Integrating equity considerations into the Israeli cost-benefit analysis

Guidelines for practice

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Content

Preface

This report represents the second output of the project 'Nohal Prat and social justice' carried out on behalf of the Israeli Ministry of Transport. The aim of the project was to assess how equity considerations can be addressed within the Israeli cost-benefit analysis (Nohal Prat). The project was part of a larger project aimed at revising the Nohal Prat.

The guidelines presented in the report are based on an earlier report, titled 'Integrating considerations of equity, fairness and justice into the Israeli cost-benefit analysis' (June 2006). Background information underlying some of the choices made in this report can be found there.

The guidelines were produced under guidance of Amalya Padon of the Ministry of Transport, and Nir Sharav, consultant to the Ministry. Their valuable comments and suggestions have substantially contributed to the current report. However, I take full responsibility for any mistakes or analytical flaws that may be contained in the text.

Karel Martens

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Summary

1. Each year, the Israeli government invests a substantial part of its budget in transport projects. The government is not only interested that these investments are worthwhile in economic terms, but also that the benefits and burdens are distributed in a fair way over its citizens. The procedures laid down in the current Nohal Prat provide a clear framework for the assessment of the economic value of a transport project, but they provide no guidance for the assessment of the distributive impacts of such a project. This report fills this gap and proposes to add a so-called equity analysis to the Nohal Prat framework. The consequence is that the Nohal Prat will consist of two elements: (1) a regular cost-benefit analysis described in the existing Nohal Prat guidelines; and (2) an equity analysis as described in this document.

2. The equity analysis proposed in this report does not cover the distribution of all benefits and burdens that may be generated by a proposed transport project. The report rather suggests focusing the equity analysis on the most important goal of virtually any transport project.[1] From the perspective of both government and average citizen, this goal is identical. For the government, the main goal of a transport project lies in the improvement of people's ability to travel from one place to another, i.e. to make it easier for people to reach desired destinations. From the perspective of the citizen, too, the improvement in 'travel ability' is the most important impact of a proposed transport project.

3. Against this background, the report proposes focusing the equity analysis on the improvements in travel ability generated by a proposed transport project. The report furthermore suggests carrying out the equity analysis at two levels: the household level and the community level. In the former case, the importance of transport improvements lies in the direct benefits for households: in their improved travel ability. In the latter case, the importance of improvements in the transport network lies in the possible spin-off effects for the community, e.g. in terms of increased attractiveness of the community for business and higher-income households.

Equity analysis at household level

4. The equity analysis at the household level is build around three central elements:

    a) The analysis uses *travel time* by car and public transport as an indicator of travel ability of different groups of households.

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[1] With the exception of transport projects that primarily aim to improve freight transport or increase road safety. For these projects another equity analysis than suggested in this report should be carried out.

b) The equity analysis distinguishes between two population groups that show a clearly different level in their 'travel ability': *citizens that have access to a car and citizens that do not have access to a car*. In the current situation, the former experience a high level of travel ability, while the latter generally experience low levels of travel ability. From all possible divisions of the general population into groups, this is the most relevant one from the perspective of travel ability.

c) The equity analysis uses the criterion of *equalization* as the yardstick to judge whether a project has positive of negative equity impacts. Given the size of the existing gaps in travel ability between car-less and car owning households, this criterion is considered to be the only equitable criterion to be used for the assessment of transport projects. Translated to practice, the yardstick implies that a project that narrows the existing gap between car-less and car-owning households is evaluated in a positive way, while a project that has the opposite impacts is evaluated in a negative way.

5. Based on these starting points a step-by-step methodology has been developed. The methodology starts with an assessment of travel times by public transport versus car for each proposed alternative. Subsequently, the ratio between public transport and car time is calculated. Finally, for each alternative, this ratio is compared to the do-nothing scenario. This comparison results in the Household Equity Indicator (HEI). A negative HEI value (below zero) implies that a proposed alternative has a negative equity impact, while a positive HEI value (above zero) means that a project alternative has a positive equity impact. In case HEI = 0, the proposed transport project has no equity impacts at the household level.

6. The table below provides an example of the possible result of an equity analysis at the household level. In this fictitious case, both proposed alternatives have a negative equity impact, i.e. both enlarge the existing gaps between car-less and car-owning households. Alternative B has the strongest negative equity impact (HEI = -0.15), while Alternative A has only a small negative impact (HEI = -0.03). The result can assist the decision-making in two ways: (1) it points to the need to design another alternative that might have more positive impacts for car-less households; (2) it suggests to choose Alternative A rather than B for reasons of equity.

Table 0.1 Example of results generated by the equity analysis at household level.

	Alternative A			**Alternative B**		
	PT/car ratio		HEI	PT/car ratio		HEI
	Without	With		Without	With	
OD Pair 1	1.67	1.71	-0.05	1.67	1.63	0.04
OD Pair 2	1.40	1.65	-0.25	1.40	2.11	-0.71
OD Pair 3	1.45	1.26	+0.19	1.45	1.29	0.16
OD Pair 4	2.50	2.69	-0.19	2.50	3.08	-0.58
Total	**1.63**	**1.66**	**-0.03**	**1.63**	**1.78**	**-0.15**

Equity analysis at the community level

7.   The equity analysis at the community level differs in a number of respects from the analysis at the household level. This differences lie in the three central elements on which the analysis is built:

   a) The analysis uses *average aerial travel speed* by car and/or public transport as an indicator of travel ability at the community level. The advantage of this measure is that it enables direct comparison of communities, irrespective of their location or position in the transport network. The AAS is defined as the quotient of, on the one hand, the aerial distance between a community and all other destinations in the study-area, and, on the other hand, the travel time on the transport network between a community and all other destinations in the study-area.

   b) The equity analysis distinguishes between two types of communities: *weak and strong communities*. The division is based on the Lamas ranking of communities by socio-economic level. Two groups of communities are distinguished: weak communities (ranked 1-5 by the Lamas) and strong communities (ranked 6-10).

   c) The equity analysis uses the criterion of *positive discrimination* as the yardstick to judge whether a project has positive of negative equity impacts. This yardstick implies that transport projects that distribute more accessibility improvements to weak communities than to strong communities should *always* score *positive* in the equity analysis, while projects that generate more accessibility improvements for strong communities than to weak communities should *always* score *negative* in the equity analysis. The underlying motivation is that weak communities are only able to close the socio-economic gap with strong communities if they are set at an advantage, in this case in terms of accessibility.

8.   Based on these starting points a step-by-step methodology has been developed. The methodology starts with the calculation of average aerial speed (AAS) for each community, for each project alternative under consideration. Subsequently, for each alternative, the AAS is compared to the do-nothing scenario. Finally, the AAS of the group of weak communities is compared with the AAS of the group of strong communities. This comparison results in the Community Equity Indicator (CEI). A CEI value between 0 and +1 indicates that a proposed project has positive equity impacts, i.e. weak communities reap the largest share of the accessibility improvements generated by the project. In case the CEI = 1 accessibility improvements are distributed in an equal way over weak and strong communities. In case the indicator scores above +1, strong communities reap most accessibility benefits.

9.   The table below provides an example of the results of an equity analysis at the community level. The table shows the scores on the Community Equity Indicator for two alternatives, for both peak and off-peak hours. The table shows that Alternative A scores

above +1 for both periods of the day, which implies that most of the accessibility improvements are reaped by strong communities. The same holds true for Alternative B during off-peak hours, but during peak hours the CEI score is below 1 suggesting that weak communities benefit most from the project during these hours. The result can assist the decision-making in two ways: (1) it points to the need to design another alternative that might have positive impacts for weak communities during both peak and off-peak hours; (2) it suggests choosing Alternative B rather than A for reasons of equity.

Table 0.2 Example of results generated by the equity analysis at community level.

Time of day	Alternative A	Alternative B
Peak hours	1.32	0.92
Off-peak hours	1.47	1.22

Result and use of equity analysis in relation to Nohal Prat

10. The two equity analyses described above generate two indicators in addition to the traditional efficiency indicators produced by the Nohal Prat. The figure below provides a schematic representation of the implications of carrying out an equity analysis in addition to the regular cost-benefit analysis.

Figure 0.1 Place and results of equity analysis within the Nohal Prat framework.
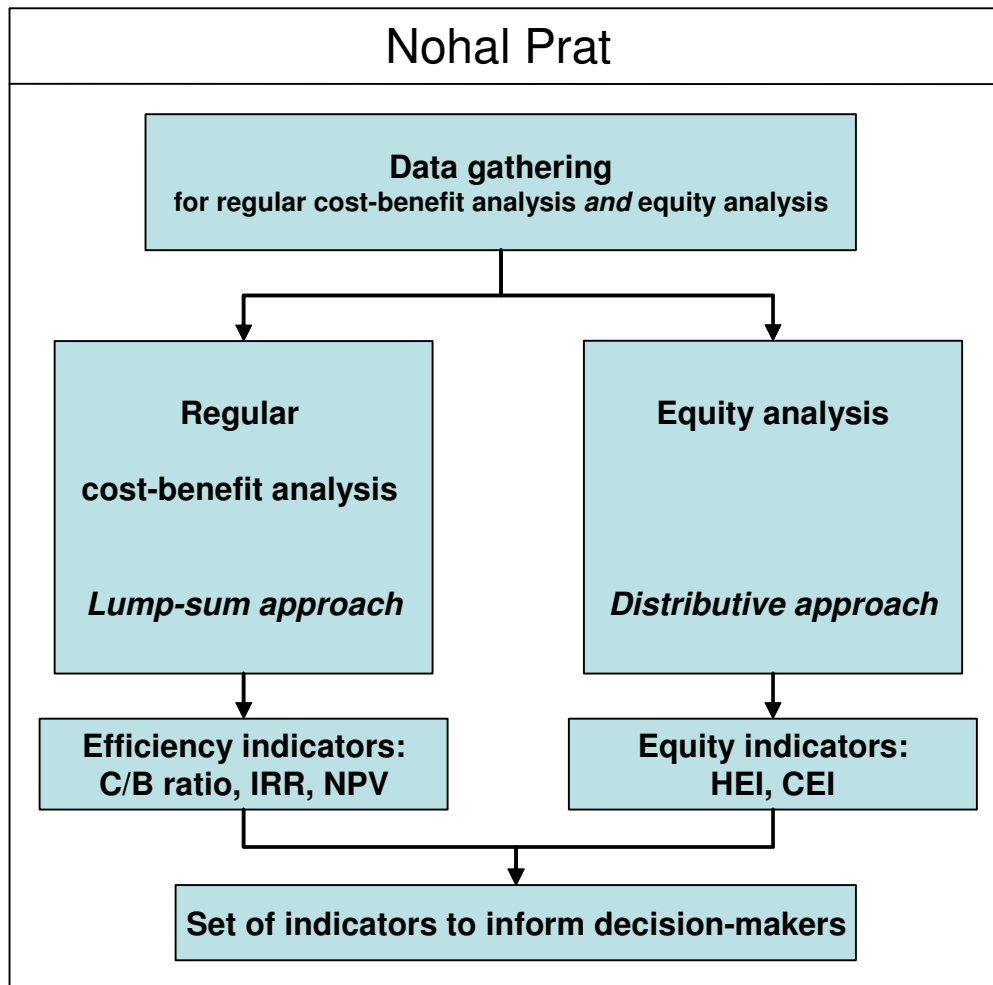
11.   The results of the proposed equity can be used both in the design stage of project alternatives (assist with identifying and specifying an alternative with more equitable effects), as in the stage of selection of alternatives (assist in selecting the alternatives with the most equitable effects).

12.   The advantage of the proposed approach lies in its simplicity, its close link to current practices of cost-benefit analysis, the clear results, and the focus on the main goal of any transport project: the improvement in the ability of people to travel from one place to another.

Chapter 1   Introduction

1.1   Introduction

13.   This report contains practical guidelines for integrating equity considerations into the assessment of transport projects (Nohal Prat). The guidelines are based on a background report, in which various possibilities for integrating equity into transport project appraisal are explored. This background report, titled 'Integrating considerations of equity, fairness and justice into the Israeli cost-benefit analysis', can be obtained from the Ministry of Transport on request.
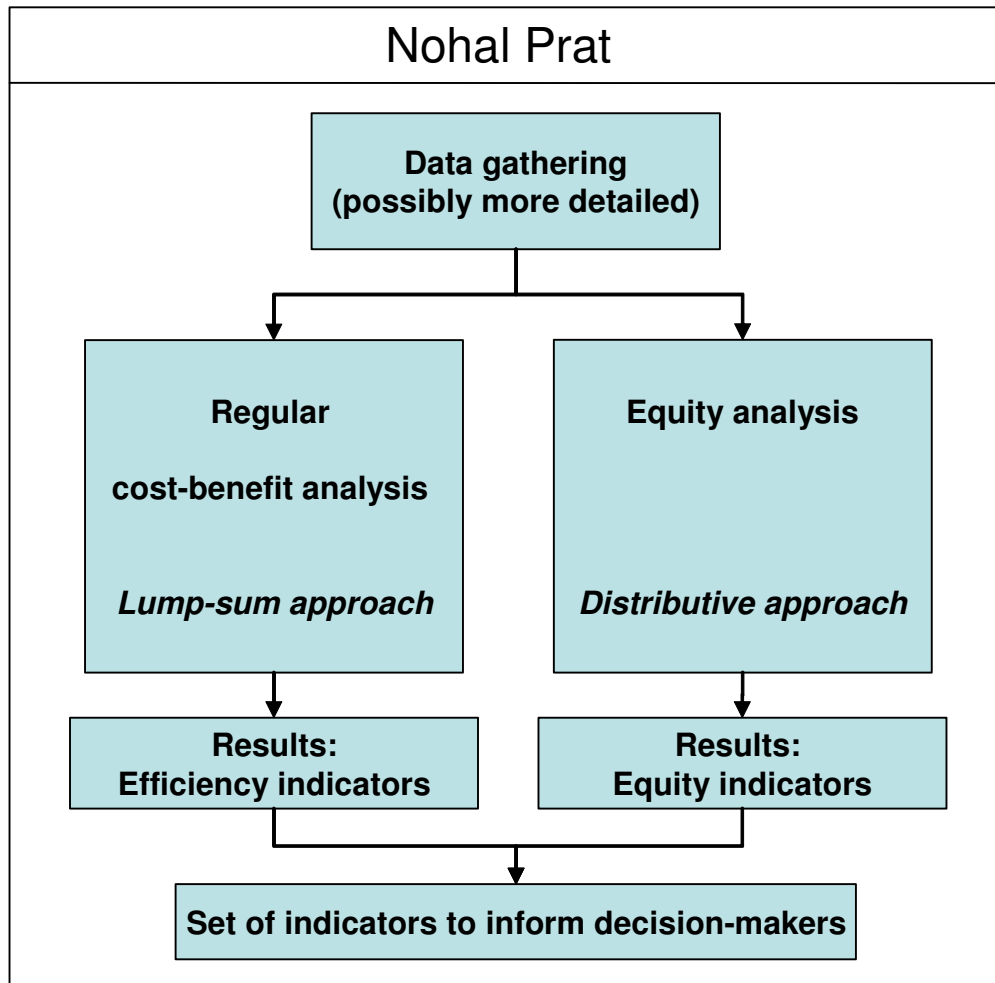
1.2   Equity analysis

14.   The Nohal Prat is a regular cost-benefit analysis and as such provides a procedure for assessing the *economic efficiency* of a transport project. Like other cost-benefit analysis around the world, the Nohal Prat applies a *lump-sum* approach, in which costs and benefits are aggregated. Based on this aggregation, the Nohal Prat generates a set of key indicators on the economic efficiency of a transport project: cost/benefit ratio (C/B ratio, net present value (NPV) and internal rate of return (IRR).

15.   The integration of equity considerations into the Nohal Prat requires a shift in the way costs and benefits are dealt with. Equity is all about the *distribution* of costs and benefits over various population groups. The integration of equity thus requires that the 'black box' of the lump-sum approach is opened up. Rather than aggregating costs and benefits, costs and benefits are to be earmarked by the population group that receives them. From an equity perspective, the question is not whether a project generates more benefits than costs. Rather, the question is who reaps the benefits and who bears the costs of a transport project? This core question can only be answered if a separate *equity analysis* is carried out to complement the regular analyses carried out within the framework of the Nohal Prat. The main goal of this equity analysis is the provision of data on the *distribution* of benefits and costs over various population groups.

16.   The application of an equity analysis within the Nohal Prat framework has consequences for both data input and the results of transport project appraisal.

17.   The consequences for data input do not concern so much the scope of data, but rather the level of the detail at which data need to be collected. Since the equity analysis focuses on the same benefits and costs as regular cost-benefit analysis, the same set of data should be used for the equity analysis. However, it may be necessary to collect the data in a more

detailed manner, in order to enable the earmarking of costs and benefits according to population group.

18.   The consequences for the results of project appraisal are more far-reaching. Equity analysis produces a set of additional results that complement the regular efficiency indicators generated by cost-benefit analysis. These additional results cannot simply be integrated into the efficiency indicators. Transport professionals and decision-makers alike will thus be faced with two sets of results and/or indicators that might point in a different direction. This will obviously complicate, but also enrich the ensuing decision-making process.

19.   In sum, these guidelines recommend carrying out a separate equity analysis in addition to the regular cost-benefit analysis executed within the Nohal Prat framework. Figure 1.1 provides a schematic representation of the implications of carrying out this equity analysis.

Figure 1.1 Place of equity analysis within the Nohal Prat framework.

1.3   Focus of the proposed equity analysis

20.   The main goal of the proposed equity analysis is the provision of data on the distribution of benefits and costs over population groups. The guidelines propose to focus the equity analysis at two levels: at the level of *households* and at the level of *communities*. In the first case, the question is whether benefits and costs are distributed in a fair way over different types of households, irrespective of their place of residence. In the second case, the question is whether different types of communities (municipalities or settlements) receive a fair share of the benefits and burdens generated by a specific transport project. Since both types of equity do not always coincide, as will be discussed further on in the report, the proposed equity analysis consists of two separate components.

1.4   Structure of the guideline report

21.   The current document provides the guidelines for carrying out an equity analysis within the framework of the overarching Nohal Prat. The report is structured as follows. Chapter 2 and 3 discuss content and methodology of the equity analysis to be carried out at the household level. In Chapter 4 and 5, the attention is directed towards content and methodology of the equity analysis at the community level.

Chapter 2   Equity between households

2.1   Introduction

22.   A typical transport project generates benefits for certain households, while it creates costs for others. For instance, a new road may reduce travel times for suburban households traveling to the central city, while it may increase air and noise pollution for citizens living close to the planned new road.

23.   The equity analysis to be carried out within the adjusted Nohal Prat cannot deal with all distributive impacts. The goal of this chapter is to determine which distributive impacts need to be included in the equity analysis at the household level. In order to do so, three questions will be answered:

– Which *benefits or burdens* should be the subject of analysis?
– Which *population groups*, i.e. types of *households*, are to be distinguished?
– Which *evaluation criterion* is to be used to asses whether the selected benefits or burdens are distributed in an equitable way over the distinguished groups of households?

24.   Each of these issues will be addressed below in order to determine the focus of the equity analysis at the household level.

2.2   Benefits: accessibility improvements

25.   Theoretically, an equity analysis at the household level could address all benefits and costs included in the regular Nohal Prat. However, this would considerably complicate the task of data analysis, and substantially increase the costs related to project appraisal. Furthermore, it would yield a large set of output data, which would be difficult to relate to in the ultimate decision-making process. The costs of such a broad approach might thus well exceed the benefits.

26.   For these reasons, governments carrying out a cost-benefit analysis are advised to focus the equity analysis at the household level only on the benefits related to the main goal of transport projects. From the perspective of households, the main goal of a transport project is the improvement in *the ability to travel from one place to another*, in other words, accessibility improvements. From all the benefits and costs of a transport project, this is the most important one from the perspective of the average citizen or household; this is the most tangible result of a transport project. The benefit becomes all the more important, if one realizes that transport infrastructure projects are the main way in which

a government can improve the accessibility of citizens. The distribution of this ability is thus of the utmost importance.

27.   The guidelines thus propose to focus the equity analysis at the household level on the distribution of accessibility improvements. The terms 'improvements in ability to travel through space' and 'accessibility improvement' will be operationalized in the next chapter, and linked to the benefits included in the Nohal Prat. In this chapter, the terms will be used interchangeably.

2.3   Population groups: car-owners versus car-less

28.   The emphasis on the benefits that improve people's ability to travel through space has implications for the way in which the total population should be divided into groups. The common way to distinguish groups along income lines is hardly relevant, as income levels do not necessarily reflect the ability of people to travel through space. Instead, the guidelines recommend distinguishing population group according to their ability to make use of the private car.

29.   There are two reasons for this choice. First, in the current circumstances of a well-developed road network, car availability is an important determinant of a person's ability to travel through space. People that have continuous access to a car will generally have no problems to travel through space, as the car is always at their disposal, as is the network of roads and parking spaces. The mobility provided for by the car may be reduced by congestion or lack of parking spaces, but in many cases will remain superior to the potential mobility provided by the public transport system. While the latter may be better for specific connections and at specific times (e.g. long-distance or peak-hour trips), the first is currently superior for the vast amount of trips. Thus, car-owners may be expected to have substantially higher ability to travel through space than car-less groups. Given this situation, car availability is a suitable practical indicator for the ability to travel through space and as a criterion to distinguish population groups.

30.   Second, data on car availability and car use for trips are generally collected within the framework of the Nohal Prat. The guidelines can therefore easily be implemented without the need for additional data gathering or analysis.

31.   Given the above considerations, the guidelines recommend governments and other bodies carrying out an equity analysis at the household level, to distinguish population groups by car availability.

2.4   Yardstick for judging project impacts

32.   The third element of the equity analysis is the definition of a criterion to judge whether a proposed transport project, or a specific alternative, has *positive* or *negative* equity impacts. For this, knowledge about the way in which a benefit is distributed over

population groups is not sufficient. A value judgment about the distribution is only possible with an explicit yardstick in hand.

33.   Governments and other bodies carrying out appraisals of transport projects are recommended to use the yardstick of *equalization*. This yardstick implies that projects that *reduce* existing gaps in the ability to move through space score *positive* in the equity analysis, while projects that *increase* the existing gaps score *negative* in the analysis.

34.   The recommendation to use the yardstick of equalization is based on the observation that, over the past decades, substantial gaps have developed in people's ability to travel through space. These gaps have started to from with the increase in private car ownership and the development of the road network. This network soon provided a superior way to travel through space, outperforming the till-then dominant public transport system. The subsequent switch from public transport to the private car resulted in a further drop in the overall quality of the public transport system, in terms of frequencies, network coverage and speed (due to congestion). The current gaps in people's ability to travel through space are largely a result of these developments. People that have (continuous) access to a car generally have a high ability to travel through space, while people dependent on the public transport system are characterized by a much lower travel ability.

35.   With its focus on economic efficiency rather than distribution, the Nohal Prat – in line with cost-benefit analyses around the world – has been instrumental in the development of this gap in travel ability. These recommendations suggest applying the updated Nohal Prat to help correct this situation and reduce rather than increase the existing gaps in travel ability.

36.   Note that the criterion of equalization does *not* suggest that the ability to travel should ultimately be distributed in a completely equal way. This is neither a feasible policy goal, nor a desired one. The choice for the yardstick of equalization is based on the observation that the existing gaps in travel ability are, in virtually all cases, clearly beyond an acceptable level.

2.5   Focus of equity analysis at household level

37.   To summarize, this guideline recommends governments and other authorities that execute transport project appraisals, to carry out an equity analysis that focuses on the way travel time savings and reductions in vehicle operation costs are distributed over car-owning and car-less households. It furthermore recommends using the yardstick of equalization as the criterion to judge whether a project alternative is more or less equitable. The focus of the equity analysis is summarized in Table 2.1.

Table 2.1 Focus of the equity analysis to be carried out within the Nohal Prat framework.

Benefits	Population groups	Evaluation yardstick
Improvements in the ability to travel through space; accessibility improvements	Car-owning versus car-less travelers	Equalization, i.e. reduction of existing gaps

Chapter 3   Equity between households: proposed methodology

3.1   Introduction

38.   The previous chapter has provided an outline of the focus of the equity analysis to be carried out at the household level. This chapter presents the methodology for carrying out this equity analysis. The chapter starts with an operationalization of the abstract terms ability to travel' or 'accessibility improvements' (Section 3.2). It is suggested to use the ratio between travel time by public transport and travel time by car (TTR) as the key measure in analyzing the distribution of accessibility improvements over groups of households. Then, in Section 3.3, a step-by-step methodology is presented on how to determine the way in which AVS improvements are distributed over weak and strong communities. Finally, Section 3.4 discusses a number of issues that need further study and may be addressed in the second stage of the Nohal Prat update.

3.2   Measure to compare households: travel time ratio

39.   The proposed equity analysis at the household level focuses on the way in which improvements in the ability to travel are distributed over population groups. From all the benefits addressed within the Nohal Prat framework, two can be linked directly to the travel-ability: travel time savings and reductions in vehicle operation costs (VOC). However, the use of these two measures in the analysis of the distribution of accessibility improvements over households is not without problems.

40.   The most important problem lies in the fact that households differ substantially in the amount of trips they make. High-income households make more trips and travel over longer distances than low-income households, ceteris paribus. Likewise, car-owning households are characterized by higher trip frequencies and longer trips than car-less households, all other things equal. The consequence is that an analysis of the distribution of travel time savings and VOC reductions will generally reveal a strong bias in favor of the better-off households.

41.   Some of the differences in trip frequencies and distances are related to the travel ability of households. For instance, high-income households will make more trips because of higher car availability and because transport costs are relatively low compared to household income. But some of the differences in trip patterns are not related to differences in travel ability. For instance, high-income households may participate more in out-of-home cultural and leisure activities, simply because these activities are more affordable to them. While the measure to assess the distribution of accessibility

improvements should be sensitive to the former interrelationship, it should not include the second one. Since travel time savings and VOC reductions incorporate both phenomena, they are inappropriate as measure to use in the equity analysis.

42.   The guidelines therefore propose to apply a measure that *only* relates to the quality of the available transport network. Following the focus on the ability to travel, the proposed measure consists of a comparison of the ease of traveling by car versus the ease of traveling by public transport. More specifically, the measure consists of either:
   − TTR: the ratio of travel time by public transport and travel time by car; or
   − GCR: the ratio of generalized travel costs by public transport and generalized travel costs by car.

43.   The guidelines therefore propose to apply a measure that *only* relates to the quality of the available transport network. Following the focus on the ability to travel, the proposed measure consists of a comparison of the ease of traveling by car versus the ease of traveling by public transport. Translated to cost-benefit analysis terms, the measure could include employ travel time as a measure of the ease with which each group can travel, or employ generalized travel costs, thus linking travel time and costs in one measure.

44.   In first case, the measure takes the following form:

$$TTR_A = \frac{TRANSIT\text{-}TIME_{ODi\text{-}n}}{CAR\text{-}TIME_{ODi\text{-}n}}$$

45.   where TTR_A is the ratio of travel time by public transport and travel time by car for project alternative A; $TRANSIT\text{-}TIME_{ODi\text{-}n}$ is the total public transport travel time between all origin-destination pairs for alternative A; and $CAR\text{-}TIME_{ODi\text{-}n}$ is the total travel time by car between all origin-destination pairs for alternative A.

46.   The generalized cost measure takes on a comparable form:

$$GCR_A = \frac{TRANSIT\text{-}GCOST_{ODi\text{-}n}}{CAR\text{-}GCOST_{ODi\text{-}n}}$$

47.   where GCR_A is the ratio of generalized travel cost by public transport and generalized travel cost by car for project alternative A; $TRANSIT\text{-}GCOST_{ODi\text{-}n}$ is the total generalized travel costs by public transport between all origin-destination pairs for alternative A; and $CAR\text{-}GCOST_{ODi\text{-}n}$ is the total generalized travel costs by car between all origin-destination pairs for alternative A.

48.   Both measures make it possible to compare the situation of the two groups of households which are the focus of the equity analysis: car-owning households and car-less households. Travel time by car ($CAR\text{-}TIME_{ODi\text{-}n}$) and generalized travel costs by car

(CAR-GCOST$_{ODi-n}$) are indicators of the travel ability of the former, while travel time by public transport (TRANSIT-TIME$_{ODi-n}$) and generalized travel costs by public transport (TRANSIT-GCOST$_{ODi-n}$) are indicators of the travel ability of the latter.

49.   The use of either the TTR or the GCR measure in actual practice will depend on data availability. The use of the GCR measure requires that not only data are available about travel time and costs by car, but also by public transport. Especially data on future travel costs by public transport may be problematic to obtain, as they are set by government and therefore highly susceptible to policy. In case no data on future public transport travel costs are collected or estimated within the framework of the Nohal Prat, the equity analysis at the household level could be limited to travel time and exclude travel costs. This makes the analysis of the distribution of improvements in travel ability less complete, but it does cover the most important benefit addressed in cost-benefit analysis. As such, this approach will still generate valuable results for the comparison and selection of project alternatives and/or transport projects.

50.   Against this background, the guidelines propose to use the TTR measure rather than the GCR measure. The latter may be applied in cases in which sufficient data are available on travel costs. Below, the methodology will be specified to obtain the TTR measure.

3.3   Step-by-step methodology

51.   This section contains a simple step-by-step methodology carry out the equity analysis at the household level. The presented methodology only relates to the TTR measure, but could easily be expanded to include travel costs and generate the GCR measure. Note that the first two steps of the methodology are already carried out within the Nohal Prat framework. The additional effort for calculating the equity measure is thus limited to the last three steps of the methodology.

Step 1: Identify links with changes in travel times
52.   Transport projects will always have localized impacts: travel times will be reduced on certain routes, while others will experience no, or even reversed, impacts. Routes are defined here as a path connecting an origin-destination pair. The same transport link can thus be part of various routes, linking various origin-destination pairs. The demarcation of origins and destinations follows the transport demand model that is being used as part of the Nohal Prat procedure, i.e. each transport activity zone (TAZ) distinguished in the model serves as an origin and/or destination.

Step 2: Calculate travel times by car
53.   The second step requires the calculation of travel times by car. In line with standard cost-benefit analysis, travel times will have to be calculated for the future without the proposed improvements in the transport network, and for each of the alternatives under considerations.

Step 3: Calculate travel times by public transport

54.   The third step consists of the calculation of travel times by public transport for each origin-destination pair with significant changes in travel time. Like in the case of the car, the travel times need to be calculated for the 'without' situation, as well as for all the alternatives under consideration.

55.   The calculation of public transport travel times is less simple than the calculation of car travel times. In the public transport case, three issues will have to be addressed.

56.   First, a travel route between one origin-destination pair may be served by a number of public transport services. These may differ substantially in travel time, e.g. because it includes train services, express bus lines, as well as slow, local, bus services. 'The' public transport travel time between an origin-destination pair does not exist. For the equity analysis, it is recommended to include only those public transport lines that provide a relatively direct service between the origin-destination pair, since these services will be used by the vast majority of the people to travel between that origin and destination. Practically this means, that slow, local, bus services are to be excluded from the calculations.

57.   The second issue concerns the public transport network in the future. In many cases, especially when a road project is subjected to the Nohal Prat procedure, few data will be available about the future public transport network. This obviously complicates the calculation of public transport travel times. If no data whatsoever are available, it is recommended to base calculations on the existing public transport system, with small adjustments. These adjustments concern changes in route choice for express bus lines. These bus lines run from mostly from central bus station to central bus station, with perhaps only a few stops at the beginning or end of the route. It may be expected that the routes of these bus lines will be changed if faster (intercity) transport links become available on the stretch that the bus does not stop. The bus network could therefore be changed in accordance to the new road network for all those stretches that relevant lines do not have bus stops.

58.   The third issue concerns the total travel time by public transport. Total travel time does not only include on-board time, but also access time, waiting time and egress-time. While on-board time and on-route waiting time are usually calculated within the Nohal Prat framework, access and egress time are often not addressed. However, excluding these times would certainly result in a substantial under-estimation of public transport travel time and, hence, of the gaps in travel time savings between car-owning and car-less households. The guidelines therefore recommend using estimates of average access and egress times for each transport activity zone.

Step 4 Calculation of public transport/car ratio

59.   The fourth step is the comparison of the travel times by car and public transport. This can be done at the level of origin-destination pairs and then added up to generate one travel time ratio for the base scenario (without any changes any changes in the existing transport network) and each proposed project alternative.

Step 5 Calculation of Household Equity Indicator (HEI)

60.   The final step consists of a comparison of the travel time ratio for the base situation
       (without any changes any changes in the existing transport network) and the situation
       after the implementation of each alternative. This without-with comparison results in the
       so-called Household Equity Indicator (HEI): a number that indicates whether the gaps in
       travel times between car-owning and car-less household have been reduced or increased.
       A negative HEI value (below zero) implies that a proposed alternative has a negative
       equity impact, while a positive HEI value (above zero) means that a project alternative
       has a positive equity impact. In case HEI=0, the proposed transport project has no equity
       impacts on the household level.

61.   Tables 3.1 and 3.2 provide an example of the ultimate result of the proposed equity
       analysis. The tables present the results of the proposed methodology for two fictitious
       scenarios, Alternative A and Alternative B. Each table contains data on the travel time by
       car ('car-users') and public transport ('car-less') for the base situation ('without') and the
       alternative ('with'). The last three columns provide data on the travel time ratio between
       both modes, as well as the score on the HEI indicator. In this fictitious case, both
       proposed alternatives have a negative equity impact, i.e. both enlarge the existing gaps in
       travel times between car-less and car-owning households. Alternative B has the strongest
       negative equity impact (HEI = -0.15), while Alternative A has only a small negative
       impact (HEI = -0.03).

Table 3.1 Travel times and travel time ratio for Alternative A

	Travel time without		Travel time with		PT/Car ratio		
	Car-users	Car-less	Car-users	Car-less	Without	With	HEI
OD Pair 1	30	50	28	48	1.67	1.71	-0.05
OD Pair 2	25	35	23	38	1.40	1.65	-0.25
OD Pair 3	42	61	38	48	1.45	1.26	+0.19
OD Pair 4	14	35	13	35	2.50	2.69	-0.19
Total	**111**	**181**	**102**	**169**	**1.63**	**1.66**	**-0.03**

Table 3.2 Travel times and travel time ratio for Alternative B

	Travel time without		Travel time with		PT/Car ratio		
	Car-users	Car-less	Car-users	Car-less	Without	With	HEI
OD Pair 1	30	50	32	52	1.67	1.63	0.04
OD Pair 2	25	35	18	38	1.40	2.11	-0.71
OD Pair 3	42	61	34	44	1.45	1.29	0.16
OD Pair 4	14	35	12	37	2.50	3.08	-0.58
Total	**111**	**181**	**96**	**171**	**1.63**	**1.78**	**-0.15**

3.4 Possible future improvements in the methodology

62. The methodology presented above provides a simple procedure to determine how accessibility improvements generated by a transport project are distributed over car-owning and car-less households. While the travel time ratio between car and public transport is a well-known measure in transport studies, it has never been used explicitly as an indicator to assess the *equity* aspects of a transport project. This, then, is the novelty of the proposed indicator.

63. Obviously, the Household Equity Indicator (HEI) could be fine-tuned in the future, possibly even in the second stage of the Nohal Prat update. Here, we suffice with identifying a number of issues that could be addressed in the future.

64. A first possibility for improvements is the use of generalized travel costs rather than travel time as the basis for the equity indicators. Note that this is not a straightforward issue from an equity perspective, as different population groups may give a different weight to costs and time. The translation from absolute values of travel time and costs to a generalized value is therefore not a simple step.

65. A second issue relates to the relative importance of different O-D pairs. Currently, the proposed indicator does not give a weight to the O-D pairs in relation to their relative importance, e.g. in terms of population size. This implies that an improvement in travel time ratio between two small towns is weighted in the same way as an improvement in the ratio for a trip between two large cities. Since more people will use the latter, it may be argued that some kind of weighting should be applied.

Chapter 4   Equity between communities

4.1   Introduction

66.   Just like a typical transport project distributes costs and benefits over households, it distributes them over communities as a whole (municipalities or settlements). While the previous two chapters dealt with distribution at the household level, this and the following chapter are about equity at the community level.

67.   There are two reasons to carry out a separate equity analysis at the community level. First, equity at the household level does not always imply that there is equity at the community level. The methodology proposed in the previous two chapters does not rule out such a possibility. In general, projects that lead to poor access by car and transit will score the same as projects that lead to good access by car and transit, as the transit-car ratio will be the same in both cases. While it will not occur very often, the proposed methodology does open the possibility that projects having positive effects for one community but undesired effects for others, score well in the equity analysis. Explicit analysis of the situation at the community level can avoid selecting such undesirable projects.

68.   Second, transport projects have different implications for communities than they have for households. While accessibility and travel times are arguably the most important impact from the household perspective, from a community perspective impacts on for example economic development may be just as important. This suggests that the focus of the equity analysis should not be the same at both levels of aggregation.

69.   For this reason, the goal of this chapter is to determine which distributive impacts need to be included in the equity analysis at the community level. In order to do so, again the three key questions of any equity analaysis will be answered:

    – Which *benefits or burdens* should be the subject of analysis?
    – Which *population groups*, i.e. types of *communities*, are to be distinguished?
    – Which *evaluation criterion* is to be used to asses whether the selected benefits
       or burdens are distributed in an equitable way over the distinguished groups of
       communities?

70.   Each of these issues will be addressed below in order to determine the focus of the equity analysis at the community level.

4.2   Benefits: accessibility improvements

71.   From a community perspective, transport projects may bring a variety of advantages. For instance, a connection to the highway system may turn the community into an attractive location for companies that prefer to locate close to the highway. Likewise, companies already located in a community may profit from a new railway station, as they will be able to attract employees from a larger area. Communities may also experience reduced through-traffic, and hence pollution, as a result of a new highway replacing an old main road. Transit or road projects could also result in a reduction in road fatalities and the number of seriously injured in a community, for instance if a level-crossing is replaced by a split-level crossing.

72.   These examples show that transport projects may have a different meaning for communities than for households. At the same time, it is clear that also at the community level transport projects generate a wide array of benefits and costs that could be subject of the equity analysis. And, like in the case of households, there is a need to limit the equity analysis to the most important benefits.

73.   The guidelines therefore propose to focus the equity analysis at the community level on the improvements in accessibility generated by a transport project. These improvements are of the utmost importance for communities, for a number of reasons. Generally, four positive impacts of improved accessibility can be distinguished:

    −   Increase in the productivity and profitability of companies located in the community.[2]
    −   Increase in the attractiveness of the community as a location for companies.
    −   Increase in the number of job and educational opportunities for the residents of the community.
    −   Increase in the attractiveness of the community as a residential location for higher income households (given the trip distances of these households and the value they will attach to accessibility as a result).

74.   The importance of these impacts reaches beyond the companies and households directly involved, since the positive benefits may trickle down to other companies and population groups. For instance, an influx of high income households may generate new (low-wage) jobs in e.g. cleaning, and may boost the turn-over of local shops. Likewise, increased opportunities to study at institutions of higher education may benefit a whole family, rather than only the person making use of these opportunities.

75.   These potential direct and indirect impacts of improved accessibility at the community level provide strong reasons to focus the equity analysis at the community level on the accessibility impacts of a new transport project. Since the Nohal Prat does not include accessibility improvements as such in the cost-benefit analysis, the exact focus of the equity analysis still needs to be determined. While it seems obvious to focus on the

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[2] See for instance {Fuerst, 1999 #1288}; {Fuerst, 2000 #1289}.

distribution of travel time savings and reductions in vehicle operation costs, it will be argued in the next chapter that such an approach is problematic to apply at the community level. In that chapter, a different measure to assess the distribution of accessibility improvements over communities will be presented. In this chapter, we will continue to use the general term 'accessibility improvements'.

4.3   Population groups: communities by socio-economic level

76.   The previous section outlined a number of positive impacts that new transport infrastructure can have on communities. All of these impacts are closely related to the socio-economic strength of a community. This holds true for the impacts on the productivity and profitability of local companies, for the attractiveness of the community as a location for companies, for the access of local residents to job and educational opportunities, and for the attractiveness of the community as a residential location for higher income groups. All of these benefits of improved accessibility will have positive impacts on the socio-economic strength of a community.

77.   Against this background, the guidelines propose to distinguish the communities by socio-economic level and to use the broadly accepted measurement of the Lamas (Israeli Central Bureau of Statistics) for this purpose. On a regular, the Lamas rates communities (local councils and municipalities) by their socio-economic level, using a set of indicators that includes, among others, financial resources of the residents, housing-related variables, motorization level (number of quality), schooling and education, (un)employment, and data on socio-economic distress.[3] Based on these indicators, all localities are given a score ranging between 1 (weakest communities) and 10 (strongest communities).[4]

78.   The guidelines recommend using the most recent Lamas ranking in the equity analysis at the community level. For reasons of simplicity, it is recommended to divide the communities into two groups:

−   Weak communities: all communities with score ranging from 1 to 5.
−   Strong communities: all communities with score ranging from 6 to 10.

79.   The goal of the equity analysis is then to determine how the accessibility improvements generated by a new transport project are distributed over these two groups of communities.

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[3] See for instance the report for the year 2003: {Central Bureau of Statistics Israel, 2003 #1290}.

[4] For example, localities like Kuseife, Betar Illit and Rahat were among the weakest communities (with score 1); while Omer and Savyon were rated as the two strongest localities in Israel in 2003 (score 10). See: http://www.cbs.gov.il/publications/local_authorities2003/pdf/t02.pdf.

4.4   Criterion to use as a yardstick for judging project impacts

80.   The third element of the equity analysis is the definition of a criterion that determines whether a certain transport project has positive or negative equity impacts. Governments and other bodies carrying out appraisals of transport projects are recommended to use the yardstick of *positive discrimination* for this purpose.

81.   The criterion of positive discrimination is widely used in the fields of education and employment. In the latter field, for example, positive discrimination is a policy that aims to increase the representation of certain designated groups among the workforce of a company or a sector, in an effort to redress discrimination or bias that occurred in the past.[5] As the word indicates, positive discrimination suggests that certain candidates for a job position, even when they are considered only equal but not better in terms of suitability for the job, are to be preferred over other candidates. Positive discrimination policies have often been used to stimulate the number of women, ethnic minorities, or people with disability in the workforce.

82.   In case of the distribution of accessibility improvements over communities, the criterion of positive discrimination implies that transport projects that distribute more accessibility improvements to weak communities than to strong communities should *always* score *positive* in the equity analysis, while projects that generate more accessibility improvements for strong communities than to weak communities should *always* score *negative* in the equity analysis. Projects that distribute the accessibility improvements in an even way between the two types of communities, in turn, should receive a *neutral* score. This way of scoring should be applied *even if* weak communities are already characterized by higher accessibility levels than strong communities. This is so because the goal is not reach equality in terms of accessibility, but in terms of socio-economic strength of the community. In social justice terms: the goal of transport projects is not to achieve equality of resources (i.e. equality in terms of accessibility levels), but to achieve equality of outcomes (i.e. equality in terms of socio-economic strength).

83.   The recommendation to use the yardstick of positive discrimination is based on the observation that it is only possible to close the existing gaps between communities in terms of their socio-economic strength, if the conditions are created for a positive dynamic in weak communities. Given the importance of mobility in current Israeli society, a high level of accessibility is certainly one of the conditions necessary to make such a dynamic happen. Moreover, in order to close the gap with strong communities, weak communities should be given better conditions than strong communities. In case weak communities would be characterized by the *same level* of accessibility as strong communities, the chances would be limited that the weak communities would be able to close the existing gaps. Positive discrimination in the distribution of accessibility improvements will correct the existing disadvantage of weak communities: it creates a relative advantage which weak communities can use to catch up with strong communities.

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[5] See http://en.wikipedia.org/wiki/Positive_discrimination, last accessed March 2007.

4.5   Focus of equity analysis at community level

84.   To summarize, this guideline recommends governments and other authorities that execute transport project appraisals, to carry out an equity analysis that focuses on the way in which improvements in accessibility are distributed over communities by their socio-economic strength. It furthermore recommends using the yardstick of positive discrimination as the criterion to judge whether a project alternative is more or less equitable. The focus of the equity analysis is summarized in Table 4.1. Note that the concept of accessibility improvements is operationalized in the next chapter.

Table 4.1 Focus of the equity analysis to be carried out within the Nohal Prat framework.

Benefits	Population groups	Evaluation yardstick
Improvements in accessibility	Communities divided into two groups by socio-economic strength	Positive discrimination, i.e. a distribution of travel time savings in favor of weak communities score positive in equity analysis

Chapter 5   Equity between communities: proposed methodology

5.1   Introduction

85.   The previous chapter has provided an outline of the focus of the equity analysis to be carried out at the community level. This chapter presents the methodology for carrying out this equity analysis. The chapter starts with an operationalization of the abstract term 'accessibility improvements' (Section 5.2). It is suggested to use the measure of 'average aerial speed' (AAS) to assess improvements in accessibility at the community level. Then, in Section 5.3, a step-by-step methodology is presented on how to determine the way in which AVS improvements are distributed over weak and strong communities. Finally, Section 5.4 discusses a number of issues that need further study and may be addressed in the second stage of the Nohal Prat update.

5.2   Measure to compare communities: average aerial speed (AAS)

86.   The operationalization of the abstract term 'accessibility improvements' is not a straightforward issue. Given the CBA framework, the most obvious way would be to focus on travel time savings and reductions in vehicle operation costs. However, there are a number of problems in using these measures in the analysis of the distribution of accessibility improvements over communities.

87.   First, weak and strong communities differ structurally in the number of trips they generate. All other things equal, a weak community will generate fewer trips than a strong community. The consequence is that weak communities will also reap less travel time savings from a transport project, ceteris paribus. The use of travel time savings as an indicator of accessibility improvements, in combination with the equity yardstick of positive discrimination, would thus generate extreme outcomes. Most likely, only projects that are strongly biased towards poor communities would score positive in the assessment. This could imply, for instance, that a new road would only score positive in the equity analysis if the entrance points of the road served mainly weak communities and hardly any rich communities. Likewise, a new railway line would only score positive if most stations along that line would be located in weak communities.

88.   Second, the amount of travel time savings 'gathered' by a community will to a large extend depend on the location of a community. Communities located at the periphery of a metropolitan area will generally be characterized by longer trip-distances than communities located in the center of that metropolitan area. This is because centrally

located communities have more destinations within a short distance, and trips will thus be shorter than in the case of peripheral communities, ceteris paribus. These differences are especially important in the assessment of line infrastructure, like new roads or railways. In that case, it is highly likely that communities located on the periphery will reap more travel time savings than communities located in the center, all other things being equal. Travel time savings are thus hardly suitable as an indicator of accessibility improvements, since they make it nearly impossible to compare communities in a direct way. A different accessibility measure is necessary, which rules out the impact of the relative location of a community in the study-area.

89.   These two arguments point out that travel time savings are not an appropriate indicator for assessing the distribution of accessibility improvements over communities. Against this background, the guidelines propose to use an alternative measure. This measure is called 'average aerial speed on the transport network' (AAS). The AAS is defined as the quotient of, on the one hand, the *aerial distance* between a community and all other destinations in the study-area ('as the crow flies'), and, on the other hand, the *travel time on the transport network* between a community and all other destinations in the study-area. In formula:

$$V_{TAZi\text{-}n} = \frac{D_{TAZi\text{-}n}}{T_{TAZi\text{-}n}}$$

90.   where $V_{TAZi\text{-}n}$ is the average aerial speed between transport activity zone i and all other transport activity zones; $D_{TAZi\text{-}n}$ is the *aerial distance* between zone i and all other zones; and $T_{TAZi\text{-}n}$ is the travel time *on the transport network* between zone i and all other zones.

91.   The first advantage of the AAS measure lies in the fact that it can compare the accessibility improvements reaped by communities *irrespective* of their location in the study area. For instance, the AAS of a peripheral community can be identical to that of a community in the center. This makes the AAS measure much better suited for its purposes, than a measure like average travel time. The latter would always reveal differences between center and periphery, making it difficult to assess whether improvements in travel time are distributed in a fair way over communities.

92.   The second advantage of the AAS measure lies in the fact that it can compare the accessibility improvements reaped by communities *irrespective* of the amount of travel generated by those communities. The AAS measure is based solely on the improvements in actual travel times on the network, not on the savings that are generated by these improvements.

93.   The third advantage of using the AVS measure lies in the fact that it can assess the efficiency of the network structure in a simple way. A more traditional measure, like average speed *on the network* could not do this. A simple example can explain this. In case a community does not have its own entrance point to a highway, but is linked to the highway through a secondary road with low traffic volumes, the average speed on the

transport network may be relatively high. However, since drivers will have to make a detour to reach the highway, the actual accessibility level of this community may be relatively low. The AAS measure provides a more appropriate assessment of the accessibility level of such a community, as it links travel time to the lowest possible distance (the aerial distance). Network inefficiencies are thus revealed for by the AAS measure. The same line of reasoning holds for other 'inefficiencies' in the network, e.g. the fact that main roads tend to provide an efficient route between main cities, but a less optimal route between communities of lower importance. The AAS measure can thus account for these network effects in a simple way.

94.   Following the arguments presented above, the guidelines propose to use the average aerial speed (AAS) as a measure to determine how accessibility improvements generated by a transport project are distributed over communities that differ in socio-economic strength.

5.3   Step-by-step methodology

95.   This paragraph presents a simple step-by-step methodology to assess how accessibility improvements generated by a proposed transport project are distributed over communities of different socio-economic strength. The end-result of the methodology is a simple equity measure.

Step 1: Determine type of community

96.   The goal of the equity analysis at the community level is to determine how travel time savings are distributed between strong and weak communities. The first step in the methodology is therefore to determine the socio-economic level of each community. This assessment can be based on data available at the Central Bureau of Statistics ('Lamas'). Each year, the Lamas ranks the socio-economic level of each community in Israel. Communities are ranked from 1 to 10, with the weakest communities receiving a score of 1 and the strongest communities a score of 10.

97.   For reasons of simplicity, the guidelines propose to distinguish only two types of communities: weak and strong communities. Communities that score from 1 to 5 in the Lamas ranking are considered *weak* communities, while communities ranking from 6 to 10 are considered *strong* communities. The goal of the equity analysis is then to assess whether the accessibility improvements generated by a transport project are distributed in a fair way between these two sets of communities.

Step 2: Determine transport activity zones per community

98.   The delineation of communities used by the Lamas not necessarily corresponds with transport activity zones used in the transport models that underlie the CBA calculations. Therefore, the second step is to link each transport activity zone to *only one* community. In case a transport activity zone is situated in two communities, the transport activity zone is ascribed to the community in which the largest surface area of the zone is located.

Step 3: Calculate average aerial speeds between zones for each community

99.   The third step encompasses the calculation of average aerial speeds between each transport activity zone in a community and all other transport activity zone within the study-area. The size of the study-area will follow the boundaries set within the regular CBA framework. Note that in case of large projects, the study-area may encompass the whole of Israel.

100. The average virtual travel speed is calculated as follows (see also above):

$$V_{TAZi-n} = \frac{D_{TAZi-n}}{T_{TAZi-n}}$$

101. where V_{TAZi-n} is the average aerial speed between transport activity zone *i* and all other transport activity zones; D_{TAZi-n} is the *aerial distance* between zone *i* and all other zones; and T_{TAZi-n} is the *travel time on the transport network* between zone *i* and all other zones.

102. For each community, the necessary data for these calculations and the results can be presented in a table (see Table 5.1). The bottom-line of the table presents the result of this step. In the example, the average aerial speed for the example community to all other transport activity zones in the study-area is 69.5 km/h. Note that the distances between the transport activity zones within one community should not be taken into account in the calculations.

Table 5.1 Example table: aerial distance, travel time and average aerial speed for community 'A'.

From	To destination	Aerial distance (km)	Travel time on network (min)	Average aerial speed (km/h)
TAZ_1	TAZ_{234}	24	20	72.0
	TAZ_{235}	35	27	77.8
	$TAZ_{...}$	…	…	…
TAZ_2	TAZ_{234}	25	24	62.5
	TAZ_{235}	34	31	65.8
	$TAZ_{...}$	..	…	…
TAZ_X	TAZ_{234}	22	19	69.5
	TAZ_{235}	37	32	69.4
	$TAZ_{...}$	..	…	…
Average		**29.5**	**25.5**	**69.5**

103. The same calculations should be carried out for each community within the study-area, *for both peak and off-peak travel times*. Given the large differences in congestion levels between different parts of Israel, such a distinction between peak and off-peak travel times if of the utmost importance. The calculations will result in two tables, one for the situation during peak hours and one for the situation during off-peak hours. The tables will contain, for each community, the following data: average aerial distance to all other transport activity zones, average travel time on the network to all other zones, and average aerial speed. Table 5.2 provides an example of such a table.

Table 5.2 Example table: aerial distance, travel time and average aerial speed, situation before network improvement and for off-peak hours.

Community	Aerial distance (km)	Travel time on network (min)	Average aerial speed (km/h)
A (see Table 5.1)	29.5	25.5	69.5
B	35	27	77.8
C	25	24	62.5
D	34	31	65.8
E	42	39	64.6
F	22	19	69.5
G	49	48	61.3
H	37	32	69.4
…	..	…	…

Step 4: Calculate improvements in average aerial speeds for each group of communities

104.   Step four encompasses the calculation of the gains in average aerial speed as a result of a proposed transport project by community and group of communities. The gains are defined as the difference in average aerial speed between the situation without and with the proposed improvement in the transport network. The exercise results in a figure of the improvement (or deterioration) in average aerial speed per community, in kilometers per hour. Subsequently, the results can be summed together for the two groups of communities: weak and strong communities. Table 5.3 shows the results. The figures provide the basis for the calculation of the community indicator in the final step.

105.   Note that the table also helps identifying communities that do not benefit at all from the proposed transport project, or even experience regressive effects. In case of the example presented in Table 5.3, this holds true for Community G in Alternative A and for Community B in Alternative B. Knowledge of this type may, if calculated early-on in the planning process, assist in developing additional alternatives that do not generate unwanted impacts for any of the communities involved (see Chapter 6).

Table 5.3 Example table: AAS improvements for Alternative A and B, for off-peak hours (data are taken from Table 5.2).

Community	Alternative A			Alternative B		
	Average aerial speed (km/h)			Average aerial speed (km/h)		
	Without	With	Gain	Without	With	Gain
Weak communities						
A	69.5	71.2	+ 1.7	69.5	70.4	+ 0.9
C	62.5	63.8	+ 1.3	62.5	62.9	+ 0.4
F	69.5	70.5	+ 1.0	69.5	70.8	+ 1.3
G	61.3	61.0	- 0.3	61.3	62.1	+ 0.8
Total	*65.7*	*66.6*	*+ 0.93*	*65.7*	*66.5*	*+ 0.85*
Strong communities						
B	77.8	78.3	+ 0.5	77.8	76.8	- 1.0
D	65.8	65.8	0.0	65.8	67.2	+ 1.4
E	64.6	64.6	0.0	64.6	66.3	+ 1.7
H	69.4	72.1	+ 2.7	69.4	72.3	+ 2.9
Total	*69.4*	*72.1*	*+ 0.80*	*69.4*	*70.65*	*1.25*

Step 5: Calculate equity indicator

106.   The final step of the methodology encompasses the calculation of the community equity indicator. This indicator is defined as the ratio of the AAS improvements of the rich communities divided by the AAS improvements of the poor communities. In formula:

$$\text{Community Equity Indicator (CEI)} = \frac{\text{AAS improvements}_{strong}}{\text{AAS improvements}_{weak}}$$

107.   In case the Community Equity Indicator lies between 0 and +1, the proposed transport project has positive equity impacts, i.e. weak communities reap the largest share of the accessibility improvements generated by the project. In case the score on the Community Equity Indicator is exactly +1, accessibility improvements are distributed in an equal way between weak and strong communities. In case the indicator scores above +1, strong communities reap the most accessibility benefits.

108.   The Community Equity Indicator should be calculated for peak and off-peak hours. Furthermore, in case proposed project or alternative has impact on travel times for both car and public transport, separate indicators should be calculated for each mode. This implies that the equity analysis generates either two indicators (single-mode case) or four equity indicators (dual-mode case).

109.   Table 5.3 provides an example of the output generated by the equity analysis at the community level for a project that only changes travel times by car. The table shows the scores on the Community Equity Indicator for the three alternatives being considered, for both peak and off-peak hours. The table shows that Alternative B scores above +1 for both periods of the day, which implies that most of the accessibility improvements are reaped by strong communities. The same holds true for Alternative C during off-peak hours, but during peak hours the score is below +1 suggesting that weak communities benefit most from this transport project. For Alternative A, both scores are below +1, so weak communities profit the most both during peak and off-peak hours. The results point to either Alternative A or C. In case traffic flows free during off-peak hours, Alternative C might be preferred as this alternatives directs most improvements to weak communities during peak hours. This may make the weaker communities more attractive as a location for higher income groups or for industries, and make it easier for the existing population to access job and educational opportunities located outside the community.

Table 5.4 Example output table: scores on Community Equity Indicator (CEI) for three alternatives.

Time of day	Alternative A	Alternative B	Alternative C
Peak hours	0.96	1.32	0.92
Off-peak hours	0.86	1.47	1.22

5.4   Possible future improvements in the methodology

110.   The methodology presented above provides a novel procedure to determine how the accessibility improvements generated by a transport project are distributed over weak and strong communities. Obviously, the community indicator could be fine-tuned in the future, possibly even in the second stage of the Nohal Prat update. Here, we suffice with identifying a number of issues that could be addressed in the future.

111.   First, the proposed community indicator does not give a weight to the communities in relation to their relative importance, e.g. in terms of population size. This implies that an improvement in average aerial speed for a small community is weighted in the same way as an improvement for a large community. The consequence is that an AAS improvement for a city like Kiriyat Shmona is considered of the same importance, as an identical AAS improvement for a small community like Betar Illit. Given the goal to strengthen weak communities, it could be argued that it is of more importance to strengthen larger communities – and this reach more weak households – than smaller communities. Therefore, some kind of weighting may be necessary in the future.

112.   A second issue concerns the importance of travel times to various destinations. In the proposed methodology, no difference is made between a reduction in travel time to a large city or to a small rural community. Both reductions have the same impact on the AAS improvement, on which the indicator is based. Given the goal to strengthen weak communities, it seems reasonable to attach more weight to improvements in accessibility to localities that offer plenty of job and educational opportunities. In other words, here, too, a weighting issue is at stake. In the future, some kind of weighting could be added to the methodology, linking the weight of a community to its attractiveness. Possibilities include a rating of communities by the numbers of jobs located in that community, or a rating based on the Lamas ranking of communities. In the first case, links with job-rich destinations would be weighted more heavily in the calculation of the average aerial speed and subsequently into the score on the community indicator, while in the second case communities that score higher in the Lamas ranking would receive a higher weight.