Institute of Transport Economics
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Summary

Effects of measures for improving public transport travel time and reliability

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Using detailed data on travel time for buses, we have illustrated congestion problems for selected bus routes in Bergen, and investigated the effects of measures for improving public transport travel time and reliability. We demonstrate that congestion problems can be documented using such data, and that different measures of congestion and reliability largely give the same impression. The results show that active signal prioritization (ASP) in signal-controlled intersections has had a significant effect on travel time of buses at two intersections at Haukås north of Bergen. A new bus lane in the same area does not appear to have had any effect. We also find no effect of the project for Route 10 between Gyldenpris and Wergeland, where a number of minor improvements have been made. Simple cost-benefit analyses indicate that ASP gives positive net present value in one or three intersections, depending on how travel time gains are valued.

Scope of the project

The aim of the project is to (1) document methods for handling driving time data for public transport, (2) use this type of data to identify congestion problems for selected bus routes in Bergen, (3) compare different measures of congestion and reliability, (4) identify the effect of implemented measures for improved travel time and reliability, and (5) estimate the economic impact of the measures. For this, we use large amounts of detailed operational data from Skyss, which is responsible for public transport in Vestland regional government

We analyse the effects of the following measures:

- A new bus lane at Haukås
- Active signal prioritization (ASP), where we have looked at the effect in four of the 13 signal-controlled intersections where this has been introduced
- The project for Route 10 between Gyldenpris and Wergeland, which consists of upgrading bus stops, removal of parking spaces and other minor measures

For the analyses of the new bus lane at Haukås and two signal-controlled intersections with ASP in the same area, we have used data for bus route 36 and 37. For the analyses of the other two signal-controlled intersections, we have used data for route 83 (Fantoft-intersection) and 25 and 51 (Kråkeneskrysset-intersection). For the analysis of the Route 10 project, we have used data for route 10.

Measuring congestion and reliability

Using the driving time data, we investigate the extent to which we can detect congestion problems in the various areas in the period before the relevant measures were implemented. We are using two different approaches to measuring congestion and reliability:

1. We measure delay at one stop relative to the route's timetable, and change in delay from one stop to another.
2. We look at how the driving time is distributed on a section of the route, regardless of the timetable. We examine how much variation there is in driving time and whether typical driving time is much longer than it would be in free-flow conditions. Free-flow conditions are defined as the driving time that 10 percent of the buses stay below (the 10^{th} percentile).

The results show that the two approaches largely give the same impression of the degree of congestion problems, but there are some areas where they give slightly different results.

The advantage of looking at delay in relation to the timetable is that this provides a measure of perceived reliability for the travellers. The disadvantage is that the way the timetable is designed may hide the underlying problems, and that changes in the timetable can have an impact on the measured reliability. We show an example where changes in delay are due to changes in the timetable, not changes in actual driving time.

The advantage of looking at the distribution of driving time regardless of the timetable is that how the timetable is set up does not affect the results. The disadvantage of using driving time relative to free-flow driving time as a measure of congestion is that we do not have a perfect measure of free-flow driving time. We see, for example, that the 10^{th} percentile of driving time over the day, which indicates that congestion also affects the fastest buses to a certain extent.

Congestion and reliability in the pre-period

The analyses indicate that route 37 is affected by congestion in the northbound direction on the road section Vikaleitet - Haukåsvegen, where ASP has been introduced in the Vikaleitet intersection and which is also covered by the new bus lane at Haukås. Route 36 also seems to have some challenges on the corresponding northbound road section (Vågsbotn - Haukåsvegen), but not to the same extent. As expected, the challenges seem to be related to the afternoon rush hour.

We see no apparent congestion problems on the neighbouring road section to the north, Haukåsvegen - Myrsæter, which is also covered by the new bus lane. If there have been challenges here, it appears that they have propagated backwards to the previous road section southwards, or that they have had other effects than unpredictable driving time.

Furthermore, the analyses indicate that both route 36 and 37 in the pre-period are affected by congestion in the southbound direction on the road section Myrsæter - Haukåsskogen/Bergen Travpark, where ASP has been introduced at the Breistein intersection. The problems are significantly greater for route 37. There are little or no problems in the northbound direction. The challenges are greatest during the afternoon rush hour.

Route 83 is affected by ASP at the Fantoft intersection on the road section Fantoft - Storetveit. Here we see no clear signs of congestion problems in the pre-period. This is not unexpected, as congestion or delays were not the reason why ASP was introduced at this junction. The cross can thus work as a validation of our methods.

ASP has also been introduced in the Kråkenes intersection, which affects the road section Langegården - Bergveien/Langebekken southwards and the road section Bergveien/Kråkenesveien - Langebekken northwards of route 25 and route 51. Here we see signs of congestion problems southwards for both routes, especially route 51, but not of the same scope as the challenges for route 37 mentioned above. In the northbound direction, problems are smaller, especially for route 51.

In the case of route 10, both delays and variation in driving time are larger for southbound buses than northbound buses. The problems seem to be larger during rush hour, but the difference is not dramatic. The road section between Mindeveien/Fjøsangerveien and Wergeland stands out as the one with the largest variation in driving time.

Effects of implemented measures

We have examined the effect of the implemented measures on average driving time on the relevant road section for selected bus routes. A challenge in quantifying the effect of an intervention on the reliability of buses is to distinguish the effect of the intervention from other factors that affect accessibility. For this, we have used slightly different methods for the different interventions.

To identify the effect of the new bus lane at Haukås, we have exploited that this only has an effect in the northbound direction. We can thus use the southbound buses as a control group and identify the effect for northbound buses using the so-called difference-in-difference method.

ASP can potentially have an effect on all buses that pass through the signalling intersection, so we do not have the opportunity to use the same method here. Instead, we do simple before/after analyses without a control group, but examine the extent to which there is an apparent break in the trend that can be attributed to the measure.

In the analysis of the effects of the new bus lane at Haukås, we control for the introduction of ASP in the Vikaleitet intersection in the post-period, as this affects the same road section. Similarly, we control for the effect of the new bus lane when we look at the effect of ASP in the Vikaleitet intersection. These two analyses thus complement each other.

For the Route 10 project, we take advantage of the fact that there is road section between Blekenberg and Mindeveien/Fjøsangerveien where northbound and southbound buses drive along different roads, and where measures only has been implemented on the southbound route. We thus use the same method here as for the new bus lane at Haukås, but for a longer road section.

The results do not indicate any particular effect of the new bus lane at Haukås on the driving time of the buses. On the other hand, we see a significant effect of ASP in the Vikaleitet intersection on driving time in the northbound direction for route 37. We acknowledge that there may be challenges in separating the effects of the two measures from each other.

Furthermore, the results show a significant effect of ASP in the Breistein intersection in the northbound direction. Also here, the effect is larger for route 37. In the Fantoft intersection we find no effect, as expected. In the Kråkenes intersection there are some signs of negative effects on driving time, but not as great as in the two intersections in the Haukås area.

For the Route 10 project, we find no signs of an improvement in driving time on the road section Blekenberg - Mindeveien/Fjøsangerveien, where measures were implemented in on the southbound route. The graphical analyses also show no clear break in the trend for the road section Gyldenpris - Wergeland as a whole. Any improvements here thus do not appear to have resulted in shorter and more predictable driving times.

Economic assessment

We have carried out simplified cost-benefit analyses of the new bus lane at Haukås and for the introduction of ASP in three signal-controlled intersections. As we cannot demonstrate any accessibility effect of ASP in the Fantoft intersection or in the Route 10 project, we have not done a cost-benefit analysis of these measures.

In the analyses, we have included the cost of the measure, benefits in the form of time savings for passengers and the public transport company. In the case of ASP, we have also estimated the disadvantage in the form of a possible time loss for other road users. We consider these to be the most important effects, but there may be other effects that are not included.

For those measures that have a positive effect, this consists of a shorter driving time of buses on the affected road section. This might not results in a visible economic gain in the short term, as travel time for passengers depends on the timetable and driving time on the other road sections of the route. Taking a longer-term system perspective, we nevertheless assume that the entire reduction in driving time can be reaped in the form of shorter travel time, which provides benefits for passengers and saved costs for the public transport company. We have also performed sensitivity analyses where we assign a higher weight to travel time gains for passengers such that we regard the time gain as improved reliability.

The results show that ASP in the Breistein intersection leads to a social welfare loss (i.e. negative net present value) if we only count the benefits associated with shorter travel time. However, it turns profitable (i.e. positive NPV) if we apply higher weights on passenger time savings and regard them as reliability gains. ASP in the Vikaleitet intersection is profitable under both conditions.

The new bus lane at Haukås is highly economically unprofitable, as the benefits are very small in relation to the cost. Here, it is conceivable that some of the effect we find of ASP in the Vikaleitet intersection might be attributed to the new bus lane, but even if we analyse the two measures as one, the economic case is clearly negative.

For ASP at the Kråkenes intersection, the gains are moderate, but the cost is at the same time lower than for the other signalling intersections. The measure is not economically profitable if we only count the benefits associated with shorter travel time, but profitable if we also include the benefits of increased reliability.