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**Title:** The short-term land value impacts of urban rail transit: quantitative evidence from Sunderland, UK

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Abstract

Experience of light rail, metro and other urban rail transit schemes in the world shows they can play a significant role in improving the attractiveness and quality of urban public transport. In terms of the high cost of rail transit systems, land value capture has drawn increasing attention as a result of its potential for funding public transport infrastructure. To evaluate its potential success, it is crucial to examine critically the impact of public transport on land value before approaching the question of land value capture.

This paper considers how the introduction of a rail transit system can lead to land value changes using the extension to Sunderland of the Tyne and Wear Metro (UK) as a case study. Changes in land values, specifically residential land prices, have been investigated using residential property prices data from local newspapers. This paper presents a statistical analysis of residential property price change in the vicinity of Sunderland Metro stations together with the results on the significance of land value uplift associated with the Metro in Sunderland. The results are discussed in the context of previous studies of the Tyne & Wear Metro before the Sunderland extension was planned. The paper concludes with a discussion of the reasons for the results.

Keywords: land value; land value uplift; Sunderland Metro Extension; statistical evidence

1. Introduction

In recent years, land value capture has attracted increasing attention as a result of its potential for funding transport infrastructure. It is well acknowledged that location plays a key role in property choices. Accessibility is one of the most important factors about location. Transport infrastructure can improve accessibility to both employment and amenities suggesting that improved accessibility can add value to land. The central question is therefore “Can this added value be captured to fund or partly fund transport infrastructures?” To answer this question it is crucial to examine the evidence as to how much value transport facilities add to land value.

This research is undertaken against a background where light rail, a specific form of urban rail transit, is seen as a key element of the future transport networks in major UK cities. However promoters of these light rail schemes face tangible difficulties over their ‘affordability’ and financing. Modern light rail schemes have been introduced in the UK since the late 1970s and the first to be built was the
Tyne and Wear Metro. Since this introduction of Metro, more than 30 different schemes have been proposed throughout the country and now seven light rail systems exist\textsuperscript{1}. Most recently, light rail has had a disappointing response from the UK government which, although agreeing a funding package for extensions to the Manchester Metrolink, revoked the funding for schemes in Hampshire, Leeds and Blackpool (DfT, 2004). Other proposals for light rail are proceeding with attempts to meet the funding gap by some form of land value capture as in Edinburgh. The ability to generate funds by land value capture is predicated on the land value impacts of new transport infrastructure being positive and this is the focus of this paper.

There has been substantial research into this issue recently in the US but very little in the UK. Most recently, the Royal Institute of Chartered Surveyors (RICS) and the Office of the Deputy Prime Minister (ODPM) have commissioned ATIS REAL Weatheralls, University College of London and the Symonds Group to undertake a study on land value and public transport (ARW et al. 2002), choosing the Croydon Tramlink, located in Greater London, as their case study. However, the capital is often different in many aspects from other places in the country and conurbations such as Newcastle and Manchester might be more representative for British cities as a whole. This study considers the Sunderland Metro Extension to examine the land value impacts of new public transport infrastructure.

2. Literature review

The relationship between land value and transport investment has been mostly examined through residential properties and commercial properties on the grounds that the value added by transport improvements is capitalised into land by adding to the site value of properties. The price of a property consists of two parts: one is the value of building itself and the other is the value of land. Normally, the change in property prices is the result of the change in the value of land rather than the change in the value of buildings if there is no substantial improvement work on the building. This paper focuses on residential properties partly as a result of data limitations as well as a belief that house owners were likely to be less entrepreneurial in their choice of location. For these reasons, the literature review in this section concentrates on the land value impacts on residential properties.

Studies in the US which have looked at the effect of new rail transit provision on house prices have generally found positive effects, Only the studies by Landis et al. (1994), Lawless and Dabinett (1995) claimed no discernable effect was found on residential property prices as a result of new rail transit provision. Other studies show significant statistical evidence of residential property price increases, of up to 25%, which have been attributed to new rail transit provision (Armstrong 1994; Hack 2002). Accessibility to transport has been found in Hong Kong to be an important determinant of house prices and access to minibus emerged as the most influential factor in determining house prices (So et al.\textsuperscript{1})

\textsuperscript{1}Tyne and Wear Metro, Docklands Light Railway (DLR), Manchester Metrolink, Sheffield Supertram, Midland Metro, Croydon Tramlink and the most recent, opened in 2004, Nottingham Express Transit.
In Japan, along the Tokaido line (near Tokyo) the value of commercial parcels of land within 50m of stations increased by 57% (Cervero 1998).

In the UK, the increase in house prices in London as a result of new rail transit has been dramatic. Don Riley (2001), a south London property developer, estimated that land values around the stations of the Jubilee Line extension have increased by £13bn when the cost of the extension itself was only £3.5bn. These positive results – whilst not so dramatic – were confirmed by a recent study on the impact of the London Jubilee Extension which found positive but variable results in residential property prices (Chesterton 2002). A very early study about the impacts of London Victoria Line showed the value of properties in the catchment of the line increased between 1% and 5% as compared to properties outside the catchment (Wacher 1971). Similarly, the Channel Tunnel rail link has uplifted house prices in Stratford and east London significantly (Riley 2001). The ex-post study on the impact of the Croydon Tramlink on land value has not yet reported (Thomas and Copley 2002).

Elsewhere in the UK, evidence of land value uplift as a result of new public transport infrastructure has not been found. The first study into the impacts of Tyne & Wear metro revealed that there was a rise of residential housing price close to two of the metro lines but a fall in housing prices for the other two metro lines at the same time (TRRL 1984). A further study into the longer-term impacts of Tyne & Wear metro failed to find statistical evidence of land value uplift resulting from the introduction of metro (Davoudi et al. 1993). Similar findings were identified by the Manchester Metrolink study (Forrest and Glen 1995) as well as Sheffield Supertram study (Lewis 1998).

3. The case study

Tyne & Wear Metro, operated by Nexus, is the backbone of the area’s public transport system. The first 55.5km of the network was completed in 1984. An 18.5km extension to South Tyneside and Sunderland area was announced in September 1999 and opened in March 2002, running over the existing heavy rail route and on the alignment of the former railway line. There are 12 stations on the new extension. Four are upgrades of existing stations and eight are new, including a new transport interchange, Park Lane, in the centre of Sunderland. The extension runs mainly through the City of Sunderland, where there are nine stations including two of the upgraded ones.

Before the opening of the extension, Sunderland was the only district in Tyne and Wear not directly served by Metro and the extension was expected to mean significant added value from cross-city and cross-river journeys. Whilst the beneficiary of heavy rail links between Sunderland and the city centre of Newcastle prior to the extension, the Metro extension to Sunderland offered not only enhanced frequencies but the opportunity for enhanced accessibility by the provision of additional stations.

More than three years has elapsed since the announcement and this study uses data from one year after the opening of this extension to look at the short-term impacts of the new infrastructure on land value. A map of this extension is shown as Figure 1.
4. Methodology

In this study, combinations of quantitative and qualitative approaches have been used to examine the extension to Sunderland of the Tyne & Wear Metro. Primary and secondary data have been collected for the quantitative data on residential property prices. The comparison method, which has been used in a number of previous studies (TRRL 1984; Cervero and Landis 1993; Daboudi et al. 1993), is employed in this study. The price changes of houses in the catchment areas of a station are compared with the property price changes in control areas. The key methodological issues are discussed in the following sub-sections.

4.1. The treatment of time

Identifying the appropriate time period is very important as studies based on different time windows may lead to different results of land use change. The RICS Policy Unit Report (ARW et al. 2002) suggests that “Ideally, data should be available from before the decision to build was taken and immediately after opening, as well as downstream. A continuous database is ideal, but data are needed for at least these three points in time” and “this is because changes will take place in land and property values in advance of the completion of the transport investment as developers and house builders will invest in the expectation of improvements in transport infrastructure. Effects might also be expected immediately after the transport investment is opened, and further in the future as the full benefits are recognised”. This paper concentrates on the effect on residential house prices, specifically using existing housing stock as the main focus as it was felt that entrepreneurial expectations would apply least to this sector.

In this case study, the decision to build an extension to Sunderland was taken in September 1999 and Nexus (the operator) commenced work on the project in January 2000 with the confirmation of Government funding. The Sunderland Metro extension was fully operational in March 2002, with the exception of Park Lane Station, which was opened one month later in April 2002. In terms of collecting data on property prices, the three points in time were identified as August 1999, April 2002 (May 2002 for Park Lane Station) and March 2003 respectively.

4.2. Studied areas

In most studies, areas within walking distance from the station were identified as the catchment areas for the new transport infrastructure on the grounds that the impacts of rail transit follow the improvement of accessibility. There is evidence from the study on walking distances to and from light rail transit stations in the city of Calgary, Canada, that average walking distance to light rail stations is 326 metres in CBD area or 649 metres in suburban area (O'Sullivan and Morrall 1995). Nevertheless, according to RICS Policy Unit Report (ARW et al. 2002), the impact area for residential developments could extend to 1000m from a station depending on the type of investment and the size of urban area. Guided by these references, areas of 500m radius around the stations were adopted as the catchment
areas (this would approximate to about a ten minute walk) and the control areas were areas of at least 1000m away from a station.

The selection of control areas were subject to two criteria. The first was that a control area should have similar characteristics to its’ paired catchment area so, for example, if the catchment area was located in an inner city area surrounding terrace houses, it would not fit to have a seaside area with semi-detached houses as the control area. Second, the control area should not have benefited from other improvements and this was checked by looking at the Adopted Urban Development Plan (SCC 2001).

In Sunderland itself, there are nine new metro stations, of which two are upgraded stations located on the previous heavy rail system (Seaburn and Sunderland). Among the seven new stations (Stadium of Light, St. Peter’s, Park Lane, University, Millfield, Pallion and South Hylton), the prominent land use is residential with the exception of St. Peter’s where the land use is largely commercial rather than residential. The station space between University and Park Lane is small and the catchment areas overlap, so these have been combined for this study. Pallion and Millfield stations connect in a row (see map at Figure 1) and have similar characteristics so one control area in Hendon was chosen for both. Thus, this study considers in total five catchment areas and four control areas as shown in Table 1.

4.3. Data acquisition

In house related data analysis, transaction house price data are normally thought to be the best data as these prices are the proven prices by the market whilst asking prices are considered as expected prices based on the valuation by agencies. In many cases asking prices are reasonable prices since there is evidence that asking house price and transaction house prices are highly correlated with the actual sales price achieved being above 93% on average of asking price in the UK housing market since 2002 (Hometrack 2005). In May 2004, when the data for this study were collected, the transaction house price achieved was, on average, 98.6% of the asking price in the North Region (Hometrack 2005). It is therefore possible to examine the determinants of house prices by looking at asking prices without introducing too much inaccuracy.

House price data at the three points of time of August 1999, April 2002 and March 2003 were sought. Transactional price data at full 6-digit postcode level (e.g. SR2 8JX) would have been ideal but was unavailable due to commercial confidentiality or only available with limited information about the property characteristics. Thus, the asking prices of properties were obtained from the local newspaper, the Sunderland Echo, as an alternative data source. Transactional data at postcode sectors level (SR2 8) on a more aggregate level was used as an additional check on the collected asking prices (available from Land Registry website) and this data forms the basis of the more macro level analysis presented below.
5. Results and analysis

As much of the new extension to Sunderland passes through areas which are already developed, the impact of this extension is likely to be more evident through changes in property prices rather than through new development opportunities. Hence this paper examines land value change by looking at changes in residential property prices. The results are considered in two stages, first by reference to a series of indices and then by the results of the statistical analysis.

5.1. Index of property prices

Using indices allows the percentage change in a variable, such as costs or prices, to be considered from some fixed point in the past. The base period of an index is the period against which all other periods are compared. In this paper, this simple index method is used to show the percentage changes of residential property prices over two periods, namely from the point of before the announcement (August 1999) to the point of after the opening (April 2002) and to the latest point (March 2003). Indices are used since it is not possible to achieve exactly the same mean price between a catchment area and a control area, given the other constraints on matching areas although this paper does examine whether any differences in such means are statistically significant using a one-way ANOVA (see section 5.2 below).

The results are first considered for Sunderland as a whole and then in more detail at the inner and outer city levels.

5.1.1. Overall comparison in Sunderland

Before starting to analyse property price changes in the studied areas, it is necessary to look at Sunderland as a whole. The breakdown of transactional property prices by property type and region are available from the website of HM Land Registry (Registry 2003). The data of transactional property prices at the level of relevant region or area in October-December 1999, July-September 2002 and April- June 2003 to reflect August 1999, April 2002 and March 2003 respectively, have been derived and plotted in Figure 2. The reason why these periods have been chosen was that it was expected that transactional prices would actually occur some months after asking prices, normally at least two months later.

Figure 2 shows that there has been increase in the indices over the period of October 1999 to June 2003 throughout the country including the North region. But, whilst there was a significant rise in average property prices in the whole of England over the period of October 1999 – September 2002, the North region was below average and Sunderland benefited from lower than regional changes. In contrast, over the period of Sep 2002 – Jun 2003, the property prices in Sunderland kept rising steadily, continuing at the same rate as the previous period whilst the property prices in the whole of England, the North region and Newcastle upon Tyne rose more slowly than before. The question that
this paper addresses is as follows: is the strong growth of property prices in Sunderland during the period of September 2002 to June 2003 the result of the opening the extension to the Metro service?

Looking in more detail, it is interesting to see if there were different rates of growth in prices between different types of property and this is shown in Figure 3. Between July to September 2002, the index of flat prices was the lowest (110) whilst the index of detached house prices was the highest (161) whereas in April – June 2003, the index of flat prices (154) was just slightly higher than those of terraced houses (149) but the index of detached house prices was still the highest (192). It would appear that there are few exceptions to the observation that the better types of property have the highest increases in their selling prices. This means that the quality of property is one of the factors which influences property value changes in a positive way so that better houses tend to have more added value.

The following sections look at changes in house prices in a more disaggregate way.

5.1.2. Inner city area

The indices of property prices in the catchment area of metro, Pallion and Millfield, University & Park Lane, as well as their control areas, High Barns and Hendon, are considered together as being located in an inner city area. Property prices from the local newspaper, Sunderland Echo, are the basis of the indices shown in Figure 4.

As can be seen from Figure 4, both in April 2002 and March 2003, the indices of property prices in the High Barns area (Control area 1) are the highest (164 and 200 respectively) whilst the indices of property prices in the Hendon area (Control area 2) are the lowest (100 and 125 respectively) among all the five studied areas. In addition, in April 2002, the index for each of the three catchment areas is similar: the lowest is Pallion and the highest in the University & Park Lane area. In March 2003, the index in each of the three catchment areas are still similar with the lowest in Pallion but the highest now in Millfield.

Comparing the catchment areas with High Barns (Control area 1), which is a desirable residential area, the rise of property prices in the catchment areas are lower. On the other hand, comparing the catchment area with Hendon (Control area 2), an undesirable area, the rise of property prices in the catchment areas are higher. On this evidence, it appears that any link between accessibility and house price rises is dominated by the environmental factors of whether an area is desirable or not.

5.1.3. Outer city area

The outer city area comprises the catchment areas, Stadium of Light (SL) and South Hylton (SH) and their control areas. As before the property prices comparisons (SL and SH), are based on property prices obtained from the Sunderland Echo and are shown in Figure 5.
Stadium of Light (SL)
In April 2002, the index of property prices in the catchment area is almost the same as that in the control area (130/131); but in March 2003, the index of property in catchment area is much lower than that in the control area (162/183). So, in the Stadium of Light area, against expectation, the impact of the Metro on property value would not appear to be positive as compared to the control area, which is 1000m away from the station.

South Hylton (SH)
In April 2002, the index of property prices in the catchment area is slightly lower than that in the control area (111/119); but in March 2003, the index of property prices in the catchment area is considerably higher than that in the control area (160/142).

In the South Hylton area, property value did not increase significantly until one year after the Metro opening. South Hylton area was originally a relatively remote village and the station is now the terminal of the Metro line. It seems that people took some time to recognise the benefit of accessibility to the Metro, giving a delay of the influence on property value from the improvement of access to the Metro.

In conclusion, there is no strong evidence, using this analytical approach, as to whether the strong growth property prices observed in Sunderland during the period of September 2002 to June 2003 (and shown in Figure 2) was as a result of the opening of the Metro service. Some other factors, such as the quality of property and its environment, would appear to be more influential than accessibility to changes in property price.

5.2. Statistical analysis
In this section, a more sophisticated statistical analysis is used to examine the potential impact of accessibility on house prices. Using difference of mean tests, the mean changes in property values around stations are compared with the mean changes identified in the control areas over two periods. The following null ($H_0$) and alternative ($H_1$) hypotheses are the basis of the tests:

<table>
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<tr>
<th>Hypothesis</th>
<th>Null Hypothesis ($H_0$)</th>
<th>Alternative Hypothesis ($H_1$)</th>
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<td>1</td>
<td>There is no significant difference in property prices in the control and catchment areas at a point in time</td>
<td>There is significant difference in property prices in the control and catchment areas at a point in time</td>
</tr>
<tr>
<td>2</td>
<td>There is no significant change in property prices in one area over time</td>
<td>There is significant change in property prices in one area over time</td>
</tr>
<tr>
<td>3</td>
<td>There is no significant interaction between time and area.</td>
<td>There is significant interaction between time and area.</td>
</tr>
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A one-way ANOVA method was used for testing hypotheses 1 and 2 with contrast tests. Repeated Measures ANOVA method was used for testing hypothesis 3 with tests of within-subjects contrasts. The latter method requires the same size samples, which were randomly sampled from the collected data sets. Figure 6, with three separate diagrams, demonstrates these contrast tests using Millfield area as the example. For hypothesis 1, the diagram labelled Millfield (H1), shows the one-way ANOVA contrast test between the catchment area (Millfield) and the control area (Hendon) at August 1999, April 2002 and March 2003 to look at the difference in mean property prices between the catchment areas and associated control areas. For hypothesis 2, the diagram labelled Millfield (H2), property changes in Millfield and Hendon areas are compared over the periods from August 1999 to April 2002 and from April 2002 to March 2003 respectively using a one-way ANOVA contrast test. The diagram labelled Millfield (H3) is the key test and addresses hypothesis 3: the difference in property prices between Millfield and Hendon areas from August 1999 to April 2002 as well as from April 2002 to March 2003 thus capturing both time and area effects.

For all areas, the variables to be used in the One-way ANOVA and Repeated Measures ANOVA were tested for normality as this is an important assumption of this statistical method: the tests confirmed that the data could be considered as if from a normal distribution. Hypotheses tests were undertaken by One-way ANOVA and Repeated Measures ANOVA. At a 5% level of significance, a p-value less than 0.05 allows the null hypothesis ($H_0$) to be rejected and the alternative hypothesis accepted– the result envisaged if there is significant land value uplift. The results are summarised in Table 2.

Table 2 shows that the null hypothesis ($H_0$) for hypothesis 1 is accepted in all the contrasts in the period 1999 between the catchment area and the control area. This means that, before the announcement of the Metro, there was no significant difference between the property prices in each pair of the catchment area and control areas. This confirms the selection of control area as being appropriate. However, in the area of Stadium of Light (SL), the null hypothesis ($H_0$) for hypothesis 1 is accepted in all the contrasts and appears to be more strongly accepted as time goes forward. From the plot of means in SL area, Figure 7, it can be seen that the mean of property prices in the control area rose more quickly than that in the catchment area so that it was getting closer to the mean of property prices in the catchment area. In the area of University & Park Lane (UP) and South Hylton (SH), the null hypothesis ($H_0$) for hypothesis 1 is rejected in the contrasts in period 2003, suggesting that there was significant difference between the property prices in the catchment area and control area one year after the Metro service opened. In the area of Millfield and Pallion, the null hypothesis ($H_0$) for hypothesis 1 is only accepted in the first contrast, which means since August 1999, the changes of property prices in the catchment area and control area have been different. These differences can be seen from the plots of means Figure 7.

As far as hypothesis 2 is concerned, for catchment area, the null hypothesis ($H_0$) is only accepted in the SL case and these results agree with the previous indices analysis. In all other cases (Millfield, Pallion and SH), the null hypothesis ($H_0$) is accepted in the control area for the period 1999-2002,
which demonstrates that changes in property prices in the control areas are not significant. However, this did not happen in UP case, which is in the city centre, suggesting that city centre property tends to add more value regardless proximity to the metro.

With respect to hypothesis 3, apart from Millfield, the null hypothesis ($H_0$) is accepted in all the areas, suggesting there is no significant difference between the property prices in the catchment area and control area when the interaction between time and area is taken into account together.

To summarise, the statistical analysis generally suggests that, with the exception of Millfield, there is no significant difference in property prices between the catchment and control areas either at a point in time or with the interaction over time. This confirms the choice of control area for each catchment area as appropriate but also suggests there is no overwhelming statistical evidence that land value uplift has occurred as a result of the introduction of new transport infrastructure in Sunderland. Some other factors, such as the regional economic environment and quality of property seem to have much influence and perhaps more influence than the accessibility to public transport in Sunderland. These confirms the result of a previous study of Tyne and Wear Metro (Davoudi et al. 1993).

6. Conclusion

This conclusion considers a number of reasons why the analysis in this paper has not shown positive changes in property prices, reflecting changes in their underlying land values, as a result of the new transport infrastructure in the form of the extension of Metro to the City of Sunderland.

This paper has considered a time frame appropriate to examine the short-term impacts of changes in accessibility on land values, as measured by changes in residential property prices. In many cases, residents do not see the purchase of their home as an investment decision and this might mean that a longer period is required for the effects of improved accessibility to feed through into house prices.

House prices are a function of many other features such as the number of bedrooms, the general state of decoration and whether or not, for example, there is a garage. These factors are hard to separately identify when using a single house price as the basis for analysis. The absence of this information leads to a high variation in house prices masking what might be a statistically small interaction effect. As a result, some benefits associated with Metro may not be identified by this type of statistical analysis. For instance, the effect that improved accessibility may make a house quicker to sell rather than increase its value. Also, the existence of Metro may help improve the image of city, thus contributing to the strong overall growth of property prices in Sunderland during the period September 2002 to June 2003 identified in this paper.

The literature suggests that the degree of land use impacts can be affected by the existence of co-ordinated land use policies, available land for development, regional economic trends and favourable social and physical conditions. Nearly all these factors would appear indispensable for substantial land
use impact to occur (Knight 1980) and are likely to have accounted for the positive effects found by studies in the US using this methodology. The extension of Metro to Sunderland utilised existing rights of way for the track, only traverses the northern area of the city of Sunderland and did not give rise to significant opportunities for new development. In addition, Sunderland, as part of the Northern Region in the UK, does not enjoy favourable regional economic trends or favourable social and physical conditions. This suggests that any land use impact in Sunderland might be smaller than observed elsewhere where the factors leading to substantial land use impact are present. This would suggest that a more sophisticated tool for analysing the changes in property price in Sunderland might be more successful.

It may be that residential land value uplift is less pronounced than commercial land value uplift. The business community may well be better able to internalise the effect of improved accessibility by increasing rents. A comparison of residential property prices with commercial rents in Sunderland would therefore make an interesting follow on to this work. Indeed, as positive land value impacts of light rail are the basis for land value capture providing some finance for the development of new light rail systems in cities throughout the UK, it is imperative to undertake more disaggregate research in both the residential and the commercial sectors to see if such impacts exist.

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References


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<table>
<thead>
<tr>
<th>Catchment area</th>
<th>Control area</th>
<th>Characteristics</th>
</tr>
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</table>
| West of Stadium of Light | Southwick    | At the north of River Wear  
Predominantly terrace houses  
Similar accessibility to trunk roads and Bridges |
| Park Lane / University | High Barns   | At inner city area  
Predominantly terrace houses  
Accessibility to trunk roads |
| Millfield           | Hendon       | At inner city area  
Near to the river side (or sea side) and the area of works  
Predominantly terrace houses  
Similar accessibility to trunk roads and city centre  
(Millfield is closer to city centre) |
| Pallion             |              |                                                                                |
| South Hylton        | Castletown   | At the beside of the River Wear  
Predominantly semi-detached houses  
Similar accessibility to trunk roads and city centre |
### Table 2: Results of Contrast Tests

<table>
<thead>
<tr>
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<th>Hypothesis 2</th>
<th>Hypothesis 3</th>
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<td>Contrast</td>
<td>p-value</td>
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<td>Ca02-Co02</td>
<td>0.039</td>
<td>✗</td>
</tr>
<tr>
<td></td>
<td>Ca03-Co03</td>
<td>0.039</td>
<td>✗</td>
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<td>Pallion</td>
<td>Ca99-Co99</td>
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<td>Ca03-Co03</td>
<td>0.019</td>
<td>✗</td>
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<tr>
<td>South Hylton (SH)</td>
<td>Ca99-Co99</td>
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Ca**-Co** is the contrast for the catchment and control area in the period 19**/20**: # is the contrast of the interaction of Area & Time. Level 1 - Level 2 is for the period of Aug 99 – Apr 02, Level 2 – Level 3 for the period of Apr 02 – Mar 03.

Source: data based on property prices obtained from Sunderland Echo
Figure 1: Map of Sunderland Metro Extension of Tyne and Wear Metro

Source: Based on Edina Digimap
Figure 2: Index of property prices comparison (at region level)

Source: data based on the breakdown of transactional property prices by region from the website of HM land registry; Index 100 = Oct–Dec 99
Figure 3; Index of different type of property prices comparison in Sunderland

Source: data based on the breakdown of transactional property prices by type from the website of HM Land Registry; Index 100 = Oct–Dec 99
Figure 4: Index of property prices for the Inner city area of Sunderland

Source: data based on property prices obtained from Sunderland Echo; Index 100 = Aug 99
Figure 5: Index of property prices for Outer urban area of Sunderland

Source: data based on property prices obtained from Sunderland Echo; Index 100 = Aug 99
Figure 6: Demonstration of the contrast tests using Millfield example

Source: data based on property prices obtained from Sunderland Echo (2003)
Figure 7: Comparisons of Means of property prices

Source: data based on property prices obtained from Sunderland Echo (2003)