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Improving Risk Adjustment in the Czech Republic

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Abstract:
This paper analyses possible options how to improve the risk adjustment of the health insurance system in the Czech Republic. Out of possible options it argues for including Pharmaceutical Cost Groups (PCGs) as additional risk factors since it is an improvement that can be implemented almost instantaneously. On real data from an anonymous sickness fund it confirms that predictive performance of PCGs models is consistently better than the performance of the demographic model that is currently used. The study also describes and examines the Czech health insurance market and implications of proposed changes of the current government. Based on experience from other countries we point to a problem of risk selection if the changes are not accompanies by a tighter regulation, specifically in the form of improved risk adjustment formula.

Keywords: Risk adjustment, Managed competition, Health insurance, Pharmaceutical Cost Groups, Czech Republic

JEL: C10, D82, G22, I10, I11, I18

1. Introduction

Health care policy is currently one of the key economic and political issues in Europe and the United States. Health care systems face challenges of population ageing, new medical technologies and higher expectations of health care services consumers, which increase demand on financial resources. Increasing health care production *efficiency* is a natural response to these challenges; however, attaining higher efficiency is made more difficult by a concurrent demand for equal access to health care. Compared to majority of other goods, *equity*[1] in consumption of health care services is considered to be more important, which makes functioning of a health care market more difficult.

One of possibilities aimed to achieve adequate level of efficiency and equity envisioned by Enthoven (1988) is *managed competition*[2] with a role of insurers[3] paying for health care consumed by insured individuals. Acting as agents, the insurers collect funds and buy health care for their customers. Competition between the insurers ensures better consumer choice whereas financial accountability provides incentives to minimise costs of covered health care services. This should ultimately result in increased production efficiency of a health care system, taking

[1] More details to equity in health care can be found for instance in Wagstaff and van Doorslaer (2000).

[2] The term *managed* implies a need of appropriate regulation of a health care market as described later in the paper. For a more recent update of this concept the reader is referred to Enthoven (1993) or Enthoven and van de Ven (2007).

[3] In the paper, we use both the general term *insurer* and a more traditional term *sickness fund*. For instance in the Netherlands (van de Ven et al., 2007), basic health insurance and supplemental insurance can be at the moment sold by the same entities so the term insurers for these entities is more appropriate. On the contrary, in the Czech Republic the health insurance is still provided by traditional sickness funds. In the U.S., the term *health plan* is typically used.

into account both production level and costs. [4] Equity (or solidarity[5]) within the framework of competing insurers can be achieved by a system of ***risk adjustment***[6]. Under a system of risk adjustment, premiums[7] to be received by an insurer are adjusted for a risk of each insured individual based on characteristics such as age, gender or health status. All or part of health insurance contributions collected by all insurers are pooled together and then redistributed; insurers insuring people with higher expected[8] health care costs receive higher premiums and vice-versa. This mechanism supervised by a sponsor such as government enables cross-subsidisation between individuals (groups) with lower and higher risk. [9] Van de Ven and Ellis (2000) summarise this concept by defining risk adjustment as *"the use of information to calculate the expected health expenditures of individual consumers over a fixed interval of time (e.g., a month, quarter, or year) and set subsidies to consumers or health plans to improve efficiency and equity"*.

The systems of risk adjustment used worldwide are currently not perfect (van de Ven and Ellis, 2000). They are able to capture only a proportion of variation in health care expenditures. Moreover, the insurers providing basic health insurance are typically restricted to set insurance premiums, which provides incentives to select profitable individuals with lower expected costs than the compensation received by the insurer and distract those with expected losses. This process of ***risk selection***[10] (also being called cream skimming or cherry picking) undermines the benefits of competition between the insurers who are not competing in their ability to buy the best health care services but in their ability to select the most advantageous risks (the resources used in this process being a welfare loss – van de Ven et al., 2003). The risk selection can take various

[4] Players in an underdeveloped health care market often have a one-side view, being concerned only about maximisation of output (e.g. patient organisations) or minimisation of costs (e.g. insurers).

[5] Van de Ven et al. (2003) define two types of solidarity; risk solidarity entails that individuals with low risk (healthy persons) subsidise those with higher health risks while income solidarity implies redistribution between individuals with higher income who pay higher insurance contributions to subsidise individuals with lower income. A combination of both enables general accessibility of health care to members of a particular community (e.g. a country).

[6] Other terms for risk adjustment with similar meaning such as *risk compensation* or *risk equalisation* are used in the literature. In the Czech Republic the concept of risk adjustment is being referred to as *redistribution of insurance premium income*. For an excellent discussion of risk adjustment terminology the reader is referred to Ellis (2008).

[7] Three different expressions are encountered in the literature – *risk adjusted premiums*, *risk adjusted payments* or *risk adjusted capitation*.

[8] From the efficiency perspective, it is preferable to base risk adjustment on *expected* costs (prospective risk adjustment), however, full or partial retrospective risk adjustment based on *actual* costs is also encountered.

[9] There are also cross-subsidies from people with higher income to people with lower income (income solidarity) as insurance premium contributions are typically at least partly calculated as a fixed percentage of income.

[10] Newhouse (1996) defines *selection* as actions (not including risk rating) by consumers and sickness funds to exploit unpriced risk heterogeneity and break pooling arrangements.

forms, from the most visible forms such as refusing selected potential enrolees[11] to more subtle ways such as selective marketing or providing lower quality care for the unprofitable risks (e.g. chronic patients), thus forcing them to change the fund (van de Ven et al., 2003).

The first contribution of this paper is the analysis of possible options to improve the risk adjustment system in the Czech Republic. Currently only age/gender risk factors are used and hence naturally there is a room for improvement. We analyse various alternatives from the literature and choose an improvement based on Pharmaceutical Cost Groups (PCGs). The conclusion to choose PCGs is based on the fact that they can be implemented almost instantaneously. Based on a sample of real data we confirm that adding PCGs significantly improves predictability of health care expenditures.

As our second contribution, we provide an analysis of current health insurance market in the Czech Republic and draw health policy conclusions and recommendations that might be relevant to policy makers. We base our analysis on the lessons from other countries documented in the literature.

In the next section we provide a brief literature review followed by a description of the current health insurance market and the risk adjustment system in the Czech Republic. The fourth section presents a theoretical model which captures basic issues and principles of risk adjustment. Throughout the paper we claim that PCGs are a feasible option how to make the system in the Czech Republic better so in the fifth section we quantitatively test this choice on a sample of real data. Our main finding is that employing PCGs significantly more variance is explained, the part of resources redistributed due to pharmaceutical groups is quantitatively important and hence risk selection incentives are lowered. In the subsequent sixth section, we discuss important policy issues regarding risk adjustment and risk selection and draw conclusions relevant for the Czech Republic. We conclude all the findings in the final seventh section.

2. Literature review

In this section we would like to present risk factors observed in the literature which can be included in a risk adjustment formula. Age and gender currently used in the Czech Republic and

[11] Refusing of potential enrolees is usually made officially impossible by law for mandatory basic insurance (open enrolment requirement). However, if supplemental voluntary insurance (no open enrolment requirement) is sold together with the basic insurance, insurers who refuse to provide supplemental insurance to unfavourable risks can possibly distract them also from buying the basic insurance (van de Ven et al., 2007).

other countries are the most obvious choice. Their use is considered as fair, it is difficult to manipulate them and their implementation is not difficult. The major drawback, however, is that the ability to predict future health care costs is quite low (e.g. van de Ven et al., 2003).

Better results in predicting future health care costs are achieved by adding prior costs as risk factors. The percentage of explained variance is 7–10% (van de Ven, 1992, Ash and Byrne-Logan, 1998). On the contrary, its justification is more controversial. Using prior costs as a predictor rewards plans with higher past expenditures without distinguishing whether these costs were adequate or not (McClure, 1984). Furthermore, as Beebe et al. (1985) argue, it makes no distinction between chronic cases (costs are supposed to be high also in the next period) and acute cases (costs are likely to fall). Using past costs can be considered as a form of ***risk-sharing*** between the insurers, if costs are high for an insured person this year, an insurer is partly compensated for the next year. Risk-sharing (ex-post compensation for a part of actual costs) can be complementary to prospective risk-adjustment (ex-ante compensation based on expected costs). As argued by van Barneveld et al. (2001) although risk sharing[12] sacrifices part of efficiency it is a preferable option to reduce incentives for risk selection under imperfect risk adjusters.

The next group of risk-adjustment efforts encompasses diagnosis information to measure a health status of individuals and hence to predict their costs. Different classifications are being used; the three most widely used classifications are (Stam, 2007):

- The Ambulatory Care Group (ACG) system, developed at Johns Hopkins (Weiner et al., 1996);
- The Diagnostic Cost Group (DCG) family of models, developed at Boston University and Health Economics Research (Ash et al. 1989; Ash and Byrne-Logan 1998; Ellis et al. 1996; Pope et al. 1998 and 2004), one of the DCG models – the CMS-HCC model – was implemented in 2004 for risk adjustment in the U.S. Medicare program[13];

[12] The authors analyse four typical types of risk sharing – proportional risk sharing (a fixed percentage of costs of all insured is risk-shared), outlier risk sharing (costs for an insured above a threshold are risk-shared), risk sharing for high risks (all costs for a percentage of insured determined *ex-ante* are risk-shared) and risk sharing for high costs (all costs for a percentage of insured with the highest *ex-post* costs are risk-shared).

[13] Federal system in the U.S. established to finance health care for the elderly, disabled and people suffering from end-stage renal disease (ESRD).

- The Disability Payment System (DPS) developed primarily for the U.S. Medicaid[14] program disabled enrolees (Kronick et al. 1996).

All these nomenclatures attempt to group diseases into relatively small group of conditions based on clinical, cost and incentive considerations. Although these complex taxonomies increase predictability of future expenditures, it is currently impossible to use them in the Czech situation, since the providers of health care generally do not supply reliable information about patient diagnoses.[15] Provided that reliable data are collected on national-wide basis, the developed classifications can also be used in the Czech case. The starting point could be the utilization of the Principal In-Patient Diagnostic Cost Groups (PIP/DCGs) which are based on the "worst" diagnosis recorded as the principal reason for hospital admission during a one-year-period (i.e. the diagnosis "having the highest future cost implication"). PIP/DCGs are used in the Netherlands since 2004 (Stam, 2007). Compared to CMS-HCC used in Medicare this classification is simpler and hence easier for implementation.

Another alternative is to use automated pharmacy data as a proxy for diagnosis. Clark et al. (1995) use information about prescribed drugs to assume chronic conditions that are correlated with higher future costs. Lamers and van Vliet (2004) built on this classification and adjusted it to the Dutch situation. They identify 22 chronic conditions (Pharmaceutical Costs Groups – PCGs) based on relevant prescription of a particular ATC group[16]. Using PCGs alongside demographic variables almost doubles the predictive performance measured by R^2. Using pharmaceutical information to improve risk-adjustment is quite plausible also in the Czech Republic, as the valid information about prescribed drugs is readily available. The setback of this method is that it provides incentives to prescribe unnecessary pharmaceuticals since additional compensation may be much higher than the costs of drugs themselves, Lamers (1998). [17]

[14] Federal system in the U.S. established to finance health care for the poor.

[15] The situation is improving though. In 2007 hospitals supervised by the Ministry of Health Care received 4% of their annual budget based on DRGs (Diagnostic Related Groups – payment mechanism for treating a certain diagnosis), which motivated hospitals to improve quality of collected diagnosis information.

[16] Anatomic Therapeutic Chemical groups – a classification of pharmaceuticals into different groups according to the organ or system on which they act and on therapeutic and chemical similarities.

[17] This disadvantage can be mitigated as argued by Lamers and van Vliet (2003) by the following strategies (1) requiring high number of daily doses prescribed to a patient to be included to a PCG, (2) assign each person only into one condition, and (3) exclude conditions with relatively small contribution to costs. However, based on experience from the Netherlands, the risks proved to be less pronounced and the strategies (2) and partly (3) have been abandoned since 2006 and 2007 when more PCGs were added and more than one PCG for a patient was allowed, respectively. (e.g. van Vliet, 2007).

The next choice of a risk factor discussed in the literature is mortality of insured. For instance, sickness funds in Belgium receive compensation based on different average mortality per 1000 of enrolees. The argument for using mortality is high expenditures associated with the end stage of life. The arguments against include the fact, that the majority of costs related to death are unpredictable; hence risk-selection is unlikely to occur due to this reason. Additionally, it is not so acceptable to increase the compensation to an insurer based on a higher number of deaths (the phenomenon being ironically called as "mortal hazard", van de Ven and Ellis, 2000).
Lastly, other factors including demographic (e.g. employment, family size, region), socioeconomic (e.g. income), functional disability or different input costs in different regions may be used to make the competition between the sickness funds more fair. The choice of each of them similarly to those already mentioned depends on the additional predictive ability and on incentives they create.[18]

3. Health insurance market and risk adjustment in CR

Czech health insurance market

In the Czech Republic health insurance enrolment is mandatory for every person working or having residence in the country. **Table 1** provides overview of money flows in the health insurance market between the four major players (consumers, providers, insurers and a sponsor). Sickness funds[19] collect health insurance tax (a fixed percentage[20]) levied on gross income[21] supplemented by the payment of the state (the sponsor) for economically non-active citizens (children, elderly, students, people receiving unemployment or social benefits, disabled, etc.) financed from general taxes. Employers pay the insurance premium on behalf of employees but they do not interfere into a free choice of a sickness fund. The insured are allowed to change an insurer every quarter with an obligation to stay with it for at least one year. Risk adjustment is carried out by the Risk Adjustment Fund whose functioning is described in the law. General practitioners are also partly paid by prospective risk-adjusted payments. Similarly to the whole

[18] Van de Ven and Ellis (2000) distinguish two classes of risk factors, the risk factors for which solidarity is desired (S-type) and the factors for which solidarity is not desired (N-type) depending on preferences of a society. Factors such as region can belong to any of these groups since it can be explained by overutilization or ineffective care in certain regions (N-type factor) but also by higher input costs (possibly S-type factor).
[19] In the Czech Republic the sickness funds are named *health insurance companies* and currently they do not provide supplemental health insurance.
[20] Health insurance contributions for employees are capped since 2008 to four times the average health insurance tax base, self-employed used to be capped also in the past. Persons with no income are obliged to pay a fixed amount.

system, gender and age groups are the risk adjusters. Currently, private expenditures of consumers represent only a small proportion of the total health care budget (12% as of 2007). [22]

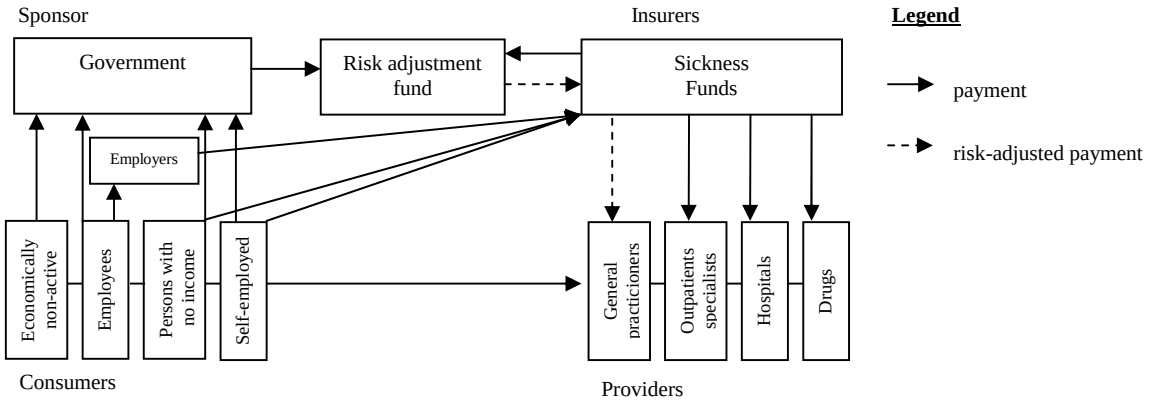


Table 1 – *Mandatory health insurance system in the Czech Republic, 2008*

Table 2 depicts basic characteristics of sickness funds operating on the Czech health insurance market. The number of funds is relatively small and it was stable for the period 2000–2007. Since 2007 privately owned companies[23] started to apply for a licence to provide mandatory health insurance as a consequence of the undergoing health care reform. [24] This will inevitably increase competition and motivation for risk selection; hence a more tight regulation is necessary. As of today, the market is dominated by the largest sickness fund which currently insures almost two thirds of all insured in the Czech Republic. The enrolees of this fund are on average more costly than the average population as reflected by a higher share on the total insurance premium compared to the percentage of enrolees. For all other funds the reverse holds, primarily because they were originally established as "employee sickness funds" with a specific industry focus (as depicted in the table). Health care costs of employees are significantly lower than costs of retired people and hence this pattern is not surprising.

[21] We term this contribution also as *insurance premium*.
[22] The figure is based on ÚZIS (2008). This percentage is expected to increase in 2008 due to introduction of copayments for doctor visit (EUR 1.2), hospital stay (EUR 2.4 per day) and prescription of drugs (EUR 1.2 per one presc ription of a different drug). Other health care expenditures borne by consumers include primarily costs of not fully reimbursed drugs and medical devices.
[23] Currently operating Czech sickness funds have a special legal status, they have no owners, the institutions are governed by a board composed of representatives of the Ministry of Health Care, employers and insured.
[24] The first private insurer applied for the licence in 2007, several others expressed their intentions to enter the market in 2008.

	Operation	Original industry specialisation	Share on total number of enrolees (2007)	Share on total insurance premium[a] (2007)
Všeobecná zdravotní pojišťovna ČR	Countrywide	General	63.4%	67.7%
Vojenská zdravotní pojišťovna ČR	Countrywide	Armed forces	5.5%	5.1%
Hutnická zaměstnanecká pojišťovna	Regional	Steelmaking	3.4%	3.1%
Oborová zdravotní pojišťovna zaměstnanců bank, pojišťoven a stavebnictví	Countrywide	Financial services, construction	6.3%	5.5%
Zaměstnanecká pojišťovna ŠKODA	Regional	Automotive	1.3%	1.2%
Zdravotní pojišťovna MV ČR	Countrywide	Police	10.2%	9.0%
Revírní bratrská pokladna - zdravotní pojišťovna	Regional	Mining	3.5%	2.9%
Zdravotní pojišťovna Metal - Aliance	Countrywide	Steel and engineering	3.4%	2.8%
Česká národní zdravotní pojišťovna	Countrywide	General	3.0%	2.7%
Zdravotní pojišťovna Agel	Regional	General	new	new

[a] Based on the current risk adjustment mechanism using age/gender risk factors.

Table 2 – *Sickness funds registered in the Czech Republic in 2008 (Annual reports of sickness funds for 2007)*

Since the introduction of the new risk adjustment system in 2005, there have been no obvious signs of risk selection. However, based on our analysis of data from smaller sickness funds we have found at least two signs of risk selection of a more subtle kind. Firstly, mortality in one sickness fund in certain years was very low compared to the national average. As end-life costs are both significant and might be predictable for people already in bad health, this fact indicates that the sickness fund was able to get rid of the insured persons who would represent a high loss. Secondly, our analysis of another sickness fund revealed a dramatic decrease in consumption of group of drugs for people having renal problems between two years to a disproportionally low level. This again indicates motivation to "shift away" high-cost patients uncompensated by the risk adjustment system.

We can make a conclusion that although there are some signs of risk selection in the Czech Republic at the moment, the problem is not so evident. However, we believe that this a result of lack of motivation of current sickness funds to earn extra money. As they have no owners, the extra profit translates into higher reserves or pressure of doctor trade union representatives to increase reimbursement to health care providers[25]. Entrance of private players naturally increases the motivation to earn extra profit. Therefore, we argue that the current trends in the health care

[25] The managements of sickness funds are yet careful to avoid losses as they would create pressure for their replacement by the representatives of the Ministry of Health Care in the governing boards.

market should be accompanied by tighter regulation to avoid risk selection. A better risk adjustment system is one of the steps to be taken.

Risk adjustment in the Czech Republic

In the Czech Republic, a system of health insurance in health care delivery was implemented in 1993. There are significant differences between the sickness funds both in the average income level of the enrolees as well as their morbidity. Therefore, insurers having disproportionably higher number of employees in their enrolee structure compared to the total population receive higher income (payment of the state for economically non-active insured has been significantly lower than the average payment from the income) and have to pay lower amount for health care (enrolees are healthier). These two inequalities used to be solved by a quite simple system of risk adjustment. A fraction (50% and then 60%) of the total income collected by all insurance funds plus the payments of the state was redistributed to the insurers according to the total number of enrolees for whom the state was the payer; differentiating between the people under the age of 60 (weight one) and above (weight 2 and then 3 – **Figure 1**). This system attempted to solve both the income and morbidity discrepancy but managed to reduce only a part of the differences between the insurers. As it can be seen in the figure, age groups younger than 45 and older than 60 received higher amount of funds per enrolee than are the actual average costs while for the rests the opposite held which created incentives to attract the former and distract the latter. As a result a significant risk selection occurred and sickness funds with sicker enrolees faced profound financial problems.

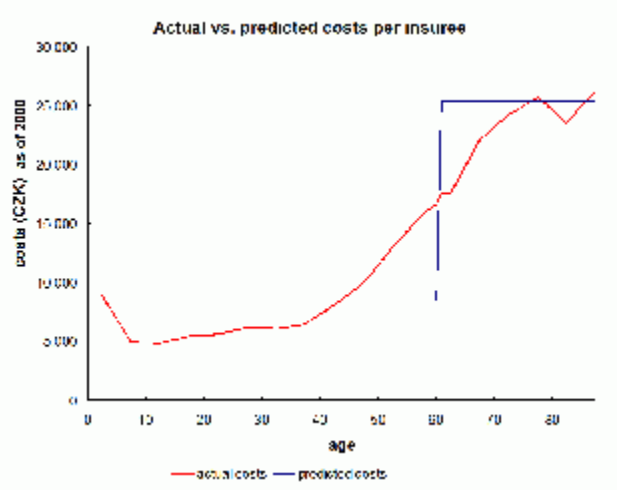


Figure 1 – *Actual vs. predicted costs using risk adjustment used in the Czech Republic until 2005 (Hroboň, 2007)*

The first step toward a better risk adjustment system was taken in 2005 when risk adjustment according to gender and age groups was implemented. [26] The entire insurance premium collected[27] from enrolees and the amount from the state is now redistributed based on 18 age indices for men and the same for women (**Figure 2**). This eliminates the predictable losses for a given age group if a sickness fund has members with average morbidity.

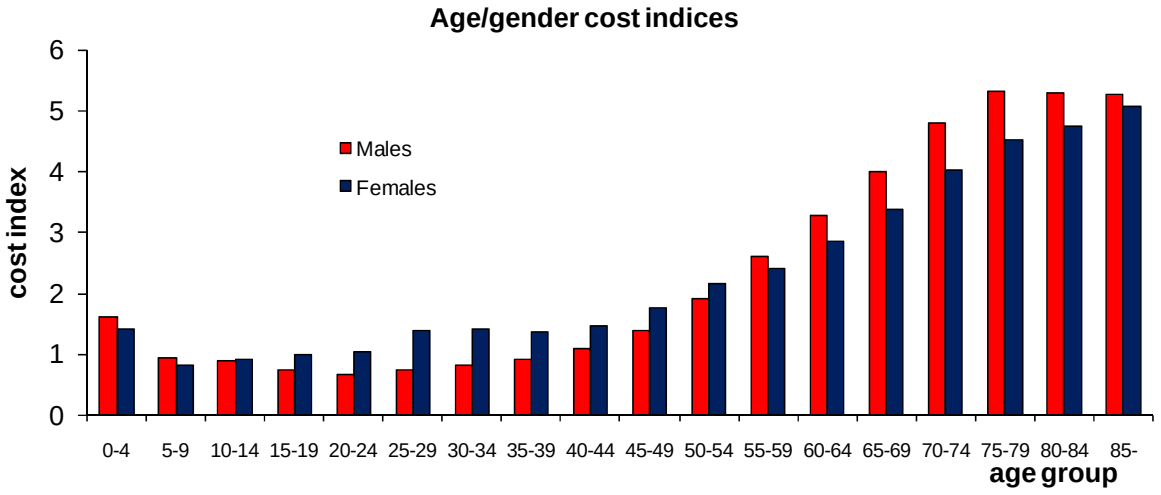


Figure 2 – *Cost indices for age/gender groups used in the Czech Republic for the year 2008 (Decree No. 294/2007 Coll.)*

Nonetheless, there is additional variability within each of 36 age and gender groups that is not explained by the demographic model. For instance, a sickness fund with a high proportion of chronically sick enrolees is worse off compared to an insurer with relatively healthy enrolees even if a different demographic profile is accounted for. The natural suggestion for improvement is to include a measure of health status in the risk adjustment formula.

4. Risk adjustment theory

In this section we provide a theoretical framework of risk adjustment. We try to discuss the key issues such as perfect and imperfect signals, strategic response of insurers to imperfect risk

[26] Moreover, a risk-sharing mechanism was introduced establishing a special fund for extremely costly care. Sickness funds receive ex-post compensation for 80% of costs for enrolees whose costs exceed a threshold of thirty times the average costs per an insured – i.e. a combination of outlier and proportional risk sharing (Decree No. 644/2004 Coll.).

[27] I.e. 100% compared to 50% (60%) in the previous system. During 01/2005 – 03/2006 a combination of old and the new system was effective.

adjustment and how the incentives can be improved by a concept of optimal risk adjustment. This section is based on Ellis (2008) who summarises the current theoretical literature.

The basic assumptions of the theoretical model presented in this section are as following. There are two types of consumers, two types of health care services and two signals about the type of the consumer. The low-risk ("healthy") consumers use only general practitioner (GP) services and cost α per year while the high-risk (e.g. "diabetic") consumers use both GP and specialists services (SP) and cost $\alpha + \beta$ per year. Both types of consumers are equally common in the population. The signal S classifies a consumer either as low-risk (S equals to 0) or high-risk (S equals to 1). The objective function of the insurer is to maximise profits while the sponsor under conventional risk adjustment tries to pay each consumer the expected value of each signal for each consumer.

No risk adjustment signals

The simplest case is when quantities of care offered are unaffected by capitation payments and there are no signals about consumer types. Under purely prospectively set capitation payments, insurers receive the expected amount of $\alpha + \beta/2$ per person as the low and high-risk consumers are equally prevalent.

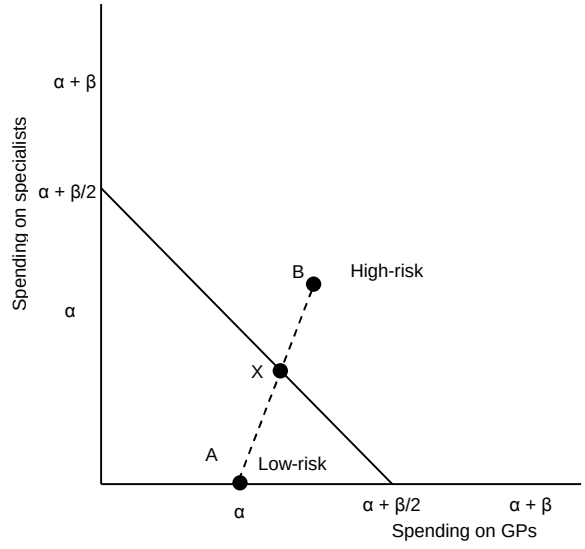


Figure 3 – *No risk adjustment when quantities of each service supplied are exogenous*

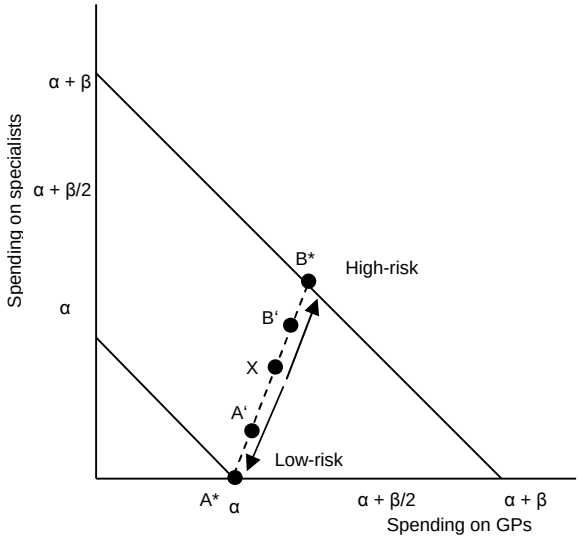
This situation is depicted in **Figure 3** where X is the average amount of services consumed. The insurers that cannot change the quantity of services provided cross-subsidise high risk enrolees from profits earned on low-risk individuals as long as they have lower than the average number of

high-risk consumers. Insurers who have higher number of high risks do not want to participate in this scheme as in total they will incur loss.

Perfect and exogenous imperfect signals

If health status signals S are costlessly available and there are perfectly informative, a risk-adjusted payment paid by the sponsor will be $R_i = \alpha + \beta S_i$ for each consumer *i*, i.e. $R_1 = \alpha$ and $R_2 = \alpha + \beta$. Profits on each type of consumer are zero, so an insurer is indifferent to enrolling consumers who have low- or high-risk signals.

Empirical studies find that even signals of serious illness are highly imperfect. Glazer and McGuire (2000) examine exogenous imperfect signals.[28] Suppose that proportion γ_i of type *i* consumers have a signal S = 1. Empirically, some low-risk types have a false positive signal ($0 < \gamma_L$), and many high-risk types have false negative signals ($\gamma_H < 1$). Hence, if the signal is to be informative, the proportion satisfies $0 < \gamma_L < \gamma_H < 1$. Under these and the general assumptions, the proportion of consumers with high-risk signal S = 1 would be $(\gamma_H + \gamma_L)/2$, the average cost of signal S = 1 would be $R_1 = \alpha + \beta \gamma_H/(\gamma_L + \gamma_H)$, while the average cost of signal S = 0 would be $R_0 = \alpha + \beta(1 - \gamma_H)/(2 - \gamma_L - \gamma_H)$. As **Figure 4** shows, starting from X with no available information, improving information will better differentiate between low- and high-risk types, thus eliminating the respective losses and profits.



[28] Signals may be endogenously (intentionally) misinterpreted so as to influence payments. If service quantities are exogenous, the insurers wish to increase the proportion of high-risk types reported beyond the levels used to calibrate the models (e.g. Newhouse, 2002). Under endogenous service quantities, the classic supply-side response to capitation would be a reduction in spending on all types of service (Newhouse, 1996).

Figure 4 – *Perfect (A*, B*) and imperfect (X, A', B') risk adjustment*

Insurer strategic response to capitation payments and optimal risk adjustment

If certain types of consumers are unprofitable because of imperfect risk adjustment, the insurers can strategically react by decreasing the provision of services which are the most attractive to them. Within the framework of our model, the insurers will have an incentive to reduce spending on SP as it is used only by high-risk consumers and oversupply GP services to the healthy (**Figure 5**, panel A). If we consider the case with no false positive signals ($\gamma_L = 0$) and a 50% chance that a high-risk consumer is not indicated by the signal S ($\gamma_H = 1/2$), the conventional risk adjustment would pay $\alpha^0 + \beta^0$ for S = 1, and $\alpha^0 + (1 - \gamma_H)\beta^0$ for the S = 0 consumers. Under this pay-out scheme there is a natural incentives of insurers to distract high-risk consumers as those with S = 1 signal represent zero profit and those with the signal S = 0 are unprofitable.

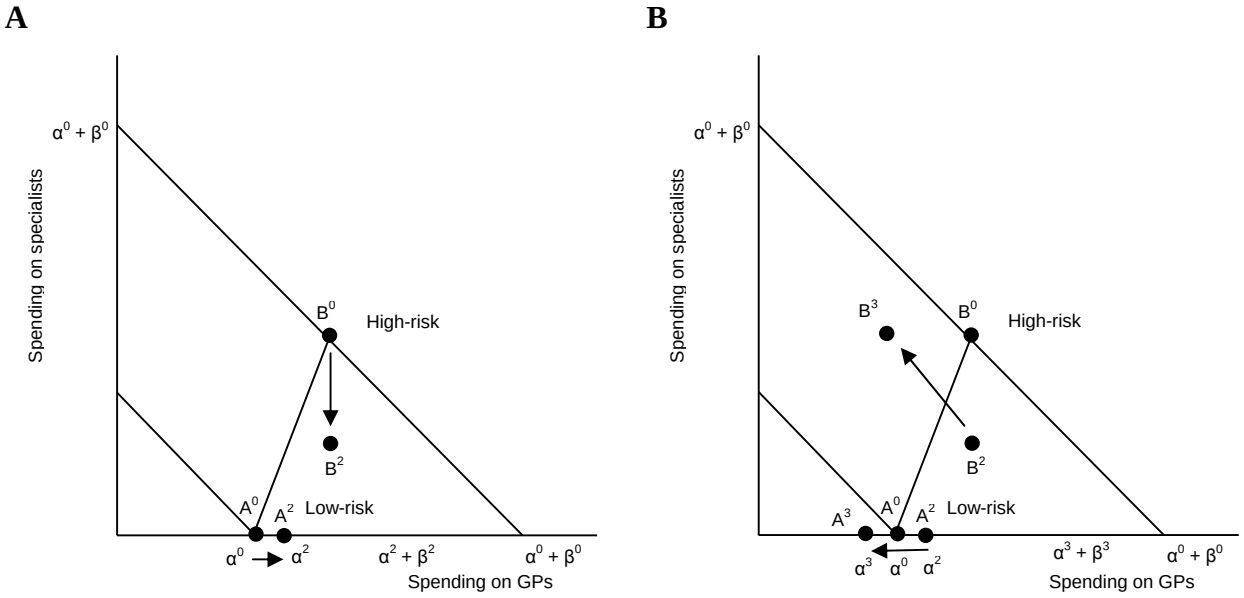


Figure 5 – *Conventional (panel A) and optimal risk adjustment (panel B) with quantities of services strategically determined*

Glazer and McGuire (2000) introduce the concept "optimal risk adjustment" in which the sponsor's objective function is to maximise consumer welfare rather than just break even. The optimal risk-adjustment solution to the problem of under provision of services to high-risk consumers is to overpay for signals S = 1, while underpaying for S = 0. The optimal solution based on the previously states assumptions would be to pay α^0 to the S = 0 types, and $\alpha^0 + \beta^0/\gamma_H = \alpha^0 + 2\beta$ for the S = 1 consumers. By overpaying, the insurers have an incentive to attract high-

risk consumers as an S = 1 consumer is clearly profitable and the overpayment just compensates for the possibility of attracting high-risk consumers with S = 0 signal. Compared to the conventional risk adjustment, amount of services to high-risk consumers is increased (**Figure 5**, panel B).

Although achieving the first best solution of optimal risk-adjustment may be difficult in practice due to imperfect knowledge about optimal consumption combination of different services or about the information contained in the signals about risk types, as argued by Ellis (2008) it is a direction that should be considered by sponsors. In order to encourage desirable competition to attract high-risk-type consumers, the insurers should be overpaid for high-risk-type signals and underpaid for low-risk-type signals relative to the conventional risk adjustment.

5. Empirical analysis of PCGs in the Czech context

As we argued in the previous sections, utilising information from prescribed pharmaceuticals is a viable option to enhance the risk adjustment in the Czech Republic. In this section we would like to test this hypothesis using real data.

Data and methodology

For the empirical part of our study, we used a sample of data about prescription drugs and total health care expenditures from an anonymous Czech sickness fund for the period 2000–2004. The data set contains initially almost 60,000 insured, this number decreases to slightly more than 50,000 as people die or leave for another sickness funds. Although relatively small, we believe this sample is able to capture typical patterns occurring in the whole system. Furthermore, the time-series of five years enables to track these patterns in time.

Health care costs data are typically extremely skewed toward the high end of the distribution. Therefore, treating many observations that are very far from a median as outliers is not appropriate. However, in each of the years 2000, 2001 and 2004 based on graphical inspection we identified a single observation that was significantly higher than even other extremely costly cases. We decided to exclude these three observations from our analysis.

To assign enrolees into a chronic condition we have essentially used the Dutch classification (Lamers and van Vliet, 2004) with a few exceptions; we changed the definition of low and high hypertension in a way that in our view better correspond to the current practice (**Table 3**), we excluded tuberculosis as it is no longer a chronic condition that cannot be cured, we excluded

renal diseases due to very few individuals classified in this PCG and finally, we excluded gout because of a very small contribution to health care expenditures.[29]

	ATC code	Description of ATC code
Group A	C03A	Low-ceiling diuretics, thiazides
	C03EA01	Hydrochlorothiazide and potassium-sparing agents
	C07	Beta blocking agents
	C09A	Ace inhibitors, plain
	C08	Calcium channel blockers
Group B	C09B	Ace inhibitors, combinations
	C09C	Angiotensin II antagonists, plain
	C09D	Angiotensin II antagonists, combinations
	C02	Antihypertensives
Hypertension-low	At least 6 prescriptions of a drug of a single ATC code or a combination of maximum two ATC codes (both must be from Group A).	
Hypertension-high	At least 6 prescriptions of drugs from any group; not classified as hypertension-low	

Table 3 – *Definition of hypertension used in our analysis*

Additionally, our classification uses a different number of prescriptions, not 4 prescriptions as it was in the Dutch case. The numbers are quite arbitral, we tried to achieve prevalence of these conditions comparable to the original article. The list of 19 chronic conditions used in our analysis, the minimal number of prescriptions for a classification into a condition and prevalence in our dataset is shown in **Table 4**. It can be seen from the table that as the sample ages from 2001-2004[30], the prevalence of chronic conditions generally increases and the number of those without any condition decreases from 89.6% to 86.2%.

[29] The author thanks Tomáš Macháček from Health reform forum cz (www.healthreform.cz) and from the Ministry of Health Care for designing this PCG classification.

[30] As we already stated, no new individuals are entering the sample.

Chronic condition		Min. number of prescriptions	Prevalence per 1,000 enrolees			
			2001	2002	2003	2004
0	No PCG	-	895.8	880.5	868.8	861.7
1	Hypertension – low	6	26.7	31.6	34.7	36.7
2	Hypertension – high	6	7.4	8.3	7.4	9.8
3	Glaucoma	6	1.5	1.8	2.2	2.1
4	Depression	5	4.4	5.0	6.4	7.7
5	Thyroid disorders	4	1.8	2.3	3.5	3.9
6	Hyperlipidemia	6	6.9	8.1	9.6	6.2
7	Respiratory illness, asthma	4	10.7	15.8	12.9	13.7
8	Epilepsy	5	4.1	4.4	5.1	4.8
9	Peptic acid disease	5	9.7	9.9	10.4	11.9
10	Crohn's and ulcerative colitis	3	0.9	1.1	1.2	1.1
11	Rheumatologic conditions	4	1.1	0.9	0.9	1.1
12	Parkinson's disease	5	0.9	0.9	0.7	0.9
13	Diabetes-type I	4	5.2	5.7	5.9	6.2
14	Diabetes-type II	5	3.2	6.1	6.6	4.7
15	Cystic fibrosis	8	0.2	0.8	0.8	1.2
16	Transplantations	3	0.5	0.7	0.7	0.7
17	Malignancies	6	0.1	0.2	0.1	0.3
18	HIV/AIDS	2	0.1	0.1	0.1	0.1
19	Cardiac disease/ASCVD/CHF	4	18.5	15.8	21.8	25.1

Table 4 – *List and prevalence of chronic conditions in our dataset*

Only those insured who are present in the sample for the whole year *t* and at least a month in *t+1* are classified into a PCG category for a given year and included in the calculation. Based on a classification into a PCG group in time *t*, an age/gender group in *t+1*, annualised expenditures[31] in *t+1* are estimated using a linear model with intercept by ordinary least squares. Each observation is weighted with a weight equal to the number of months each person is present in the sample in period *t+1*. To obtain robust estimate of variance a Huber/White estimation of variance-covariance matrix is employed.

Predictive performance is compared by *adjusted* R^2 and *prediction ratios.* To calculate prediction ratios, the insured are ordered by their annual expenditures into ten deciles and a ratio of actual over predicted expenditures is calculated for each of these groups. Three models were utilised each year, a demographic model with 36 age/gender groups as a benchmark, PCG model allowing for co-morbidity (more than one PCG for an individual is possible)[32] and PCG model with all 19 PCGs and no co-morbidity (54 dummy variables). To assign every enrolee to at most one PCG,

[31] I.e. if a person is in the sample for 6 months in the period *t+1*, the annualised expenditures are twice the actual ones.

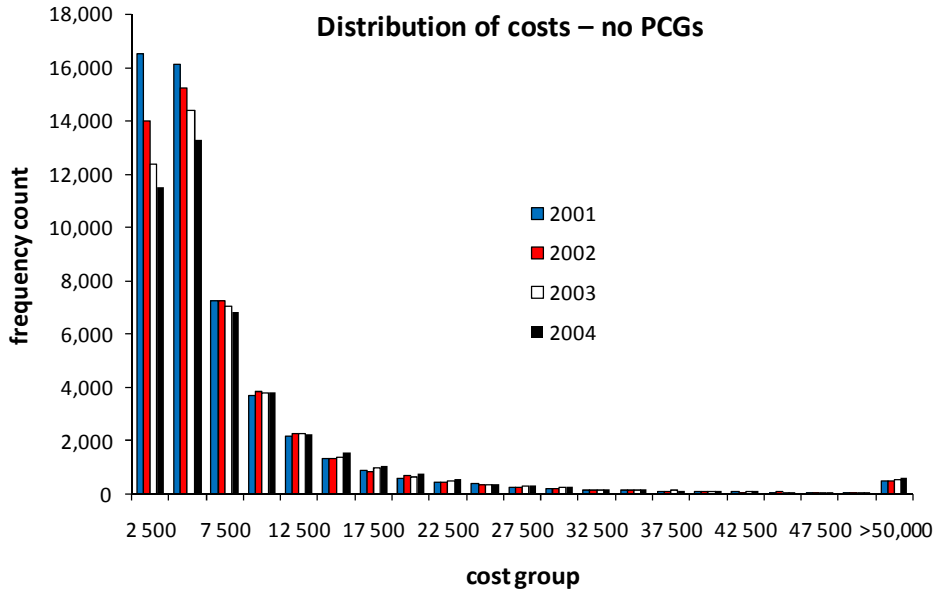
the iteration procedure to rank PCGs according to decreasing costs was used as described in Lamers and van Vliet (2003).

Homogeneity of chronic conditions

Cost homogeneity is an important issue to be analysed when appropriateness of using a given chronic condition is assessed. Obvious measures such as variance are not very useful since a few very costly patients drive the variance toward high values. Omitting extreme observations as outliers is not the best solution in our view either since high costs for some cases are expected due to complication (risk) of a given condition. By deleting these observations, we are losing valuable information.

Therefore, we opted for graphical analysis and used frequency histograms. We grouped the insured in every chronic condition into twenty-one categories, the first group being the insured with annual costs CZK 0–2,500 and the last one covering cases with annual costs above CZK 50,000.

Figure 6 is the histogram for the insured without any chronic condition. As expected, the frequencies of individuals are the highest for the two least costly groups (below CZK 5,000), then they decrease exponentially. This figure also shows what we noted earlier that the number of healthy persons decreases as the sample ages.



[32] Not included in the results, yielded similar performance to the other PCG model.

Figure 6 – *Histogram of costs for the insured without any PCG (2001-2004) based on our data sample*

As an example of a chronic condition with relatively homogenous costs we have chosen thyroid disorders (**Figure 7**). We can see that there is a very small number of people with costs less than CZK 2,500, the costs then peak in the following four categories and then gradually decrease. There is a very small number of individuals with costs above CZK 50,000, though this number increased in 2003 and 2004.

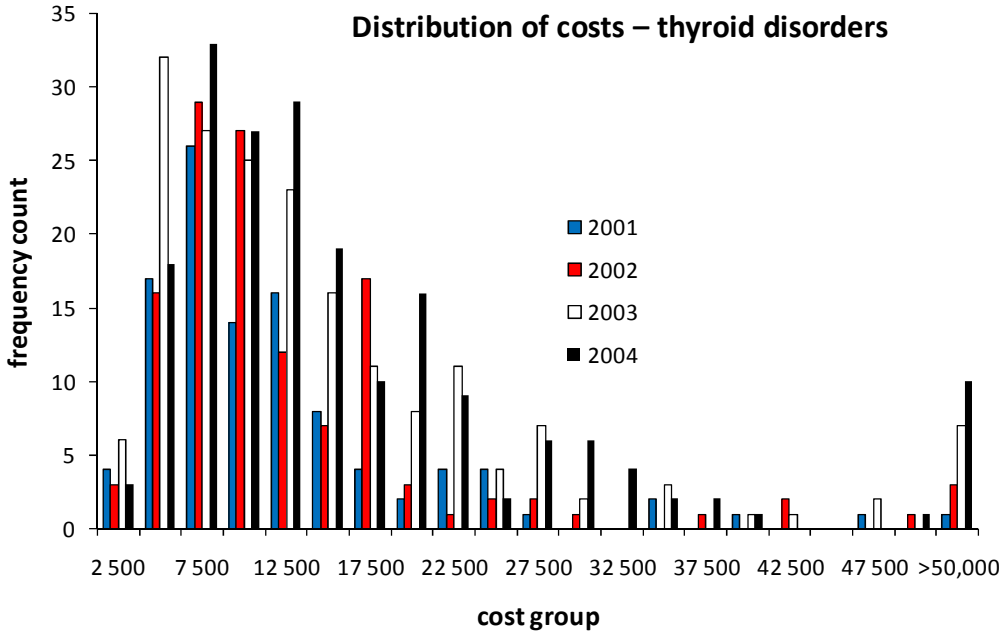


Figure 7 – *Histogram of costs for the insured with thyroid disorders (2001-2004) based on our data sample*

On the other hand, the costs of diabetes type I (people using insulin) are spread over much wider range (**Figure 8**). The distribution is quite symmetric around the peak of CZK 27,500-30,000 category with many individuals falling into the most costly group indicating that this chronic condition could eventually lead to very costly cases.

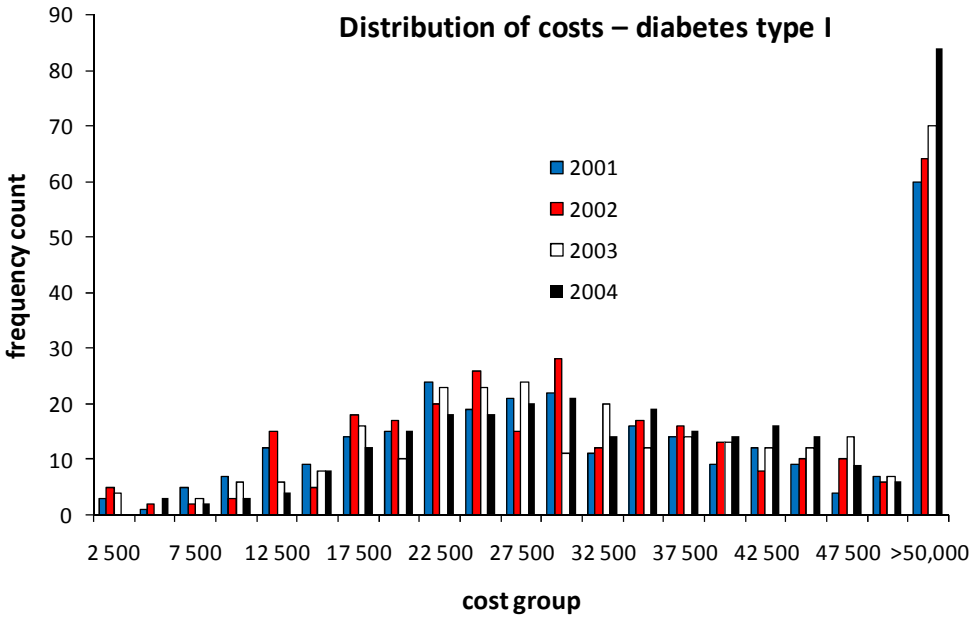


Figure 8 – *Histogram of costs for the insured with diabetes type I (2001-2004) based on our data sample*

The last pattern we would like to point out is a distribution of costs for glaucoma (**Figure 9**). It appears that we can recognise two levels of severity. The first one is reaching maximum at CZK 12,500-15,000, while the more severe one attains the highest point at about CZK 32,500-35,000. This pattern confirmed on a larger sample would imply that this chronic diagnose should be divided into less and more severe conditions.

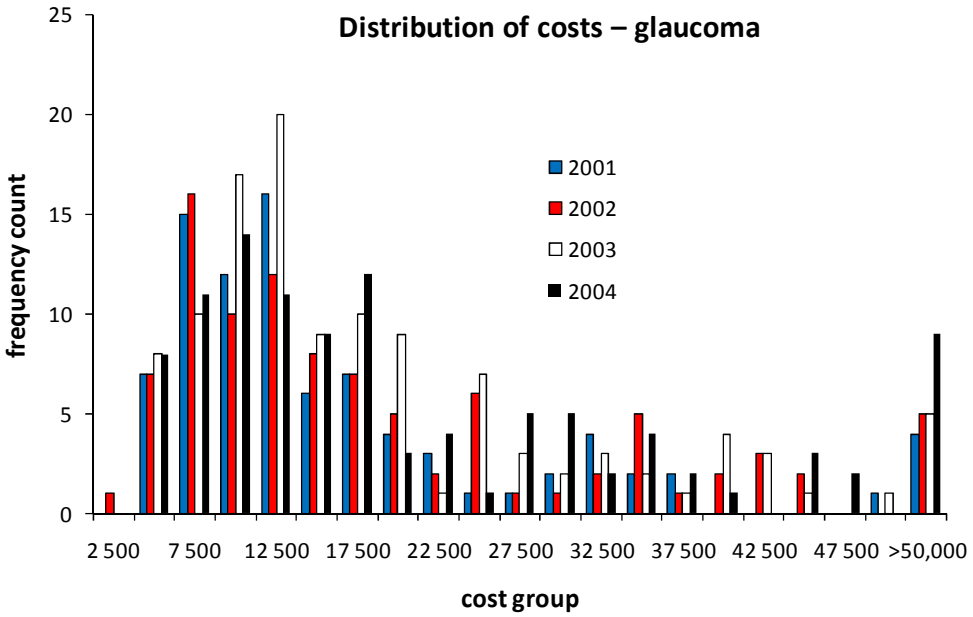


Figure 9 – *Histogram of costs for the insured with glaucoma (2001-2004) based on our data sample*

We can conclude that different chronic conditions[33] exhibit different patterns as to their homogeneity. Some of them are more homogenous whilst the costs of others are quite dispersed or are concentrated into two ranges. The important point to note is, however, that even if the actual costs are not very homogenous, the conditions themselves could still be potentially cost homogenous. The scattered costs might be a result of different ways how these diagnoses are treated (use of differently priced drugs, procedures, etc.). Especially in health care systems with low incentives for efficiency (as it is probably currently the case in the Czech Republic) the costs of a single procedure (and hence certainly of a complete diagnosis) may differ significantly. These costs would likely converge provided there is pressure for efficiency. Nonetheless, we can see that chronic conditions we used exhibit systematic distributions and they are therefore appropriate cost predictors.

Overall results

The overall results are depicted in **Table 5**. Demographic model alone is able to explain 3.2–4.4% of the variation of expenditures. This figure increases to 8.5%–9.5% if PCGs are added. Therefore, we can conclude that including chronic conditions implied by prescribed drugs

[33] For chronic conditions cystic fibrosis, transplantations, malignities and HIV/AIDS it was impossible to recognise any pattern due to a low number of observations.

roughly doubles the predictive performance and hence it is certainly a preferred option. The results are quite consistent across individual years; the small differences can be explained by the relatively small sample. Additionally, as our sample is getting older, the increased predictive performance of the PCG model can be attributed to higher prevalence of chronic conditions which are characterised by predictable costs. Thirdly, drug prescription patterns change in time and it is possible that the practice in 2003 and 2004 matches better the classification used. The implication of this argument is that drug classification used for a PCG model should be updated regularly if it is to be used in practice.

A similar conclusion may be drawn from the prediction ratios. PCG models attain ratios closer to one (where the predicted costs equal the actual expenditures) contrasted to the situation of the demographic model or no model at all. Better performance of the models with PCGs is noticeable especially for the last decile. Adding PCGs thus enables to explain some of expenditures of high-cost patients. However, there are two notable exceptions – the eight and the ninth decile. For both of these deciles PCG models underpredict actual costs and they are consistently worse than both the demographic model and the no model case[34]. This indicates that chronic conditions concentrated in these deciles incur higher actual costs than the costs implied by the regression coefficients of PCG models. The consistency across years points to a systematic pattern and a need to further refinement of the PCG classification.

	Prediction indices for each decile										**Adjusted R^2**
	0-10%	10-	20-	30-	40-	50-	60-	70-	80-	90-	

[34] If no model is applied, the costs are predicted by the overal average.

			20%	30%	40%	50%	60%	70%	80%	90%	100%	
2000	no model	0.123	0.203	0.270	0.343	0.432	0.544	0.698	0.945	1.449	4.965	0.0%
2001	no model	0.113	0.195	0.262	0.337	0.425	0.537	0.699	0.959	1.474	4.956	0.0%
2002	no model	0.111	0.194	0.262	0.336	0.425	0.537	0.702	0.964	1.483	4.942	0.0%
2003	no model	0.105	0.181	0.246	0.316	0.401	0.513	0.674	0.935	1.454	5.137	0.0%
2004	no model	0.100	0.173	0.237	0.308	0.396	0.512	0.679	0.946	1.464	5.080	0.0%
2000	demo	0.185	0.295	0.385	0.477	0.569	0.678	0.836	1.043	1.432	4.275	3.6%
2001	demo	0.172	0.289	0.381	0.474	0.576	0.686	0.850	1.064	1.455	4.125	4.4%
2002	demo	0.169	0.289	0.379	0.477	0.579	0.693	0.844	1.059	1.458	4.107	4.4%
2003	demo	0.166	0.273	0.365	0.456	0.547	0.674	0.823	1.028	1.439	4.307	3.2%
2004	demo	0.167	0.279	0.370	0.465	0.565	0.685	0.838	1.058	1.452	4.288	4.3%
2001	PCG	0.190	0.314	0.413	0.511	0.620	0.735	0.904	1.125	1.489	3.738	8.5%
2002	PCG	0.191	0.321	0.417	0.523	0.633	0.754	0.911	1.129	1.489	3.724	8.2%
2003	PCG	0.193	0.309	0.408	0.507	0.606	0.742	0.894	1.108	1.476	3.924	8.9%
2004	PCG	0.186	0.309	0.408	0.511	0.622	0.749	0.909	1.121	1.483	3.838	9.5%

Table 5 – *Overall performance of different models using R^2 and prediction ratios (actual / predicted expenditures)*

The next table (**Table 6**) contrasts different expected costs for different models. The index one is set for costs of girls aged 15-19. For a demographic model alone, the cost indices range from 0.67 (men 20-24) to 4.91 (women 75-79), more than a sevenfold difference. If a PCG model is applied, the indices for younger groups without a chronic condition are basically the same as in the demographic model since young people have a chronic condition only very rarely. The indices for older groups are lower than before, implying a shift of predicted costs from age to PCG risk factors.

For a low-cost chronic condition such as hypertension-low, a difference between demographic and the PCG model is not significant for older groups because such condition is frequent at this age and it does not incur extra additional costs. For younger groups, even this condition is exceptional and the PCG model enables to adequately compensate for it. For a very costly chronic condition such as Diabetes type I (people taking insulin) the expected costs and hence indices are much higher for all age groups. In addition, by using PCGs, the difference between the lowest-cost group (0.66) and the highest (9.06) is much higher. This shows the ability of PCG models to discriminate between different health conditions within each of the age/gender group.

Demographic model

	0-4	5-9	10- 14	15- 19	20- 24	25- 29	30- 34	35- 39	40- 44	45- 49	50- 54	55-59	60-64	65-69	70-74	75-79	80-84	85-
M	1.47	1.10	0.89	0.72	0.67	0.90	0.84	1.06	1.09	1.50	1.81	2.67	2.99	3.47	4.91	4.71	4.71	4.15
F	1.26	1.01	0.94	1.00	1.03	1.33	1.30	1.33	1.54	1.97	2.09	2.35	2.93	3.54	3.94	4.98	4.19	4.48
Demo + PCG model – no PCG																		
M	1.46	1.05	0.88	0.71	0.66	0.83	0.78	0.96	0.98	1.29	1.54	2.18	2.33	2.63	3.76	3.25	3.31	2.65
F	1.27	1.00	0.91	1.00	1.02	1.30	1.27	1.26	1.44	1.79	1.80	1.89	2.29	2.54	2.56	3.56	2.55	2.80
Demo + PCG model – hypertension-low																		
M	2.36	1.95	1.78	1.61	1.56	1.74	1.68	1.86	1.88	2.20	2.45	3.08	3.23	3.53	4.66	4.15	4.21	3.55
F	2.17	1.90	1.81	1.90	1.92	2.20	2.17	2.16	2.34	2.69	2.70	2.79	3.19	3.44	3.46	4.46	3.45	3.70
Demo + PCG model – Diabetes type I																		
M	6.76	6.35	6.17	6.01	5.95	6.13	6.07	6.26	6.27	6.59	6.84	7.48	7.63	7.93	9.06	8.55	8.61	7.95
F	6.57	6.30	6.21	6.30	6.32	6.60	6.57	6.55	6.74	7.09	7.09	7.19	7.59	7.84	7.86	8.86	7.84	8.10

Table 6 –*Indices for expected costs based on different models (2004)*

Quantitative significance

We have shown that PCGs considerably increase predictive performance of the demographic model. In this section we would like to add more details to the quantitative significance of this improvement. In this short scrutiny we are limited by the fact that we do not know actual distribution of people classed into chronic conditions for all sickness funds operating in the Czech Republic so we cannot provide an exact figure as to the amount of money that will be distributed differently if a PCG risk adjustment model is implemented. However, we can still make informative conclusions based on current experience with the demographic risk adjustment and statistics from the regressions.

	2000	2001	2002	2003	2004
Root mean square error (no model) / mean	275.8%	268.2%	270.3%	313.6%	280.7%
Sum of squares of errors (demo / no model)	3.7%	4.5%	4.4%	3.3%	4.3%
Sum of squares of errors (PCG / no model)	n.a.	8.6%	8.3%	9.0%	9.5%
Mean absolute error (no model) / mean	88.0%	88.8%	89.3%	91.8%	91.2%
Sum of absolute errors (demo / no model)	45.1%	47.7%	48.7%	47.3%	49.9%
Sum of absolute errors (PCG / no model)	n.a.	54.5%	56.6%	56.4%	57.5%

Table 7 – *Quantitative impact measures of different risk factors*

Table 7 shows regression statistics for years 2000-2004. The first and the fourth row provide information on how dispersed from a mean the data are. Root mean square error[35] is a quadratic score which gives higher weight (penalty) to high deviations from the mean and hence not surprisingly the figures for all years are very high, almost three times the mean in each year. Mean

absolute error[36], on the contrary, is a linear measure assigning equal weight to each deviation. Both measures indicate high dispersion of health care data and hence potentially high weight to be placed on the risk factors if they are able to explain it. The second and the third row give percentage of variance measured by sum of square errors that is explained by demographic and PCG models, respectively. This is equivalent to the definition of R^2. The figures are almost identical to the adjusted R^2 already presented; the PCG models are about twice successful compared to the demographic models. Finally, the fifth and the sixth row provide the proportion of explained sum of absolute errors. Based on these measures, the explanatory power of both models is higher as no extra penalty for inability to explain high costs is incurred, but the difference between demographic and PCG models is not so pronounced as in the case of the quadratic score. This confirms the conclusion drawn from the prediction ratios that the most significant comparative advantage of PCGs is their ability to explain some of very high costs. This is a very plausible property as the high costs patients are the most prone to risk selection. From the sum of absolute errors statistics we can make an intuitive conclusion about quantitative significance of different risk factors. If the mean absolute error is about the same as the mean[37] and both demographic and PCG models are able to explain about half of the mean absolute error then the demographic and PCG risk factors will have a weight of one third in the allocation of funds in a risk adjustment system. Stating differently, two third of funds will be distributed based on the average costs and the one third based on demographic and PCG risk factors. The actual redistribution depends on the different distribution of risk factors between the insurers. The already presented **Table 2** shows that the risk adjusted income of the largest insurer in the Czech Republic is increased by 4% due to adding gender and age as risk factors. The incremental contribution of PCGs is likely to be smaller; however, the improved predictive ability is especially significant for high-cost patients which are more likely to be a target of risk selection.

6. Policy recommendations

In this section we discuss various policy issues associated with risk adjustment and risk selection. Based on the lessons learned in other countries we analyse the situation in the Czech Republic

[35] Root mean square error is calculated by firstly summing the squared differences between forecast and corresponding observed values and then taking the square root of the average.
[36] Mean absolute error is the average of the absolute values of the differences between forecast and the corresponding observation.
[37] This sentence uses a very high level of approximation to present a simple intuitive conclusion.

and attempt to draw relevant policy conclusions. We start with the country comparison presented in the **Table 8.** As argued by van de Ven et al. (2007) the potential profits from risk selection depends also on the types and costs of care for which the insurers bear financial responsibility. In the table it can be seen that in the Czech Republic the insurers are held responsible for all types of listed care except for sick leave payments. This creates ample room for risk selection. Particularly, the inclusion of home health care, nursing home care and psychiatric care which are characterised by a small group of users with (very) high costs and utilisation that is highly predictable creates significant potential profits from risk selection. Therefore, a relevant policy recommendation would be to give special attention and make different financing arrangements for these types of care to mitigate the problem of risk selection.

	Belgium	Germany	Israel	Netherlands	Switzerland	Czech Republic
Physicians services	Yes	Yes	Yes	Yes	Yes	Yes
Hospital care	Yes	Yes	Yes	Yes	Yes	Yes
Financial responsibility for hospital's capital costs	0%	0%	100%	5%	100%	100%
Prescription drugs	Yes	Yes	Yes	Yes	Yes	Yes
Physiotherapy	Restricted	Yes	Restricted	Restricted	Yes	Yes
Dental care	Restricted	Yes	Restricted	Restricted	No	Yes
Home health care	Yes	Restricted	Restricted	No	Yes	Yes
Nursing home care	Yes	No	No	No	Yes	Yes
Psychiatric care	Yes[a]	Yes	No	No	Restricted	Yes
Sick leave payments	No	Yes[b]	No	No	No	No

[a] With large co-payments by consumers

[b] About 7% of total expenditures of the mandatory sickness fund insurance.

Table 8 – *Types of care for which sickness funds bear financial responsibility (based on van de Ven et al., 2007)*

Secondly, the potential profits from risk selection depend also on the proportion of health care costs for which an insurer is accountable for. If a high fraction of actual health care costs are reimbursed retrospectively or financed from other sources than the insurance premiums, the risk that the insurer bears is lowered and hence also the incentives for risk selection and vice versa. In the Czech Republic, the risk-sharing arrangement is the only explicit mechanism that decreases the financial risk of the insurers after they receive prospectively set risk-adjusted payments. Based on this arrangement, the insurers are reimbursed 80% costs above a threshold which is set to

equal thirty times the average health care costs for an average enrolee. High level of financial accountability of insurers creates motivation for risk selection and hence it asks for improvement in the risk adjustment system.

Experience from other countries particularly from Switzerland (Paolucci et al., 2007) demonstrates that supplemental voluntary health insurance is a powerful tool for risk selection. Unlike mandatory health insurance where refusing enrolees based on health status is typically prohibited, selling voluntary health insurance allows to screen health status of potential enrolees and to reject those who would be unprofitable for the mandatory insurance if both types of insurance are sold by the same entities. Currently, the basic benefit package[38] is very broad in the Czech Republic and it leaves little room for voluntary health insurance. However, proposed plans of the current government to reduce the benefit package and to introduce supplemental health insurance would mean a significant thread of risk selection if this measure is not accompanied by a corresponding improvement in the risk adjustment system.

Furthermore, as we already discussed, entrance of private insurers will increase competition in the Czech health insurance market. If the risk adjustment does not keep pace with this trend, the situation can easily create early winners – the insurers who will benefit from the imperfect system and who will block the attempts for further improvement (Hellman, 1998). In Switzerland the lobbying of the risk selecting fund against the risk adjustment improvement was so evident that newspapers published the names of the members of parliament who were paid by this fund (van de Ven et al., 2007). As the Czech Republic is still a young democracy with lower adherence to formal and informal rules, occurrence of such situations is easily imaginable.

Lessons from Israel point to a problem of risk selection if insurers are allowed to provide services directly to consumers. Implicit selection activities include waiting times for particular specialities, accessibility problems to certain clinics or opening of clinics where there is mainly young and healthy population (van de Ven et al., 2007). On the other hand, the Netherlands is much more cautious to allow so far only a limited vertical integration of insurers and providers. Insurers are allowed to set up new pharmacies or outpatient primary care centres. The natural policy recommendation would again be the improvement of the risk adjustment system to mitigate motivation for risk selection. Additionally, a tight regulation of the health care market (such as

[38] Health care services that are covered from the mandatory health insurance.

monitoring and enforcing accessibility of particular specialties) is necessary if a vertical integration of insurers and health care providers is allowed.

Other tools of managing health care system by insurers such as selective contracting and freely negotiated prices between insurers and providers, high-deductible or managed care plans[39] are the last point we would like to discuss in this section. These tools can help to contain health care costs but increase the risk selection problem. The conclusion of this point and the whole section is hence straightforward; the freedom (more tools for managing a health care system by insurers) must be associated with accountability (a better risk adjustment system and tighter regulation of a health care market).

7. Conclusion

In this paper we have discussed various methods to improve the risk-adjustment system in the Czech Republic. We have concluded that using pharmaceutical cost groups (PCGs) are a feasible option and verified on a sample of data that models with PCGs have about a twofold better performance measured by R^2 compared to the demographic model, consistent with the results encountered in the literature. We have also shown that the results are quantitatively important seeing the amount of financial resources that are being redistributed based on PCGs. We have also shown than the chronic conditions are quite homogenous and we hypothesise that costs of individual chronic conditions are likely to converge if the health care market in the Czech Republic becomes more competitive and the insurers have stronger incentives to contain costs. However, we want to emphasise that the PCG classification we used in this paper is a good starting point, but it must be fine-tuned to account for new drug molecules and medical practice if it is to be used in the current practice.

We also analysed the Czech health care market. The current status quo is likely to change due to reform proposals of the current government. The insurers will receive more tools to manage provision of health care services such as split between mandatory and voluntary health insurance, selective contracting, freely negotiated prices of health care services or high deductible and manage care health plans. Furthermore, entrance of many private insurers is expected, which will make the system more competitive and more profit oriented. Although these changes aim to

[39] High-deductible plans offer reduction in insurance premium for higher cost sharing by the insured. Managed care plans limit use of services in particular circumstances or choice of a health care provider, a detailed overview can be found in Glied (1999).

achieve higher level of production efficiency of the health care system, the experience from other countries show that they can be associated with a negative effect of risk selection if they are not accompanied by a tight regulation, specifically by a more sophisticated risk adjustment system. The imperfect risk adjustment system could easily produce early winners, the situation in which the insurers who would benefit from partial reform would block later attempts to improve the system.

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