody>
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<td>23.35962</td>
<td>47.23519</td>
<td>71.63785</td>
<td>96.38203</td>
<td>122.0826</td>
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<td>Scenario 4</td>
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<td>16.84306</td>
<td>34.05161</td>
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<td>69.61863</td>
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<td>126.006</td>
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<td>Scenario 6</td>
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<td>10.77114</td>
<td>21.7774</td>
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<td>56.26681</td>
<td>68.28203</td>
<td>80.56804</td>
<td>93.13235</td>
<td>105.9828</td>
</tr>
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</table>

Elaboration: QASER Lab.

According to the calculations, the second scheme under study provides the amount necessary to fill the funding gap due to central government grant withdrawal. Through this scheme the GLA raises between £780 million and £1.9 trillion. Therefore, the second scheme is a very flexible tool that can be tailored to different situations and requirements. The additional BRS rate may be decreased, or the time extension may be reduced in order to deliver a more sustainable fiscal tool for developing the Crossrail extension. The possibility to charge according to the benefits received assumes a larger impact of the transport investment, and mitigates the overall cost of the fiscal measure through a balanced strategy over space and time. In the event of a central government grant reduction, the local authority can identify, prioritise and optimise the best BRS fiscal strategy because it is able to spread the cost of investment across a broader and heterogeneous tax base.

The second scheme not only delivers an optimal fiscal tool but also achieves savings to taxpayer contributions: the larger the interest rate reduction achieved, the more proceeds are available. The savings attained through these schemes can be used either to finance another portion of the Crossrail infrastructure or to reduce the time extension of the additional BRS rates. As in the first analysis, the bottom of Table 6 shows the analysis of the savings that could be achieved if the interest rate from PWLB were to be reduced. In our studied cases, a reduction of 10 BP generates savings of £20 million above the
total money borrowed from municipal bond investors. The intermediate case (outlined in yellow) shows that the reduction of 40 BP achieved £90 million savings, equivalent to 1 year of additional BRS contribution. Furthermore, in the extreme case scenario, a 90 BP savings sum up to 2 years of BRS reduction provides a total savings above £220 million for taxpayers.

Nevertheless, the validity of the schemes presented here relies on the strong assumption that an increase in the BRS tax rate does not influence the economic and fiscal activity of the city. Nevertheless, businesses could choose to move due to a surge in BRS tax rates. The increasing tax burden not only prompts the settled businesses to relocate to cheaper tax locations, but also makes the location unattractive to new business. In a dynamic real estate market, a drop in demand also pushes prices downward. The decrease in demand fuelled by the “business flight,” generates a contraction in non-domestic real estate prices and therefore shrinks the tax base of the BRS.

The events outlined throughout the work here may severely affect the LVF scheme also proposed here, and thus begs the question: how effective is the additional BRS fund raising? To explore how a drop in real estate prices affects the viability of aforementioned LVF scheme, the estimation provides a BRS tax base threshold that neutralises all efforts to raise additional money through the Business Rate Supplement. The discounted cash flow evaluation simulates different reductions in BRS tax base (ranging from -1% to -10%) and monitors the flow of fiscal fund behaviour. According to these assumptions, the discounted cash flow simulation of BRS tax base is carried out; the results of the simulations are summarised in Figure 8. Scenarios 5 and 6 are not evaluated because they do not provide enough proceeds to make the financing mechanism viable.
Figure 8. The threshold for the viability of LVF scheme

Elaboration: QASER Lab.

As Figure 8 shows, a drop in the demand of non-domestic real estate prices and a decrease in prices can strongly affect the viability of an LVF mechanism. A reduction larger than 1% in BRS tax base makes Scenario 4 ineffective. (Scenario 4 was the less stable scheme in the former analysis), and this result is confirmed by a further estimation: a tax base reduction of only 1% makes this possibility completely unviable. Scenarios 2 and 3 are more resilient to a decrease in non-domestic real estate prices. If the business flight is large enough to cause a 2% drop in the tax base, then all the positive effects of the LVF strategy are cancelled out. The scenario most resilient to a price drop is Scenario 1, and this is mainly due to the characteristics of the tax base. Indeed, only the boroughs having a station within their borders provide the additional funds to finance the funding gap. Many of these boroughs are situated in central London, where a unique real estate market creates a more stable tax base to raise the additional funds. This result contradicts a policy recommendation drawn previously. In Section 4.2, results show that the strategies where both groups contribute to the repayment is the best solution, and the opposite result is found in the case of the real estate market’s negative inelastic response to the increase in tax rate (Figure 9).
In particular, although Scenario 2 performs very well in Strategy 1, it becomes one of the worst scenarios of Strategy 2. In this second part of the analysis, Scenario 3 achieves the best compromise between funds raised and impacts on the tax base: it provides a resilient strategy that does not affect economic activity too much and at the same time is able to raise sufficient proceeds in less than 30 years (see Figure 9).

The discussed scenarios imply that LVF tools coupled with the BRS scheme should be screened before its implementation, and in particular, be monitored closely during its application. It must be mentioned that any further increase in the BRS has an impact on the tax base. Although the schemes’ viability is not affected in many cases, the reduction in fiscal revenues is substantial. Furthermore, any increase in tax rate needs to be monitored for its effect on business attractiveness within the city. The distortion created by the tax increase could, however, be large enough to offset all the positive benefits accrued from the transport infrastructure improvement. We have found that Land Value Finance is a highly appropriate fiscal tool, but also that one must keep in mind that the scope of its effectiveness increases when this mechanism is tailored to the urban context under examination.
Section 4. Conclusions

The objective of the work has been to evaluate how to raise complementary financial resources for the construction of a transport infrastructure, which in our case is the London Crossrail project. Three research strands were examined: (1.) in the case of a central government grant reduction for the construction of Crossrail transit infrastructure, we have evaluated if London Authorities can raise additional funds by implementing a progressive BRS tax rate to bridge a funding gap of £1.02 billion. (2.) We have assessed whether additional BRS revenues generated by Strategy 1, can be pledged to the repayment of a municipal bond. (3.) And finally, we have carried out a Fiscal Burden Test to determine whether the increase in BRS tax rate leads to a drop in the tax base which would then offset benefits achieved in Strategies 1 and 2. The innovative aspects of the analytical approach proposed in Strategy 1 and 2, are that it emphasises the role of Land Value Finance as a catalyst to leverage funds through municipal bonds in order to obtain financing for urban mass transit infrastructure, and that it also evaluates the drawbacks of the extensive use of this scheme, which if ignored, could lead to a shrink in the tax base and ultimately an unsuccessful LVF policy.

The results developed in our study indicate that the proposed strategies can successfully raise the necessary funds. In particular, it has been demonstrated that the GLA can save, on average across the different scenarios, £90 million, or put another way, achieve a reduction of the BRS life by a period of two years. According to the estimations, scheme one raises between £1.5 billion and £0.8 billion. Scheme two involving taxpayers from a broader area of London (Group A and B boroughs), is able to raise £1.7 billion and provides an average savings of £60.9 million. Scheme one highlights the benefits accrued in the Boroughs with stations within its borders and raises fiscal revenues only in boroughs with at least one station within their administrative borders. The second scheme assumes that the benefits arising from Crossrail constructions spread over a broader area and therefore extends the additional contribution over a larger taxpayers’ population. Under scheme two, the GLA has the opportunity to charge according to the benefits received, and assumes that a larger impact is the consequence of the transport investment benefits. Furthermore, scheme two mitigates the overall cost by balancing and distributing the fiscal strategy over space and time. To deliver a more sustainable fiscal tool for developing the infrastructure, the additional BRS rate may be decreased, or the time may be reduced. In essence, the levying authority has the capability of identifying, prioritising and optimising the most suitable BRS fiscal strategy, since in scheme two it is able to spread the cost of investment across a broader tax base.

However, the additional fiscal burden can impact negatively on the tax base, so to account for this burden, we have evaluated that an increase in the BRS tax rate that reduces London’s non-domestic real estate values by 4%, largely undermines the strategy’s validity and leads to a distortion in the market, thereby inducing business flight and consequently shrinking the tax base.
Several policy implications have arisen from the results of our analyses. According to the estimations carried out here, it is possible for local authorities that engage in delivering large and long-lived urban infrastructure projects to apply LVF in order to secure a municipal bond issue. The bond issue benefits from the more stable cash flows generated by the LVF and thus decreases the cost of borrowing. The interest savings not only provide a more efficient way to finance the infrastructure but also decrease the costs borne by the local taxpayers who would experience the impacts. However, an additional tax rate burden negates the attractiveness aspect of a location and may potentially lead to a drop in real estate prices; such an effect undermines the viability of the LVF and municipal bond scheme, resulting in the loss of accrued benefits. We can conclude that Land Value Finance is a valid and useful tool for raising financial sources for transport infrastructure, but it needs to be tailored to the context and fiscal regime in the city under consideration. For these reasons, and based on the results obtained in the final part of the data analysis, this work suggests that LVF tools and the BRS scheme should be screened before its implementation and monitored closely during its application.
References

Ahlfeldt, G. M., 2011. If We Build, Will They Pay? Predicting Property Price Effects of Transport Innovations, s.l.: SERC.


