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ORIGINAL PAPER

An analysis of the determinants of local public transport demand focusing the effects of income changes

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Abstract
Purpose In order for public transport to be a part of the solution to the environmental problems caused by traffic there need to be a clear understanding of how, and to what extent, different factors affect demand. There still seem to be some confusion regarding some key relationships, one of them being the effect of income on public transport demand. The purpose of this article is therefore to provide empirical estimates of how different factors, including price and car ownership (although income being the main issue), affect the demand for local public transport.
Methods In order to achieve the aim of the study, an econometric FD-model, allowing for unobserved effects, was estimated using panel data from Swedish counes from 1986 to 2001.
Results The short-run (direct) elascies with respect to fare, vehicle-kilometres, income and car ownership were found to be −0,4, 0,55, 0,34, and −1,37 respectively. However, income affects public transport demand directly, and through its effect on car ownership, these effects works in opposite direction. Combining these it is found that total income effect is close to zero.
Conclusions It is concluded that, although the findings of several previous studies suggests that demand for public transport might be falling with increased income, there is no evidence of such effects even when the full effect of changes in income (including changes in car ownership) is taken into account.

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1 Problem and purpose

For a long time increasing car and truck traffic volumes have gone hand in hand with increasing economic activity. This development has led to increased traffic congestion as well as to wider environmental problems, and threatens to further do so. Despite this, private car continues to gain market shares at the expense of public transport in most urban areas of the industrialised world. In order to explain this development, and provide a basis for policy, a large amount of studies have been performed and published [1–4] provide overviews of previous results.

In view of all the previous research in this area it is strange that it has not been used in order to reverse the negative development. There are several (non-excluding) possible explanations of this. One is that the political commitment to promoting public transport is not strong enough when it comes to actually providing the necessary resources. Another possible explanation is that, although well meaning, the decision makers is forced by the harsh reality of Baumol's cost disease to continuously increase fares and reduce quality of service in order to keep the level of subsidies from increasing. A third explanation might be the uncertainty that seems to be present as regards key relationships affecting public transport. In a meta-analysis Holmgren [5] shows that estimated fare elasticities range from zero to −1,32, and demand elasticities with respect to service level range from almost zero up to 1,9. The most striking variation concerns the effects of income on public transport demand. In this case the estimations range from almost minus one (−0,82) up to well above one (1,18). In other words, there is no consensus even as to the sign of the income effect. Results exhibiting this kind of variation make a poor base for policy recommendation. If the income effect is in fact negative, it would be difficult for public transport to act as part of a long-run solution to the environmental problems caused by the transport sector.

The main focus of most previous studies has been the effect of fares and the effect of quality of service (usually measured by vehicle-kilometres) [5]. This is understandable since these variables are considered to be under direct control of the supplier of public transport, but in order to understand the past development and predict the future, other variables must also be considered.

Nijkamp and Pepping [6], Kremers et al. [7], Holmgren [5], and Hensher [8] have used meta-analysis in order to explain the variation in previous results and conclude that the specification of the model greatly affects the results but also that some of the variation is due to regional differences, the time period observed, and the type of data used. Based on these studies, two important questions which need to be examined further can be identified due to the lack of previous information or the presence of a large degree of uncertainty. Those are the interrelationship between demand for public transport and quality of service and the question of the total income effect.

Public transport patronage is generally found to be highly correlated with quality of service, vehicle-kilometres or vehicle-kilometres per km^2, and the latter is often used as an explanatory variable in demand functions. The problem is that there are good reasons to believe that although quality of service certainly affects demand, the level of demand also affects the level of service. This issue has been raised by several authors, the perhaps most influential being Mohring [9–11] who showed that capacity and quality of service were joint products. His models have also been extended and generalized by Jansson [12, 13] and by Jara-Diaz and Gschwender [14] (see also [15–20] for cases were this has been mentioned but incorporated into the model) Despite this, the most common practice in statistical/econometric applications is to assume that quality cause demand and not the other way around. Holmgren [21] applied a Granger causality test to Swedish data and concluded that there was a two-way relationship between public transport patronage and vehicle-kilometres. Failing to take into account a prevailing two-way relationship when estimating a demand model will result in biased estimates.

Previous, empirical, studies where level of service has been treated as an endogenous variable, has been based on different assumptions as to the behaviour of the public transport supplier. These include supply functions derived from assuming profit maximisation, passenger maximisation and maximisation of operations as well as various ad hoc formulations of supply functions. Although useful contributions to the knowledge of public transport have been made through such assumptions, which might accurately capture producer behaviour in some cases, they fail to point out the key element of supply and demand interaction in the case of public transport: the fact that capacity and quality are joint products. Increasing (decreasing) capacity will also increase (decrease) the quality of service. This is most obvious when capacity is expanded by increasing the number of vehicles in use. In that case waiting times are reduced by shorter headway [9–11].

The purpose of this article is to investigate the effects of income changes on local public transport demand. In order to do this, a demand model, taking into account the two-way relationship caused by the jointness of capacity and quality is estimated. Increased understanding of the long-run effects of income changes on public transport demand will improve the possibilities of making accurate forecasts and efficient planning.

2 The Swedish data

The study uses annual data of the urban traffic of the 26 Swedish counties from the period of 1986 to 2001. Due to changes in the county structure and missing data, the panel is unbalanced and the total number of usable observations is therefore 346. The data concerning patronage, vehicle-kilometres, costs and fares are supplied by The Swedish Public Transport Association (Svenska lokaltrafikföreningen, SLTF) to which local public transport authorities report several key statistics. Before 1986 the data was not reported in the same way and it is not possible to convert the series to be compatible and after 2001 local and regional travel is no longer reported separately. The rest of the data needed were obtained from Statistics Sweden (SCB).

Between 1986 and 2001 the total number of local trips by public transport in Sweden increased by 18,5 %, a figure sometimes used in order to portray public transport as a success story. However, this is misleading for two reasons. The uncharacteristic development of the county of Stockholm (including the Swedish capital) obscures the fact that patronage fell in most other counties. If Stockholm is excluded the total number of trips actually fell by 27,5 %. Looking at the development of per capita figures, the total number of trips per capita fell by 5,2 % during the period in question, and excluding Stockholm by 31 %.

Behind these aggregates, the demand differs immensely between counties. 634 million trips were made in Stockholm the year 2001, while only 280 thousand trips were made in the county of Gotland. Table 1 shows the heterogeneity of demand in terms of average per capita figures as well as the percentage change in number of trips per capita during the period in question.

The unique position of Stockholm is further underlined by these figures, not only is the number of trips per capita by far the highest but there has also been an increase in demand during the observed period. The only other counties where this has

Table 1 Average number of trips per capita (i.e. average for the period 1986–2001) in Swedish counties and percentage change between 1986 and 2001

County	Trips/Pop.	Δ%
Stockholm	350	8
Uppland	72	−47
Södermanland	22	−28
Östergötland	71	−42
Jönköping	46	−31
Kronoberg	19	−17
Kalmar	10	−79
Gotland	11	−44
Blekinge	24	4
Kristianstad[a]	12	−23
Malmöhus[a]	66	−32
Halland	25	−56
Göteborg/Bohus[a]	183	−20
Älvsborg[a]	32	−29
Skaraborg[a]	19	−39
Värmland	25	−32
Örebro	36	−36
Västmanland	33	−41
Dalarna	32	−45
Gävleborg	35	−32
Västernorrland	29	20
Jämtland	128	−72
Västerbotten	30	−16
Norrbotten	28	−37
Skåne[a]	39	15
Västra götaland[a]	108	−0,5

[a]In 1997 the Skåne and Västra götaland regions where formed, the former from Kristianstad and Malmöhus and the latter from Göteborg/bohus, Älvsborg and Skaraborg. The figures from these counties therefore cover the years 1986 to 1997 while the figures from Skåne and Västra götaland exist from 1999 to 2001

Table 2 Average number of vehicle-kilometres supplied per km^2 (i.e. average for the period 1986–2001) in Swedish counties and percentage change between 1986 and 2001

County	VKM/km^2	Δ%
Stockholm	3227	12
Uppland	620	−30
Södermanland	205	4
Östergötland	433	−16
Jönköping	318	−20
Kronoberg	112	10
Kalmar	139	−34
Gotland	80	−7
Blekinge	160	9
Kristianstad[a]	62	−42[a]
Malmöhus[a]	547	−18[a]
Halland	154	−4
Göteborg/Bohus[a]	895	−26[a]
Älvsborg[a]	174	−12[a]
Skaraborg[a]	110	−23[a]
Värmland	121	−9
Örebro	161	−4
Västmanland	249	−5
Dalarna	90	−10
Gävleborg	165	−2
Västernorrland	157	1
Jämtland	352	−42
Västerbotten	163	−11
Norrbotten	200	6
Skåne[a]	322	14[a]
Västra götaland[a]	457	5[a]

[a]In 1997 the Skåne and Västra götaland regions where formed, the former from Kristianstad and Malmöhus and the latter from Göteborg/bohus, Älvsborg and Skaraborg. The figures from these counties therefore cover the years 1986 to 1997 while the figures from Skåne and Västra götaland exist from 1999 to 2001

occurred in is Blekinge, Västernorrland and Skåne (1999–2001). In all other counties number of trips per capita has fallen since 1986.

Hardly surprising there is also a great deal of variation in service levels. Table 2 shows these variations in terms of average number of vehicle-kilometres per km^2 as well as the percentage change during the observed period.

Again Stockholm stands out, this time as the region having the highest level of service in the public transport system. In most counties all public transport trips are made by bus but it should be pointed out that in the case of Stockholm the figures also include the underground system and the figures from Göteborg/Bohus and Östergötland include tram systems.[1]

Measured in terms of revenue per trip,[2] the fare facing the traveller ranged from 1,96 SEK in the county of Västernorrland to 20,55 SEK in Kalmar making the monetary part of the generalised cost facing the consumer vary a great deal (Monetary terms are expressed in the 2001 price level). With an increase in real fares of 200 % during the period, the county of Kalmar also exhibits one of the most striking developments in this area, surpassed only by Jämtland where fares were increased by 251 %. At the other end of the scale, Blekinge and Västernorrland lowered their fares substantially (66 % and 73 % respectively). It is interesting to note that these two counties also are among the few where patronage increased. County averages and changes are shown in Table 3.

When it comes to income and car ownership the variation between counties is less than in the other variables. Gotland, together with Dalarna, Norrbotten and Värmland all exhibits car ownership levels exceeding 0,5 cars per capita (0,53, 0,52, 0,5 and 0,5 respectively) in 2001, while Stockholm was the only county with car ownership below 0,4 (0,39) cars per person. Average car ownership levels as well as income is shown in Table 4.

The variation in income is also relatively small between most counties although average income in Stockholm exceeded average income in Gotland by 40 % in 2001. During the period 1986 to 2001 the increase in average real

[1] This also applies to the demand figures presented in Table 1.

[2] Revenue per trip is obviously a simplification of the actual fare structure but it is likely to be a better measure of the (monetary) cost of a trip than the single trip fare due to many people using travel cards of different kinds.

Table 3 Average public transport fare in SEK (i.e. average for the period 1986–2001) in Swedish counties and the change between 1986 and 2001. Monetary terms are expressed in the 2001 price level

County	Fare	Change %
Stockholm	5,15	70
Uppland	8,93	87
Södermanland	8,95	92
Östergötland	4,88	6
Jönköping	6,91	87
Kronoberg	5,81	57
Kalmar	11,63	200
Gotland	4,62	103
Blekinge	7,02	−66
Kristianstad[a]	3,88	3
Malmöhus[a]	5,51	94
Halland	7,3	129
Göteborg/Bohus[a]	3,52	23
Älvsborg[a]	5,1	11
Skaraborg[a]	4,58	32
Värmland	5,61	29
Örebro	5,94	36
Västmanland	6,88	84
Dalarna	4,53	50
Gävleborg	4,45	−8
Västernorrland	5,51	−73
Jämtland	4,55	251
Västerbotten	8	32
Norrbotten	7,38	54
Skåne[a]	6,69	−29
Västra götaland[a]	6,48	−13

[a]In 1997 the Skåne and Västra götaland regions where formed, the former from Kristianstad and Malmöhus and the latter from Göteborg/bohus, Älvsborg and Skaraborg. The figures from these counties therefore cover the years 1986 to 1997 while the figures from Skåne and Västra götaland exist from 1999 to 2001

Table 4 Average level of car ownership and income (i.e. average for the period 1986–2001) in Swedish counties between 1986 and 2001. Monetary terms are expressed in the 2001 price level

County	Cars/Pop.	Income
Stockholm	0,36	188178
Uppland	0,40	162020
Södermanland	0,43	157308
Östergötland	0,41	154820
Jönköping	0,43	154211
Kronoberg	0,45	152364
Kalmar	0,44	147969
Gotland	0,47	140383
Blekinge	0,45	152459
Kristianstad[a]	0,46	146172
Malmöhus[a]	0,40	154869
Halland	0,46	157796
Göteborg/Bohus[a]	0,38	160111
Älvsborg[a]	0,44	152975
Skaraborg[a]	0,45	146255
Värmland	0,47	152109
Örebro	0,43	155988
Västmanland	0,42	160102
Dalarna	0,47	153376
Gävleborg	0,44	154245
Västernorrland	0,46	158264
Jämtland	0,44	142917
Västerbotten	0,43	154645
Norrbotten	0,47	159869
Skåne[a]	0,45	167472
Västra götaland[a]	0,44	174164

[a]In 1997 the Skåne and Västra götaland regions where formed, the former from Kristianstad and Malmöhus and the latter from Göteborg/bohus, Älvsborg and Skaraborg. The figures from these counties therefore cover the years 1986 to 1997 while the figures from Skåne and Västra götaland exist from 1999 to 2001

income (in the 2001 price level) varied between 20 % (Västerbotten and Norrbotten) and 28 % (Stockholm).

3 Demand model and estimation

Demand for urban public transport is expressed as the number of trips per capita made in the urban areas (q) and the variables used to explain demand consists of fare (F), Vehicle-kilometres (V), Price of petrol (PP),[3] Income (Y) and Car ownership (C). The demand function is assumed to be logarithmic, therefore:

$$\ln q_{i,t} = \beta_1 \cdot \ln F_{i,t} + \beta_2 \cdot \ln V_{i,t} + \beta_3 \cdot \ln PP_{i,t} + \beta_4 \cdot \ln Y_{i,t} + \beta_5 \cdot \ln C_{i,t} + \phi_i + \varepsilon_{i,t} \quad (1)$$

In which is assumed to be affected by the price of petrol and income so that:

$$C = C(PP, Y)$$

Prices as well as income have been divided by a price index including all goods and services except public transport and petrol in order to preserve homogeneity. As previously mentioned, in three counties (Stockholm, Göteborg/Bohus and Östergötland) the number of trips made is an aggregate of bus trips and trips by underground (Stockholm) and tram (Göteborg/Bohus and Östergötland) which might be considered a problem. Vehicle-kilometres is also aggregated over different modes in those counties. Another potential problem that might occur when comparing the counties is that there might be differences in the preferences of people living in different areas, e.g. a difference between Stockholm and other areas. The latter is only a problem if these differences are not captured by the variation in the explanatory variables included in the model such as income and car ownership. These potential problems can be addressed in different ways. Some of the county differences is accounted for by including county specific effects (ϕ_i) in the model. These capture factors that differ

[3] The price of petrol is a yearly average calculated by the Swedish Petroleum and Biofuels Institute (SPBI), an association of propellant fuel and lubricant companies in Sweden. This is also a simplification since the price might vary between counties (although not by much due to competition) and over a year.

between counties and are constant over time. ϕ_i are also called unobserved effects in the literature, referring to the fact that they capture the effect of all (time invariant) factors that might affect q but not included in the other explanatory variables. In addition to county specific preferences this can also capture the effects of different demographic structure, geography, infrastructure etc. The most significant advantage of this is that it is possible to obtain correct estimates for the parameters of the variables actually included in the model even if they are correlated with an unobserved effect. This is not possible if the variable is simply left out of the model altogether [22]. The possibility of the unobserved effects being correlated with the explanatory variables in the model is also reason for not modelling the individual effects as part of the error term, i.e. using a random effects (RE) model. RE models are generally more suited to situations in which the individuals under study are drawn randomly from a larger population while the individuals in this case (the counties) constitute the entire population [22].

If all explanatory variables were strictly exogenous[4] this model could be estimated using the fixed effects estimator (FE) or the first difference estimator (FD). However, this is unlikely to be the case here. Vehicle-kilometres is most likely affected by the level of demand, either by past levels of demand if capacity adjustment takes time or by present levels if the adjustment is assumed to be instantaneous. In both cases vehicle-kilometres will be correlated with the error term ε thus violating the assumptions underlying both the FE and the FD estimator, rendering them both inconsistent. Wooldridge [22] suggests estimation in two steps where the first step is to remove the unobserved effects (ϕ_i) using either the FE or the FD transformation and the second step is to find variables to use as instruments for the endogenous variable in the transformed equation. After first differentiating, the demand equation is:

$$\Delta \ln q_{i,t} = \beta_1 \cdot \Delta \ln F_{i,t} + \beta_2 \cdot \Delta \ln V_{i,t} + \beta_3 \cdot \Delta \ln PP_{i,t} + \beta_4 \cdot \Delta \ln Y_{i,t} + \beta_5 \cdot \Delta \ln C_{i,t} + \Delta\varepsilon_{i,t} \quad (2)$$

In this case lnF, lnPP, lnY and lnC might be used as instruments for ΔlnV (since they are assumed to be exogenous). However, using only these variables as instruments is likely to provide poor IV estimates due to limited correlation with V. Therefore additional variables that can work as instruments would be useful. Such variable has to be correlated with vehicle-kilometres but uncorrelated with the error term.

In this case the number of urban areas in each county, cost per vehicle-kilometre and size of the urban areas are used as additional instrument variables since they have been found to be correlated with vehicle-kilometres in previous studies (i.e. [15]).

[4] In a panel data model where $y_{i,t}$ are to be explained by a vector of variables $x_{i,t}$, strict exogeneity applies when: $\mathrm{E}(y_{i,t}|x_{i,1}, x_{i,2}, \ldots x_{i,T}, \varphi_i) = \mathrm{E}(y_{i,t}|x_{i,t}, \varphi_i)$ for t=1, 2, …, T.

Table 5 Results from estimation of Eq. (2)

Variable	Coefficient	std. error
Fare	−0,4[c]	0,048
Vehicle-kilometres	0,55[c]	0,19
Price of petrol	0,34[a]	0,2
Income	0,34[c]	0,11
Car ownership	−1,37[c]	0,45

[a] Significant on the 10 % level, [b] significant on the 5 % level, [c] significant on the 1 % level

In addition to allowing for county specific (time invariant) effects some other measures were takin in order to account for additional heterogeneity in the data. The models were also estimated using data where Stockholm and Göteborg/Bohus were excluded and also where Stockholm, Göteborg/Bohus, Malmöhus and Skåne were excluded. The same variables were statistically significant in those estimations and the differences in the estimated parameters in those models were very small. This indicates that the variation in travel behaviour between the counties with large cities and the rest can be explained reasonably well by the differences in the variables included in the model. In addition to this a model in which the effect of price changes were allowed to differ between counties were also tested using an interaction term ($d_i \cdot \Delta F_{i,t}$, where d_i is a county dummy) but the interaction terms were not found to be statistically significant as a group and therefore excluded from the model.

Results from estimation of (2) using the aforementioned variables as instruments for ΔlnV are shown in Table 5.

The Durbin-Watson value is 2,14 indicating that the model does not suffer from autocorrelation nor misspecification. A Breusch-Godfrey test[5] was also applied in order to test for higher order autocorrelation [23]. The null hypothesis of no autocorrelation could not be rejected on a 5 % level, indicating that the model does not suffer from autocorrelation of higher order. The model was also tested for heteroscedasticity using White's general test.[6] The null

[5] In the test, the residuals from estimation of model 2 ($\Delta\hat{\varepsilon}_{i,t}$), are regressed on the explanatory variables included in the model (2) and lagged residuals. It is then tested if the coefficients connected to the lagged residuals are (jointly) different from zero. If so, H_0 of no autocorrelation is rejected.

[6] The test regresses the squared residuals from estimation of model 2 (i.e. $(\Delta\hat{\varepsilon}_{i,t})^2$ on the explanatory variables included in model(2), the explanatory variables from model (2) squared and interaction terms of the explanatory variables from model (2). The variables are then tested (jointly) for significance and if they not found significant H_0 of no heteroscedasticity is rejected. In the present application, dummy variables for the counties were also included in the test in order to test for group wise differences in error variance. No indication of group wise differences were detected.

hypothesis of no could not be rejected indicating that the model does not suffer from heteroscedasticity.

The coefficients for all variables except price of petrol are significant at the 5 % level or better and have the expected sign. The coefficients can be interpreted as (constant) elasticities. The results are in the range of what might be expected from comparison with previous results [5].

4 The effect of income changes

Returning to the question of how public transport demand is affected by increases (decreases) in income it is reasonable to assume that there is a direct effect on demand and an indirect effect working through the effects of income on car ownership. A change in income is likely to affect our travel behaviour in several ways. Higher income is generally associated with increased mobility in general and it is therefore likely that the overall number of trips made by all modes of transportation would increase as a response to such change. However, it is likely that higher income increase the possibility of owning a car and people having access to a car might be assumed to make fewer trips by public transport. The total effect on demand for public transport (Q[7]) from a change in income is:

$$dQ = \frac{\partial Q}{\partial Y} dY + \frac{\partial Q}{\partial C} dC$$

Were

$$dC = \frac{\partial C}{\partial Y} dY$$

Therefore

$$dQ = \frac{\partial Q}{\partial Y} dY + \frac{\partial Q}{\partial C}\frac{\partial C}{\partial Y} dY$$

$$\frac{dQ}{dY} = \frac{\partial Q}{\partial Y} + \frac{\partial Q}{\partial C}\frac{\partial C}{\partial Y}$$

Multiplying through with $\frac{Y}{Q}$ give:

$$\frac{dQ}{dY}\frac{Y}{Q} = e_{QY} + \frac{\partial Q}{\partial C}\frac{\partial C}{\partial Y}\frac{Y}{Q}$$

Multiplying both nominator and denominator of the second term by C give

$$E_{QY} = e_{QY} + e_{QC} \cdot e_{CY} \tag{3}$$

[7] Q refers to a general measure of demand, in the empirical study in question the number of trips per capita (q) is used as a measure of demand.

Table 6 Results from estimation of Eq. (4)

Variable	Coefficient	std. error
Income	0,055[a]	0,01
Price of petrol	−0,022[a]	0,0083
Car ownership t-1	0,74[a]	0,06

[a] Significant on the 1 % level

The first term in (3) ought to be positive, since higher income increase demand for travel in general, while the second term is negative (e_{QC} is negative and e_{CY} is positive).

In order to obtain e_{cy} a dynamic model explaining car ownership by income and price of petrol[8] is estimated using the same data as when estimating the demand function. The model is:

$$\Delta \ln C_{i,t} = \alpha_1 \cdot \Delta \ln Y_{i,t} + \alpha_2 \cdot \Delta \ln PP_{i,t} + \alpha_3 \cdot \Delta \ln C_{i,t-1} + \Delta\delta_{i,t} \tag{4}$$

The model (4) is subjected to the same tests for autocorrelation and heteroscedasticity as model (2) above, none of which indicated the presence of any problem with the model. The results are shown in Table 6

The long run elasticity of car ownership with respect to income is therefore found to be 0,21.[9] Using this result in combination with the results from the demand equation give:

$$E_{QY} = 0,34 + (-1,37 \cdot 0,21)$$
$$E_{QY} = 0,052$$

Based on these results the total effect of income changes therefore seem to be close to zero. The confusion regarding the effects of income might very well be due to the omission of car ownership in the demand model in which case the resulting estimate is a mixture of both effects.

5 Conclusions

The focus of this article has been on the demand for local public transport. Using a constant elasticity demand equation it is found that the elasticities with respect to fare, vehicle-kilometres, income and car ownership are −0,4, 0,55, 0,34, and −1,37 respectively.

Changes in income affect public transport demand both directly and indirectly through increased car ownership. The direct effect is positive while the indirect effect is negative. Using the results presented in this article regarding the effects

[8] Vehicle-kilometers and public transport fare were also included in a previous version of the model, none of which were found significant and the former also had the wrong sign. They were therefore excluded.

[9] $0,055/(1-0,74) \approx 0,21$

of income on car ownership and public transport demand, it is found that the total effect (in elasticity terms) of income is 0,05. Therefore it is concluded that the total effect of income on public transport demand is virtually zero.

This result is of importance for planning and future policy for public transport. If demand for public transport would have been falling with increased real income (as suggested by some previous studies, Dargay et al. 2003, 2002, Dargay and hanly 2002, Frankena 1978), public transport planners would have to expect decreasing demand for public transport when the general level of income is increased. This would make it increasingly harder for them to sustain a good level of service for the remaining passengers.

However, this study shows that the increase in demand from the increase in movement offsets the decrease caused by the increase in car ownership making the outlook for the future of public transport less bleak. If the total effect of increased income on public transport demand would have been negative, the possibility of using public transport as an instrument for alleviating environmental impacts from the transport sector, by gaining passengers from the private car, would have been small. Although the results are based on Swedish data, the methodology in finding the relevant effects is applicable to other areas as well. The actual figures might vary but it is not unlikely that similar results could be found in areas and countries with similar economic and social structure.

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