THE ACTUARIAL USES OF HEALTH SERVICE INDICATORS AND PROJECTIONS OF HEALTH SERVICE EXPENDITURES IN CROATIA

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ABSTRACT

The level of future health service expenditure is one of the most important issues in planning and calculating contributions for social health insurance and premiums in private health insurance. Working without knowing trends in health expenditures and utilisation of health care, or misjudgement of those trends, could cause serious problems in conducting the business of the state health insurance funds and especially in private insurance companies. Therefore it is useful to build a model for projecting future health service expenditures and risk cost per insured person.

Based on the data in the National Health Service reports for the past periods, and assumptions about future trends, it is possible to project future health service performance. Overall health care expenditures depend on the two basic parameters: the price of the health care service and the utilisation of health services. Both parameters depend on a lot of subparameters and some of the subparameters, for example organization of health care provision, introduction of new methods of treatment, appearance of new diseases, cannot be predicted for the long term. It leads us to make sensitivity tests of the stochastic model in respect of changes of the assumed parameters.

The model is based on the data of the Croatian National Institute of Public Health and other Croatian statistics.

KEYWORDS

health care, health expenditures, stochastic modelling, Monte Carlo method

1. INTRODUCTION

Every Croatian citizen is entitled to receive basic health care. In 1993 a new Health Insurance Act and a Health Care Act were adopted which have introduced a new approach to health, establishing a base for subsequent health insurance development. The new legislation permits the opening of private practices and the founding of private institutions. Coupled with the current national insurance scheme it also permits the introduction of supplementary and private health insurance schemes.

Through the compulsory (national) insurance scheme, insured persons are entitled to health care as well as to compensation and allowances in connection with health care. Health care includes:

1. primary health care including dental health care (general medicine, school medicine, hygienic and epidemiological care, dental care, emergency health services, occupational medicine, primary health care of women and children and community nursing),
2. drugs by prescriptions,
3. polyclinical - consultative specialist health care (specialised outpatient diagnostics and treatments provided by specialised health workers in outpatient clinics and hospitals),

4. inpatient health care (health care in general and specialized hospitals and health resorts),
5. orthopaedic devices and prostheses.

Compensations and allowances include:

1. sick leave compensation including maternity leave compensation, compensation for longer maternity leave and work less than full - time,
2. coverage of travelling expenses, travelling allowances and transportation expenses in connection with health care,
3. layette assistance,
4. funeral expenses reimbursement.

All insured persons, except for some special categories like children under 15 years, have to meet some health care expenses, which can be paid on the spot or through voluntary supplementary health insurance.

Voluntary health insurance may be either supplementary health insurance or private health insurance.

Supplementary health insurance provides for services which are supplementary to the compulsory health insurance. It may be provided by an insurance company or directly by a health institution or private health worker on the basis of a written agreement. Only a person with the status of an insured person with compulsory health insurance is entitled to supplementary health insurance.

Private health insurance is voluntary health insurance, which provides for complete health insurance for the insured person. It may be provided only by an insurance company. By taking out private health insurance an insured person looses the right to receive benefits under compulsory health insurance. The level of health care and service provided by private health insurance must be at least equal to that of compulsory health insurance. Someone may join private health insurance only if their annual income in the previous year was more than a prescribed limit.

In Croatia in 1995 total health expenditure amounted to 8,22% of gross domestic product (GDP) and 311 US dollars per capita, the latter being much lower than in EU countries.

2. MODEL DESCRIPTION

2.1 Data

The model is based on two data sources:

1. The Croatian Health Service Yearbooks for the period 1975 - 1996,
2. The Croatian Statistical Yearbooks for the period 1975 - 1996.

The Croatian Health Service Yearbooks are based on the data collected from all parts of the national health system. This ensures data coverage but it also results in some omissions and anomalies. The data used in the simulations were not modified to allow for any such anomalies because it was beyond the scope of the paper.

The data used in the model are mostly multi-year series and a certain lack of comparability is present for data expressed in monetary values due to denominations and changes of monetary units, but mostly due to high inflation. Therefore, in order to make the data comparable, all monetary amounts from different years have been converted to the 1996 value in kunas, using retail price indices and denomination factors published in the Statistical Yearbooks. Consequently, in analyses of expenses, inflation, other than health expenditure inflation, was not included and has therefore been separately modelled.

2.2 Model

According to the Health Insurance Act, the compulsory health insurance provides health care as well as compensation and allowances in connection with health care. In order to follow this structure, the model is built with nine submodels:

1. primary health care,
2. polyclinical - consultative specialist health care,
3. inpatient health care,
4. drugs by prescription,
5. orthopaedic devices and prostheses,
6. other health care expenditures,
7. travelling expenses,
8. sick and maternity leave compensation,
9. other compensation (allowances).

Submodels 1 - 6 represent the health care part of the health insurance and submodels 7 - 9 the compensation and allowances part. Other expenditures, such as system operating expenditures or special projects, have not been included in the model.

It is important to analyse the submodels separately, since their performance differs from one another during the observed period and changes in the underlying factors, such as changes in the regulations concerning rights of insured persons, have a different impact on them.

In 1996 the submodels for *primary health care*, *polyclinical - consultative specialist health care* and *inpatient health care* covered 57% of total health insurance expenditures and 62% of total utilisation of health insurance services. Similar results can be observed in other years.

The time period in the model is one year and a unit of population is 1 insured person.

In all submodels the risk cost is the expenditure for that submodel per unit of population measured over a time period. It has been calculated as the product of claim frequency and claim severity, except for the *other health care expenditure* submodel where it has been calculated directly. The total health insurance risk cost is obtained by summing the risk costs of all the submodels.

Claim frequency is the number of claims arising in a time period divided by the exposure for that period. It is the average measure of utilisation of health care. The definition of claim frequency for each submodel is given below:

1. *primary health care*: the number of patient visits per unit of population measured over a time period,
2. *polyclinical - consultative specialist health care*: the number of patient visits per unit of population measured over a time period,
3. *inpatient health care*: the number of hospitalizations per unit of population measured over a time period,
4. *drugs by prescription*: the number of drugs by prescription per unit of population measured over a time period,
5. *orthopaedic devices and prostheses*: the number of orthopaedic devices and prostheses per unit of population measured over a time period,
6. *other health care expenditures*: not defined,

7. *travelling expenses*: the amount of reimbursed travel expenses per unit of population measured over a time period,
8. *sick and maternity leave compensation*: the number of sick and maternity leave days per unit of population measured over a time period,
9. *other compensation*: the amount of layette assistance and reimbursed funeral expenses per unit of population measured over a time period.

Claim severity is the mean claim size. It is the average expenditure per utilisation of health care. The claim severities of the submodels are defined as:

1. *primary health care*: the average expenditure per patient visit measured over a time period,
2. *polyclinical - consultative specialist health care*: the average expenditure per patient visit measured over a time period,
3. *inpatient health care*: the average expenditure per hospitalization measured over a time period,
4. *drugs by prescription*: the average expenditure per drug by prescription measured over a time period,
5. *orthopaedic devices and prostheses*: the average expenditure per orthopaedic device and prosthesis measured over a time period,
6. *other health care expenditures*: not defined,
7. *travelling expenses*: the average expenditure per reimbursement measured over a time period,
8. *sick and maternity leave compensation*: the average expenditure per day measured over a time period,
9. *other compensation*: the average expenditure per assistance and reimbursement measured over a time period.

For the *inpatient health care* submodel claim severity is observed through two factors:

$$\text{severity} = \text{average length of treatment} * \text{average expenditure per day of treatment}$$

where

$$\text{average length of treatment} = \frac{\text{number of bed days}}{\text{number of hospitalizations}}$$

and

$$\text{average expenditure per day of treatment} = \frac{\text{total expenditure}}{\text{number of bed days}}.$$

The two factors are observed separately, since their performance can differ, especially with the introduction of new treatment techniques or drugs. Even if the cost of treatment is the same, the average length of treatment can be shortened but the average expenditure can rise. These two factors are also important for analysing the performance of inpatient health care departments.

In the *other health care expenditures* submodel claim frequency and claim severity are not defined since adequate data for the utilisation of health care service are not available. For this submodel the risk cost is calculated directly from the expenditures as

$$\text{risk cost} = \frac{\text{other health care expenditures}}{\text{population number}}.$$

Most of the analysed data demonstrate mainly rising trends. In modelling, the percentage change from year to year was observed and an adequate distribution fitted rather than observing the distribution of actual numbers occurring.

In the model no assumptions are made about claim frequency and claim severity distributions. Past data are analysed and distribution assumptions are made for percentage change of population, inflation, medical inflation and utilisation of health care services, compensation and allowances. Based on those assumptions, population numbers, utilisation of health insurance services and health expenditures are modelled for each submodel. Claim frequency, claim severity and claim risk are calculated for each submodel according to the previously given definitions.

Projections for population numbers, utilisation of health insurance services and health expenditures are given by the formulae:

1. population

$$P(t) = P(t-1)*(1+PP(t))$$

2. utilisation of health insurance

$$U_i(t) = U_i(t-1)*(1+PU_i(t))*(1+PP(t))$$

3. expenditures

$$E_i(t) = E_i(t-1)*(1+MI_i(t))*(1+PU_i(t))*(1+PP(t))*(1+I(t))$$

where

t - observed year,

i - submodel index,

P(t) - projected population number (number of insured persons) in year t,

PP(t) - projected annual percentage change of population in year t,

$U_i(t)$ - projected number of utilisation of health insurance services in year t for submodel i,

$PU_i(t)$ - projected annual percentage change of utilisation of health insurance services per capita in year t for submodel i,

$E_i(t)$ - projected expenditures in year t for submodel i,

$MI_i(t)$ - projected annual percentage change in medical care price in year t for submodel i,

I(t) - projected annual percentage change in retail price index in year t.

Depending on the submodel, the extent of utilisation is measured by patient visits, number of hospitalizations, number of drugs or similar measures, which comprise morbidity as well as prevention, control and other use of health services.

The projected annual percentage change of utilisation of health insurance services per capita reflects also shifts in the demographic mix, like a shift towards a more aged population.

The annual percentage change in the retail price index reflects economy wide cost pressures that are external to the health care industry.

Annual percentage changes in medical care prices, deflated to the 1996 level by retail price indices, measures changes in medical care prices which originate from the health care industry. It captures the implicit underlying interplay of factors like changes in coinsurance level, cost pressures specific to the industry, supply - side pricing behaviour, and supply - side productivity behaviour. Since the percentage change in medical care prices is not officially published, it is deduced from the past health expenditure data. Therefore, it includes also the impact of some factors other then changes in the numbers in the population, changes in utilisation of health care services and general inflation. Those factors could be a change in the number of diagnostic and therapeutic procedures provided per visit or inpatient day or changes in the mix of services.

Investigations conducted in the United States concerning the increase of health expenditures showed that about one third of the growth in health care expenditures per capita would be attributable to changes in the quantity of medical services (both from changing demographics and changing utilization and intensity patterns) and the rest of the growth (two thirds) would be due to relative medical price inflation. As will be shown, Croatian results are similar and therefore medical inflation is modelled separately. Observing its behaviour could provide valuable data to permit adequate actions to be taken in time.

In the *other health care expenditures* submodel projections of expenditure are given by the formula:

$$E(t) = E(t-1) * (1 + PE(t))$$

where

E(t) - projected expenditures in year t for the submodel *other health care expenditures*,

PE(t) - projected annual percentage change of expenditures in year t for the submodel *other health care expenditures*.

The percentage change of expenditures for the submodel *other health care expenditures* includes the impact of changes in the numbers in the population, changes in utilisation of health care services and changes in medical care prices.

When analysing data covering several years, which is a 22 year period in this case, claim sizes are often subject to other systematic changes besides the effect of inflation and monetary changes. New drugs, treatments and equipment are invented, and new diseases appear, which all make healthcare provision and healthcare insurance data and statistics subject to variations that make forecasting extremely difficult. Therefore the dynamic financial model which is constructed has to be robust enough to withstand these variations in all reasonable circumstances. (Orros et.al., 1993) One way of overcoming this problem is to make sensitivity analyses, to consider more than one model for input parameters and to check for agreement between the estimates from the different models.

3. MODEL ASSUMPTIONS

3.1 Population

The population projections used in the model are deterministic ones based on the Projections of Croatian Population for years 1981-2011, which were issued in 1989. Projections are based on the "de jure" principle and made in five years intervals, for years 1986, 1991, 1996, 2001, 2006 and 2011. In the population projections changes in the mortality rates and migration due to the war have not been taken into account, since this is far beyond the scope of this paper.

An assumption is used in the model that in all years 96% of the population are insured persons according to the definition in the Health Insurance Act. This assumption is based on the average rate of insured persons in the population in the period 1992-1995.

3.2 Inflation

In the period 1987-1993 Croatian market suffered from hyperinflation (120% - 1500% per annum) and in the period 1975 - 1994, excluding hyperinflation years, average annual inflation was 38%. The annual inflation rate only fell under 5% p.a after 1995.

As a result of the end of war operations in Croatia and the process of reorganization towards a market economy, lower inflation rates are to be expected in comparison to those which were present in Croatia in the past. Therefore, in the basic model, inflation is modelled by the Wilkie model for the retail price index with unit normal random variables for the noise term, without allowing for random shock inflation and with parameters based on the UK data for period 1919-1982

$$\bar{i}=0{,}05;\ \alpha=0{,}6;\ \sigma_i=0{,}05.$$

The Wilkie model for the UK retail price index is based on autoregressive models. Arguing that:

1. proportional rather than absolute changes are important for all the index variables,
2. there is no "natural" level of retail prices,
3. the logarithm of the retail price index is not stationary

Wilkie based his model on the annual differences $\Delta(t) = \ln I(t) - \ln I(t-1)$ where $I(t)$ is the value of the retail price index at time t.

Empirical observations show that $\Delta(t)$ is distributed roughly symmetrically and roughly normally, with a correlation coefficient between successive values of $\Delta(t)$ of about 0,6 in the UK and other countries. The noise term in the Wilkie model, which introduces stochastic variation into the model, is assumed to be normally distributed with zero mean and expressed as product of a standard deviation and a unit normal random variable.

The retail price index $I(t)$ is given by

$$\ln\left(\frac{I(t)}{I(t-1)}\right) = \bar{i} + \alpha * \left[\ln\left(\frac{I(t-1)}{I(t-2)}\right) - \bar{i}\right] + \sigma_i * \varepsilon(t)$$

where

$I(t)$ is the value of the retail price index at time t,

$\bar{i}$ is the average rate of inflation,

α is non-zero autoregression coefficient ($0<\alpha<1$),

σ_i is the standard deviation of the noise term,

$\varepsilon(t)$ is a unit normal random variable, independent and identically distributed for different values of t.

3.3 Health Insurance Data

As a result of the war situation, reports from occupied territories were not collected after the year 1991 and therefore a big drop in reported utilisation of health services and health expenditures occurs for some services. In 1992 a drop occurs in the expenditures for most of the services except for orthopaedic devices and prostheses due to the war injuries. In 1995 the provision of health care services became more restrictive, which resulted in a temporary drop in the utilisation and expenditures for some services. At the same time, in the middle of 1995 occupied territories were included again, which is partly the reason for the rise in the figures for 1995 and 1996. Since adequate data are not available to distinguish changes due to inclusion of reports from previously occupied territories from changes in utilisation of services, all changes have been attributed to the changes in utilisation of service. In the process of analysing data and choosing the model distributions, unusually big changes were omitted.

In modelling claim severity simplifying assumptions are used for expenditures. It is assumed that expenditures per utilisation do not vary by specialization, length of hospitalization, drug or similar submodel factors. For example, in the *inpatient health care* submodel, it is assumed that all hospital days cost the same, regardless of speciality or length of stay in hospital. This is a simplification of the real world, since shorter stays can be more expensive per day due to the intensity of treatment. The distinction can be made also for the first few days in hospital and the rest of the stay, since first days are usually more intensive in respect of diagnostic and treatment procedures. The available data does not permit such distinctions.

Four distributions (normal, lognormal, gamma distribution with parameters defined by method of moments and by maximum likelihood method) were fitted to the past data to obtain distributions for the percentage change in the utilisation of health services and the percentage change in the medical service prices for each submodel. The performances of the fitted distributions are measured by chi-squared test.

Three sets of distribution assumptions for the percentage change in the utilisation of health services and in medical service prices are considered. In the submodel *other health care expenditures,* assumptions about percentage changes in health expenditures are considered and in the *inpatient health care* submodel, changes in the number of bed days. The basic set of assumptions uses the distributions with best fit. For the sensitivity analyses, distributions with second best fit are chosen for the second set of assumptions and the third set of assumptions are distributions with worst fit which in some cases even means rejection of the distribution according to the chi - squared test.

4. SIMULATIONS RESULTS

Projections are made for a fifteen-year period from 1997 – 2011 with the starting data being from 1996. The model simulations were made on the Gateway 2000 personal computer, 150 MHz. with Crystal Ball version 4.0 software in conjunction with Excel 7.0. for running Monte Carlo simulations. Simulations are made with 10.000 iterations with seed 999. Observed simulation results are represented by mean values. All monetary amounts are expressed in kunas.

4.1 Retrospective test

To test the correctness of the model on the past data, the model was adapted to project expenditures for a fifteen-year period 1982-1996 with 1981 data used for model starting data, except for *travelling expenses* and *orthopaedic devices and prostheses* submodels where for the utilisation of health care services, 1991 figures were used since data for the period 1975 - 1990 are not available. Comparison of projected and past data is given in the Appendix, **Figure 1**.

Results show that the model correctly projects trends in the period 1982 - 1990. Discrepancies in the period 1991 - 1996 are due to the unusual behaviour of the health insurance system due to the war situation and the reorganization of health care services.

The behaviour of health expenditures in the period 1991 - 1996 leads us to consider the introduction of an additional residual term in the expenditures' projection formula. The residual could be with relatively high standard deviation and its activation could depend on a random number generator according to a specified probability distribution.

4.2 Results

Results of simulations for overall expenditures and utilisation of health services are given in the Table 1 and Table 2. Claim frequency, claim severity and risk cost per person have similar behaviour.

Table 1

EXPENDITURES' MEAN, STANDARD DEVIATION AND MEAN STANDARD ERROR

YEAR	MEAN	STANDARD DEVIATION	MEAN STANDARD ERROR
1997	8.713.907.350	894.243.661	8.942.437
1998	9.359.025.308	1.501.679.088	15.016.791
1999	10.083.691.631	2.159.600.133	21.596.001
2000	10.887.421.248	2.834.268.692	28.342.687
2001	11.814.153.877	3.625.518.001	36.255.180
2002	12.826.872.029	4.474.223.832	44.742.238
2003	13.937.376.167	5.460.491.867	54.604.919
2004	15.181.738.572	6.580.118.393	65.801.184
2005	16.534.964.604	7.943.933.627	79.439.336
2006	18.048.280.424	9.394.750.576	93.947.506
2007	19.622.122.191	10.848.074.473	108.480.745
2008	21.339.318.492	12.569.886.616	125.698.866
2009	23.359.860.237	15.292.015.728	152.920.157
2010	25.539.586.928	17.629.330.548	176.293.305
2011	27.943.208.693	20.686.452.817	206.864.528

All results have a rising tendency throughout the observed period except utilisation of health services and claim frequency at the beginning of the period. The dispersion of the results, especially during the first years, is rising more rapidly. While the expected value for risk costs rose three times from the beginning to the end of period, the standard deviation rose almost 23 times. Projections of the utilisation of health services and consequently claim frequency are more stable then projections of health expenditures, claim severity and risk costs, since projections of health expenditures depend on several uncertain factors.

Graphical presentation of historical and projected total health expenditure performance for period 1976 - 2011 is given in the Appendix, **Figure 2**. All data are deflated to the 1996 level in kunas since monetary changes and denominations otherwise make comparisons impossible.

Table 2

HEALTH SERVICE UTILISATION'S MEAN, STANDARD DEVIATION AND MEAN STANDARD ERROR

YEAR	MEAN	STANDARD DEVIATION	MEAN STANDARD ERROR
1997	88.774.481	3.833.638	38.336
1998	88.741.299	5.357.224	53.572
1999	88.807.984	6.482.603	64.826
2000	88.858.159	7.402.616	74.026
2001	89.031.064	8.216.443	82.164
2002	89.184.206	8.950.431	89.504
2003	89.363.476	9.579.087	95.791
2004	89.547.281	10.117.609	101.176
2005	89.809.128	10.619.937	106.199
2006	90.205.965	11.096.538	110.965
2007	90.541.188	11.577.777	115.778
2008	90.876.559	11.967.044	119.670
2009	91.340.713	12.446.009	124.460
2010	91.807.732	12.780.186	127.802
2011	92.341.592	13.196.382	131.964

Projected claim frequencies and claim severities of submodels are observed. *Primary health care*, *drugs on prescription* and *sick and maternity leave compensations* submodels have significantly higher claim frequencies than other submodels. Most submodels have decreasing trends for claim frequency except *primary health care*, *polyclinical - consultative specialist health care* and *orthopaedic devices and prostheses* submodels where the trends are increasing ones. Claim severity for the *inpatient health care* submodel is several times bigger than other submodels' claim severity. In all submodels claim severity has a rising tendency. A graphical presentation of the submodels' frequency for the period 1996 - 2003 is given in the Appendix, **Figure 3**.

The average annual expenditures' growth rates for the observed period 1997 - 2011 were computed for four factors accounting for the expenditures' growth: population, utilisation of health insurance services, medical service prices and inflation. Average annual growth rate is computed for each factor in each observed year for all submodels, except *other health care expenditures* submodel for which data are not available, and from this overall average annual growth rates in the period are obtained for each factor. Negative growth rates resulting from declines in utilisation of health services or medical care prices for some submodels are included to demonstrate their negative impact on the overall growth. To obtain the relative contribution of factors without inflation, expenditures are deflated to 1996 level. The relative contribution of each factor to the total growth is represented by relative proportion figures. Growth rates and relative proportions for the four factors are given in Table 3.

Table 3

FACTORS ACCOUNTING FOR GROWTH IN EXPENDITURES

FACTORS ACCOUNTING FOR GROWTH	AVERAGE ANNUAL RATE OF GROWTH	RELATIVE PROPORTION	
		WITH INFLATION	WITHOUT INFLATION
Population	0,08%	1,26%	5,49%
Utilisation of health services	0,51%	7,92%	34,79%
Medical care prices	0,87%	13,63%	59,72%
Inflation	4,95%	77,19%	-
TOTAL WITHOUT INFLATION	1,46%	-	-
TOTAL	6,41%	100,00%	100,00%

The greatest impact on the growth of expenditures is from inflation, amounting to almost 80% of the total growth. When the impact of inflation is excluded, the biggest contribution to the growth in expenditure comes from the growth in medical care prices. It amounts to almost 60%, a result similar to that in the United States.

4.3 Sensitivity analyses

Sensitivity analyses are performed in respect of changes in the population, inflation and health data assumptions.

Sensitivity to the change in the population assumptions is important and similar throughout the observed period for the health expenditures and the utilisation of health care services. For lower projections of population numbers these are both lower and for higher projection higher. Claim frequency is not sensitive to population assumptions at all. Claim severity and risk cost are modestly sensitive to the changes in the population assumptions.

In order to analyse sensitivity to the inflation assumptions, changes are made to the Wilkie model parameters. The standard deviation parameter is changed from 0,05 to 0,07 and the average interest rate parameter from 0,05 to 0,06.

As was expected for health expenditures, claim severity and risk costs, the model shows substantial sensitivity to changes in the average interest rate parameter, where the impact of the change increases during the observed period, starting with less than 0,2% and reaching 14% of change in the result after 15 years. Outcomes on both sets of health data assumptions are in agreement and the impact on health expenditures, claim severity and risk costs is similar. The sensitivity of the model to changes in the standard deviation parameter has similar characteristics, with changes ranging from 0,02% to 10%. Utilisation of health services and claim frequency are not sensitive to changes in inflation assumptions.

Sensitivity to the health data assumptions is modest, ranging from almost 0% to a maximum of 1,2% in absolute values. Similar behaviour can be seen for health expenditures, claim severity and risk costs on one side and utilisation of health services and claim frequency on the other.

From previous considerations it can be seen that model is very sensitive to the general inflation assumptions, and health expenditures and utilisation of health services are also sensitive to population assumptions.

4.4 Stability of simulations

Stability and convergence of the simulation results were tested by comparison of the simulation with 10.000 iterations and seed 999 to simulations with 5.000 and 20.000 iterations and with seed 500. The average percentage change in the obtained results of five controlled simulations in respect of the basic simulation for risk cost for a fifteen-year period is less then 1,5%.

For 10.000 iterations the mean standard error (MSE) is 1% of the simulation standard deviation which means that the true value of the simulation mean is in the interval 2% of the simulation standard deviation around the simulation estimated mean. In the case of 20.000 iterations the mean standard error is 0,7% of the simulation standard deviation.

5. CONCLUSION

Obviously such a model cannot predict the future, but it shows what might happen if current mechanisms and laws continue in the same way. Unexpected changes in mortality or morbidity, macroeconomic shocks, reforms in health care delivery or financing and technological changes will all have impact on the future performance of the health industry.

During the last few years several changes have taken place in the organization of health care in Croatia: new laws have been adopted, privatization of clinics and health offices has started, occupational diseases and work injuries are no longer the financial responsibility of the Croatian Health Insurance Institute but of employers, through compulsory insurance provided by private insurance companies (although this split is still not in full operation in practice). These changes obviously influence the degree of utilisation of health care and the expenditures incurred. Further analyses and test of the impact on the results of the model should be made for practical use of the model.

If the model is used in practice it should be monitored periodically by examining the assumptions used in constructing the model and confirming their validity. Special care should be taken with the assumptions for which the model proved to be sensitive. Periodic valuations of the model will enable early warning to possible problems and adequate actions to be taken on time.

The analysed data are time series and they vary by time period. In the paper it is assumed that the time series, except for inflation, are independent. However, sometimes this is not a case, for example restrictions imposed by regulators on the provision of health care may cause a shift in utilisation of health care in subsequent years or for other submodels. This should be investigated for application of the model in the real world.

The model could be developed to analyse data and project future utilisation of health services and expenditures by specialities, by cities, counties, urban and rural parts, by sex and by age. For private health insurance, where premiums usually depend on age and sex, the last two items would be of special interest. To perform such an analysis, health insurance data according to sex and age groups would be needed.

In an analogous way several other models could be built: models for estimation of the necessary number and structure of health workers in future, models for estimating the number of beds needed according to hospital divisions, hospital centres, cities, counties or the country as a whole.

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7. APPENDIX

Figure 1

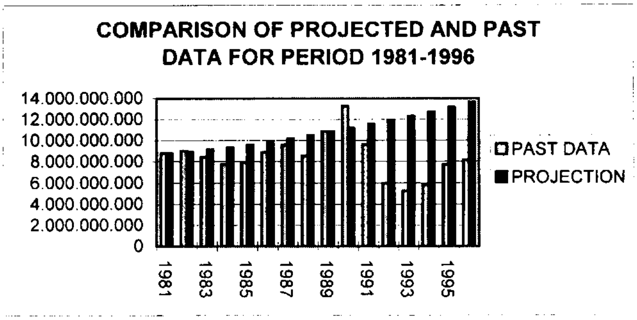

Figure 2

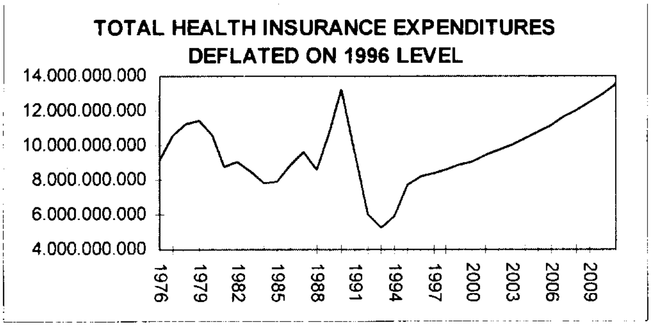

Figure 3