

Session Number: 4B

Session Title: Multidimensional Measurement and Comparisons of Economic Well Being

Paper Number:

Session Organizer: Thesia I. Garner, Jean-Yves Duclos, Lars Osberg.

Discussant: Michael Wolfson

*Paper Prepared for the 28th General Conference of
The International Association for Research in Income and Wealth Cork, Ireland, August
22 – 28, 2004*

*Variation of Income Inequality Caused by the Health Care Finance : an Application to the
Data from the Household Income and Expenditure Survey in Switzerland*

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Abstract

In this study we developed an estimation technique associating macroeconomic and microeconomic data in order to estimate the various financial components of the health system. We applied then the very recent decomposition of Duclos, Jalbert and Araar to the redistributive effect caused by the financing of the Swiss health system for the years 1998 and 2000. Calculations for the financing of the system taken in its entirety, and equally for its component parts, were carried out.

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1. Introduction

The structure of the Swiss health system has changed considerably since the new Lamal¹ health insurance law came into effect in 1996. Since the introduction of this new obligatory health insurance, the premiums have not ceased increasing at a sustained rate. Overall the proposed solutions have proved to be ineffective in stopping the premiums of the obligatory health insurance from increasing, and more generally, health costs increasing either. A large increase in the health insurance base premiums was announced at the end of each year leading to an ever increasing number of insured people reconsidering the choice of health insurance financing on offer to them.

In this context of rapid health sector change, this study aims to measure the inequality in the distribution of household revenues caused by the financing of the health system. In addition, the study aims to reveal the vertical, horizontal and rearrangement effects caused by this financing. The vertical effect is a measure of the progressivity or regressivity brought about by the financing in the absence of horizontal or rearrangement effects. The horizontal effect is a measure of horizontal inequality measuring the size and extent of inequalities affecting treatment of equal households from the point of view of their income before financing the health system. Regarding the rearrangement effect, it quantifies the extent of the modifications made to household classifications according to the incomes resulting from the financing.

This study is concerned with the financing of the health system from a global point of view and attempts to identify all the ways through which households finance the health system. In effect, households can either finance health services directly or indirectly through an intermediary economic agent. This agent can be the State, social or private insurance, or some other non profit-making organisation. And in turn, these economic intermediaries are financed by households through different taxes, insurance premiums, deductions from salaries, or via donations. The total financing from households is also defined as being the sum of their direct finance and all the finance they raise through economic intermediaries. This study is as concerned with the redistributive effect caused by the total financing as it is with that due to each of its components.

The first decomposition for the redistributive effect revealing the vertical, horizontal and rearrangement effects was developed by Aronson and Lambert in 1994, and concerned taxation. This was applied for the first time to the domain of health financing by Wagstaff and von Doorslaer in 1997. In 1999 Wagstaff, von Doorslaer et al. published a study in which they applied the decomposition of Aronson and Lambert to 12 OECD countries. Among the countries studied was Switzerland but the data used came from 1992. Consequently, measurements were not available for Switzerland before the new health insurance law came into force.

However, the Aronson and Lambert decomposition presents a serious drawback. In practice insufficient households have perfectly equal pre-tax revenue. So the Aronson and Lambert method is composed of grouped households with close pre-tax revenue, and considers these households as if they are equal before applying taxation to them. Furthermore, the measure of horizontal inequality which results does not correspond exactly to the classic definition of horizontal inequality which is defined as being an unequal treatment of complete equals. In addition, the results obtained using the Aronson and Lambert method very much depend on the breadth of the groups chosen. Furthermore, the choice of the size of a group is neither

¹ French abbreviation for “Loi sur l’Assurance Maladie”.

guided by the theory of inequality nor based on a statistical criterion. Indeed, the choice has an arbitrary element and consequently so do the results obtained. Duclos and Lambert resolved this problem in 2000 by proposing a classically defined measurement for horizontal inequality that identifies the equal households by using a non-parametric estimation of the joint pre-tax and post-tax density function. Finally, in 2003 Duclos, Jalbert and Araar developed a measure of decomposition for the redistributive effect inferred from taxation that integrates the measure of horizontal inequality developed by Duclos and Lambert. In addition, this measure integrates the vertical and rearrangement effects equally. Another advantage of the breakdown of Duclos, Jalbert and Araar is its flexibility thanks to being based on a class of inequality index that includes the indices classes of Gini and Atkinson, which in practice are met very frequently. Furthermore, the social well-being function underlying the inequality index class used allows the normative choices can be explained clearly using two parameters which are, respectively, the levels of aversion to horizontal inequality and to rearrangement. Given the advantages of the Duclos, Jalbert and Araar method over that of Aronson and Lambert, the former will be used in this study to analyse the inferred redistributive effects in the financing of the Swiss health system.

From an empirical point of view, it is regrettable that the data concerning the various components of Swiss health system financing are not always available or are otherwise of poor quality. In this study an original method of estimating these components was developed before proceeding to the inequality calculations. This very simple estimation method associates microeconomic and macroeconomic data and has been applied to each financial components of the health system.

The second part of this paper examines the data used for the estimations. Next, the third part briefly presents the special features of financing for the Swiss health system. After this, the fourth part presents the method of estimating the financial components of the health system with the help of microeconomic and macroeconomic data. Following this, the fifth part presents the decomposition according to Duclos, Jalbert and Araar. The sixth part explains our choices in estimating the inequality and the seventh presents the results obtained for Switzerland for the years 1998 and 2000. Lastly, the conclusions are drawn.

2. Data

Unfortunately, there is little data concerning the Swiss health system and it is sometimes of poor quality. This is a result of the great complexity of the Swiss health system since it is very decentralised and involves a multitude of agents.

However, the macroeconomic data are fairly satisfactory. In effect, the Federal Office of Statistics (FOS) publishes the “Costs of the Health System” (CHS) annually. It uses an estimation method which combines the cost data according to the three perspectives of the paying agent, the service provider and the services. Thanks to this threefold perspective, the FOS succeeds in estimating the missing data and also in providing exhaustive statistics about the Swiss health system. It is quite regrettable that the CHS are not a true satellite account of the national account. Moreover, the link between the National Accounts according to the SEC95 methodology and the (CHS) can be established by means of several approximations.

The microeconomic data is very difficult to obtain. Nevertheless, every four years the FOS carries out a national survey in the field of health. The data from this “Swiss Health Survey” (SHS) unfortunately does not contain any quantitative variables concerning the costs or financing of health services. A base grouping data from service providers or health insurers at

a sufficiently desegregated level does not exist. The solution for this study was to use the data of the Swiss Survey of Income and Expenditure (SIE), which is not specialised in the field of health. The SIE is a survey that measures the incomes and expenditures of a sample of Swiss households. The incomes and expenditures are observed in equal periods. In addition, a certain number of household characteristics are observed as well. Another advantage of the SIE is its importance in calculating the consumption price indices and so it was decided to carry it out annually, which it has been since the year 2000. It is thus possible to carry out the analysis for this study in a regular manner with the aim of observing changes in the inequalities caused by health financing. At the time of writing, calculations have been carried out for the years 1998 and 2000.

The problem with working with the SIE data is its non-specialised character in terms of the health field. Furthermore, certain financial components of health system financing are not always available or otherwise are of poor quality. This study developed a simple method of estimation for these financial components that relate the CHS and CN macroeconomic data with the SIE microeconomic data. This method is presented in Chapter 4.1 of this document.

3. Financing of the Swiss health system

In 2000 the total cost of the Swiss health system was 43.4 milliard Swiss francs. The cost of health represents 10.7% of GDP, which places Switzerland second in the ranking of OECD countries. Between 1995 and 2000 the costs of health increased by 20% while GDP only increased by 11%. Consequently, Switzerland dedicates continuously a greater part of its resources to the health system. The purpose of this chapter is to present the economic agents who finance the costs.

The Swiss political system possesses the dual characteristic of being both liberal and federal. This tendency is clearly reflected in the organisation of its health system. The liberal orientation of the health systems means the State only intervenes in cases where the private sector fails to produce satisfactory results. The principal of federalism is that the Confederation can only legislate instead of the cantons in fields authorised by the constitution. Consequently, the Confederation only has limited powers in the field of health. In addition, the cantons have the power to delegate certain tasks to the level of the communes. The principals of liberalism and federalism have consequently produced a very complicated health system in which numerous different agents play a role.

Social insurance companies are the agent that finances the larger part of the Swiss health system, that is to say, approximately 40%. The social insurance companies are composed of basic health insurance (Lamal), old age insurance and invalidity insurance, accident insurance, as well as military insurance. The basic health insurance contributes more than three-quarters of the total financing obtained from social insurances. In 1996 this insurance replaced statutory insurance through which almost all the population was insured voluntarily. This statutory insurance provided a catalogue of medical services fixed by law, was not obligatory, and the level of premiums was related to the risk. In contrast, Lamal insurance is obligatory for all Swiss nationals and the level of the premiums is not linked to the risk presented by the individual insured but is set according to the community² in which the insured belong to. In addition, the range of services covered by the basic insurance has been

² The communities are defined geographically. Most of them are cantons.

considerably expended compared to that offered in the framework of the statutory insurance. The basic insurance provides then a very satisfactory overall cover.

Lamal insurers must fix the same premium level for all inhabitants of the same region, and this is independent of all personal considerations such as the state of health. In compensation for the obligation to be insured, the insured have a free choice of insurer and the latter is barred from refusing all new applications. Furthermore, Lamal insurers must be approved by the Federal Office of Social Security (FOSS) and are barred from making a profit on their basic insurance business. In this system it is not the State which establishes the level of premiums but the Lamal insurers. With regard to the insured, they are encouraged to exploit the competition between the providers and change insurers if they consider that the premium paid to be too high. Moreover, there is no competition over levels of service because each Lamal insurer covers the same range of service as defined by the law. In addition, FOSS controls the level of premiums and can oppose an increase if it is considered excessive. A drawback of the system stems from the fact that certain insurers sustain a higher degree of risk than others because of the greater risk represented by their insured customers as a group. These insurers cannot set the premiums at a higher level though because of the law. To compensate for this problem, financial adjustments are effected between insurers on the basis of a model evaluating the risk as a function of the age structure and type of their insured clients.

About a quarter of the Swiss population finance the health system through the intermediary of a private insurance company. Private insurance cover is called complimentary insurance because it covers services not included in the basic insurance. The most frequent contracts offer a free choice of the doctor in the hospitals, better accommodation while staying in hospital, dental care or reimbursement of medicine not covered by Lamal. Private insurance premiums are linked to the risk represented by the insured. In addition, the State does not offer any fiscal incentives encouraging individuals to take up this type of insurance.

As a health system finance agent, the State contributes approximately 15% of the total costs. Indeed, it allocates grants to hospitals in addition to non hospital establishments. Furthermore, it has administrative expenses resulting from its regulation of the health market and equally from its preventative activities. Finally, for the purpose of reducing the considerable burden that the basic insurance premium represents in some households, the State provided grants in order to reduce the premiums for households with modest incomes.

In spite of the considerable number of agents in the field of health system finance, private households must directly finance about a third of the total costs. In part this finance comes from payments for services not covered by the basic insurance, and in part from the participation of the basic insurance costs. Indeed, the basic insurance is financed by an annual excess which is a threshold below which the health costs are entirely born by the insured person. The standard annual excess is 230³ Swiss francs but the insured can choose to increase it up to 1500 Swiss francs and in compensation obtain a reduction in the insurance premium. Once the health expenditure has reached the level of the excess, the insured must still contribute 10% of the costs. This contribution to the costs, however, is limited to 600 francs for an insured adult. Consequently, in spite of the very complex financial system, the households directly finance the health system to a significant degree.

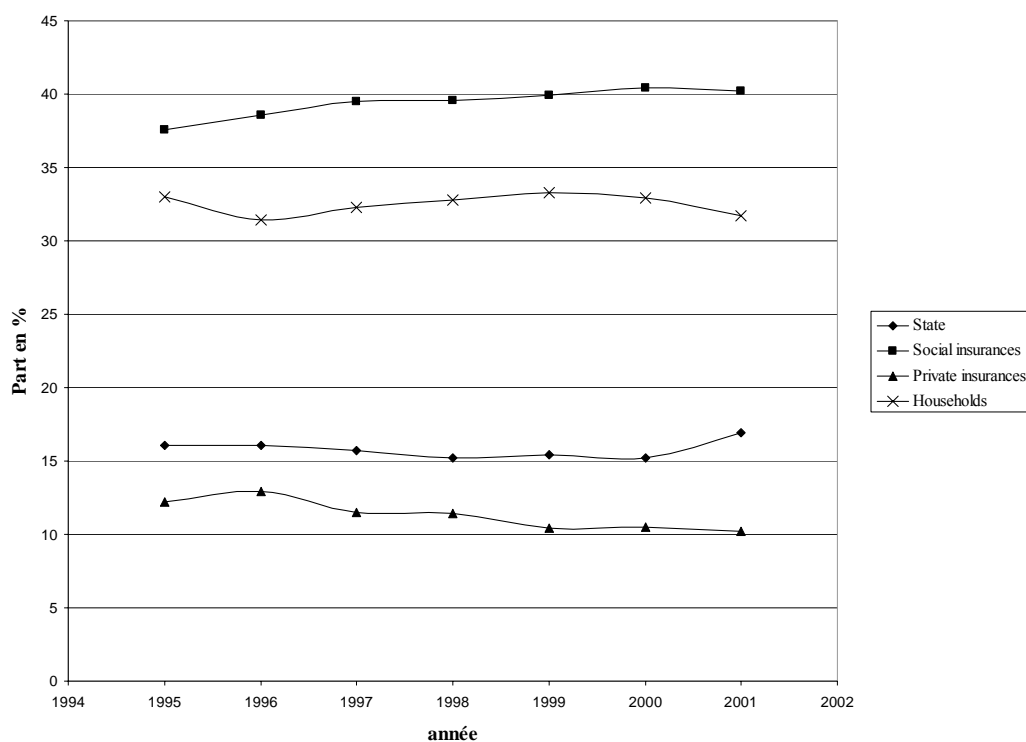
³ The figures presented are those which were in force in the year 2000

Table 1 presents health service costs according to the economic agent paying for the services. Graph 1 shows the development of the share of total health cost financing contributed by different economic agents between 1995 and 2001. It can be seen that the social insurances represent an increasingly important proportion of the financial structure. Indeed, it increased by 2.6% between 1995 and 2001. In parallel, the share borne by the private insurance agent companies tends to diminish. One explanation lies in the significant increase in the obligatory insurance premiums which incentives individuals to terminate their private insurance contracts in order to economise.

Table 1: Costs of the health system from the paying agent's perspective

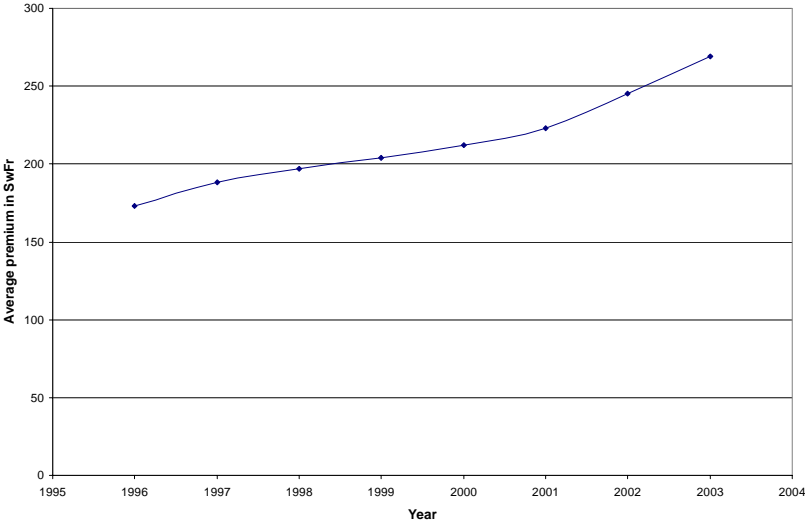
| Paying Agent | Payment at current prices in millions of Swiss francs | |
|-----------------------|---|-----------------|
| | 1998 | 2000 |
| State | 6'131.7 | 6'599.5 |
| Social insurances | 15'975.1 | 17'518.1 |
| Private insurances | 4'590.2 | 4'546.7 |
| Households | 13'200.2 | 14'257.3 |
| Other private finance | 395.2 | 443.7 |
| Total | 40'292.4 | 43'365.3 |

Graph 1 : Share of total health financing costs according to paying agent.



Graph 2 shows one of the main preoccupations of Swiss households, that is, the high and incessant increases in the obligatory health insurance premiums. Between 1996 and 2003, the increase was 55%, while the average annual increase was 6.2%. Furthermore, the basic health insurance premiums weigh more and more heavily in household budgets. Faced with this increase, a growing number of insured people opt for a more advantageous health fund in order to limit the increase in their premiums. In addition, the health insurance premium can be reduced by choosing types of contracts that compete with the standard insurance contract. Indeed, there are contracts with options allowing the level of the excess to be increased, contracts matched by a no-claims bonus for long period without claims for benefits, and contracts limiting the choice of service provider such as the HMO system⁴. A constant increase in insured people contracting these insurance types can be seen. The ‘with options’ contracts are the most favoured, with almost 2.8⁵ million individuals having chosen a higher than the ordinary excess. Half a million people have chosen to limit their choice of service provider, while contracts with an added bonus have met with very little success. Furthermore, under the pressure from significant and incessant basic health insurance premium increases, each year an ever increasing number of individuals have reconsidered the various options offered to them.

Graph 2 : Change in the average health insurance premium⁶ between 1996 and 2003.



4. Estimation of cost components in health system financing

4.1. Method of estimation

This section examines the method of assessing the various components in the financing of the health system at the household level. Indeed, the problem is that these components are sometimes measured imprecisely or are even sometimes totally absent from the Swiss Survey

⁴ Health Maintenance Organisation.

⁵ In 2000 there were approximately 7.2 million insured in Switzerland

⁶ It concerns the average premium of an adult entering into an insurance contract with an ordinary excess of 230 Swiss francs.

of Incomes and Expenditure (SIE). To counteract these problems we developed a very simple estimation technique linking the macroeconomic data from national accounting to microeconomic data from the SIE sample.

A weighted sample of m households concerned with the value of a health service financing component x was used for this study. The population is composed of n households and the total sum of variable x for the total population is represented by X . The relationship between the x_i household values in the survey and the macroeconomic X value is found by using the intermediary of n_i weights assigned to the households.

$$(1) \sum_{i=1}^m n_i \cdot x_i = X ,$$

where n_i is the number of households in the total population representing household i in the survey. n_i is thus the inverse of the probability of the inclusion of household i in the survey. The problem for this case is that the x_i values cannot be observed. Therefore, instead of attempting to infer the macroeconomic value X from the survey data, the value of X can be used to estimate the values of x_i . This estimation is possible if the survey data contain a variable p which is assumed to be proportional to the unobserved variable x_i :

$$(2) x_i = \alpha \cdot p_i$$

Finally, combining equation (1) and (2) produces the following relationship:

$$(3) x_i = \frac{p_i \cdot X}{\sum_{i=1}^m n_i \cdot p_i}$$

The values of the unobserved x_i can also be estimated by using their macroeconomic aggregate X and the proportional values of a microeconomic variable p .

4.2. Choice of variables and hypotheses

The health system is financed directly in part by households, and in part by other economic agents. However, these agents are in turn financed by households. Consequently, the health system can be thought of as being entirely financed by households and the various financial schemes of the other economic agents can be thought of as being components in the total financing from households. The second column in table 2 presents the ten financial components of the health system used in this study. The first column in the table presents an aggregation of these components which is helpful for international comparisons.

The health system components were estimated at the household level by following the method described in section 2. The microeconomic values required for the estimations were obtained from the « Costs of Health System» (CHS). These macroeconomic statistics are the total annual finance from each economic agent involved in financing health. One difficulty results from the fact that the idea of what a household is differs between the CHS and the Swiss Survey of Income and Expenditure (SIE). Some adjustments need to be made in order to obtain valid macroeconomic values for private households, which is the notion used in the

SIE⁷. Hypotheses concerning how private households finance intermediary economic agents were formulated. Finally, within the SIE a proxy variable was chosen for each of the financial components of the health system. Columns 3 and 4 in table 2 present respectively the hypotheses formulated in addition to the proxy variables chosen.

A further explanation of the calculations concerns the modelling of the State used. In fact, the macroeconomic values for the various financial components provided by the State are not available in the CHS. Only the total financing contributed by the State is available. In addition, no tax allocated to health exists in Switzerland. Therefore, the State is supposed to finance the health system through three taxes, which are the direct tax, the tax on consumption and the tax on business. The values of the financial components of the State as an intermediary were obtained by dividing the total financing provided by the State through the three taxes on a pro rata basis.

⁷ Indeed, the ERC is a survey which only addresses private households, whereas the CSS groups private and collective households. The principal collective households are : establishments for the elderly, establishments for the handicapped, and prisons. The adjustments made are composed of estimating the various contributions from collective households to health system financing and the subtractions from CSS data.

Table 2: Hypotheses and choice of variables to estimate the health system costs

| Aggregated components of health system financing | Financial components of health system financing | Hypotheses | SIE variable used |
|--|---|--------------------------------------|--|
| State | Direct Tax | Supported by taxpayers | Total amount of tax paid |
| | Tax on consumption | Supported by taxpayers | Estimated total amount of VAT paid |
| | Tax on consumption | Supported by taxpayers | total income from interest and dividends |
| Social insurance companies | LAMAL health insurance | Supported by taxpayers | Amount of basic health insurance premiums |
| | LAA accident insurance | Supported by the employed | Amount of accident contributions |
| | AVS/AI ⁸ insurance | Supported by the employed | Sum of AVS/AI contributions |
| | Military insurance | Supported by the military servicemen | Number of men of military service age in the household |
| Private insurance | | Supported by taxpayers | Total amount of supplementary insurance premiums |
| Direct Tax | | Supported directly by households | Total amount of expenditure on health ⁹ |
| ISBL ¹⁰ | | Supported by private households | Total amount of donations to ISBLs |

⁸ Old age insurance and invalidity insurance

⁹ More precisely the sum of the expenditures on health services and the participation of the insurance costs.

¹⁰ Non-profit making Institutions which serve the households.

5. Presentation of the decomposition of the overall redistributive effect proposed by Duclos, Jalbert and Araar

5.1. Measure of inequality

The analysis of the redistributive effect caused by the financing of the health system was carried out using the Duclos, Jalbert and Araar method. Given that this decomposition is extremely recent and a good understanding of the method is necessary, the principal aspects of this decomposition are presented in detail.

The first section presents the class of inequality indices used in the decomposition. Let $R(r)$ be the quantile function of the distribution of incomes. This function can be interpreted as being that which gives the household income the relative ranking r ($r \in [0,1]$) in the ordered distribution of incomes according to their monotonic values. The class of inequality indices used in the analysis is based on the following function of social well-being:

$$W_R(\varepsilon, \nu) = \int_0^1 U_\varepsilon(R(r)) \omega(r, \nu) dr$$

$$(4) U_\varepsilon(y) = \begin{cases} \frac{y^{1-\varepsilon}}{1-\varepsilon} & \text{if } \varepsilon \in [0,1[\\ \ln(y) & \text{if } \varepsilon = 1 \end{cases}$$

$$\omega(r, \nu) = (1-r)^{\nu-1}, \nu \geq 1$$

The function of social well-being chosen by the authors was consequently a weighted sum of the individual benefits. The utility function $U_\varepsilon(\cdot)$ is defined as monotonic and concave. The parameter ε can be interpreted as a parameter of risk aversion. The weighting function $\omega(\cdot)$ was chosen so that the weights diminish with the rank of the household in the distribution of incomes. In other words, the company gives a larger weight to the lowest income households. The function of social well-being thus obeys the transfer principal of Pigou-Dalton. In addition, the rate of decline of the weights ω in relation to rank r is a linear function of ν . Furthermore, the larger the parameter ν , the more rapidly the weight diminishes when the rank increases. In other words, a large ν value makes the function of well-being very sensitive to changes in rank. Furthermore, ν can be interpreted as an aversion parameter to the rearrangement effect.

Starting with the function of social well-being, the equally distributed equivalent income ξ_R can be defined, being the income required by each household to reach the same level of social well-being W_R as the unequal distribution of incomes R . This income is calculated by applying the inverse of the utility function to the social well-being generated by the distribution of incomes. Finally, the class of inequality index $I_R(\varepsilon, \nu)$ is defined using the method presented by Atkinson in 1970. Equations (5) and (6) are the formal definitions of ξ_R and $I_R(\varepsilon, \nu)$ respectively

$$(5) \xi_R(\varepsilon, \nu) = U_\varepsilon^{-1}(W_R(\varepsilon, \nu))$$

$$(6) I_R(\varepsilon, \nu) = 1 - \frac{\xi_R(\varepsilon, \nu)}{\mu_R}$$

Now that the class of inequality index used has been defined, the analysis of the redistributive effect proposed by Duclos, Jalbert and Araar can be outlined. What is more, the authors developed two approaches in order to obtain results according to the change in inequality, and the costs of inequality. In this study, we used the change in inequality approach of their decomposition.

5.2. The decomposition according to the change in inequality approach

According to this approach, the overall redistributive effect is measured by the difference between the inequality indexes of the pre-tax and post-tax distributions. According to this convention, a positive redistributive effect indicates a decrease in the inequality. Clearly, the indices G and N are used to describe the variables respectively associated with incomes before and after taxation, the total redistributive effect being expressed by the following:

$$(7) \Delta I(\varepsilon, \nu) = I_G(\varepsilon, \nu) - I_N(\varepsilon, \nu)$$

The vertical effect is defined by the difference between the pre-tax distribution inequality index and the index of inequality of a fictitious income distribution obtained with the aid of taxation not generating either horizontal effects or rearrangement effects. This fictitious taxation leads to the pre-tax income of a household of rank r_G in the distribution of pre-tax incomes being equal to its expected net income before taxation. Furthermore, effect V measures the redistributive effect generated by the taxation system in the absence of both horizontal inequality and rearrangement effect. This difference is positive if the taxation system is progressive and negative if it is regressive. Equations (8), (9) and (10) respectively present the expressions of expected net income of the r_G ranking household, of social well-being associated with the fictitious distribution of incomes, and the definition of the vertical effect. The index of inequality $I_N^E(\varepsilon, \nu)$ is obtained by substituting $W_N^E(\varepsilon, \nu)$ with $W_R(\varepsilon, \nu)$ in equation (5) and by substituting $\xi_N^E(\varepsilon, \nu)$ with $\xi_R(\varepsilon, \nu)$ in equation (6).

$$(8) \bar{N}(r_G) = \int_0^1 N(r_N | r_G) dr_N,$$

$$(9) W_N^E(\varepsilon, \nu) = \int_0^1 U_\varepsilon(\bar{N}(r_G)) \omega(r_G, \nu) dr_G,$$

$$(10) V(\varepsilon, \nu) = I_G(\varepsilon, \nu) - I_N^E(\varepsilon, \nu)$$

The horizontal effect is defined by the difference between the inequality index of a fictitious income distribution obtained by using taxation not generating the rearrangement effect and the previously defined index of inequality $I_N^E(\varepsilon, \nu)$. This fictitious taxation leads to the utility level for a household of rank r_G in the distribution of pre-tax incomes being equal to its expected net utility before taxation. In the discrete case, the distribution of fictitious incomes obtained is that of the distribution of net incomes but in which the classification is that of the

distribution of gross incomes. Effect H measures the redistributive effect caused by classically defined horizontal inequality. This H effect can only be positive or null since the utility of the expected income is always greater than or equal to the expected utility in the case of concave utility functions. Equations (11), (12) and (13) respectively present the expressions of expected net income of the r_G ranking household, of social well-being associated with the fictitious distribution of incomes, and the definition of the horizontal effect. The index of inequality $I_N^P(\varepsilon, \nu)$ is obtained by using social well-being $W_N^P(\varepsilon, \nu)$ as well as expressions (5) and (6).

$$(11) \bar{U}_\varepsilon(r_G) = \int_0^1 U_\varepsilon(N(r_N | r_G)) dr_N$$

$$(12) W_N^P(\varepsilon, \nu) = \int_0^1 \bar{U}_\varepsilon(r_G) \omega(r_G, \nu) dr_G$$

$$(13) H(\varepsilon, \nu) = I_N^P(\varepsilon, \nu) - I_N^E(\varepsilon, \nu)$$

Finally, the R effect is defined as being the difference between the index of inequality of the post-tax distribution and the previously defined $I_N^P(\varepsilon, \nu)$. The R effect is thus the redistributive effect of rearrangement caused by taxation. This effect is positive or null since the social well-being $W_N^P(\varepsilon, \nu)$ is always greater than or equal to $W_N(\varepsilon, \nu)$. Indeed, the classification of the pre-tax distribution is preserved, $W_N^P(\varepsilon, \nu)$ assigns very important normative weights to individuals whose rank in the post-tax distribution is higher than the one they have in the pre-tax distribution. Furthermore, certain individuals whose rank is improved are under-weighted leading to an increase in the social well-being function. Expression (14) provides the formal definition of the effect of rearrangement.

$$(14) R(\varepsilon, \nu) = I_N(\varepsilon, \nu) - I_N^P(\varepsilon, \nu)$$

Finally, by combining equations (7), (10), (13) and (14) the expression of the decomposition of Duclos, Jalbert and Araar according to the change in inequality approach is obtained:

$$(15) \Delta I(\varepsilon, \nu) = V(\varepsilon, \nu) - H(\varepsilon, \nu) - R(\varepsilon, \nu)$$

6. Estimation

In order to carry out the calculations, a weighted version of the social well-being estimator presented by Duclos, Jalbert and Araar was used:

$$(16) \hat{W}_R(\varepsilon, \nu) = \sum_{i=1}^m U_\varepsilon(r_i) \left[\left(\frac{n - \sum_{j=1}^{i-1} n_j}{n} \right)^\nu - \left(\frac{n - \sum_{j=1}^i n_j}{n} \right)^\nu \right]$$

where m representing the number of households in the sample, n the number of households in the population, and n_i the household weights. R is any distribution of incomes classified in

increasing order. In order to obtain the expression of the estimator $\hat{W}_G(\varepsilon, \nu)$, it is sufficient to replace R with the distribution of incomes before financial classification in increasing order. To obtain the estimator $\hat{W}_N(\varepsilon, \nu)$, R needs replacing with the distribution of incomes after financing, classified by increasing order. The expression of $\hat{W}_N^P(\varepsilon, \nu)$ is obtained by replacing R with the distribution of incomes after financial classification according to the incomes before financing. Finally, in order to obtain the expression of $\hat{W}_N^E(\varepsilon, \nu)$, prior estimation of the function that relates the revenues before and after financing must be carried out. This estimation was carried out non-parametrically using a normal kernel and a variable bandwidth fixed by local cross-validation. Finally, R needs to be replaced by the distribution of incomes after financing estimated for each value of income before financing and this distribution classified according to the incomes before financing. The estimators $\hat{V}(\varepsilon, \nu)$, $\hat{H}(\varepsilon, \nu)$ and $\hat{R}(\varepsilon, \nu)$ are then easily obtained, beginning with the equations (5), (6), (10), (13) and (14). The standard deviation was estimated using the bootstrap method. The density function of the incomes before and after financing was estimated non-parametrically, and after that the resampling was carried out utilising this density function. The non-parametric estimation was carried out using a normal kernel and the bandwidth was fixed by referring to a normal law.

7. Results

Table 3 presents the results of the decomposition and the redistributive effect caused by the total financing of the health system. The first column in the table contains the total redistributive effect. The three following columns respectively contain the V, H and R effects, and the three final columns present the measurement of these effects in comparison with the total redistributive effect. Calculations were carried out for the years 1998 and 2000. The last line of the table contains the variation in the effects between these two years. The standard deviations are indicated in brackets.

Firstly, it can be seen that the redistributive effect for the two years studied is negative. This means that the financing of the health system contributes to an increase in the inequality in the incomes distribution. The increase in this trend measured between 1998 and 2000 is not significant. However, in our opinion continuing to measure the evolution of this redistributive effect may be important so that the possible existence of a longer term trend may be demonstrated.

The V, H and R effects are all significant for both years studied. Moreover, the horizontal inequality measured for the year 2000 is at the limit of significance. In addition, it can be seen that it is the regressivity of the financing system that explains the larger part of the total redistributive effects at percentages of 89.5% et 83.7% for 1998 and 2000 respectively. On the contrary, a significant increase in the rearrangement effect was measured. In 1998, the H and R effects were of the same order of magnitude whereas in 2000 the rearrangement effect was clearly much stronger than the horizontal inequality.

Table 3 : Decomposition of the redistributive effect caused by the total financing of the health system

| | ΔI | V | H | R | $ V/ \Delta I $ | $ H/ \Delta I $ | $ R/ \Delta I $ |
|-----------|-----------------------|-----------------------|-----------------------|----------------------|------------------|-------------------|------------------|
| 1998 | -0.01921 (0.00083) | -0.01720 (0.00088) | 0.00095 (0.00029) | 0.00106 (0.00011) | 0.895 (0.026) | 0.049 (0.017) | 0.055 (0.012) |
| 2000 | -0.02055 (0.00137) | -0.01721 (0.00149) | 0.00094 (0.00052) | 0.00241 (0.00039) | 0.837 (0.054) | 0.046 (0.029) | 0.117 (0.034) |
| Variation | -0.00134 (0.00171) | -0.00001 (0.00181) | -0.00001 (0.00065) | 0.00134 (0.00043) | 0.058 (0.062) | -0.003 (0.036) | 0.062 (0.038) |

With the aim of explaining the reasons for the increase in inequality caused by the financing of the health system, the various components of the total financing were analysed. Table 4 presents the total redistributive effect for the aggregated components in the health system financing. Once again calculations were carried out for the years 1998 and 2000. The final column in this table contains the variation of the redistributive effect for both years. It can be seen that only two components clearly have a significant redistributive effect. These are direct financing and financing through intermediary social insurance companies. The two components generate a negative redistributive effect and consequently contribute to increasing the inequality in the distribution of incomes.

Table 4 : Total redistributive effect caused by the various financial components of the health system

| Financial components of health system financing | 1998 | 2000 | Variation |
|---|-----------------------|-----------------------|-----------------------|
| State | 0.00057 (0.00062) | 0.00054 (0.00132) | -0.00004 (0.00136) |
| <i>Social insurance companies</i> | -0.01075 (0.00053) | -0.01139 (0.00132) | -0.00064 (0.00137) |
| Private insurance | -0.00154 (0.00075) | -0.00176 (0.00137) | -0.00022 (0.00145) |
| Private households | -0.00542 (0.00063) | -0.00733 (0.00155) | -0.00191 (0.00153) |
| Autre financement privé | -0.00016 (0.00057) | -0.00015 (0.00098) | -0.00002 (0.00110) |

Furthermore, the total redistributive effect is essentially explained by the direct financing and by the financing provided by intermediary social insurance companies. Therefore, the analysis

was continued with the decomposition of the redistributive effect caused by the two components. The results are presented in tables 5 and 6.

It can be seen that in 1998 the regressivity of direct financing explains 80.7% of the total redistributive effect. This share was greatly diminished in 2000 because of a significant increase in the rearrangement effect. This increase in the rearrangement effect has already been observed in this analysis of the redistributive effect caused by the total financing. Therefore, it can be confirmed that this increase in the *R* effect stems from direct financing.

Regarding the financing provided by intermediary social insurance companies, it can be seen that it exclusively generates a redistributive effect through regressivity. Indeed, this financing does not generate either horizontal inequality or rearrangement effects. In addition, the total redistributive effect caused by the social insurance companies is twice as large as that generated by direct financing. Furthermore, the social insurance companies are principally responsible for the increase in inequality in the distribution of incomes during the financing of the health system. Therefore, the redistributive effect of the various insurance companies composing the aggregate of social insurance companies was analysed. It is apparent that only basic Lamal health insurance has a significant effect. In addition, its structure of inequality is very close to that presented in table 6 and consequently it has not been reproduced. The Lamal health insurance is thus strongly regressive but does not generate horizontal inequality or rearrangement effects.

Table 5 : Decomposition of the redistributive effect caused by the total direct financing from households

| | ΔI | V | H | R | $ V/ \Delta I $ | $ H/ \Delta I $ | $ R/ \Delta I $ |
|-----------|-----------------------|-----------------------|----------------------|----------------------|------------------|-------------------|------------------|
| 1998 | -0.00542 (0.00063) | -0.00438 (0.00061) | 0.00052 (0.00014) | 0.00053 (0.00009) | 0.807 (0.162) | 0.095 (0.075) | 0.097 (0.089) |
| 2000 | -0.00733 (0.00155) | -0.00427 (0.00139) | 0.00112 (0.00046) | 0.00194 (0.00047) | 0.582 (0.425) | 0.153 (0.170) | 0.265 (0.260) |
| Variation | -0.00191 (0.00153) | 0.00011 (0.00132) | 0.00060 (0.00048) | 0.00142 (0.00047) | 0.058 (0.407) | -0.003 (0.162) | 0.062 (0.253) |

Table 6 : Decomposition of the redistributive effect caused by the total financing from intermediary social insurance companies

| | ΔI | V | H | R | $ V/ \Delta I $ | $ H/ \Delta I $ | $ R/ \Delta I $ |
|-----------|-----------------------|-----------------------|-----------------------|----------------------|-------------------|------------------|------------------|
| 1998 | -0.01075 (0.00051) | -0.01075 (0.00015) | -0.00001 (0.00029) | 0.00009 (0.00007) | 0.992 (0.031) | 0.001 (0.017) | 0.008 (0.018) |
| 2000 | -0.01139 (0.00132) | -0.01129 (0.00132) | 0.00002 (0.00024) | 0.00009 (0.00022) | 0.990 (0.106) | 0.001 (0.052) | 0.008 (0.057) |
| Variation | -0.00064 (0.00137) | -0.00062 (0.00138) | 0.00002 (0.00029) | 0.00000 (0.00023) | -0.002 (0.109) | 0.000 (0.054) | 0.000 (0.058) |

8. Conclusion

In this study we applied the very recent decomposition of Duclos, Jalbert and Araar to the redistributive effect caused by the financing of the Swiss health system for the years 1998 and 2000. Calculations for the financing of the system taken in its entirety, and equally for its component parts, were carried out. Because of a lack of quality data at a disaggregated level for Switzerland, the various financial components of the health system were estimated beforehand at the level of the household. In order to do this, we developed a simple estimation technique associating the proxys for the unobserved financial components with macroeconomic data.

The principal results show that the financing of health has the effect of increasing inequality in the distribution of incomes. Comparison of redistributive effects in the years 1998 and 2000 do not reveal any significant increase in the phenomenon. On the other hand, it seems pertinent to continue with measurements for several years to come in order to discover a possible longer term trend. It was observed that direct financing by the households and the financing by the social insurance Lamal are responsible for the bulk of the total redistributive effect. The direct financing is in effect regressive and is accompanied equally by horizontal inequality and by a rearrangement effect. Furthermore, this rearrangement effect significantly increased between 1998 and 2000. The financing of Lamal insurance causes a negative redistributive effect approximately twice as strong as that caused by direct financing. The redistributive effect caused by the Lamal insurance possesses the particular characteristic of only being composed of a regressive vertical effect. Indeed, finance from Lamal insurance generates neither horizontal inequality nor rearrangement effect. The severe regressivity of financing from Lamal health insurance intermediaries arises without doubt out of the fact that the insurance premiums are fixed per head without bearing any relationship to the income of the individuals. Furthermore, the premium as a proportion of income is so much greater when the income of an individual is low. The subsidies granted by the State to individuals who have a modest income do not compensate sufficiently for this effect.

Regarding the quality of the results obtained, it has only been possible to show the important effects. Indeed, when the authors wanted to analyse the redistributive effects caused by each component of the health system, there were too few results significantly different from zero. It is evident that the more the financing disaggregates, the more the importance of each financial component decreases. Consequently, the impact of this financing on the distribution is reduced. On the other hand, we feel that if there had been better quality data available, the quality of the analysis would have been better. Indeed, the fact of having to work with proxys certainly implies an increase in the variability of the results, so that it has the effect of masking the end results. The lack of quality disaggregated data in the health sector remains an important problem in Switzerland.

To apply the decomposition of Duclos, Jalbert and Araar on the total financing produces very interesting results. The problem is that the same starting distribution is always referred to in order to find out the distribution of incomes after financing. Consequently, the sum of the effects caused by the different components is not equal to the effect caused by the total financing. A decomposition of the Duclos Jalbert and Araar decomposition according to the financing components would be very useful for results interpretation. Finally, this study is limited to analysing the financing of the health system independently from all other considerations. And yet, it will certainly be interesting to integrate the state of health of individuals composing the households in the analysis.

References

- Aronson, J.R., Johnson P and Lambert P.J (1994), "Redistributive Effect and Unequal Income Tax Treatment", *The Economic Journal*, Vol. 104, 262-270.
- Aronson, J.R., Lambert P.J. (1994), "Decomposing the Gini coefficient to reveal the vertical, horizontal, and reranking effects of income taxation", *National tax Journal* 47(2) : 273-294.
- Atkinson A.B. (1970), "On the Measurement of Inequality", *Journal of Economic Theory*, 2(3), 244-263.
- Duclos, J.-Y., Jalbert V., Araar A. (2003), "Classical Horizontal Inequity and Reranking: an Integrated Approach", *Research on Economic Inequality*, vol. 10, pp. 65-100.
- Duclos, J.-Y., Lambert P.J. (2000), "A Normative Approach to Measuring Classical Horizontal Inequity", *Canadian Journal of Economics-La Revue canadienne de science économique*, vol. 33, #1, February, 87-113.
- European Observatory on Health Care Systems (2000), "Health Care Systems in Transition, Switzerland".
- Office Fédéral de la Santé Publique (2004), "Statistique de l'assurance-maladie de base 2002", *Office Fédéral de la Santé Publique, 2004*
- Office Fédéral de la Statistique (2003a), "Coûts du système de santé : Résultats détaillés 2001 et évolution depuis 1996", ISBN : 3-303-14076-6, Neuchâtel.
- Office Fédéral de la Statistique (2003b), "Une introduction à la théorie et à la pratique des Comptes nationaux, Méthodes et concepts du SEC", ISBN : 3-303-04068-0, Neuchâtel.
- Silverman B. W. (1986), "Density Estimation for Statistics and Data Analysis", *Chapman and Hall, London and New-York*.
- Wagstaff, A., E. van Doorslaer (1997), "Progressivity, horizontal equity and reranking in health care finance : a decomposition analysis for the Netherlands", *Journal of Health Economics* 16 : 499-516.
- Wagstaff, A., E. van Doorslaer and al. (1999a), "Equity in the finance of health care : some further international comparisons", *Journal of Health Economics* 18 : 263-290.
- Wagstaff, A., E. van Doorslaer and al. (1999b), "The redistributive effect of health care finance in twelve OECD countries", *Journal of Health Economics* 18 : 291-313.