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Measuring Equity in Health Care Delivery

A New Method Based on the Concept of Aristotelian Equality

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Measuring equity in health care delivery: A new method based on the concept of Aristotelian equality.

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Contents

1. Introduction

Equity is perceived as an important or even the most important goal in health care. (Cuyler and Wagstaff 1993, Gwatkin 2001. Scott 2001, 11-13) Indeed it is even seen by some as a (human) right (Faden and Shebaya 2010, McLachlan and Maynard 1982 in Le Grand 1987). At the least equity is something most governments try to achieve and value in their policy making. (Whitehead 1991, Dahlgren and Whitehead 2007) Therefore, the analysis of whether equity is indeed reached in health care is important and has major policy consequences. (Mooney 2000, Mackino and Starfield 2002) Thus good methods for the analysis of equity in health care delivery are crucial.

Equity research in health care often focusses on either financing of health care (e.g. Wagstaff et al. 1999), health care delivery (e.g. van Doorslaer et al. 2000), access to health care facilities (e.g. Goddard and Smith 2001) or on an equitable distribution of health itself (e.g. Whitehead 1991). (Mackino and Starfield 2002) (Cuyler and Wagstaff 1993) In this article, the focus will be on health care delivery since much work still needs to be done in this field and methods to accomplish this are still incomplete. The method suggested in this article can however also be used to measure equitable access to health care facilities.

But what is that equity this article focusses on? Other terms that are often used instead of equity are fairness or (social) justice (Braveman and Gruskin 2003). These more philosophical and legal terms have been widely interpreted and various definitions have been given. To find a definition suitable for the use of analysing equity in health care delivery, we should look for definitions of distributive justice. That is because when we talk about health care delivery and equity, we are in fact discussing distributive justice (fair distribution of the scarce health care resources). (Gillon 1994, Mooney 2000)

The most used definition of distributive justice is still that of Aristotle. For a distribution to be just in the sense of Aristotle, there has to be formal and proportional equality. (Gosepath 2009) Formal equality means that you have to “treat like cases as like”. (Chroust 1942, Gosepath 2009) In economics, this is often referred to as horizontal equity. (Cuyler and Wagstaff 1992, Bambas and Casas 2001, Duclos 2008) Proportional equality, on the other hand, means to treat all relevant persons in relation to their due. (Gillon 1994, Gosepath 2009) In economics, this is referred to as vertical equity. (Cuyler and Wagstaff 1992, Bambas and Casas 2001, Duclos 2008) When we study the health economics literature, vertical and horizontal equity are indeed the terms most used. (Mackino and Starfield 2002) Therefore it should be no surprise that this new suggested method will also be based on the same philosophical principles and use the same economic terms.

But why is a new method for measuring equity in health care delivery necessary? Existing methods for measuring equity (relying on the Aristotelian definition), analyse only parts of equity in health

care delivery, as we will see in chapter 2. Chapter 3 therefore illustrates a new method, based on Aristotelian equality. In chapter 4 this method will be illustrated, using an example from the Netherlands and Belgium. In chapter 5 a conclusion and discussion will then follow, outlining both the difficulties and possibilities for this new method.

2. Existing methods for measuring equity.

Equity can be divided into horizontal and vertical equity. Horizontal equity means to treat like cases alike, vertical equity means to give appropriate unequal treatment to unequals. (Cuyler 2001) Horizontal equity is researched extensively in health economics, so several methods are available to test whether equal treatment applies. Vertical inequity, on the other hand, is barely studied, while this is deemed an important consideration for the making of health policies. (Mackino and Starfield 2002, Mooney et al. 2002) Because the measurement of vertical and horizontal equity require different methods, both will be discussed individually.

Central in the thinking about equity in health care delivery is the idea that health care resources should be allocated purely according to need, excluding all other factors like for instance income. (Cuyler 2001, Wagstaff and van Doorslaer 2000a, 7 -9) This idea forms the basis for all methods described and will be used as the basis for the new method. However, most methods can be equally applied to, for instance, equal access to health care. Therefore the discussion concerning what exactly should be measured (access to or delivery of health care) will not be waged here.

2.1 Horizontal equity

An easy method to test for the existence of inequity in health care utilization is to test whether two (or more) groups (for instance the rich and the poor) receive the same amount of care. If they do not, this indicates inequality between the two groups; they are not treated alike. Inequality is however not the same as inequity. Inequity is inequality due to factors that should not matter for the allocation process. In health care delivery this means that inequity is discrimination for non-need factors, since we determined that only allocation according to need is equitable. (Wagstaff and van Doorslaer 2000a)

When we compare whether inequity is present, for instance by comparing the care use of two different income groups, we need to take into account that these two groups may not have the same amount of need (are not equal) and are therefore not completely comparable. This can be amended by correcting for the difference in need between the groups, either via the direct or via the indirect standardization method. (For a more extensive explanation of the methods for direct and indirect standardization I refer to O'Donnell et al. 2008 and Wagstaff and van Doorslaer 2000a) The direct standardization method estimates how much care each group should get if both groups had the same amount of need. The indirect method on the other hand looks separately at each individual in the sample, estimating which amount of care would be received if that person was treated like the others with the same need characteristics. (O'Donnell et al 2008, 60-62. Wagstaff and van Doorslaer 2000b)

When both groups are equal with respect to need, or when is standardized for need, they can be compared. Any differences between the groups is then due to non-need factors and thus inequitable. (Wagstaff and van Doorslaer 2000a) As useful as this method may be, it has its limitations. The method only shows that there is inequity, but not how large that inequity is. Furthermore, it does not say anything concerning the overall inequity in a country or population group; it only points out that there are differences between certain groups. Comparisons of differences in inequity between countries of populations are not possible. Also, this method points to only one channel through which inequity can occur (e.g. income) and leaves all other channels out.

Thus a method for comparing countries had to be devised. For this, a concentration index is often used. This index measures relative income-related inequality in health care use by plotting on a horizontal axis the cumulative percentage of the population ranked by socio-economic status and on the vertical axis the cumulative percentage of health care use. The concentration index is then twice the distance between this line (the concentration curve) and the diagonal, which represents an equitable distribution (the same use for all socio-economic groups) after standardization for need. (O'Donnell et al. 2008, 83-85. Wagstaff and van Doorslaer 2000a) After this calculating a concentration index, the index can be decomposed to show which factors constitute the inequity. (O'Donnell et al. 2008, 159-163. Van Doorslaer and Jones 2003, Morris et al. 2005)

Thus the concentration index helps to quantify the inequity. However, this measure still only calculates income-related inequity and not inequity in health care delivery per se. A measure where the income factor is left out, so where just use and need are correlated, does not exist. That is regrettable, since this means that we have incomplete information about one of the most important values in the health care sector. Therefore in chapter 3 a new method will be introduced to rectify this gap.

2.2 Vertical equity

As opposed to horizontal equity, vertical equity is not much researched. (Mackino and Starfield 2002) When it is, it often is done implicitly as part of measuring horizontal equity, to be exact in the standardization for need. When we standardize for need, we assume implicitly that it is necessary to give more care to those with higher need and less to those with lesser needs. That is vertical equity. However, the basis for the usual methods of standardisation is that on average the system gets it right. (O'Donnell et al. 2008, 177. Sutton 2002.) The idea behind standardization is to look how a person would have been treated if he was treated like other individuals with the same need (indirect method), or to see what would happen if we set the mean for all need variables at the average for all groups (direct method). (O'Donnell et al. 2998, 60-62. Wagstaff and van Doorslaer 2000a. Wagstaff

and van Doorslaer 2000b) While standardization is useful for making the horizontal equity calculations more reliable, it is a bit presumptuous to assume that every system always gets it right on average. Thus if we really want to say something about vertical equity, a better method is needed. Therefore the method presented in chapter 3 will not take the empirical found distribution of health care use as a basis, but focus on a theory-based equitable distribution. That way, the problem of failing systems will be addressed.

While it is limited, some empirical research has also been done directly measuring vertical equity in health care delivery. Abasolo et al. (2001) state that individuals with greater need should make greater use of GP services and test this hypothesis. However, they are not able to say how much more GP care individuals with greater need should use. Therefore they are not able to say whether there is indeed vertical equity or not.

Sutton (2002) uses the decomposition approach of the concentration curve mentioned above. He states that vertical equity is the difference between the concentration coefficient for the current allocation of health care with respect to health, age and gender at mean income and the concentration coefficient for the target allocation of health care. However, using the standard mean for income may affect the amount of inequity measured, making this method less reliable. (Sutton 2002) It would be better to use a method where the steps concerning socio-economic differences are not needed, directly identifying the relation between health care use and need. That is the method presented in chapter 3.

2.3 A new method is needed

As we see there is not yet a good method to identify whether health care is delivered according to need or not, and if not to what extent not. This holds for both vertical and horizontal inequity. Income rankings often play a prominent role in the calculations of equity; an overall measure correlating just health care use and health care need does not exist, making calculations on an individual level impossible. Therefore, in chapter 3 a method will be constructed to measure this.

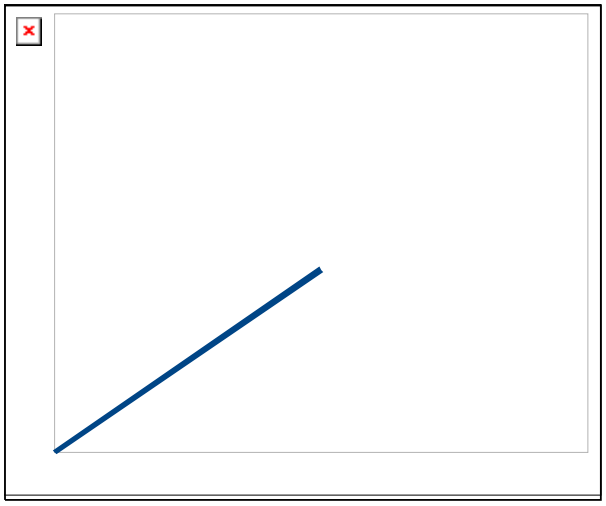
3. A new method for measuring equity.

If we talk about equity in health care delivery, we almost always talk about allocation according to need. To define what horizontal and vertical equity are, the Aristotelian concept of equality is almost always used. (Mackino and Starfield 2002) Aristotle stated that equals should be treated equal and unequals should be treated proportional to their inequality. For equity in health care delivery, where need is often said to be the only value that should be relevant, this means that people with equal need should be treated equal (horizontal equity). Vertical equity then means that people with higher need should get more health care, proportional to their need. (Cuyler 2001) An example: If A needs twice the health care that B does, he should get twice as much. So if B gets one visit to the doctor, A should get two. Or in a formula: X/Y=X'/Y'. (Gosepath 2009)

For something to be equitable, this should hold for everyone. For equity in health care delivery this means:

$$\frac{Need_A}{Use_A} = \frac{Need_B}{Use_B} \quad \forall A, B \qquad (1)$$

If we examine this function, we see that if we put need against use in a graph, the graph is a straight line going through the origin, as we see in Graph 1. That the line goes through the origin should be no surprise: if you have absolutely no need for health care, society should give it to someone else who could benefit from it. Need in this context should not be confused with illness. People who are not ill may still have a need for health care, e.g. for diagnostic procedures, reassurance, preventive care, etc. (Wagstaff et al. 1991, Cuyler 2001)



Thus the line in graph 1 represents perfect vertical equity and every allocation of health care to an individual that does not fit on this line is inequitable. However, in order to determine whether allocation is following the equity line or not, we need to know where this line lies. Therefore we

need to know what the slope of the line is in order to determine whether equity is achieved or not. The slope of the line is dependent on the amount of health care available in a country or population. If a lot of health care is available, the line will be steeper than in a country with the same characteristics but less health care available. The total amount of health care available in a population can be calculated by simply adding all the health care used in that population.
The total amount of health care available in the population should, in a situation of perfect equity, be allocated according to need. Suppose need ranges from 0 (no need for health care) to 1 (maximum need for health care). The amount of need a person has, indicates how large a proportion of the available care this person should get. Thus if we add all need weights in the population and then divide all used care by this, we have the amount of care that a person with need 1 should get. From this we can easily deduct the care all others should get, since a linear equation was used (a person with need 0,2 should get 0,2 times as much, a person with need 0,5 should get 0,5 times as much).
In order to make comparisons between countries or populations easy, it is a good idea to standardise for the amount of care available in a country. This is easiest done by setting maximal use at 1 and adapting all measurements for need accordingly (e.g. when maximal use is actually 5 you divide all need measurements by 5).
Now we can calculate vertical inequity per individual, which is his or her vertical deviation from the equity line. Since the correction for care available, the equitable amount of care is the same as the need of each individual person. Therefore the vertical inequity for each person is use minus

How to measure equity in health care delivery (steps in the calculation)

Vertical equity:

1: Add all used care.

2: Add all need.

3: Divide no. 1 (all used care) by no. 2 (all need). This is all care a person with need 1 should get.

4: Set maximal use per person (as calculated in no. 3) at 1 and adapt all use measurements accordingly by dividing by no. 3.

5: Calculate use minus need for each person. Absolutize this. Add all.

6: Divide no. 5 by the amount of people in the sample. This is the VII.

7: Make a graph with all individual observations in it.

Horizontal equity:

8: Use the graph from no. 7.

9: Find the best fitting function.

10: Calculate actual use minus predicted use based on the function in no. 9 for each individual.

11: Add all differences absolute calculated in no. 10.

12: Divide no. 11 by the amount of people in the sample. This is the HII

need. Total inequity is then all inequity absolute added. In order to make comparisons between populations of different sizes possible, we divide this by the amount of people in the sample. This gives the vertical inequity index (VII). The formula of how this index is reached is represented in formula 2:

$$VII = \frac{\sum_{0}^{n} \left[use_i - need_i \left(\frac{\sum_{0}^{n} use_i}{\sum_{0}^{n} need_i} \right) \right]}{n} \qquad (2)$$

In order to determine how the VII came to be and in which groups inequality problems take place, it is useful to put all individual observations in a graph. Also, specific data like the range of inequity in a sample might be given. Thus can be said whether the inequity measured is caused by a few large outliers or by frequent but small deviations from the equity line.

In order to gain still more information a group analysis can be made, indicating how large the inequity is in a specific need group.

Horizontal equity is equal treatment for equal need. To calculate horizontal equity, the same data and graph can be used as for the determination of vertical equity. In order to see what an equitable horizontal distribution should be, find the best fitting function that represents all observations. Note that this function does not need to go through the origin or be linear; in fact it can take any shape at all, since it represents actual use. Any deviation from this function is horizontal inequity (equals treated unequally). Therefore determine the absolute difference between all observations and the function found. Add these differences and divide by the amount of people in the sample to make comparisons between populations of different sizes possible. This is the horizontal inequity index (HII). The formula for calculating this index is given in formula 3.

For the HII a group analysis per need group can also be given.

$$HII = \frac{\sum_{0}^{n} \left| use_i - f_{use}(i) \right|}{n} \qquad (3)$$

4. An example: inequity in the Netherlands and Belgium.

In order to illustrate the methods mentioned above, an example is given both for the Netherlands and Belgium. Data for this example are derived from the European Community Household Panel (ECHP). The ECHP contains a multitude of topics, which were examined for a large panel of European Union citizens over 8 years. (Communication and Information Resource Centre Administrator 2010) For a review of the ECHP I refer to Peracchi (2002). I will note, however, that individuals with very poor health are more likely not to participate (Jones, Koolman and Rice 2006), which might influence results. For our example the last wave (2001) is used, excluding data not from Belgium or the Netherlands.

4.1 Health care use

Health care use will be measured as the amount of hospital days, general practitioner visits and specialist visits. This means that not all health care is included, some things like medication and home care are not counted. The main reason for this is that the ECHP did not include this information. In order to get an overall view of the health care used in a country, overall use per person should be measured, for instance by using insurance data.

Table 1: Costs of medical care use

	Netherlands	Belgium
GP visit	20,22	18,26
Specialist visit	58,64	29,09
Hospital day	355,64	335,6

Hospital days, general practitioner visits and specialist visits are combined into one continuous measure by converting all to euros and then adding all. This manner of conversion will as much as possible be based on the guidelines for farmaco-economic evaluation in Belgium (Federaal Kenniscentrum voor de Gezondheidszorg 2008) for the Belgian data and on the guideline for cost evaluation (Oostenbrink et al. 2004) for the Netherlands.

For a GP visit in the Netherlands, the standard costs are 20,20 euros in 2003 (Oostenbrink et al. 2004). In an academic hospital, a polyclinic consult costs 100 euros and in a non-academic hospital 53 euros. (Oostenbrink et al. 2004) Since there were 20.550.710 non-academic polyclinic visits and 2.707.079 polyclinic visits in 2003 (van Wieren 2008), the average polyclinic visit in the Netherlands costs 58,64 euros. A day in an academic hospital costs 476 euros and a day in a non-academic hospital 337 euros. (Oostenbrink et al. 2004) With 46.611 beds in non-academic hospitals and 7742 beds in academic hospitals (Giesbers 2004), this makes an average of 355,64 euros per hospital day.

Conform the Belgian guideline, Belgian data come from the RIVIZ website (www.riviz.be). For a GP consult, RIVIZ code 101076 is used, with a fee of 18,26 euros per visit. (RIVIZ 2004) For a

specialist visit, the average of RIVIZ codes 102550, 102675, 102690, 102712, 102572, 102594, 102616, 102631, 102653 and 102756 was used, each number representing the price for a different speciality. (RIVIZ 2004) Thus the price of a specialist visit is 29,09 euros (note that this is not the same as the policlinic visit, as is used in the Netherlands). For hospital prices, the 2010 "verpleegdagprijs" is used. (RIVIZ 2010) Since the verpleegdagprijs is determined per hospital, the price used is that of the average hospital price: 335,60 euros.

4.2 Health care need

Health care need will be measured using self-assessed health. In the ECHP self-assessed health is measured with the question "How is your health in general?". Available responses were very good, good, fair, bad or very bad. Thus 5 ordinal responses are possible. For our research, however, a continuous scale from 0 to 1 is needed. Therefore the responses will be recoded to a continuous scale. This does however not change the fact that the underlying responses are still ordinal and that only a limited amount of responses (5) are possible, which may distort the outcomes.

Using self-assessed health has a few problems. It is a subjective judgement of health. Thus it is subject both to adaptation to disease (especially chronical disease) and to scale of reference bias (Groot 2000, Crossley and Kennedy 2002, Simon et al. 2005) due both to culture (Jurges 2007a) and individual factors like age and gender (Lindeboom and van Doorslaer 2004). Individuals even incorporate non-disease-related factors into their health assessment (Benyamine et al. 2000). In order to avoid scale of reference bias, anchoring vignettes can be used. (Salomon, Tandon and Murray 2004) This was not done here, the assumption was made that scale of reference bias did not occur.

There is not yet a good and validated method for the conversion of self-assessed health (an ordinal variable) to need (a continuous variable). Usually need is determined by determining how much care a person should have received if he had been treated like others with the same need characteristics. (e.g. Van Doorslaer, Masseria and Koolman 2006) This implies that the average person is treated right, which is not an assumption fitting this research. Therefore a few different methods will be shown here for the conversion from ordinal to continuous, making clear which impact a change of method has on the equity results. The methods used are as follows:

a) Jurges (2007b) constructed a 0-1 scale of health, based on diagnosed conditions and measurements. This scale was then correlated with a 5-point self-assessed health scale, ranging from excellent to poor. The Dutch data will be used, assuming that Jurges scale is the same as the ECHP scale (thus, for example, "excellent" on Jurges' scale would be the same as "very good" on the ECHP scale). Because Jurges only gives the boundaries of each

category and he puts excellent health at 1, the numbers for each category will be calculated as one minus the category average. Note that Jurges used self-assessed health to construct the disability weight of all diseases. (Jurges 2007b)

b) Self-assessed health is strongly associated with mortality in the Dutch population (Mackenbach et al. 2002). Assumed is that the risk of mortality is a factor reflecting health (ill people have a higher risk of dying) and thus need for health care. Risk of death ranges from 0 (no risk), to 1 (definite occurrence) Therefore we use risk of death over a seven year period (which is arbitrarily chosen), as calculated from the amount of people dying in each subgroup in the study of Mackenbach et al. (2002) as need variable. The variable "sometimes poor" is assumed to be the same as the "poor" variable in the ECHP study and the variable "poor" is assumed to be the same as the variable "very poor" in the ECHP study. Assumed is that the same data can be applied to Belgium.
   For men, self-assessed health judgements reflect the presence of life-threatening diseases. For women, non-life-threatening diseases and other (non-health) factors play a larger role. For women mortality and self-assessed health are therefore less related (Benyamini, Leventhal and Leventhal 2000) and this method of conversion may be less reliable.

c) For this method it is assumed that self-assessed health has a lognormal distribution. (this is done more often, e.g. by Wagstaff and van Doorslaer 1994) This makes it possible to determine the boundaries for each category, making use of the percentages in each SAH category, with the lower most boundary at 0 and the upper most boundary at infinity. Because this last boundary makes it hard to convert to a 0-1 distribution, the upper boundary will be set at the value for 0,1 percent, which is 29. The mean of each category divided by 29 gives then the need value corresponding to each value of self-assessed health.

The ECHP also comprises a question about disability: "Are you hampered in your daily activities by any physical or mental health problem, illness or disability?". Possible answers are: "yes, severely", "yes, to some extent" and "no". This makes it possible to construct a continuous scale using these responses.

d) Those with higher health care need (worse health) are more likely to report disability. (Ahn 2002) Disability and need are thus related. Therefore self-assessed health can be scaled, using the presence of some extent of disability in percentages as the scale or

e) using the presence of disability in percentages as the scale, while weighing the amount of disability. To illustrate this method, severe disability will be given weight 1 and some disability weight 0,5.

f) Van Dooslaer and Jones (2003) calculated the mean HUI (Health Utility Index) III scores for

5 SAH categories, all divided into two groups, according to the presence or absence of disability. Here we will use these scores. Note that the scales used by van Doorslaer and Jones and the ECHP are not equivalent, the van Doorslaer and Jones-scale ranging from excellent to poor and the ECHP scale ranging from very good to very bad. We will assume equivalence of scales, with the highest response category in the ECHP being equivalent to the highest response category on the van Doorslaer and Jones-scale. In practice, however, responses are influenced by the phrasing of the answers. (Hernandez-Quevedo, Jones and Rice 2005, Jurges, Avendano and Mackenbach 2007) The association with health variables does however not seem to change much. (Jurges, Avendano and Mackenbach 2007)

Since the van Doorslaer and Jones scale ranges from 0 (very bad) to 1 (very good) health, we will inverse it by using one minus the van Doorslaer and Jones responses.

Note also that these are Canadian data, which cannot automatically be transported to the Dutch and Belgian situation. Cultural diffenrences may exist.

An overview of the numbers used for each method to place self-assessed health on a continuous scale is given in table 2.

Table 2: Self-assessed health on a continuous scale in the various methods

SAH	Method A	Method B	Method C		Method D		Method E		Method F	
			NL	B	NL	B	NL	B	No disability	With disability
Very good	0,009	0,0245	0,007690076	0,008828781	0,019580	0,013201	0,011538	0,006601	0,056	0,186
Good	0,040	0,0387	0,029831820	0,032643055	0,101342	0,064559	0,057895	0,038290	0,078	0,170
Fair	0,127	0,1032	0,097213373	0,100613388	0,612330	0,360184	0,670846	0,231876	0,124	0,300
Poor	0,294	0,1508	0,245711862	0,242933718	0,992878	0,757225	0,834758	0,627168	0,232	0,364
Very poor	0,698	0,2250	0,561715737	0,545175511	0,983051	0,870968	0,974576	0,822581	0,397	0,519

4.3 Results

For the Netherlands 8603 of the total 12079 ECHP participants submitted information about their health in the 2001 wave. For Belgium 4258 individuals (out of 5985) submitted health information. Vertical equity was calculated using the method outlined in chapter 3. Outcomes were determined for all methods of converting self-assessed health to a continuous scale. Results are shown in table 3.

Table 3: Vertical inequity index

	Netherlands	**Belgium**
Method A	0,48301223	0,5180564
Method B	0,21795633	0,2261849
Method C	0,39609864	0,4160780
Method D	1,2264854	1,0122030
Method E	1,1569309	0,8615925
Method F	0,3777516	0,3793106

As becomes clear from table 3, how large the vertical inequity index is, is very dependent on the method chosen for conversion of self-assessed health to a continuous scale. Even whether the Netherlands or Belgium do better is dependent on the method chosen. This underlines the fact that we have yet to find a dependable method to measure health and put this on a continuous scale. However, that is the case for all methods measuring equity, not just for the method outlined in this thesis.

The horizontal inequity index was also calculated, using the method outlined in chapter 3. This was also done for all methods of converting self-assessed health from an ordinal to a continuous scale. The empirical function representing use was calculated using linear regression, based on the formula Use=A*Need +C. Both A and C are given in table 4. Note that the actual distribution need not always be linear. For these linear regressions, very small R-squares were found, as is shown in

table 4. R-squares were lower for the Netherlands than for Belgium. Especially remarkable was, that the relationship between need was a negative one in all cases, reflecting higher use for people with less need. This is probably caused by the fact that large amounts of outliers were present among those in good health. Having such small R-squares suggests that there is either only a very small association between need and use, or that the wrong form of equation is chosen. Seeing that there seems to be only a limited association between use and need in the scatterplots in appendix A, the first is probably true. This can be caused either by distorted measurements or by horizontal inequity in the distribution of health care. Since it is obvious that the measurements of both use and need are far from perfect, it is hard to judge the role of inequity in this. Seeing however that very large outliers exist, suggests that inequity also plays a role.

Table 4: Results for the linear regressions determining the empirical distribution of use

	R-squares		**A**		**C**	
	NL	**B**	**NL**	**B**	**NL**	**B**
Method A	0,0152	0,0906	-1,227249	-1,261411	0,6949338	0,7544923
Method B	0,0276	0,0496	-3,298966	-3,251924	0,6329216	0,6436852
Method C	0,0160	0,0307	-1,272702	-1,357785	0,579761	0,6319492
Method D	0,0412	0,0664	-4,772176	-3,509653	4,780244	3,003859
Method E	0,0415	0,0575	-5,151364	-2,684098	4,828518	2,059436
Method F	0,0029	0,0097	-1,076636	-1,303487	0,5487638	0,5971811

Using the data from table 4, the horizontal inequity index was calculated for all methods of converting self-assessed health to a continuous scale. The results are represented in table 5. Again results vary a lot depending on which method is chosen for conversion of self-assessed health to a continuous scale. This shows that these measurements are still unreliable.

Table 5: Horizontal Inequity Index

	Netherlands	**Belgium**
Method A	0,4703275	0,5971811

Method B	0,2272457	0,2363889
Method C	0,3846534	0,4098836
Method D	1,075077	0,8871478
Method E	1,078200	0,7908389
Method F	0,6233160	0,5699071

Scatterplots were drawn for the distribution. These are reproduced in appendix A. Note that these scatterplots are already adjusted for the amount of care available in a country. Thus the maximum care anyone should receive is 1 (for a person with need 1). In the scatterplots it is obvious that very large outliers exist. This means that a lot of people get far more care than they should get, based on their need as reflected by their self-assessed health.

In appendix B boxplots are drawn, reflecting the amount of vertical inequity people face in the different categories of need (as in method F). These scatterplots show that in Belgium large within-group equity differences are more common, especially among the group with low need. In the Netherlands, smaller differences exist.

Also linear regressions were made to see what are the contributing factors for inequity (both horizontal and vertical). For this the non-absoluted equity-calculations were used. Regressions included the presence of a chronic physical or mental health problem (chronic), being hampered in daily activities because of illness or disability (illness), age, being hampered in daily activities because of an emotional or mental health problem (ment. probl.), BMI (a measure for obesity, only available for Belgium), self-assessed health (SAH), income, marital status (married, separated, divorced, widowed, never married), highest education (less than second stage of secondary education (no sec. educ.), second stage of secondary education (sec. educ), third level education), and working status (working, inactive or unemployed). Income was measured using household income, which was adjusted for household size and composition using the OECD modified equivalence scale. (artikel invoegen) Results with a p-value of smaller than 0,05 were marked with an asterisk.

The results of the linear regressions of the Vertical Inequity Index are presented in table 6. Tertiary education was left out because of collinearity of results, except for method F, where secondary education, respectively no secondary education was left out. The results for tertiary education are

there marked with a T. Widowhood was left out for the same reason, except for method F in the Netherlands, where it was used instead of divorce (marked with a W). For the Netherlands separation was left out because of collinearity (marked with an X). The same is true for the results of the Horizontal Inequity regressions.

Health problems increased the Vertical Inequity Index, while self-assessed health decreased it. Significant effects were sometimes found for marital status (being married and never being married) and working. The R-squares found for the regressions were in general low, indicating that much variation is not yet explained. What variation was explained, depended mainly on health status. Surprisingly no income effect was seen, indicating that income may not play such a large role as we always believed, which devaluates the methods most used for determining inequity.

The results of the linear regressions of the Horizontal Inequity Index are presented in table 7. Once more the main effects are from health-related factors, although here all effects are negative. Also there were again some effects of marital status (being married or never being married) and a few times from working. R-squares were even smaller here than with the regressions of the Vertical Inequity Index, leaving still more variation unexplained. Again there was no effect of income.

Table 6: Linear regression of the Vertical Inequity Index

	Method A		Method B		Method C		Method D		Method E		Method F	
	NL	B	NL	B	NL	B	NL	B	NL	B	NL	B
chronic	0,32*	0,34*	0,11*	0,13*	0,26*	0,27*	0,31*	0,43*	0,38*	0,42*	0,36*	0,33*
illness	0,41*	0,74*	0,17*	0,31*	0,34*	0,59*	0,77*	1,25*	0,71*	1,11*	0,35*	0,57*
age	0,01*	0	0,00*	0	0,00*	0	0,01*	0	0,01*	0	0,01*	0
ment. probl.	0,38*	0,68	0,16*	0,28*	0,31*	0,54*	0,75*	1,09*	0,70*	0,99*	0,32*	0,53*
BMI	n.a.	0,01	n.a.	0	n.a.	0	n.a.	0,01	n.a.	0,01	n.a.	0
SAH	-1,38*	-1,40*	-2,67*	-2,43*	-1,40*	-1,44*	-4,26*	-2,87*	-4,54*	-2,29*	-1,98*	-1,67*
income	0	0	0	0	0	0	0	0	0	0	0	0
married	0,11	-0,28*	0,05	-0,12*	0,09	-0,22*	0,23	-0,51*	0,21	-0,45*	-0,1	-0,22*
separated	X	0,03	X	0,01	X	0,03	X	0,05	X	0,04	X	0,02
divorced	0,23	-0,25	0,1	-0,11	0,18	-0,2	0,5	-0,49	0,47	-0,41	W -0,19	-0,19
never married	0,21	-0,29*	0,09	-0,13*	0,16	-0,23*	0,43	-0,54*	0,43	-0,46	-0,03	-0,22*
sec. educ.	-0,02	-0,03	-0,01	-0,02	-0,02	-0,03	-0,04	-0,08	-0,05	-0,06	T 0,03	0
no sec. educ.	-0,07	-0,03	0,02	-0,02	0,06	-0,03	0,13	-0,13	0,11	-0,1	0,09	T 0,03
working	-0,11*	-0,03	-0,05	-0,01	-0,09*	-0,03	-0,21	-0,03	-0,21	-0,03	-0,09*	-0,02
unemployed	0,08	0,03	0,03	0,01	0,07	0,02	0,12	0,02	0,12	0,02	0,07	0,02
inactive	0,04	0,14	0,02	0,06	0,03	0,11	0,1	0,25	0,11	0,22	0,04	0,1
R-squared	0,07	0,14	0,06	0,12	0,07	0,14	0,07	0,13	0,07	0,14	0,05	0,1

Table 7: Linear regression of the Horizontal Inequity Index

	Method A		Method B		Method C		Method D		Method E		Method F	
	NL	**B**	**NL**	**B**	**NL**	**B**	**NL**	**B**	**NL**	**B**	**NL**	**B**
chronic	-0,32*	-0,34*	-0,11*	-0,13*	-0,26*	-0,27*	-0,32*	-0,43*	-0,38*	-0,42*	-0,08	-0,02
illness	-0,41*	-0,74*	-0,17*	-0,31*	-0,34*	-0,59*	-0,77*	-1,25*	-0,71*	-1,11*	-0,25*	-0,45*
age	-0,01*	0	-0,00*	0	-0,00*	0	-0,01*	0	-0,01*	0	-0,00*	0
ment. probl.	-3,83*	-0,68*	-0,16*	-0,28*	-0,31*	-0,55*	-0,75*	-1,09*	-0,70*	-0,99*	-0,24*	-3,85*
BMI	n.a.	0,01	n.a.	0	n.a.	0	n.a.	-0,01	n.a.	-0,01	n.a.	0
SAH	-0,84*	-0,87*	-1,63*	-1,82*	-0,87*	-0,92*	-1,51*	-1,64*	-1,61*	-1,40*	-0,33	-1,30*
income	0	0	0	0	0	0	0	0	0	0	0	0
married	-0,11	0,28*	-0,05	0,12*	-0,09	0,22*	-0,23	0,52*	-0,21	0,44*	0,08	0,19*
separated	X	-0,03	X	-0,01	X	-0,03	X	-0,05	X	-0,04	X	-0,03
divorced	-0,23	0,25	-0,1	0,11	-0,19	0,3	-0,5	0,49	-0,47	0,41	W 0,16	0,19
never married	-0,21	0,29*	-0,09	0,13*	-0,17	0,23*	-0,44	0,54*	-0,42	0,46*	0,02	0,20*
sec. educ.	0,02	0,03	0,01	0,02	0,02	0,03	0,04	0,08	0,06	0,07	T -0,01	-0,02
no sec. educ.	-0,07	0,03	-0,03	0,02	-0,06	0,03	-0,13	0,13	-0,11	0,1	-0,05	T-0,05
working	0,11*	0,03	0,05	0,01	0,09*	0,02	0,22	0,03	0,21	0,03	0,07	0,01
unemployed	-0,08	-0,02	-0,03	-0,01	-0,07	-0,02	-0,13	-0,03	-0,12	-0,03	-0,04	-0,01
inactive	-0,04	-0.14	-0,02	-0,06	-0,03	-0,11	-0,11	-0,25	-0,11	-0,22	-0,03	-0,09
R-squared	0,02	0,06	0,01	0,04	0,02	0,06	0,01	0,03	0,01	0,04	0,01	0,03

These results were merely meant as an example of the method outlined in chapter 3. If this method is to be used in policy making, it is recommended that more detailed analysis will take place, making use of better indicators for both use and need.

5. Conclusion and discussion.

This article shows, that both horizontal and vertical equity can be quantified using the principles of Aristotelian equality. The method developed here excludes the need for using income rankings and the complex methods associated with these. The approach described in this article is easy to use and easy to grasp, directly comparing the two most important aspects of equity in health care delivery (use and need) for each individual in the sample and combining those in a single number. As such, the method can contribute significantly to the research concerning equity in health care delivery and steer public policy making in health care.

That a measure is found, does not automatically mean that this is the answer to all our questions about equity. Our ways for calculating both need and use of health care are still far from perfect (as the example in chapter 4 shows), making equity measures unreliable. Therefore research needs to be done to improve the options for measuring both health care use and health care need. This is however not a problem exclusively affecting the method outlined in this thesis, it is a problem that touches all equity measurements.

Some argue that instead of investigating health care use, we should research equity in access to health care. (Cuyler and Wagstaff 1992) Also some say that instead of health care need we should use capacity to benefit. (Cuyler 2001, Cuyler and Wagstaff 1992) For this article, that discussion does not matter, since all can easily be interchanged, keeping the basis of the method intact.

Evidence shows that we rather reimburse health care for more severely ill people than for less ill individuals. (Koopmanschap et al. 2010) The same may apply for equity in health care delivery: equity of health care may be deemed more important for those groups who are severely ill. An analysis on group level combined with a good graph may show us in which need groups the equity problems are. If we value inequity in some groups (e.g. the very ill, children, etc.) more than in others, we can also choose to give these groups extra weight in the equity calculation, thereby increasing their importance in the calculation. All these extra measures can also be important in the light of the skewed distribution of health (Van Doorslaer and Jones 2003); luckily more people are relatively healthy than severely ill. This makes that the relatively healthy have a larger impact on the equity outcome for the whole population than the severe ill. Analysis of separate groups and weighting of outcomes can ensure that snowing under of small but important groups in the large total does not occur.

The equity indices mentioned in this article give merely an overall picture of inequity in a population. If we want to know what caused this inequity it is possible to perform regression analyses and draw conclusions from that. This way we can analyse the causes of inequity we know exist, but also signal if there remain still large causes of inequity unknown. This can stimulate us to

look for these reasons for inequity, if necessary.

This article limits itself to calculating equity. There may however be reasons why absolute equity is not wanted, the most important of these being efficiency. By allocating efficient we may be able to provide more health care, but at a cost of equity. (Norheim and Asada 2009) This is a moral choice for politicians and policy makers to be made. (Carr-Hill 1994)

If we want to improve our health care systems to decrease inequity, it is important to look both at the graphs and at the regression analyses mentioned in the previous paragraphs. Inequity in different need segments (perfectly healthy versus severe ill) or due to different reasons can need totally different approaches. A careful valuation of data is therefore necessary. If used correctly, however, the method described in this article can contribute greatly to the research of equity in health care delivery.

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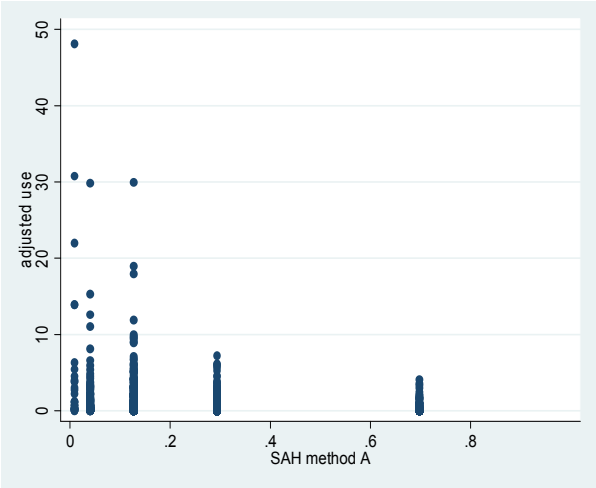
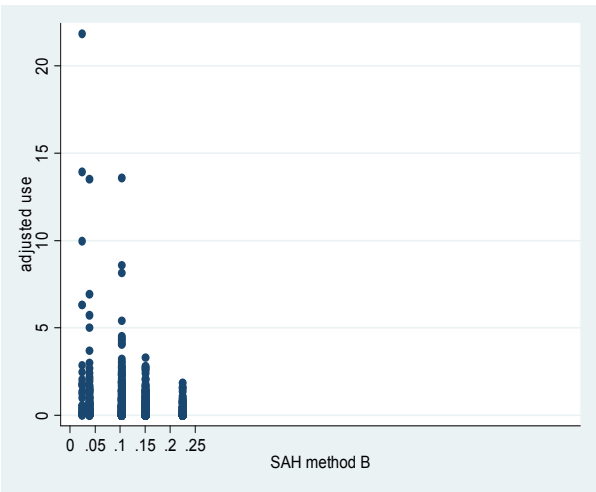
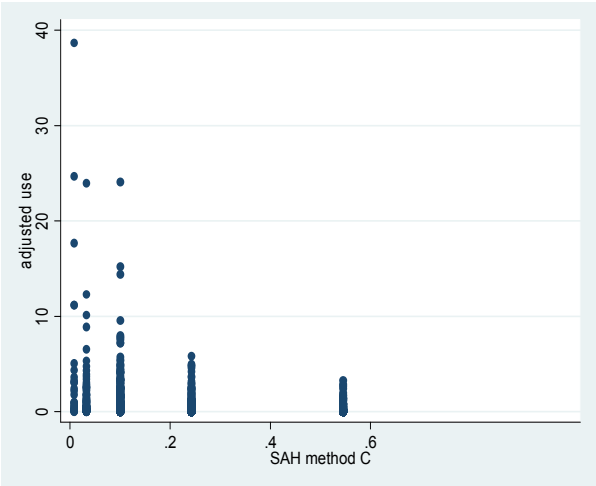
7. Summary

8. Appendix A: Scatterplots

Belgium







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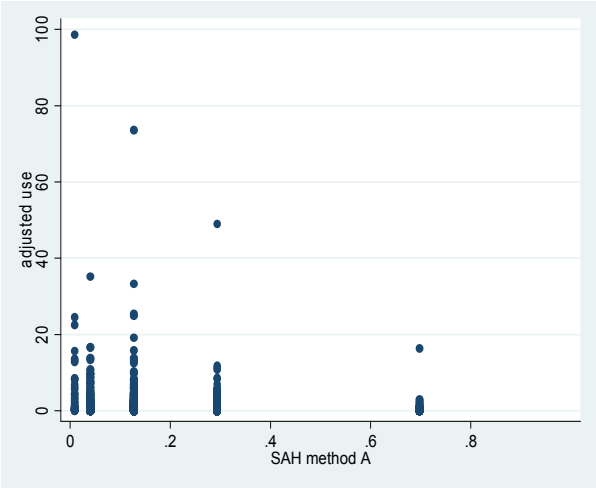
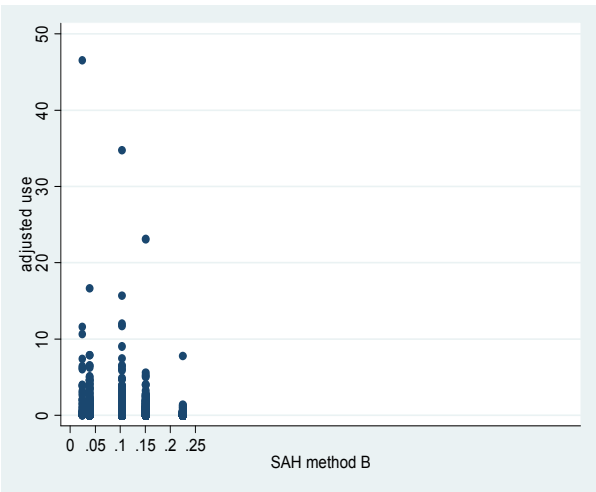
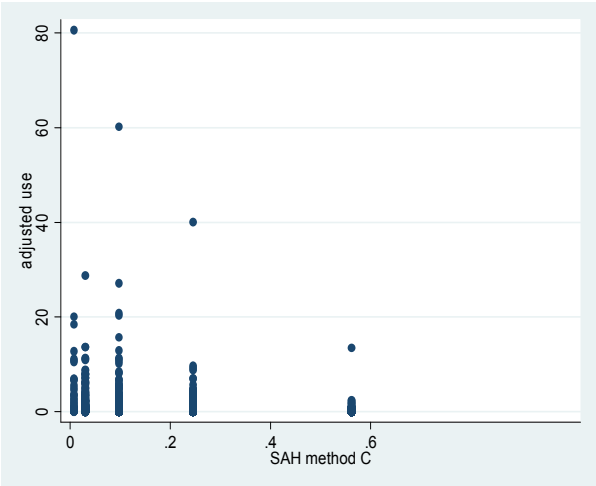
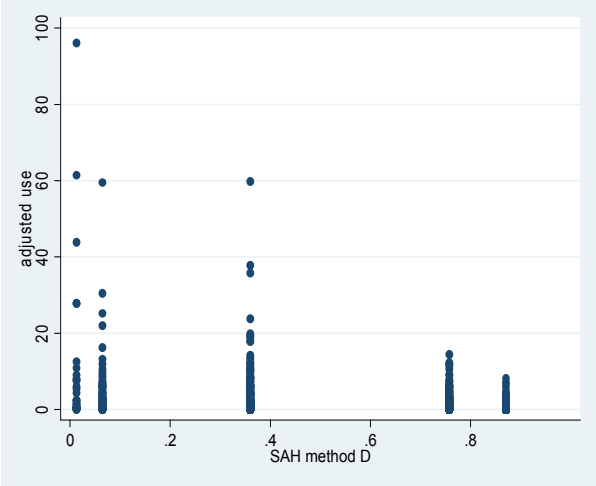
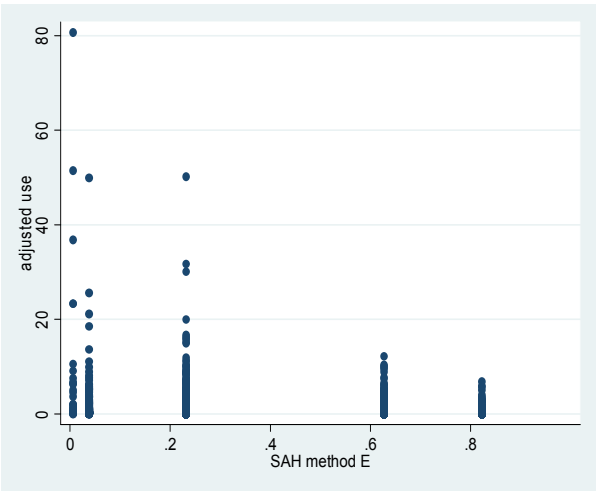


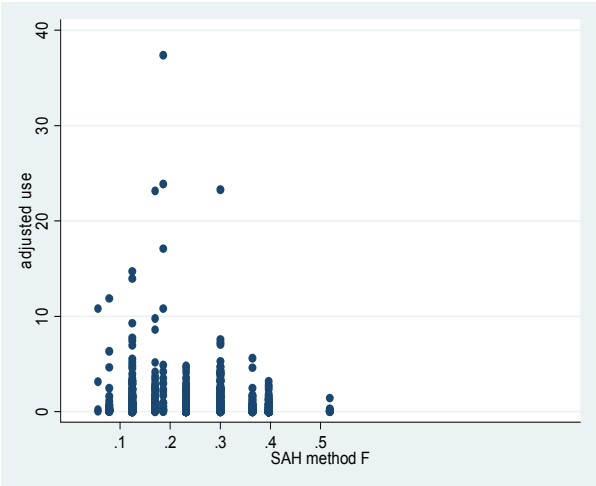




Belgium







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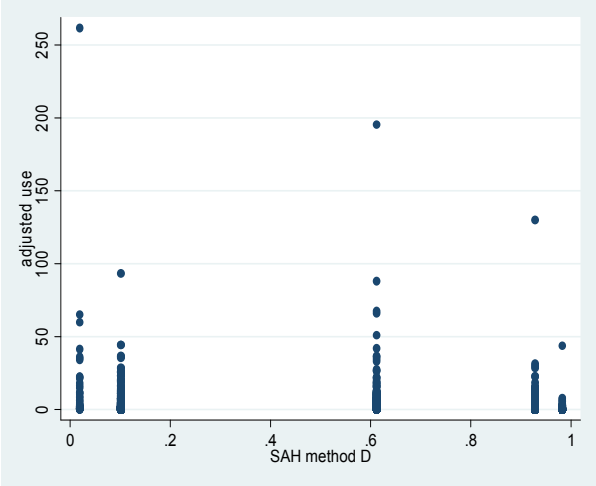
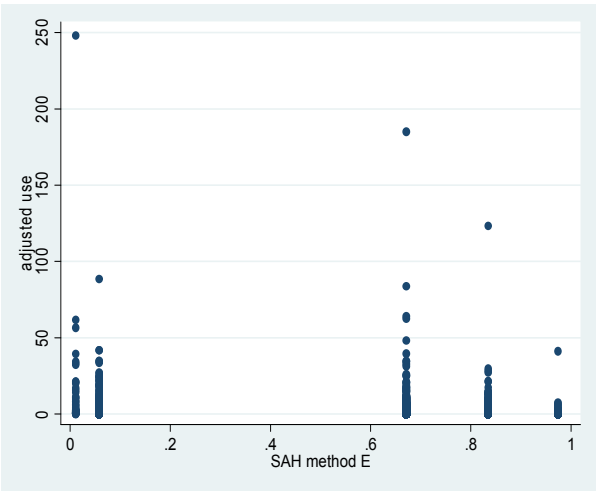
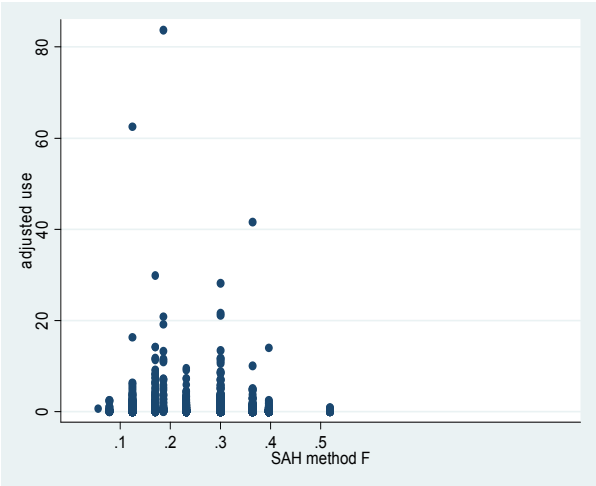
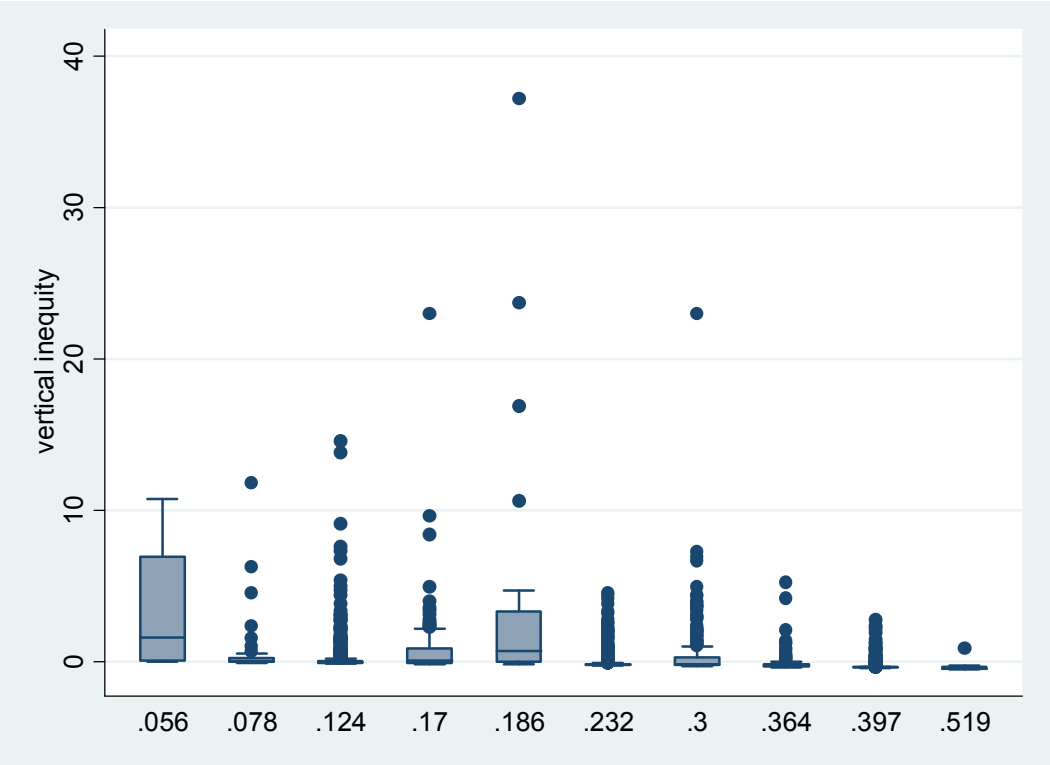






9. Appendix B: Distribution of vertical inequity per need group

Belgium



Netherlands