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# "*Waiting on the train*": The anticipatory (causal) effects of Crossrail in Ealing☆

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ABSTRACT

This paper estimates the willingness-to-pay for anticipated journey-time savings introduced by the Crossrail intervention in the London Borough of Ealing. Given Crossrail remains under construction, we estimate how the anticipated benefit of Crossrail's announcement enters the house price determination process. Anticipated journey-time savings should enter the home-buyer's pricing equation because these benefits are speculatively internalised even before the service becomes operational. Using a experimental method that accounts for the possibility of a spatial autoregressive process in housing values, we test the hypotheses that the announcement of a new commuter rail service generated a location premium, and that house price appreciation reflected proximity to Crossrail terminals. Our evidence suggests home-buyers significantly valued proximity to planned Crossrail terminals following the post-announcement period.

## 1. Introduction

Property location and value are highly interrelated. The desirability of locations are key determinants of localised variations in property price. Rail interventions that alter a location's relative accessibility will increase mobility ranges to workplaces, leisure and retail destinations (Baum-Snow and Kahn, 2000). For commuters, investments in rail access change the distribution of available employment and wage opportunities by lowering transport costs to more specialised, and potentially more productive, high-paid jobs (Gibbons and Machin, 2005). On the other hand, rail-related upgrades generate negative externalities such as visual nuisances, air pollution and transit-generated crime (Bowes and Ihlanfeldt, 2001). On this basis, assuming property markets are efficient, the value of residential housing should "reflect all the costs and benefits a location offers" (Gibbons and Machin, 2005), and the expectation of improvements in environmental conditions, such as accessibility, should be capitalised in transaction values. For these reasons, housing markets are conduits for the economic impacts of transport interventions, and provide a compelling backdrop to study the impacts of rail investments.

Standard appraisals assess the willingness-to-pay (WTP) for proximity to rail interventions by obtaining quantified measures for the economic value of rail access. Typically, journey-time savings of rail access are valued by empirical applications as shadow prices elicited by stated preferences or revealed preferences in transport mode choice (Hensher, 2010). Yet, the impacts of transport innovations are diverse, and researchers investigating rail-related interventions must situate their findings alongside wider debates in transport studies. Beyond land value changes, rail access that increases workplace density by concentrating firms generates agglomeration forces and urbanisation economies that result in productivity cost savings, knowledge spillovers and job-worker matching (Henderson, 2003; Venables, 2007). On this basis, it is tempting for governments to reiterate the wider economic benefits of transport innovations, but these impacts are not always appropriately evaluated. Transport policies that increase accessibility for some residential areas and not others will typically increase housing costs there, as these locations become desirable for workers and less desirable for non-workers (Gibbons and Machin, 2008). In this way, arguments that proposition transport as a policy lever for increasing employment are challenged by housing market processes that sort less-employable individuals into less accessible – and thus lower cost – areas (SEU, 2003). In other words, it is imperative to be aware of the labour market effects of transport interventions that are diverse, and will yield effects not fully quantified by conventional transport appraisals.

In this paper we analyse the WTP home-buyers attribute to *anticipated* passenger rail upgrades using property price to value rail access in an Outer London Borough. We consider Transport for London's (TfL) Crossrail intervention that will provide high-frequency commuter rail

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services along 118-kilometres of double-track railway lines from Reading to Shenfield. In particular, we consider Crossrail's upgrades to service provisions along the Great Western Main Line in Ealing – an Outer London Borough in West London in which Crossrail 'passes by' to connect employment centres in the City of London to Travel-To-Work-Areas (TTWAs) east and west of the capital. A Department for Transport (DfT) study featuring rail-usage statistics from the Office of Rail Regulation found First Great Western – an inter-city and regional rail service operating through its London terminus to Oxfordshire – had the highest Passengers in Excess of Capacity (PiXC) of any London and South East rail operator[1] (DfT, 2013). Given Ealing's high PiXC scores and increasing rail patronage (2.8% growth through 2001–2011 (ONS, 2013)), there remains a need to improve rail services to meet commuter demand.

To achieve this, Crossrail was announced on 22 July 2008 by the Crossrail Act 2008 which granted Cross London Rail Links (CLRL) – now Crossrail Ltd. – the powers to construct the line which is scheduled for completion by 2019 (Crossrail, 2016d). Given Crossrail's installation promises increased journey-time savings, we expect the mere announcement to provide an exogenous change that affects property values. We expect anticipated journey-time savings to enter the utility functions of home-buyers. This is because transport interventions that reduce the friction of distance between complementary activities (so as to increase net agglomeration benefits) increase journey-time savings for firms and households, meaning neighbourhoods closer to investment areas become more likely to elicit higher property values (Grimes and Young, 2013; Vessali, 1996). In essence, this study sheds light on how housing markets anticipate planned increases in accessibility.

To date, an extensive body of literature evaluates the effect of rail interventions on real estate values for European markets (e.g.,Lochl and Axhausen, 2010; Dorantes et al., 2011; Efthymiou and Antoniou, 2013a) and US markets (e.g., Hess and Almeida, 2007; Kawamura and Mahajan, 2005; Cohen, 2010). Most papers stress the marginal effect of rail interventions varies according to their location and service-level characteristics (Dubé et al., 2011a). Cervero and Duncan (2002), for example, point out 'the impacts of transport systems on property prices are highly localised' according to the district studied. Brandt and Maennig (2012) demonstrate that, for the city of Hamburg, the value premium for proximity to public transit systems was 4.6% within 250–750 m of the nearest station. Yet, for Miami, Gatzlaff and Haurin (1997) report the absence of significant price difference for homes located near Metrorail stations and cite low substitutability among transport mode choice to explain this. Other studies demonstrate the location premium is linked to service usage, the type of clientele and carrying capacities of the rail system (Bowes and Ihlanfeldt, 2001).

Measures of accessibility have also been shown to influence the expectation of the willingness-to-pay for rail transit. Ryan (1999), for example, states that variation in property values are more directly correlated with travel time savings than with distance from transport facilities, and so incorporating a direct measure of travel time savings finds more consistent property value effects. In general, however, empirical evidence implies that accessibility to rail stations increases property values. Meta-regression studies confirm this, with Debrezion et al. (2011) finding that averaging the explanatory variable causes housing prices to increase 2.4% every 250 m closer to a station, and Mohammad et al. (2013) finding properties 501–850 m away from rail stations increased values by 8.7%. Additional reviews on the effects of rail improvements on housing prices can be found in RICS (2002) and Zhang (2009).

The UK has also received attention from researchers, although empirical findings are not conclusive by any means. In London, Gibbons and Machin (2005) found the hedonic impact of the Jubilee Line Extension (JLE) and Docklands Light Railway (DLR) construction caused property value to rise by 9.3% in affected areas between 1997 and 2001. In South Yorkshire, Henneberry (1998) found Supertram's announcement increased housing prices by 4.0% for properties situated in proximity to the light-rail system in 1988 but these value premiums had dissipated by 1996. In the case of Manchester, Forrest et al. (1996) found its housing market reacted negatively to the Metrolink intervention by depreciating property values.

Despite its theoretical soundness, the marginal effect of *anticipated* transport interventions on house prices has been little studied for rail networks, with only few notable exceptions (see Grimes and Young, 2013; McMillen and McDonald, 2004). Several papers claim the introduction of a public mass transit system requires a delay during which stakeholders speculatively internalise the effect even before the service becomes operational (Dubé et al., 2011a). We contribute to this literature by demonstrating that rail interventions positively enter the utility functions of home-buyers *even before* they have been completed. At a more general level, the paper contributes additional, causal evidence of the positive valuation of rail interventions in urban housing markets.

This paper identifies the causal effect of the intervention by adopting a difference-in-difference (DiD) estimator, avoiding many of the biases inherent in standard cross-sectional models. Relying on the "opportunistic" location of Ealing, in-between employment centres and thus not the explicit target of the policy, we consider the announcement of Crossrail-related station upgrades as a quasi-natural experiment that allows us to isolate its causal effect. In all, because serving Ealing is not the explicit goal of Crossrail, the announcement can be treated as an external shock which generates an exogenous source of variation for the study area. To refine our analysis, we further include standard controls used in housing models and control for the presence of remaining spatial autocorrelation, a usually ignored condition in this type of set-up. Overall, we find for every kilometre a house is closer to a station targeted for Crossrail upgrades, the WTP of home-buyers increases between 2.4% and 2.5%.

The remainder of the paper is organised as follows. Section 2 introduces the context of the study area and descriptive statistics relating to the data series. Section 3 motivates the specification and underlying assumptions of cross-sectional, spatial autoregressive and DiD estimators. Section 4 presents model estimation results and diagnostics. Section 5 discusses policy implications of this research. Section 6 concludes the paper.

## 2. Context and data

The study area comprises the London Borough of Ealing, a 55 km$^2$ local authority district with 338,499 inhabitants that lies inside the London Travel-To-Work-Area (TTWA) (Ealing Council, 2011). Between the 2001 and 2011 censuses, the employment-household ratio remained relatively stable ~1.3:1 with only the absolute numbers for total employment and household spaces increasing.[2] Clearly, the economic profile of Ealing reflects a relatively stable local authority district, with the average household size growing only marginally by 3.8% between the census periods. As a Low Emission Zone (LEZ), Ealing monitors strict conformity to European Union emission standards in order to reduce automobile dependency and stimulate transit-orientated developments of mixed and dense urban housing around transportation nodes. Ealing's passenger rail network is provided by National Rail (NR) and London Underground (LU). The former is a main-line rail system managed by Network Rail and operated by several private rail operating companies, whilst the latter is a metro-style

[1] In 2012, for example, Ealing's PiXC peaked at 9.6% between 08:00–08:59 relative to service provisions by Northern Rail and TransPennine Express who enjoyed comparatively lower PiXC's of 3.7% and 3.9%, respectively.

[2] Total employment and household spaces increased from 153,781 to 157,500 and 118,100 to 124,082, respectively (Office for National Statistics, 2011).