# Targeting Performance of Health Services in Bosnia And Herzegovina : A Fuzzy Approach

by Jie Meng

(5346459)

Major Paper presented to the

Department of Economics at University of Ottawa

In partial fulfillment of the requirements of the M. A. Degree

Supervisor: Professor Paul Makdissi

ECO 7997

Ottawa, Ontario

September 2010

**ABSTRACT**

This paper will look at data to determine targeting efficiency of healthcare services in Bosnia and Herzegovina. Five major health service categories will be considered. Data will be drawn from "Living in Bosnia and Herzegovina,, 2004". The purpose of this essay is to answer one simple question: Which category of service best targets people in bad health? To answer this question we apply fuzzy set theory to define the set of individuals in bad health. Also, this paper presents a methodology that consists of using a membership function to identify to what extent individuals can be considered as being in bad health. The method builds on fuzzy set theory whereby the definition of the boundaries of set, say the set of individuals in good or bad health, is fuzzy. We will test for the robustness of targeting performance of health care resources comparisons to the choice of membership function.

Key words: fuzzy set, targeting efficiency, Leakage, Targeting efficiency/leakage ratio, stochastic dominance, pure health inequality

## INTRODUCTION

This paper will look at data taken from "Living in Bosnia and Herzegovina, 2004" to assess efficiency of government investments in healthcare in the country of Bosnia and Herzegovina. The discussion will address the following question: What health resources better target individuals in poor health within the country's healthcare system according to the data at our disposal? Given the limitation of the data set, we have to consider five broadly defined health categories: (1) Dentistry, (2) General Practice, (3) Private Nurse, Paramedic, Midwife, (4) Physical therapist, chiropractor, herbalist, home nurse and (5) all other health services. For each category of service we have the information on the number of visits for each individual. Out of the categories, we will use our data to answer the question and determine which type of service best targets individuals in poor health. Next, we will investigate the difference between two population groups: those who have private health insurance and those who do not. The text in this essay is divided into two main parts. It begins with an overview of literature and description of the methodology (Part 1) and then moves on to a closer analytical view of the data (Part 2). Please note that the notion of poor health status is defined using a fuzzy approach throughout the essay. In this paper, the "other" category of doctors better targets individuals in poor health to the constant. The order of targeting performance of five categories depends on the dominance test

## PART 1: Literature and methodology

### Overview of the literature

"Health inequality has intensified efforts to provide the tools to measure and analyze the distribution of health. Most of this research is empirically related and is aimed at measurement and evaluation of changes in health inequality." (J.P. Newhouse, 2002). In particular, economists have become increasingly involved in research on health inequality. Wafstaff and van Doorslaer (1992) provided a discussion on two contrasting approaches: "pure inequalities in health and socioeconomic inequalities in health". (J.P. Newhouse 2002). The pure inequalities in health approach focuses entirely on the distribution of the health variable itself within the population. The socioeconomic inequalities in health approach focuses on the distribution of health across social and economic groups ( Wagstaff and Braverman 2004). The former approach leads to usage of standard income inequality measures such as the Lorenz curve and Gini coefficients. The second approach analyzes the distribution of health across social and economic groups. This approach has led to the development of other tools, such as the concentration curve and the concentration index. (Bommier and Stecklov 2002)

**Weaknesses in the socioeconomic health inequality**

Although the socioeconomic approach appears to provide a useful framework for defining and analyzing health inequality, its benefits depend on our ability to place restrictions on the evaluation of welfare derived by the combination of given income and health levels. (Bommier_and Stecklov, 2002) In addition, health data are often also based on ordinal categories, such as self-assessed health status, which are impossible to rescale. "Health inequality should then only be compared between societies having the same marginal distributions of health, although not necessarily the same joint distribution of health and income. When health is measured by a dichotomous variable, such as child stunting or living status (dead/alive), the mean level is obviously defined. However, equal means imply identical distributions for dichotomous variables. Thus, the problem is only appropriate between societies with identical health distributions."(Bommier and Stecklov 2002).

Another difficulty of measuring health variables is a key concern. This weakness is due to the inconsistency of the social economic approach with the basic notion of a just or equitable distribution of health. The literature on health inequality suggests that a fair health distribution does not imply equal health status for all individuals since individuals may differ in their health endowments (Culyer and Wagstaff 1993). In conclusion, there is widespread interest for health inequality. Economists and other social scientists have engaged in this effort by providing analytical tools and empirical assessments aimed at facilitating the measurement of health inequality. In

particular, the socioeconomic approach treats income and health as comparable variables—an important drawback in terms of ethical considerations. Therefore, we prefer pure health measurement which is theoretically more appealing in order to determine its usefulness in empirical research on health inequality. (Bommier and Stecklov 2002).

**Methodology**

In this section, we propose a methodology to analyze the targeting performance of health services. So we apply a definition of individuals in bad and good health that is based on fuzzy set theory. Fuzzy logic is a superset of conventional (Boolean) logic that has been extended to handle the concept of partial good- bad values between "completely good" and "completely bad""(Aziz and Parthiban 1996). For example, there are salty meal and non- salty meal. When people add a little salt into no salt meal, we still believe the meal is no salty meal. When people repeat the process, the meal becomes salt meal to the content in the future. There is fuzzy definition for non-salty meal or salty meal.

**Fuzzy set**

Fuzzy sets are sets whose elements have degrees of membership. Fuzzy sets were introduced by Lotfi A. Zadeh (1965) as an extension of the classical notion of set. In classical set theory, the membership of elements in a set is assessed in binary terms according to a bivalent condition — an element either belongs or does not belong to

the set. "By contrast, fuzzy set theory permits the gradual assessment of the membership of elements in a set; this is described with the aid of a membership function valued in the real unit interval [0, 1]. Fuzzy sets generalize classical sets, since the indicator functions of classical sets are special cases of the membership functions of fuzzy sets, if the latter only take values 0 or 1. Classical bivalent sets are in fuzzy set theory usually called crisp sets. Fuzzy *set* theory defines set membership *as a* possibility distribution. In addition, the fuzzy set theory can be used in a wide range of domains in which information is incomplete or imprecise" (Makdissi and Wodon 2004), which is often the case in health care system. In this framework, we specify a membership function which indicates the degree to which an individual is considered as good $G(h)$ or bad health $B(h)$. The "bad health" membership function that we have used is the following: 1 (very poor), 0.75 (poor), 0.5 (good), 0.25(very good), 0 excellent. And the "good health" membership function (1-bad health function) is 0 (very poor), 0.25 (poor), 0.5 (good), 0.75 (very good), 1 (excellent). The reader should keep in mind that poor health status is defined here using a fuzzy approach rather than traditional set approach. In traditional set theory, we define the health status according to a threshold. When individual represents its health is below the threshold, the individual consider as bad health. When an individual represents its health is above the threshold, the individual considers as good health. Based on different degrees (since $h \in [0,1]$), we analyze the targeting performance of five types of health services. As mentioned earlier, those five categories will also be used as follows:

**Table 1(Categories of health services)**

| Five Categories of Health Service |
|---|
| 1. Dentistry |
| 2. General Practice |
| 3. Private Nurse, Paramedic, Midwife |
| 4. Physical therapist, chiropractor, herbalist, home nurse |
| 5. Other |

In addition, while we observe each category of service, we will also compare their performance for two distinct population groups: those who have private health insurance and those who do not. We will look at the evidence to see which group represents a more efficient use of healthcare dollars in BIH.

**Measuring targeting efficiency**

We wish to define indicators to measure the targeting performance of different types of health services. To do so, let f (h, c) represent the density of individuals characterized by the vector (h, c) where h means health status which is from [0, 1]. And c=1 indicates that the individual has benefitted from this type of health care and c=0 indicates that he or she does not benefit from this type of health care. Therefore, $T_A(B) = \int_0^1 B(h) f_A(h,1) dh$ represents the population share of those in bad health and are benefited from type A of health care. In addition, the formula $L_A(B) = \int_0^1 B(h) f_A(h,0) dh$ represents the population share of those who are in bad health and are not benefiting from type A of health care. We also define the targeting/leakage ration in terms of the beneficiaries of type A of health care:

$$TL = \frac{T_A(B)}{L_A(B)}$$

All there statistics can be computed with any membership function. In this paper we have defined one possible membership function. However, it is worth to mention that changing the membership function may have consequences on the ordering of the targeting performance of health services. In this context, it is interesting to perform stochastic dominance tests. If we follow Makdissi and Wodon (2004), we know that $T_X(B) \geq T_Y(B)$, $L_X(B) \leq L_Y(B)$ and $TL_X(B) \geq TL_Y(B)$ for all possible membership function B if $F_X(h,1) \geq F_Y(h,1)$ for all $h \in [0,1]$, where $F_X(h,1) = \int_0^h F_X(s,1)ds$.

**PART 2: Health services in BIH**

**History and background**

Bosnia and Herzegovina (BIH) declared independence from the Socialist Federal republic of Yugoslavia in March 1992. Unfortunately, the new country was immediately plunged into an internal conflict. The conflict lasted for three years and took many lives, destroyed large amounts of property, and severely damaged the local economy. Overall, people in the region were seriously affected by the war. The war ended in late 1995 when the Dayton peace agreement was signed between warring factions. (Subotica and David 2003)

The War had devastating effects on the economy of BIH, and the local government

had to face financial shortages. For example, "In 1990, BIH had a gross domestic product (GDP) of US $11 billion, and a per capita income of US $2400. By 1995, GDP had declined to US $2 billion, with a per capita income of US $500" (Subotica and Wildman 2003) According to these data, the GDP declined to one fifth of original GDP. Given the time periods from which the statistics are drawn, one can only deduce that the negative effects were produced by the war.

It was without question a significant time for health policy in Bosnia and Herzegovina. There was a growing recognition in many countries at the time that simply pouring resource into healthcare services would not necessarily result in better health among the population. Rather, there was a need to look at money spent on healthcare in terms of its overall effectiveness in producing the desired results. Or, in other words, there was a need to identify the most efficient investments in healthcare systems. This was due especially to limited financial resources.

The health system in BIH continued to face considerable challenges due to effects of the war, but at the same time the government needed to act responsibly and make the best use of its resources to maintain viable public health policies.

In fact, the health system pretty well collapsed after the war and due to catastrophic effects on the local economy, the BIH government had to implement a limited budget for healthcare. The question as to which healthcare resources better targeted individuals in poor health therefore became even more significant.

Before answering two questions, we would like to describe statistic to clarify the number of visit to health professions in the population.

**Table 2(Population shares of health services users)**

| Number of Visits | 0 | 1 | 2 | 3 | more than 4 |
|---|---|---|---|---|---|
| General Practice | 0.600882 | 0.054024 | 0.070195 | 0.041713 | 0.2331863 |
| Dentistry | 0.764425 | 0.074605 | 0.072584 | 0.034362 | 0.0540243 |
| Private Nurse, Paramedic, Midwife | 0.994304 | 0.00147 | 0.002205 | 0.000551 | 0.00147 |
| Physical therapist, chiropractor, herbalist, home nurse | 0.87851 | 0.015696 | 0.002716 | 0.002021 | 0.101066 |
| Other | 0.863653 | 0.029217 | 0.027012 | 0.019662 | 0.0604557 |

The table shows the number of visit in the population in five categories of health service. The first rank means the number of visits from once to more than four times. The rest of ranks stand for the proportion of population who is in different categories.

**Which health resources better target individuals in poor health in Bosnia and Herzegovina?**

As pointed out by Makdissi and Wodon (2004), the problem of comparing the targeting performance of five types of health care reduces formally to "the comparison of joint distribution functions" (Makdissi and Wodon, 2004).

Three methods are introduced to target people in poor health in BIH. However, it is difficult to determine a precise meaning for "poor health", as the notion is subject to

interpretation. The method we use in this essay builds on fuzzy sets in order to define the boundary of poor health.

**Table 3(Population shares in each health status)**

| Description of own health | Freq. | Percent | Cum. |
|---|---|---|---|
| Excellent | 1,127 | 24.17 | 24.17 |
| Very good | 709 | 15.21 | 39.38 |
| Good | 1,818 | 39.00 | 78.38 |
| Poor | 835 | 17.91 | 96.29 |
| Very poor | 173 | 3.71 | 100.00 |
| Total | 4,662 | 100.00 | |

In table 3, 3.71 percent of people are considered to be in "very poor" health, whereas 17.91 percent are considered to be in "poor" health. The cumulative total of both these categories is 21.62 percent. In other words, more than one fifth of the population concerned seems to be suffering adverse health effects, presumably due to negative effects of war. The proportion of people in poor health is quite large. As we all know, people who are in poor health require more resources and more healthcare.

We will explain five different health categories of service one by one, and try to find out which category is most efficient in relation to the government's limited budget. There are four methods we can use to test efficiency: 1. target efficiency of health care (T), 2. Target leakage (L), 3. Targeting/leakage ratio (TL) and 4. Stochastic dominance (SD).

**Targeting efficiency of health care:**

The concept of targeting efficiency means that the percent of health care benefits to individuals who are in bad health. When individuals receive more benefit from a type of health care, the value of targeting efficiency will become larger. Furthermore, we know that $T_X(B) \geq T_Y(B)$, for all possible membership function B if $F_X(h,1) \geq F_Y(h,1)$ for all $h \in [0,1]$, where $F_X(h,1) = \int_0^h F_X(s,1)ds$. So we are able to find out the comparison of targeting efficiency, provided comparison of membership function B is discovered.

Following the above process, we arrive at the table below:

**Table 4(Fuzzy targeting indices)**

| General Practice | Dentistry | Others | Private Nurse, Paramedic, Midwife | Physical therapist, chiropractor, herbalist, home nurse |
|---|---|---|---|---|
| 0.61923 | 0.286578 | 0.714929 | 0.533782 | 0.706746 |

The table demonstrates the membership function B when the individual has benefited from this type of health care. Comparing the membership function B, it is clear that the value of "Others" (0.714929) is the largest value in the TOTALS row. Since $T_X(B) \geq T_Y(B)$ if $F_X(h,1) \geq F_Y(h,1)$, the most efficient health care is "Others" in five categories. The target efficiency of each system depends on the frequency in health resources. People go to the "other" category of doctor more frequently compared to the remaining categories. Judging from this data, it would seem to make

sense to finance the most popular health services. Considering budget limitations, investing available funds in the "other" category of doctor appears to be the best choice for the government in this situation.

**Leakage:**

Now we will apply the concept of leakage to the data. In the table below, we can see that one of the health resources has the least amount of leakage. We know that, $L_X(B) \leq L_Y(B)$ for all possible membership function B if $F_X(h,1) \geq F_Y(h,1)$ for all $h \in [0,1]$, where $F_X(h,1) = \int_0^h F_X(s,1)ds$.

**Table 5(Fuzzy leakage indices)**

| General Practice | Dentistry | Others | Private Nurse, Paramedic, Midwife | Physical therapist, chiropractor, herbalist, home nurse |
|---|---|---|---|---|
| 0.38077 | 0.713422 | 0.285071 | 0.466218 | 0.293254 |

Looking at this table, "Others" has the smallest value (0.285071) in the TOTAL row. The result indicates that the "Other" type of doctor leaked the least amount. Since $T_X(B) \geq T_Y(B)$, $L_X(B) \leq L_Y(B)$ if $F_X(h,1) \geq F_Y(h,1)$, we believe that the targeting efficiency and leakage have inverse conclusion. According to this data, it would be efficient to finance the "other" type of doctor as well.

**Targeting/leakage ratio**

In targeting/leakage ratio, it is important to test robustness. The targeting efficiency is the numerator and leakage is the denominator. The ratio increases as targeting efficiency increases or leakage decreases. This method should give us the same result as the respective Targeting and Leakage measurements.

The table below shows us the targeting/leakage ratio for the five different categories *of health services outlined in this essay:*

**Table 6(Fuzzy Targeting/leakage Rations)**

| General Practice | Dentistry | Others | Private Nurse, Paramedic, Midwife | Physical therapist, chiropractor, herbalist, home nurse |
|---|---|---|---|---|
| 1.626258 | 0.401695 | 2.507895 | 1.144918 | 2.410009 |

According to formula $\mathrm{TL}_{\mathrm{X}}(\mathrm{B}) \geq \mathrm{TL}_{\mathrm{Y}}(\mathrm{B})$ for all possible membership function B if $F_X(h,1) \geq F_Y(h,1)$ for all $h \in [0,1]$, where $F_X(h,1) = \int_0^h F_X(s,1)ds$, we will determine the most efficient target category. In the second row, we can clearly see that the value of "others" has the greatest value. Therefore, "Others" is again the most efficient target category based on the targeting/leakage ratio.

According to the above three methods, we characterize properties that membership functions should have, and we test for the robustness of targeting performance. Although we use different methods to test the robustness of different health systems,

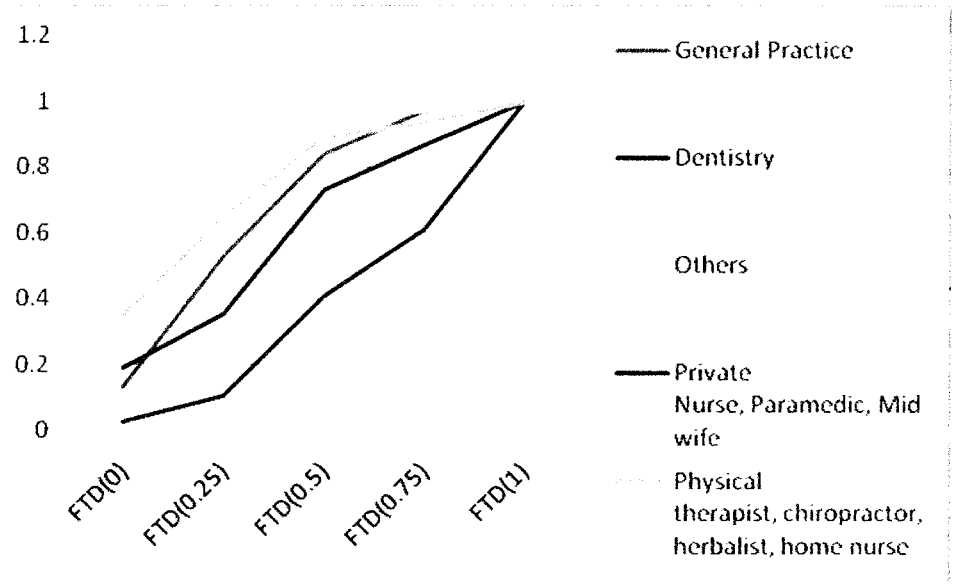
the conclusions are exactly same. For total population, the targeting efficiency, leakage, and targeting efficiency/leakage ratio gives one result. The most robust category in the five health resources we have looked at is the "other" type of doctor,. The result of these targeting performances can help policy-makers determine an efficient solution when government has a limited healthcare budget.

**Stochastic dominance test**

In the paper we have used a particular membership function to determine the targeting efficiency, leakage and Targeting/leakage ratio. However, someone may not use our particular membership function. They can imagine another membership function. Therefore, we make a stochastic dominance test which means that ordinal comparison holds for any membership function. Following the second order dominance in the figure below, the targeting performance of "Others" is better than "Private Nurse, Paramedic, Midwife", "General practice" and "Dentistry". In addition, the targeting performance of "Physical therapist, chiropractor, herbalist, home nurse" is better than the targeting performance of "Private Nurse, Paramedic, Midwife" and "dentists". And the targeting performance of "Private Nurse, Paramedic, Midwife" is better than that of "dentist"

Please notice the figure 1 to understand these orders clearly.

**Figure 1(Stochastic dominance)**




The order of dominance always returns the same results no matter how we define the membership function. Moreover, if $F_X(h,1) \geq F_Y(h,1)$ for all h, it means that for any membership function, the ordering is the same as $T_X(B) \geq T_Y(B)$.

**Comparing the health service categories in relation to people who have private insurance and those without insurance**

In order to determine the efficiency of healthcare investment in relation to insured and non-insured subjects, we need to compare the targeting efficiency, leakage, and targeting efficiency/leakage ratio. Moreover, we will perform a dominance test.

**Targeting efficiency:**

First, we will compare targeting efficiency in relation to insured and non-insured subjects. Following the table

**Table 7(Fuzzy targeting indices)**

| Insurance | General Practice | Dentistry | Others | Private Nurse, Paramedic, Midwife | Physical therapist, chiropractor, herbalist, home nurse |
|---|---|---|---|---|---|
| Yes | 0.62954722 | 0.281576 | 0.712412 | 0.542134 | 0.703775 |
| No | 0.5255668 | 0.330073 | 0.745847 | 0.5 | 0.754386 |

In the tables above, "Insurance" represents health insurance status (i.e. has or does not have health insurance). "Yes" means individuals have insurance. Inversely, "No" means individuals do not have insurance. Other variables are the five different health service categories. Now, we only compare the targeting efficiency of those with insurance and those without insurance. We can think of the other variables as one single variable. We compare the values of two rows in the last table. According to

$T_X(B) \geq T_Y(B)$, for all possible membership function B if $F_X(h,1) \geq F_Y(h,1)$ for all $h \in [0,1]$, where $F_X(h,1) = \int_0^h F_X(s,1)ds$. The function value of insurance is larger than the value of non-insurance for "Dentistry", "Others", "Physical therapist, chiropractor, herbalist, home nurse". One the other hand, the function value of non-insurance is

larger than the value of insurance for "General Practice", "Private Nurse, Paramedic, Midwife". Therefore, the target efficiency for those without insurance is larger than it is for those with insurance when government focus on "General Practice"," Private Nurse, Paramedic, Midwife. When government shifts to "Dentistry", "Others", "Physical therapist, chiropractor, herbalist, home nurse", the target efficiency for those with insurance is larger than it is for those without insurance.

**Leakage:**

Secondly, we will compare the leakage with the following Table:

**Table 8(Fuzzy leakage indices)**

| Insurance | General Practice | Dentistry | Others | Private Nurse, Paramedic, Midwife | Physical therapist, chiropractor, herbalist, home nurse |
|---|---|---|---|---|---|
| Yes | 0.37045278 | 0.718424 | 0.287588 | 0.457866 | 0.296225 |
| No | 0.47443316 | 0.669927 | 0.254153 | 0.5 | 0.245614 |

The function value of non-insurance is smaller than the value of insurance for "Dentistry", "Others", "Physical therapist, chiropractor, herbalist, home nurse". One the other hand, the function value of insurance is smaller than the value of insurance for "General Practice, Private Nurse, Paramedic, Midwife". The data provide same

results as targeting efficiency. Next, we move to move on to compare the targeting efficiency/ leakage ratio.

**Targeting efficiency/ leakage ratio.**

Thirdly, we will now compare targeting efficiency/ leakage ratio.

**Table 9(Fuzzy targeting/leakage ration)**

| Insurance | General Practice | Dentistry | Others | Private Nurse, Paramedic, Midwife | Physical therapist, chiropractor, herbalist, home nurse |
|---|---|---|---|---|---|
| yes | 1.69939939 | 0.3919359 | 2.47719763 | 1.18404283 | 2.375809931 |
| no | 1.10777849 | 0.492701 | 2.934639 | 1 | 3.071432 |

Based on the formula below:

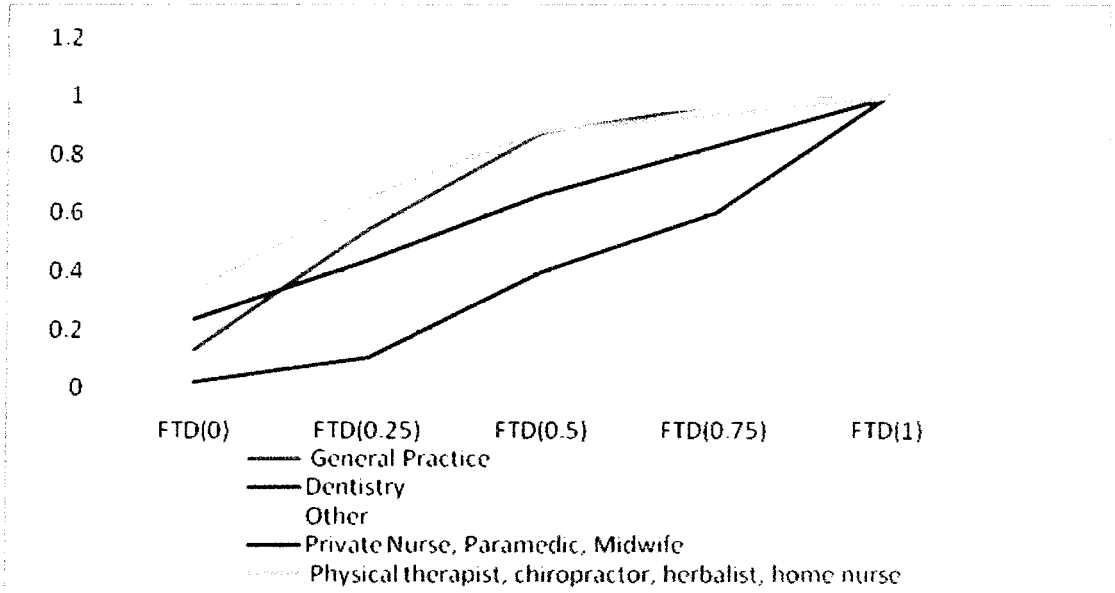
$\mathrm{TL_X(B)} \geq \mathrm{TL_Y(B)}$ for all possible membership function B if $F_X(h,1) \geq F_Y(h,1)$ for all $h \in [0,1]$, where $F_X(h,1) = \int_0^h F_X(s,1)ds$. It is obvious that the value of "people without insurance" is larger than the value of "people with insurance" when "General Practice, Private Nurse, Paramedic, Midwife". In other words, if government invests an amount of money in these two groups, people who do not have insurance will benefit more than people who have insurance. We can look at this situation in another way. Usually, people do not have insurance. Then their health cannot be guaranteed by necessary health insurance. They have to face medical fees when they

acquire terrible, incurable diseases, such as certain types of cancer, or MS, for example. Inversely, people who have insurance are in a totally different situation. However, it is efficient for BIH government to invest money to the individuals who have insurance in "Dentistry", "Others", "Physical therapist, chiropractor, herbalist, home nurse". Also, good health insurance not only covers most emergency situations, but it can be used for prevention as well. For example, there are several regular check-ups that can be used to detect or prevent diseases in the early stages.

**Dominance test**

Next, we analyze the dominance test at second order degree for people with and people without insurance. There are two separate figures in discussing this problem. We observe figure 2 (with insurance) and figure 3(without insurance) below and use two figures for the stochastic dominance test.

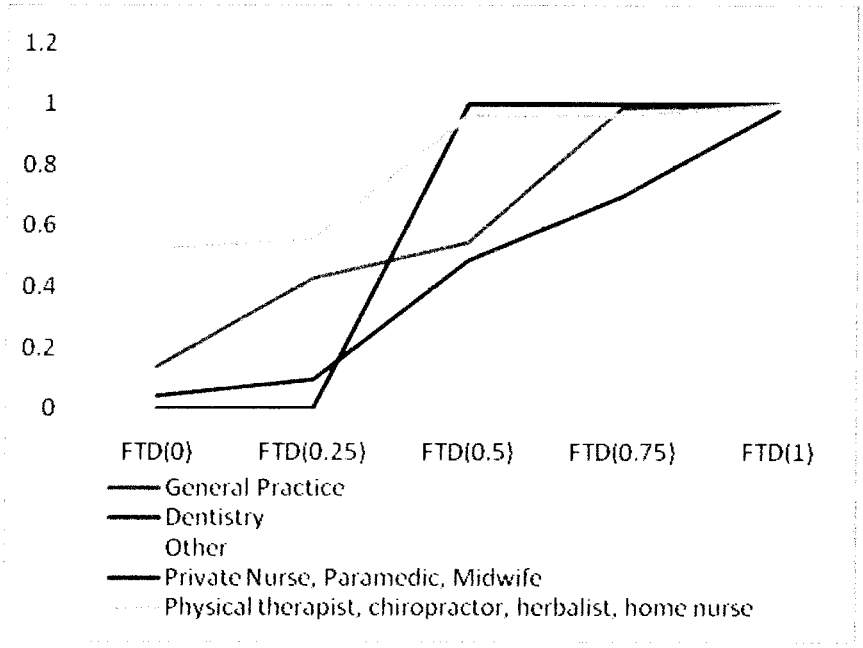
**Figure 2(Stochastic dominance)**



According to above figure, we achieve three useful results.

Firstly, the targeting performance of others is better than "Private Nurse, Paramedic, Midwife", "General practice" and "Dentistry". Secondly, the targeting performance of "Physical therapist, chiropractor, herbalist, and home nurse" is better than the targeting performance of "Private Nurse, Paramedic, Midwife" and "dentists". Thirdly, the targeting performance of "general practice" is better than that of "dentist"

**Figure 3(Stochastic dominance)**




According to the above figure, we also achieve three useful results.

Firstly, the targeting performance of "Others" is better than "Private Nurse, Paramedic, Midwife", "General practice" and "Dentistry". Secondly, the targeting performance of "Physical therapist, chiropractor, herbalist, home nurse" is better than the targeting performance of "dentists" Thirdly, the targeting performance of

"general practice" is better than that of "dentist"

**CONCLUSION:**

This paper has demonstrated that out of our five allocated categories of health service, the "Other" category of doctors better targets individuals in poor health to the constant. The order of targeting performance of five categories depends on the dominance test. In the paper, we described that a civil war happened betweem1992 and 1995 in BIH and that the economy was seriously damaged by the war. It was noted that after the war the GDP declined to one-fifth of the level that existed prior to that devastating event. The resulting economic difficulties created a need to increase efficiency of healthcare investments so as to make the best use of limited budget resources. This was especially important since the government faced a financial deficit on one hand and on the other hand according to some statistics 20% of the population was considered to be in poor health.

The concepts of pure inequalities in health and socio-economic inequalities in health were introduced. Even economists consider that socio-economic inequalities in health can be used under certain conditions; however, pure health inequalities have been considered as more suitable for the purpose of our study. In order to test efficiency accurately, we used a fuzzy approach to define poor health status. The significance of data was considered as well for testing purposes.

Two important questions were addressed based on four different methods, which included:

1. Targeting efficiency

2. Leakage

3. Targeting efficiency/leakage ratio

4. Statistical inference for stochastic dominance (second order)

We asked: What health resources better target individuals in poor health within the country's healthcare system? The answer was, out of our five categories, the "Other" category of doctors was most effective.

We also asked: When we look at government healthcare investment vis-à-vis insured versus uninsured subjects, which group represents a more effective use of government money?

The answer was: It depends on the dominance test. The order of dominance always returns the same results no matter how we define the membership function

We considered these questions because they provide us with a direction for government spending. Policy makers need to understand which components of the healthcare system are in need of more attention and which components are most efficient.

**REFERENCE:**

[1] Subotica A. and D. Wildman (2003), health briefing paper in Bosnia and Herzegovina, 2-8.

[2] Newhouse J. P. (2002), Advanced Topics in Health Economics, *Journal of Health Economics*, 3, 497-513.

[3] Makdissi P. and Q. Wodon (2004), Fuzzy Targeting Indices and Orderings, *Bulletin of Economic Research*, 1, 41-51.

[4] Aziz S. A. and P. Jeyakody, Fuzzy Sets & Fuzzy Operations, *Fuzzy Logic and Its Uses,* http://www.doc.ic.ac.uk/~nd/surprise_96/journal/vol4/sbaa/report.html

[5] Zadeh L. A. (1965), Fuzzy sets, Information and Control, 8,338–353.

[6] Wagstaff A. and E. V. Doorslaer (1992), Equity in the delivery of health care: some international comparisons, 4, 389-411.

[7] Culyer, A. J. and A. Wagstaff (1993), Equity and equality in health and health care, *Journal of Health Economics*, 12, 431-457.

[8] Bommier A. and G. Stecklov (2002), Defining health inequality: why Rawls succeeds where social welfare theory fails, *Journal of Health Economics,* 21, 497-513.