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AFFORDABILITY OF PUBLIC TRANSPORT: A METHODOLOGICAL CLARIFICATION

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Abstract

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Keywords:

transport subsidies, affordability, equity, welfare impacts

Affordability of public transport: a methodological clarification

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Abstract: There has been a surge of interest recently on the relation between poverty and transport policies. When analyzing the relation between poverty and transport, often the “affordability” of public transport is estimated. In this paper we present two alternative definitions of affordability used in the transport literature and discuss their limitations. Any affordability measure covering only transport expenditure is bound to be a very partial view of household welfare. In addition, the required affordability benchmark to determine whether transport costs are high or not is arbitrary. Therefore, the approach that uses the absolute level of these affordability measures is meaningless. We also show in this paper that the change in the affordability measures, as opposed to its absolute level, can be given a more rigorous interpretation in terms of traditional welfare economics. In spite of this last result, we argue that to analyze whether transport subsidies are meeting their social or distributional objectives it is much more fruitful to use traditional income distributional tools such as the relative benefit curve and its associated Gini coefficient.

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1. Introduction

There is a long literature in the transport field justifying public transport subsidies on economic efficiency arguments. Most, but not all, of these arguments are “second best” in nature, in the sense that subsidies compensate for externalities in other parts of the economic system, namely private transport use, that cannot be addressed directly. In this context, public transport subsidies may reduce these externalities improving resource allocation in society.

However, in many situations subsidies are introduced for social or distributive reasons, particularly in developing countries. The social case for transport subsidies starts by recognizing the importance of accessible and affordable transport for the well being of people. Transport is a complementary input to the obtainment of other social benefits such as education, health services and employment opportunities, among others. This is sometimes couched in the catch all concept of “social inclusion”, an appealing term that is unfortunately hard to define in an operationally useful way for policy decisions.

Among the multilateral agencies, the relationship between poverty and transport has received considerable attention of late. Incorporating poverty issues and pro-poor project design in transport projects has become an important priority for lending by multilateral banks.[2]

[2] See for example Asian Development Bank (2001), The World Bank (2005), chapter 3 of The World Bank (2002), Gannon and Liu (1997)

Unfortunately, much attention in this field has centered on the "affordability" of public transport and on policies to make public transport "affordable" to the poor.[3] However, it is not clear what is meant by "affordable" public transport or how this concept should be applied in designing transport policies.

In this paper we examine two definitions of affordability and discuss their relative merits. We then show that the *change* in these affordability indices can be given a rigorous economic welfare interpretation. However, in spite of this last result, we argue that the use of an affordability measure is not the most promising approach to analyze poverty and transport issues. Instead, we argue in favor of a methodological approach more in line with traditional income distribution analysis. This latter approach has been used in a number of recent case studies analyzing the impact of public transport subsidies on poor households.

2. How to define affordability in the transport sector

Most studies on poverty and transport estimate the percentage of monthly income or expenditure used on transport by poor families. In more formal terms, this affordability measure can defines as:

$$Aff_1 = \frac{\sum_{i=1}^{N} x_i\left(p_i, y\right)\cdot p}{y} \qquad (1)$$

[3] See SITRASS (2004a; 2004b), Shuiying, Han, Weili and Dening (2003), Howe and Bryceson (2000), Godard and Diaz Olivera (2000), and ECORYS and NEA (2004) among others.

where $x_i(p_i,y)$ are the number of trips —usually public transport trips or work related trips— taken during the month by household member i, and y is household income or expenditure. The number of trips is presented as an explicit function of the price of trips and household income.

This measure is then compared to a benchmark considered "affordable" to households. Armstrong-Wright and Thiese (1987) consider that there is an affordability problem with public transport when more than 10% of households spend more than 15% of their income on work related trips. According to Venter and Behrens (2005), the South African government has established a 10% of income as a policy benchmark in its 1996 White Paper on Transport Policy (Department of Transport, 1996). Gomide, A., S. Leite and J. Rebelo (2004) use a 6% limit to estimate the affordability of public transport in Bello Horizonte, Brazil.

This approach is not exclusive to the transport sector. Foster (2004) uses a 15% of a household's monthly income or expenditure as the limit of affordability of expenditure on three public services (water, electricity, and gas). In the water sector, there is a well established rule of thumb —whose origin is attributed to the World Health Organization (WHO)— whereby a water bill representing more than 5% of monthly household income or expenditure is considered unaffordable. This 5% limit is used operationally by the Chilean government to estimate the number of water subsidies given each year and their value.[4]

[4] See Gómez-Lobo (2001) for more details.

Although intuitively appealing, there are several problems with this affordability measure. The main one, as noted by Venter and Behrens (2005), is that the relation between welfare and the expenditure on transport as a percentage of income may not be monotonic. Therefore, it is not clear that households that spend less than 10% of income or expenditure on transport are necessarily better off than people that spend more. As an example, it may be that due to the high price of public transport very poor people either walk or do not make many trips. Thus, their observed transport expenditure may be low due to a suppression of trips rather than a high level of income.[5]

In order to overcome the above problem Carruthers, Dick and Saurkar (2005) use a fixed basket of trips to estimate an affordability index.[6] They define affordability as "the ability to make necessary journeys to work, school, health and other social services, and make visits to other family members or urgent other journeys without having to curtail other essential activities". Operationally, they use the percentage of monthly per capita income (or the per capita income of the lowest quintile of the income distribution) required to make sixty 10 km trips per month in each city.[7]

Formally, their affordability index is defined as:

$$Aff_1 = \frac{\sum_{i=1}^{N} \bar{x}_i p}{y} \qquad (2)$$

[5] There is substantial evidence showing that the poor choose to walk much more often than the non-poor. See Cropper (2007), Howe and Bryceson (2000), SITRASS (2004a, 2004b), and Badami, Tiwari and Mohan (2004) for evidence from developing country cities.
[6] This approach has also been used by ECLAC (1992).
[7] In a similar vain, Haider and Badami (2004) calculate the fare level that each income group could pay in order to afford a 40 work trips per month for two earner households in Islamabad, Pakistan.

where $\bar{x}_i$, a fixed parameter, replaces the observed number of trips taken by household member *i*, which in the case of Carruthers, Dick and Saurkar (2005) is 60 trips per month.

One of the advantages of using the methodology proposed by Carruthers, Dick and Saurkar (2005) is that it makes it easier to estimate comparable affordability indices across cities and countries. Their main results are reproduced in Table 1, where the percentage of per capita income required is presented for the average household and for households in the first quintile of the income distribution.

[Table 1 around here]

In spite of its attractiveness, there are several problems with this last affordability measure. First, it ignores possible changes in fares due to supply responses needed to accommodate the fixed number of trips considered. For example, if it were the case that every person made 60 trips per month, in most cities aggregate public transport demand would be different (probably much larger) than current demand. Therefore, equilibrium fares would also be different unless there are constant economies of scale in public transport supply.

Second, it is not clear either how the results are to be used for policy making. There are two possible applications for an affordability measure.

First, as an indicator to determine whether public transport is too expensive in a given city and therefore that something should be done about it. However, this would require defining a benchmark of what is considered “affordable”. Is it 10%, 15% or 5%? Any such benchmark is arbitrary and subject to further criticisms. For example, imagine two cities, one where the transport affordability index is 15% and another where it is 10%. One might be tempted to conclude that efforts should be made to reduce the transport costs in the first city. However, what if an analogous affordability index is estimated for food (or water, or whatever other good or service one may care about) and it turns out that in the first city is represents 45% of income and in the second 50% of income. Is it still the case that lowering transport cost in the first city is so important? In the end, households spend the same amount of their income in both transport and food.[8]

This last problem points to the pitfalls of analyzing welfare issues from a sectoral perspective instead of a global perspective. In order to make consistent welfare comparisons, a fixed basket of all the goods and services consumed by an average (or poor) household should be used to gauge their welfare, not just of public transport trips. This is precisely what a consumer price index does, allowing welfare comparisons across time. It is also the idea behind the Purchasing Power Parity exchange rate index used to compare welfare (real income) across countries. In both cases, a fixed basket of many goods and services is used.

Therefore, the use of an absolute measure of public transport affordability is bound to be problematic and arbitrary. A second possible use of the affordability index is to evaluate the impact of certain policy interventions. For example, it could be used to

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[8] This point is also note in World Bank (2002).

compare the affordability of transport before and after a new subsidy was introduced. Economic theory does not have a definition of affordability but it does have well developed concepts to measure welfare changes. The use of changes in the affordability measure, as opposed to its absolute level, seems like a much more promising avenue for the practical use of this concept. Below we will show that changes in the affordability index can be given a rigorous economic welfare interpretation.

3. Measuring changes in economic welfare

Throughout the unit of analysis will be the household.[9] The question is to ascertain how each household is affected by different policies in the public transport sector. Assume a money metric utility function $C(\mathbf{p}, U)$. This function measures how much money a household requires to reach a certain level of utility or welfare, and will depend on a household's preferences, the vector of prices of the goods and services consumed, $\boldsymbol{p}$, and the reference utility or welfare level (U).

The welfare impact on a household of a change in prices, say from $\boldsymbol{p}^0$ to $\boldsymbol{p}^1$, can then be measured by the Compensating Variation (CV), that is, (minus) the amount of monetary resources that a households needs to be given or taken away so that after the change it can still reach its original utility level or $CV = C(\mathbf{p}^0, U^0) - C(\mathbf{p}^1, U^0)$ where U^0 is the original welfare of the household. Since the money needed to reach the original utility level at the original prices is just the income of the household, the CV measure can also be defined as $CV = y - C(\mathbf{p}^1, U^0)$ where y is the monetary income of the household.

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[9] Nothing substantive changes if the individual is taken as the unit of analysis. However, it is more common to consider welfare impacts on households rather than individuals.

This last expression indicates that if prices rise, *CV* would be negative since the money resources needed to reach the original welfare level at these higher prices is greater than the original income level of the household. Minus *CV* is the amount of money that should be given to the household in order to 'compensate' for the price change and allow the household to reach its original welfare level.[10]

Another measure of the welfare change on a household brought about by a change in prices is the Equivalent Variation. This measures the change in the household's income that is equivalent to the change in price. In this case the reference utility is the final ex-post utility of the household, U^1 or $EV = C(\mathbf{p}^0, U^1) - C(\mathbf{p}^1, U^1) = C(\mathbf{p}^0, U^1) - y$.

Since a price rise decreases a household's welfare, reaching that ex-post level of welfare at the original price level ($C(\mathbf{p}^0, U^1)$) requires less financial resources than the household's monetary income and thus the *EV* measure is negative, as desired.

Often, the change in consumer surplus is used to gauge the welfare impact of a price change. This is defined as the change in the area below the demand curve for the good whose price rises or falls. It is well known that the change in consumer surplus is not an exact welfare measure but it will always be bounded by the other two exact measures (*CV* and *EV*). For small changes in prices all three give very similar results, especially if the good represents a small percentage of the household's expenditure (Willig, 1976).

[10] *CV* is a welfare change measurement. Since a price rise is bad for households, this measure has to be negative in this case. That is why it is defined as in the text and the negative of this measure gives the monetary amount that would have to be given to a household to compensate it for a price rise.

3.1 First order approximation to the true welfare change

In order to empirically measure the *CV* (or *EV*), the analyst needs to know the expenditure function of the household (the money metric utility function), $C(\mathbf{p},U)$. This can be recovered from the estimation of a demand system such as the Almost Ideal Demand System (Deaton and Muellbauer, 1980), or its more flexible extension, the Quadratic Almost Ideal Demand System (Banks, Blundell and Lewbel, 1997).[11] However, this requires much data and effort, and is prone to specification and estimation errors.

For most practical purposes, a more useful approach is to use a first order approximation to the true welfare change. For example, the first order Taylor approximation to the expenditure function is:

$$\begin{aligned} C(\mathbf{p}^1,U^0) &\cong C(\mathbf{p}^0,U^0) + \nabla C(\mathbf{p}^0,U^0)'(\mathbf{p}^1-\mathbf{p}^0) \\ &= y + \sum_{i=1}^{n} \frac{\partial C(\mathbf{p}^0,U^0)}{\partial p_i} \cdot \left(p_i^1 - p_i^0\right) \\ &= y + \sum_{i=1}^{n} x_i^0 \cdot \left(p_i^1 - p_i^0\right) \end{aligned} \qquad (3)$$

where x_i^0 is the original level of consumption of the good or service *i* and the last equality was obtained using Sheppard’s Lemma. Using this last expression, a first order approximation to the *CV* would be:

[11] When only a single price changes, only the demand for this good needs to be estimated, a somewhat simpler and less data intensive problem. However, this may still be not possible in many applications.

$$y - C(\mathbf{p}^1, U^0) \cong -\sum_{i=1}^{n} x_i^0 \cdot \left(p_i^1 - p_i^0\right). \qquad (4)$$

That is, the sum of the pre-change consumption of each good times its price change. This quantity does not require estimating a demand system and it will be feasible in most applications.[12]

How good is this first order approximation? This will depend on the household's preference structure and the size of the price change. However, empirical evidence such as Banks, Blundel and Lewbel (1996) using UK household data shows that even for large price changes it may be a very good approximation. In that study they compared the first order approximation with the welfare change estimated using the expenditure function recovered from a QUAIDS demand system estimation. They found that for a 20% price rise for a significant expenditure group (clothing) the first order approximation was at most 10% from the true *CV* value.[13]

Given its simplicity and advantages as regards data requirements, together with evidence that shows that it may in fact be a very good approximation, the first order approach seems like the ideal choice to use to study the impact of different policies. This is particularly so when comparing several policy interventions and comparing case studies across several countries, where data availability may be very diverse.

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[12] Note the similarity of this result with how a consumer price index is calculated. For the EV, the formula would be identical except that the post-change level of demand replaces the pre-change level of demand in the formula.
[13] The estimated value from the demand system is in reality a second order approximation to the true expenditure function, since the QUAIDS is a second order flexible functional form.

3.2 A welfare interpretation of the affordability indices

The first order approximation to the economic welfare change can be used to give a welfare interpretation to the affordability measures discussed earlier. Let us take the first order approximation to the Compensating Variation developed above and assume that only the price of one transport mode changes. Thus, from (4):

$$-CV \cong v^0 \cdot \left(p_v^1 - p_v^0\right). \qquad (5)$$

where v^0 is the original number of rides in the affected mode and p_v is the fare level. Notice that this is equal to the difference in expenditure on public transport before and after the price change (valued at the original number of rides):

$$-CV \cong v^0 \cdot p_v^1 - v^0 \cdot p_v^0 . \qquad (6)$$

If this is then normalized by the income (or expenditure of the household) then we have:

$$-\frac{CV}{y} \cong \frac{v^0 \cdot p_v^1}{y} - \frac{v^0 \cdot p_v^0}{y} = \Delta Aff_1 . \qquad (7)$$

This last expression is the change in the affordability index using effective number of rides (or Aff_1 in (1) above). Thus, the change in this affordability measure is proportional to the first order approximation of the Compensating Variation.

In most studies it is common to estimate the average affordability by income groups say quintiles or deciles of the income distribution. The average change in the affordability index in a sub-group of the population is:

$$\overline{\Delta Aff_1} = \sum_{h=1}^{H} \frac{\Delta Aff_{1h}}{H} \cong -\sum_{h=1}^{H} \frac{CV_{1h}}{y_h} \cdot \frac{1}{H} \qquad (8)$$

were h indexes the household unit. This last expression is equivalent to measuring the welfare impact of a price change using a welfare function approach. Define the social welfare function

$$W = W[u_1, u_2, ..., u_H] = W[v_1(\mathbf{p}, y_1), v_2(\mathbf{p}, y_2), ..., v_H(\mathbf{p}, y_H)] \qquad (9)$$

where, u_h is the welfare level attained by household h, measured by the indirect utility function $v_h(\mathbf{p},y_h)$. Following Stern (1987), it is trivial to derive the first order approximation to the change in social welfare of a price change as:[14]

$$\Delta W = -\sum_{h=1}^{H} \theta_h \cdot q_h^0 \cdot \Delta p = \sum_{h=1}^{H} \theta_h \cdot CV_h \qquad (10)$$

where θ_h is the marginal social weight of each household and is defined by

$$\theta_h = \frac{\partial W[v_1, v_2, ..., v_H]}{\partial v_h} \cdot \frac{\partial v_h(\mathbf{p}, y_h)}{\partial y_h}. \qquad (11)$$

[14] This derivation uses Roy's identity.

Therefore, if the marginal social weight of each household takes the particular form of

$$\theta_h = \frac{1}{y_h} \qquad (12)$$

then the average change of the affordability index over a group of households is proportional (by a constant *1/H*) to the (negative) change in social welfare:

$$\overline{\Delta Aff_1} \cong -\frac{1}{H} \cdot \sum_{h=1}^{H} \theta_h \cdot CV_h \propto -\Delta W \qquad (13)$$

The use of marginal social weight inversely proportional to income is very popular among practitioners and is often used in the empirically measure of welfare impact of policies. These social weights are reasonable since they give higher weight to lower income households. However, they are not free from criticism, as will be discussed below.

In summary, the average change in the affordability measure that uses effective trips made by households can be rationalized as a reasonable approximation to the social welfare change generated by transport policies. The affordability measure proposed by Carruthers, Dick and Saurkar (2005) also has a welfare interpretation. However, it is a bit more involved and requires additional information. Appendix 1 presents the details of the results.

4. Should we use an affordability measure to analyze social policies?

Although we can give a welfare interpretation to the change in the affordability index, it is not recommended that this approach be used when analyzing social policies in the transport sector.

First, the definition of any welfare function is arbitrary and subject to the preferences of the analyst. Different studies may arrive at different results simply because they chose different social welfare functions. There in no way to obtain a consensus or unanimous social welfare function specification.[15]

Second, the use of the change in the affordability index as a welfare change measure requires a very particular social welfare function to be assumed and some very strong assumptions regarding preferences. To be more precise, assume that the social welfare function is of the Bergson (1938) class:

$$W = \sum_{h}^{H} \frac{v_h\left(y_h, \mathbf{p}\right)^{1+\rho}}{1+\rho} \qquad (14)$$

where ρ is the inequality aversion parameter. Furthermore, assume that preferences can be represented by a Price Independent Generalized Logarithmic form (Muellbauer, 1975):

[15] In spite of this, in the transport literature several authors have used the welfare function approach to evaluate policies For example, Proost (2001), assigns a weight to lower income households which is 2 or 3 times the weight assigned to higher income households. Dodgson and Topham (1987) also use a welfare function approach, with a specific functional form due to Feldstein (1972). In both of these cases the weights or the welfare function are used to aggregate distributional results allowing quantitative trade-offs to be made between efficiency and equity in the determination of optimal policies.

$$\ln v_h(y_h, p) = \frac{\ln y_h - \ln a_h(\mathbf{p})}{b_h(\mathbf{p})}. \qquad (15)$$

The PIGLOG form includes some of the most popular preference representations used in empirical analysis, including the Almost Ideal Demand System (Deaton and Muellbauer, 1980) and Exactly Aggregable Translog Model (Jorgensen, Lau and Stocker, 1982).

Using (11) and the specified functions, the initial marginal social weight of each household is:

$$\theta_h = \frac{\partial W[v_1, v_2, \ldots, v_H]}{\partial v_h} \cdot \frac{\partial v_h(\mathbf{p}, y_h)}{\partial y_h} = v(y_h, \mathbf{p})^{\rho-1} \cdot \left(\frac{1}{y_h}\right) \cdot \left(\frac{1}{b_h(\mathbf{p})}\right). \qquad (16)$$

If all households face the same prices, then $\boldsymbol{p}^0$ can normalized to 1 and $b_h(\boldsymbol{p}^0)$ can be set to 1 for all households. With this assumption plus an inequality aversion parameter equal to 1 ($\rho = 1$), the marginal social weight valued at base line prices will be:

$$\theta_h = \frac{1}{y_h}$$

as required for the proportionality result (13) to hold.

If the price vector faced by each household is different then even more restrictions must be placed on the social welfare function and preferences. Banks, Blundell and Lewbel (1996) show that in order to obtain marginal social welfare weights that are independent of prices and inversely proportional to each household's income, the social welfare function must be:

$$W = W\left[v_1(p, y_1), v_2(p, y_2), \ldots, v_H(p, y_H)\right] = \sum_{h=1}^{H} \left(k_h \cdot \ln y_h - a_h(p)\right) \qquad (17)$$

Where k_h is a constant and a_h is a function of prices. Thus, the social welfare function must be additive in the indirect utility functions of each household and in turn these individual functions must take a particular form given by:

$$v_h(p, y_h) = k_h \cdot \ln y_h - a_h(p). \qquad (18)$$

Only in this case will the marginal social weight be independent of prices and inversely proportional to income:[16]

$$\theta_h = \frac{\partial W\left[v_1, v_2, \ldots, v_H\right]}{\partial v_h} \cdot \frac{\partial v_h(p, y_h)}{\partial y_h} = 1 \cdot \left(\frac{k_h}{y_h}\right). \qquad (19)$$

However, these assumptions imply that preferences are homothetic (Theorem 1 of Banks, Blundell and Lewbel (1996)). Therefore, the income elasticities are equal to one for all goods, which is clearly unrealistic.

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[16] The constant k_h could be set to *1/H* for each household to make the relation between the average change in affordability and the change in social welfare exact. However, given the ordinal nature of the aggregate social welfare measure, this is not really required. More troublesome is the fact that to make (14) valid, k_h must be the same for all households, thus ruling out demographic or other types of heterogeneity of preferences among households.

Therefore, in order for the change in affordability to represent a social welfare change, an additive Bergson type welfare function (with an inequality aversion parameter equal to one) and a PIGLOG preference structure must be assumed.[17] In addition, all households must face the same prices. These are strong conditions, in particular given that PIGLOG preferences imply share equations that are linear in log income. Household data, at least from the UK, shows that real preferences are more complex requiring share equations that are quadratic in log income (Banks, Blundell and Lewbel, 1997). If prices differ across households then even stronger assumptions must be made regarding the welfare function and household preferences.

5. A more convention alternative approach

Rather than aggregate individual household impacts using a welfare function, a more flexible approach is to analyze the social or distributive implications of a subsidy by graphing the Lorenz curve or relative benefit curve.

The relative benefit distribution curve (or Lorenz curve) graphs the percentage of a certain policy benefit accruing to the first n^{th} rank of households, according to some measure of income, expenditure or wealth distribution.[18] More formally, the graph of a relative distribution curve can be defined as:

$$r(j) = \sum_{h=1}^{j} \frac{s_h}{S} \cdot 100$$

[17] These are sufficient conditions. Necessary conditions are marginally more flexible. See Lewbel (1989).
[18] This discussion is couched in terms of the distribution of benefits, such as subsidies. Clearly it also applies to the distribution of costs of a policy measure.

where h denotes the j^{th} ranked household from the lowest to the highest, $r(j)$ is the value of the graph at the household ranked j, s_h is the benefit (*CV* for example) accruing to household h and S is the total benefit distributed by the policy. Figure 1 gives an example where two curves are graphed. The curve above the 45º line shows a progressive distribution of benefits, since all *K%* of poorest households receive more than *K%* of the total benefits for whatever value of *K* chosen. The curve below the 45º line shows a regressive distribution of benefits since poorer households now receive less of than a proportional amount of the benefit.

The relative benefit curve is very useful when comparing the distributive impact of different policies since it gives a graphical representation of the relative incidence of benefits. When the curves for different policy interventions are superimposed on the graph it will often be possible to rank them according to their distributive impact. This will be the case when the different curves do not cross each other, in which case the highest curve will dominate the others in terms of progressiveness.

[Figure 1 about here]

Associated with the relative distribution curve is the Gini coefficient which gives a summary measure of the distributive impact of a policy. This coefficient is calculated as the area between the 45º line and the distribution curve (with a negative value when the curve is above the 45º line) over the area below the 45º line. This is illustrated in Figure 2. The closer the Gini coefficient is to -1 the more progressive is the distribution of impacts.

[Figure 2 about here]

The distribution curve analysis is much more flexible than a welfare function approach since the data required can always be used subsequently to estimate the social welfare change if desired. However, unlike the welfare function approach, the distributional analysis conveys much useful information without having to assume a particular, and somewhat arbitrary, welfare function.

Finally, the relative distributional curve approach is consistent with prior research on the distributional consequences of transport subsidies. For example, Frankena (1973) and Guriai and Gollinz (1986) estimates the benefit and tax incidence by income groups of several transport subsidies in Canada and New Zealand, respectively. Calculating incidence by income groups is equivalent to using a step function approximation to the relative benefit curve where instead of graphing the incidence of benefits for each individual household the average over income groups is used.

This approach has been used in a number of recent case studies analyzing the distributive impact of transport subsidies in several cities around the developing world.[19] The results show that most transport subsidies are badly targeted and in many cases are regressive.

As an example of the use of relative distribution curves we present a result the distributive impact of the student preferential fares in Santiago, Chile, taken from Gómez-Lobo (2007). The use of preferential fares for certain groups of users (including students, the elderly, war veterans, etc.) is very common in many countries. However, in

[19] See Foster (2005) for the case of Buenos Aires, Flynn (2007) for the case of México City, Gómez-Lobo (2007) for the case of Santiago, Chile, and Crooper (2007) for the case of Mumbai, India.

Santiago, as in most other cases, these benefits are funded by the rest of users who pay higher regular fares.

The distributive impacts of these cross subsidies for the case of Santiago are shown in Figure 3. From this figure we can see that the student preferential fare in the bus system is somewhat progressive. The associated Gini coefficient is -0.16, which is a bit more progressive than a Gini coefficient of 0 for a neutral distributional impact. However, it can also be seen from the graph that the funding of this subsidy is also regressive in the sense that poorer households pay a higher proportion of this tax. The associated Gini coefficient for the funding of the cross subsidy is -0.11, very close to the coefficient for benefits.

These results imply that the student preferential fare is distributing resources from households without students to households with students. This distribution of resources occurs across all deciles of the income distribution. Although on average this subsidy is marginally progressive, the majority of poor households are hurt by this policy. The social impact of this subsidy would improve significantly if its funding came from general taxation instead of the current cross subsidy scheme. Although even in this case, with a Gini coefficient of -0.16, the progressiveness of the policy would still not be very impressive.

6. Conclusions

Lately, there has been a surge of interest on the relation between poverty and transport policies. This stems from the recognition of the importance of transport as a complementary input for access to basic needs such as health, education and employment. Many public transport subsidies are justified on social or distributive arguments.

When analyzing the relation between poverty and transport, often the “affordability” of public transport is estimated. This usually entails calculating the percentage of monthly income spent on public transport and comparing it to an arbitrary benchmark considered affordable. If most poor households spend more than this threshold then it is deemed that public transport is unaffordable for the poor and some type of subsidy is warranted.

In this paper we argue that the above procedure may not be the most fruitful approach to tackle the issue of transport and poverty. We present two alternative definitions of affordability used in the public transport literature and discuss their limitations. Any affordability measure covering only transport expenditure is bound to be a very partial view of household welfare. In addition, the required affordability benchmark to determine whether transport costs are high or not is arbitrary. Therefore, the approach that uses the absolute level of these affordability measures is meaningless.

We also show in this paper that the change in the affordability measures, as opposed to its absolute level, can be given a more rigorous interpretation in terms of traditional welfare economics. In particular, the average change in the affordability of public transport is a reasonable first order approximation to the change in social welfare. This implies that the change in affordability may be a valid approach to study, among other issues, the social impact of different transport subsidy policies directed to help the poor.

In spite of this last result, we argue that to analyze whether transport subsidies are meeting their social or distributional objectives it is much more fruitful to use more traditional income distributional tools such as the relative benefit curve and its associated Gini coefficient. This approach has been used in a number of recent case studies analyzing the distributive impact of transport subsidies in several cities around the developing world. The results show that most transport subsidies are badly targeted and in many cases are regressive. This implies that socially motivated transport subsidies are not meeting their stated objectives and more research and effort needs to be placed in improving their design and application.

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Appendix: A welfare interpretation to the Carruthers, Dick and Saurkar (2005) affordability measure

Carruthers, Dick and Saurkar (2005) use as an affordability measure an estimate of the percentage of household income that is devoted to public transport, considering a fixed and exogenous number of 60 trips per month.

Taking the first order approximation to the Compensating Variation and normalizing this measure by the household's income or total expenditure, we obtain:

$$\frac{y - C(p^1, U^0)}{y} \cong -\frac{x_{pt}^0 \cdot \left(p_{pt}^1 - p_{pt}^0\right)}{y} = -\left(\frac{x_{pt}^0 \cdot p_{pt}^1}{y} - \frac{x_{pt}^0 \cdot p_{pt}^0}{y}\right).$$

We can again interpret the income or expenditure normalization as the social welfare weight associated to each household.

If we interpret the initial situation as the hypothetical case where the price of public transport is sufficiently low —say p_{pt}^0—so that the household would effectively choose to make these 60 trips per month, then what Carruthers, Dick and Saurkar (2005) estimate is the first part of the above equation: $x_{tr}^0 \cdot p_{pt}^1 / y$. This is the percentage of income that is spent if these trips were made at current prices.

If we could estimate at what price the household would effectively make x_{pt}^0 trips —that is an estimate of p_{pt}^0— then the second part of the equation could be estimated and we can then use the measure devised by Carruthers, Dick and Saurkar (2005) as a first order approximation to a true welfare measure. The difficulty lies in having an estimate of the household's demand for trips.

However, even if the original expenditure, $x_{tr}^{0} \cdot p_{pt}^{0} / y$, cannot be estimated, it is reasonable to assume that it will be more similar across cities and countries than $x_{tr}^{0} \cdot p_{pt}^{1} / y$. This is so because the first measure is bounded below by 0. Therefore, even if the affordability index of Carruthers, Dick and Saurkar (2005) varies between cities, from 1% to 11% on average according to their study, the expenditure required at the price for which households would effectively make the 60 trips will probably vary by less. If we take the extreme view that this expenditure would be the same for each city or country, $\overline{w}^{0}$, then subtracting this number from the affordability index of Carruthers, Dick and Saurkar (2005) will give a reasonable welfare comparison of public transport prices across cities:

$$\frac{CV}{y} \cong -\left(\frac{x_{pt}^{0} \cdot p_{pt}^{1}}{y} - \overline{w}^{0} \right).$$

Table 1: Affordability index for different cities assuming 60 trips per person per month

	City	Affordability Index	
		Average	**Bottom Quintile**
1	Sao Paulo	11%	107%
2	Rio de Janeiro	6%	63%
3	Brasilia	6%	59%
4	Cape Town	4%	38%
5	Buenos Aires	4%	26%
6	Mumbai	9%	23%
7	Kuala Lumpur	5%	22%
8	Mexico City	3%	19%
9	Chennai	8%	19%
10	Manila	5%	17%
11	Krakow	6%	17%
12	Amsterdam	6%	16%
13	Moscow	4%	15%
14	Guangzhou	4%	14%
15	Warsaw	4%	11%
16	New York	3%	10%
17	Los Angeles	3%	10%
18	Chicago	3%	10%
19	Singapore	2%	10%
20	Beijing	3%	9%
21	Seoul	4%	9%
22	Shanghai	2%	6%
23	Cairo	3%	6%
24	Budapest	3%	6%
25	London	2%	5%
26	Prague	2%	4%
27	Bangkok	1%	4%

Source: Carruthers, Dick and Saurkar (2005).

Figure 1

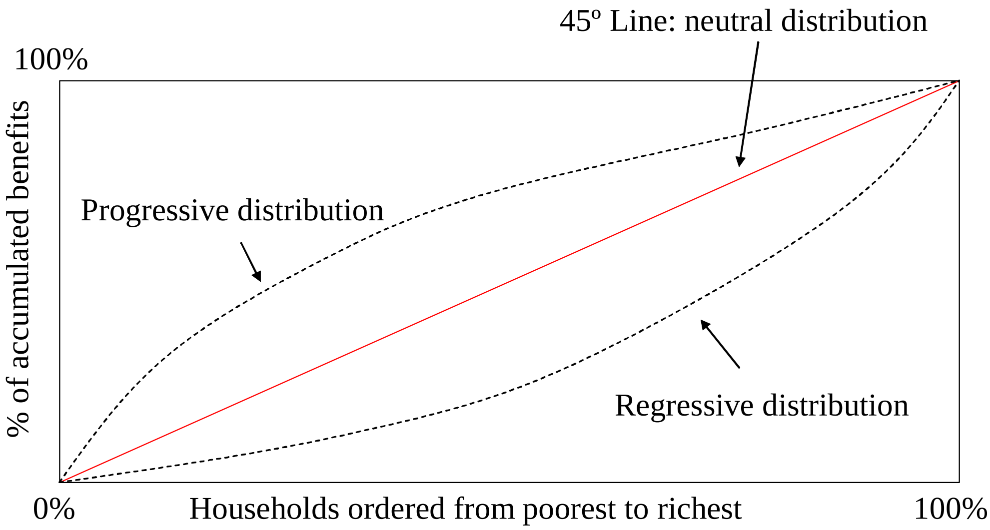


Figure 2

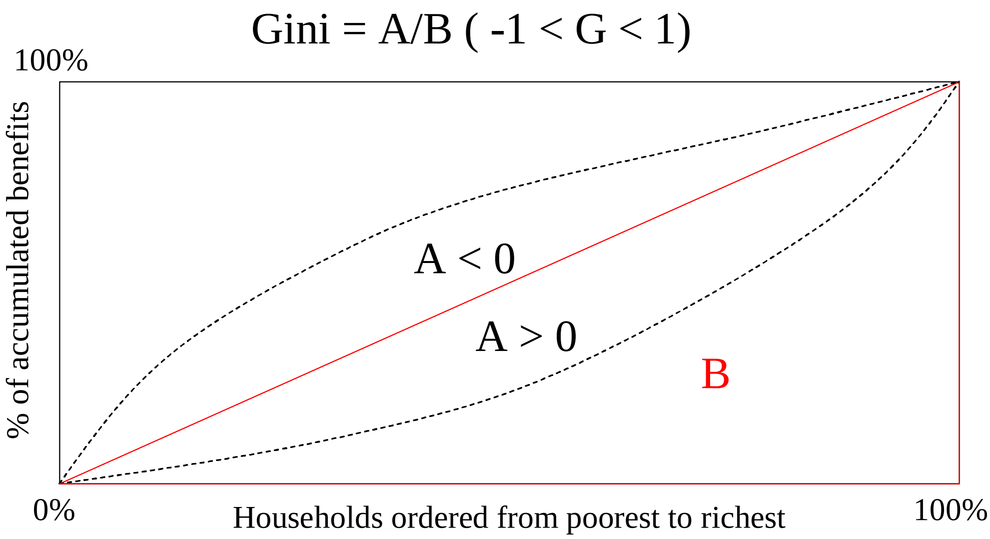
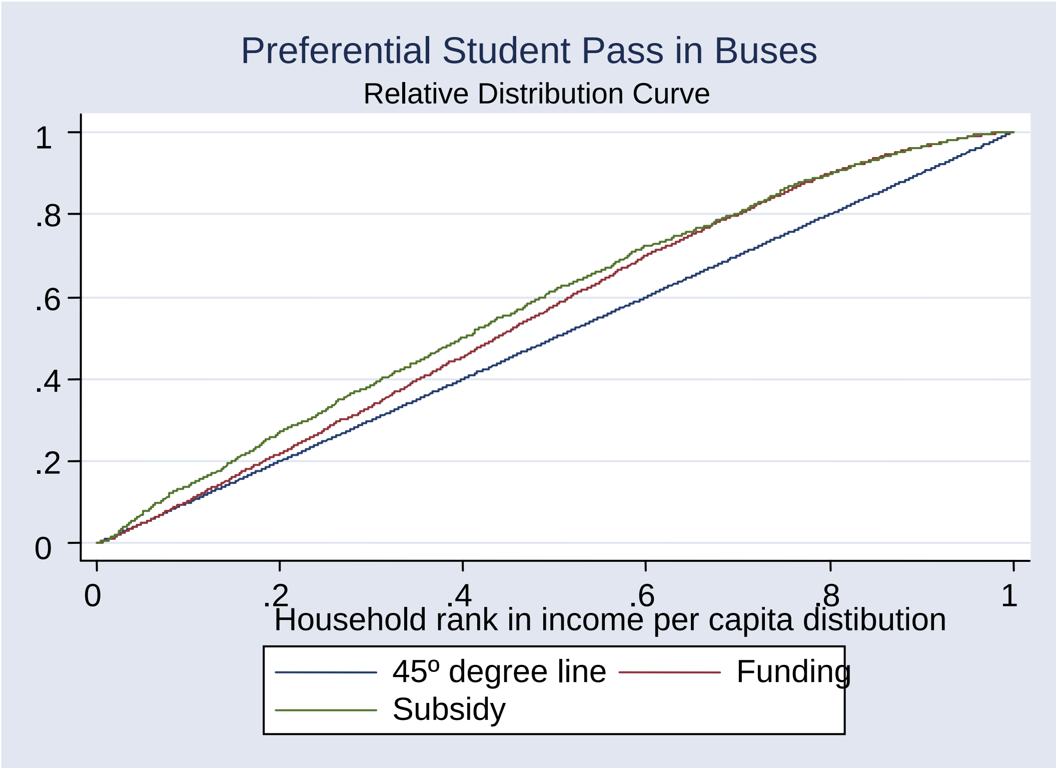


Figure 4



Source: Gómez-Lobo (2007)