Tax and Health Care Challenges in Economic Policy
Three essays

Radovan Chalupka

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Institute of Economic Studies
Faculty of Social Sciences, Charles University, Prague

Contents

1 Introduction

The thesis is a collection of three papers on current economic policy issues. At the present time, there are in my view three topics that engage minds of policy makers not only in transition economies such as the Czech Republic or Slovakia but also in countries with longer exposure to market economy principles. These objects of ongoing economic and political debates are pension, tax and health care reforms. In this thesis I focused on the latter two and attempted to tackle some of the associated challenges. As the perspective of an observer is limited by his or her own background, I confronted the issues from an angle of the countries I have been living in and predominantly analysed the situation in the Czech Republic and Slovakia. Still I believe that in line with the notion of leapfrogging these countries can not only learn from experience of more developed nations but unburdened by history they can more easily adopt some of more efficient principles and in certain aspects become role models for their counterparts.

I have been motivated by a few simple questions. What are the real world challenges of current economic policy that can be answered by the economic theory? What lessons can policy makers in the Czech Republic and Slovakia learn from the experience of other countries? What mistakes can be avoided having the hindsight of their history? Shall some features of the Slovak tax system and Czech health insurance system be followed by other countries? What are possible pitfalls and technical difficulties that must be born in mind when designing an optimal policy?

The first paper 'Tax Reform in Slovakia: 6 Years Later' is a recent update of a paper that came into existence shortly after the radical reform in Slovakia became effective. It aimed to contribute into the discussion whether the proposed changes are in line with optimal taxation and optimal tax systems. The reform is evaluated with particular regard to personal income tax and commodity taxes. The adoption of a flat personal-income-tax rate and a uniform VAT rate is viewed as in line with the optimal taxation theory, and the projected lessening of administrative costs and degree of tax evasion is also positively perceived. The update incorporates analysis of major changes in the period 2005 – 2010.

The work on my second paper started during my engagement in a think-tank Health Reform.cz which prepared health care reform concept implemented by the Czech government in 2006 – 2008. The paper analyses possible options to improve the risk adjustment of the health insurance

system in the Czech Republic. It argues for including Pharmaceutical Cost Groups as additional risk factors as this improvement can be implemented almost instantaneously. The study also describes and examines the Czech health insurance market and implications of proposed changes of policy makers. It specifically warns against the problem of early winners, the insurers who will benefit from the imperfect system and who will block the attempts for further improvement, if an improved risk adjustment formula is not put in operation along with the proposed changes of the health care system.

The third paper discusses risk sharing which is complementary to the risk adjustment. The risk sharing is used in competitive health insurance schemes primarily as an option to mitigate incentives for risk selection. The paper shows that the simple outlier risk sharing is not budget neutral to each of the risk groups and hence it might significantly distort an allocation of financial resources between insurers. On a set of real health care data it illustrates to what extent is such distortion quantitatively important and what steps might be taken to tackle it.

The original paper, the first paper is based on, was published in the Czech Journal of Economics and Finance 54 (9-10), pp. 382–390 which is a quality peer-reviewed journal. The second paper was discussed at International Atlantic Economic Conference in Berlin (2006), at the IES Annual Workshop (2006), the IES Young scholars conference (2006); its earlier version was published as the IES working paper 2009/2 and a shortened final version in Prague Economic Papers journal 19 (3), pp. 236–250 which is also a quality peer-reviewed journal.

My research was supported by the Grant Agency of the Czech Republic Grant No. 402/08/0501 and by the IES Institutional Research Framework 2005-2010, MSM0021620841. The papers benefited greatly from many comments and helpful discussions. In particular, I would like to thank P. Hroboň, T. Macháček, A. Marcinčin, J. Seidler, S. Vachek , F. Žikes, anonymous referees of the IES Working Papers series and Prague Economic Papers journal and my advisor O. Schneider for their knowledge, experience and motivation I could have encountered. I would also like to thank my family for their everlasting support.

2 Tax Reform in Slovakia: 6 Years Later

Abstract

The paper evaluates tax legislation in Slovakia, effected January 2004 and major changes in the period 2005 – 2010, according to principles of optimal taxation and optimal tax systems. The author evaluates the Slovak system with particular regard to taxes on labour, taxes on capital and taxes on consumption. The adoption of a flat personal-income-tax rate and a uniform VAT rate is viewed as in line with the optimal taxation theory, and the projected lessening of administrative costs and degree of tax evasion is positively evaluated. However, it is concluded that there is still room for improving the system by further shifting the burden away from taxes on labour to higher taxation of consumption and capital.

Keywords: Tax reform, flat tax, Slovakia

JEL classification: H2

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2.1 Introduction

Having won the 2002 general elections, the new Slovak government initiated a number of reforms, including a radical reform of the tax system. The goal of the tax reform was to eliminate the complications and ambiguities of the current taxation system, and to "tax all kinds of profit and all heights of profit equally and thus achieve the maximum possible equity" (INEKO, 2004). The new legislation came into effect on the 1st of January 2004. In this article we aim at evaluating the tax reform applying the optimal taxation and optimal tax systems theory. We try to identify both strengths and weaknesses of the proposal.

Previously (Chalupka, 2004) we analysed the system shortly after it had been introduced with particular regard to personal income tax and commodity taxes. The adoption of a flat personal-income-tax rate and uniform VAT rate was viewed as in line with the optimal taxation theory, and the projected lessening of administrative costs and degree of tax evasion was also positively evaluated. In this paper we focus on assessing the reform from a longer perspective as we analyse the development in the period 2005 – 2010. We extend our analysis of personal income taxation by mandatory social security contributions[1] to arrive at overall burden on labour. Additionally, we review some of the most important changes that took place in the Slovak tax and social contribution system in the particular period.

In **Section 2.2** we shortly summarise the concept of the Slovak tax reform, followed by a summary of major changes in the period 2005 – 2010. In **Section 2.4** we review the basic theory of optimal taxation and in **Section 2.5** we briefly analyse the development of overall tax burden. In the three sections which follow we discuss whether the current taxes on labour, capital and consumption, respectively, are optimal. **Section 2.9** examines other issues of the tax reform and in the final section we summarise the findings and point out to the areas in which the system in Slovakia could be further improved.

[1] Both employees and employers have to pay contributions for pension insurance (4 % and 14 % respectively), health insurance (4 % and 10 % respectively), disability insurance (both 3 %) and sick leave insurance (both 1.4 %), as well as unemployment insurance (both 1 %). Additionally, employers have to pay 0.8 % of employees' wages for accident insurance, 4.75 % to a solidarity fund and 0.25 % to the guarantee fund. A contributions ceiling applies to all types of insurance except accident insurance. Part of social contributions (nine percentage points) is accumulated in private pension funds (European Commission, 2010).

2.2 Concept of tax reform

Richard Sulík, the man behind the reform, maintains that the new system is built on the following principles:

– *Equity*. Horizontal equity – people with equal incomes are taxed equally.

Vertical equity – people with higher income pay relatively (in percentage terms) higher tax. When the tax is linear, this can be achieved by non-taxable personal allowance.

– *Neutrality*. Taxation should not distort economic processes and decisions of economic agents.

– *Simplicity*. Rules must be simple, easy to understand and unambiguous, and allow minimal administrative costs for each level of tax revenue.

– *Effective*. The system should not provide a possibility to avoid taxes whether legally or illegally. The higher is the number of exemptions, the easier is the possibility of tax avoidance.

Apart from these principles, the reform also encompasses another theory:

– Direct taxation should aim at serving only fiscal purposes and should not be used to meet other goals, such as social policy.

– Tax principles should be implemented without bias to any group.

– If taxes are perceived as unfair, people are more likely to avoid them.

– The tax reform should comply with EU legislation.

Incorporation of these principles led to the reformed tax system composed of linear personal and corporate income taxes, immovable property tax, automobile tax (direct taxes), VAT and excises (indirect taxes).

Linear income tax. The incomes of all subjects (physical and legal entities, domestic and foreigners) are taxed by a single rate of 19 %. The difference is only in the way the tax base is calculated (for instance, an employee can reduce his/her tax base by insurance contributions paid and non-taxable personal allowances).

Social security contributions[2]. Linking of contributions ceiling (payroll tax cap) to 1.5 times the average wage for the sick leave insurance and guarantee fund contributions and to 3 times the average wage[3] for pension insurance, health care insurance, disability insurance,

[2] Strictly speaking, social security contributions changes were not a part of the tax reform. However, taxes and social security contributions have been increasingly treated as complementary issues also by policy-makers in Slovakia.

[3] The applicable average monthly wage for the first half-year 2004 amounted to € 448.48. Hence, the respective contributions ceilings were € 672.72 and € 1 345.45.

unemployment insurance and reserve fund of solidarity contributions. At the end of 2003, the monthly contributions ceiling was fixed at €1,062.

Value added tax is set at 19 %. Exemptions to this rate should be allowed only if EU guidelines command. The threshold for VAT registration has been reduced from approx. € 100 thousand annual revenues to € 50 thousand.

Excise taxes. The reform increases almost every kind of excise tax. The two objectives are compliance with EU guidelines and compensation of possibly reduced tax revenues due to lower income tax rates.

Abolished taxes. Donation and inheritance taxes and taxation of dividends and similar income were abolished because they were perceived as a double taxation of assets, which have been previously taxed.

2.3 Major changes in 2005 – 2010

As documented in **Table 1**, the only fundamental change in the tax and social security contributions systems reflected in the legislation in the period 2005 – 2010[4] relates to the introduction of mandatory privately managed fully funded pension pillar. The introduction of the so called "millionaire tax" and the re-introduction of a reduced VAT rate on some commodities is discussed in **Section 2.6** and **Section 2.8**, respectively.

Year	Domain	Change
2005	Social security contributions	Introduction of mandatory privately managed fully funded pension pillar at 9% of gross earnings.
2005	Social security contributions	Introduction of health care contribution annual clearing.
2008	Social security contributions	Increase in contributions ceiling (payroll tax cap) from 3 to 4 times the average wage, health insurance cap stays at 3.
2009	Social security contributions	Decrease in the rate of contribution to the reserve fund of solidarity from 4.75 % to 2 % for mandatory insured self-employed.

[4] The government created after the elections in June 2010 announced proposals for other changes such as increasing the standard VAT rate from 19% to 20%, abolishment of tax deductibles for life insurance and supplementary pension insurance and abolishment of other exceptions and changes in the social security contributions system (ČTK, 2010). As these changes have not been reflected in the legislation, they are not discussed in detail in this paper.

2007	Personal income tax	Reduction in the non-taxable personal allowance (the "millionaire tax"). In particular, the maximum amount of the personal non-taxable allowance (in 2007 around € 3,200[5]) will be available only up to the yearly tax base of around € 16,500, i.e. 100 times the monthly subsistence level. The level of the allowance gradually decreases with tax base and stops being granted from around € 29,200, i.e. 176.8 the monthly subsistence level.
2009	Personal income tax	Introduction of an employee tax credit as a form of negative income tax in the maximum amount of € 181.03 per year.
2007	Value added tax	Re-introduction of reduced 10% rate on medicines and certain other medical / pharmaceutical products.
2008	Value added tax	Application of reduced 10% rate on books.
2010	Value added tax	The VAT rate on some agricultural products sold directly by farmers is reduced from 19% to 6%.
2008	Corporate income tax	Tightening rules on reserves and provisions for losses on loans and receivables through introduction of time limits and prerequisites.
2010	Corporate income tax	The period of loss carry-forward is extended from 5 to 7 years.

Table 1 – *Major changes in Slovak tax and social security contributions systems in 2005 – 2010 (European Commission, 2007 – 2010)*

2.4 Theory of optimal taxation

How do we know if one tax system is better than another? The literature (Heady, 1993) seems to agree on three criteria of optimal taxes:

(1) Taxes must be fair;

(2) Tax administrative costs must be minimised;

(3) The disincentive effects of taxes must be minimised.

These separate criteria can be treated together within a concept of social welfare function, which, summarising utilities of individuals into the utility of the whole society, is able to reflect social preferences, namely concern for equity.

The social welfare function may take the following form:

$$Social\ welfare = \frac{1}{1-\varepsilon}\sum_h \left(u^h\right)^{1-\varepsilon} \quad for\ \varepsilon \neq 1$$

$$Social\ welfare = \sum_h \log\left(u^h\right) \quad for\ \varepsilon = 1$$

[5] Common euro currency was adopted in Slovakia in 2009; all historic amounts expressed in Slovak crowns are translated to euro by a conversion rate of 30.126 SKK / EUR.

Where u^h is the utility of an individual (or household) h, positively dependant on her income and negatively on her labour supplied, and ε is the degree of concern for equity. If $\varepsilon = 0$, the society is not concerned about inequality, whereas, if ε is positive, increases in individual u^h are transformed into less than proportional increases of aggregate $\frac{1}{1-\varepsilon}\sum_h \left(u^h\right)^{1-\varepsilon}$, which implies that less weight is attached to a given absolute increase of utility for an individual with an already high level of utility, than to others with lower levels of utility.

All taxes affect the behaviour of subjects to some extent; in the case of an employee, taxes affect how many hours they are willing to work, i.e. what is their labour supply. The overall effect of tax change is decomposed into an 'income effect' and 'substitution effect'. The income effect is a synonym for one's willingness to work more in order to compensate for income lost due to taxation. The substitution effect goes in different direction: as the higher tax reduces the marginal return to work (each hour of work is less rewarding), a person is willing to work less (decrease their labour supply), because working becomes less "profitable". The composite effect of these two, which is ambiguous, determines elasticity of the labour supply[6]. If the labour supply is highly elastic, an increase in tax leads to a considerable decline of hours worked, while if it is inelastic (approaching zero), a tax increase would have little effect on the number of hours worked.

2.5 Overall taxation development

Figure 1 shows that even before the fundamental change of the tax system in 2004, the tax-to-GDP of Slovakia was below the median level of EU-27 countries. The tax reform shifted the ratio further down to the first quartile. In 2005 – 2006 the decrease continued due the introduction of a 'second pillar' fully funded pension scheme, as contributions to privately managed funds are not booked as government revenue. A significant decrease in VAT revenues in 2007 especially due to the reduced rate on pharmaceuticals was offset by higher excise and personal income tax revenues so the tax-to-GDP ratio stayed fairly stable in 2006 – 2008.

The current relatively low level of taxation in Slovakia (29.1% of GDP in 2008) is in line with taxation levels in the US and Japan for which the tax-to-GDP ratio in 2008 amounted to 26.9%

[6] I.e., percent change in labour supply given percent change in the tax rate.

and 28.3%, respectively (European Commission, 2010). The European Commission (2010) notes that "the tax level in the EU is high not only compared with to those two countries but more generally; among the major non-European OECD members, only New Zealand has a tax ratio that exceeds 34.5 % of GDP".

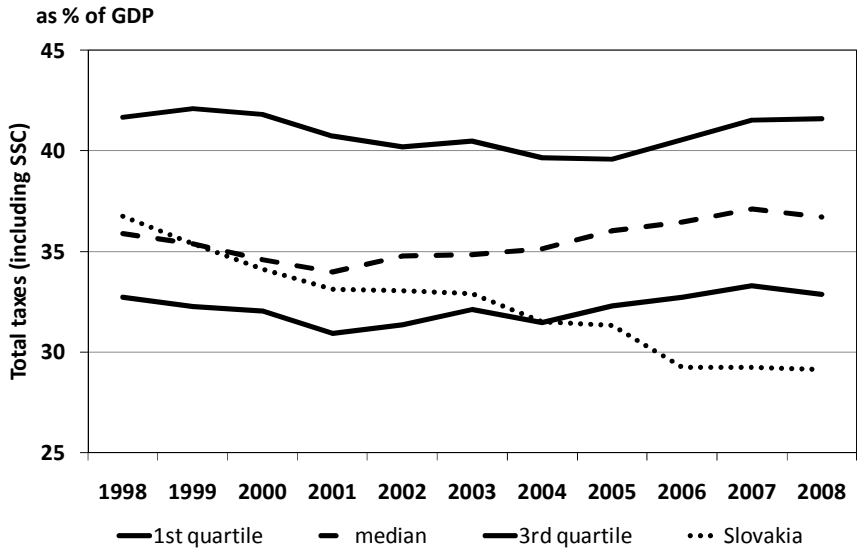

Figure 1 – *Overall taxation in EU-27 (data from European Commission, 2010)*

2.6 Taxes on labour

Income taxation embraces personal income tax (PIT) and corporate income tax (CIT). Because the optimal tax theory covers specifically, the more complex PIT, it will also be our focus. We extend our analysis of PIT also by mandatory social security contributions to arrive at overall burden on labour. In the next section, however, we will also touch upon the issue of CIT and taxes on capital in general.

Mirrlees (1971) analyses both non-linear taxation (the old tax system in Slovakia) and linear taxation (the new system). The important factors influencing the net effect of a tax increase on social welfare in the case of non-linear taxation are:

1. Compensated elasticity of labour supply (a high elasticity will mean that the net revenue gain is either small or negative, so a tax increase is less likely to increase social welfare);

2. Degree of concern for inequality (the higher the concern for inequality, the higher is the probability of increased social welfare);

3. Degree of income inequality (the higher the inequality, the higher the probability of increased social welfare);

4. Proportion of the population above the range of the tax increase (the higher the proportion, the higher the probability of increased social welfare).

The implication of the latter factor is that the marginal tax rate of a person with the highest income should be zero, because raising it above zero will not generate extra revenue. This argument can be extended to the finding that the marginal rate should be decreasing in contrast to the common practice of increasing marginal rates. The logic goes as follows: if the marginal rate for a high earning person is increased, they will experience the above mentioned substitution effect (incentive to decrease their labour supply) and income effect (incentive to increase their labour supply). However, because the new rate applies only to a small proportion of their income, the size of the reduction in their after-tax income is small, and the substitution effect dominates – the person pays less taxes. Hence, no matter how redistributive the government is (or pretends to be) the optimal tax schedule for the highest earners (top of the income distribution) should have a declining marginal rate.

Mirrlees also extended this theoretical result for the top of the income distribution to the complete optimal tax schedule. He found a very small decline in the marginal rate over most of the income distribution; so small that the optimal income tax schedule can be approximated by a constant marginal rate, i.e. linear income taxation. In this respect, the income tax in Slovakia is in line with theoretical recommendations.

Certain tax progression can be achieved by maintaining a non-taxable personal allowance (the amount of income that is not taxed; the Slovak reform suggested approx. € 2,683 instead of € 1,287). Caminada and Goudswaard (2001) showed on the example of the Netherlands that linear tax combined with a fixed non-taxable personal allowance maintains satisfactory level of progression measured by the Gini coefficient. The current Slovak tax code goes even further as shown in **Figure 2** which depicts the progression of taxes on labour as of the second half-year 2010 for an employee with no dependent children and spouse. The progression at the beginning of the income schedule is magnified by the employee tax credit[7]. Under this provision of the tax code taxpayers are compensated for an unused portion of the non-taxable allowance, effectively creating a negative income tax for people with lower tax base than the allowance. The figure also

[7] As already described in **Table 1**, employee tax credit was introduced in 2009. In 2010 the maximum level amounted to € 157.04.

shows that as all contributions ceilings are reached the total taxes on labour become regressive, asymptotically converging to the marginal rate of 19%. This is in line with the theoretical argument that the marginal rate should be decreasing as the substitution effect for high earners prevails.

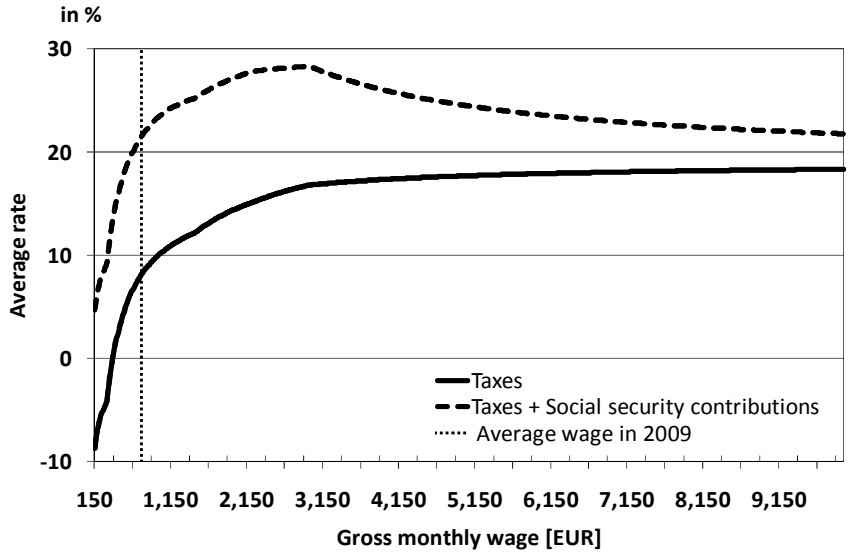

Figure 2 – *The progression of taxes on labour in the second half-year 2010 (an employee with no dependent children and spouse)*

Is a tax rate of 19 % correct? Stern (1976) included in his model concern for equity, compensated the elasticity of labour supply and the size of the government's revenue requirement. His results showed that the optimal marginal rate of income tax is higher for:

– Lower values of the compensated elasticity of labour supply,

– Higher degree of concern for inequality,

– Greater inequality in pre-tax wages,

– Higher government revenue requirement.

The actual rates then range from 54 – 90 %, and include all tax burdens (VAT, excises, and compulsory social security contributions). Atkinson (1995) conducted analysis to find out the optimal linear tax. He used the same first three parameters as Stern to derive the formula:

$$\frac{t}{1-t} = \frac{1}{\varepsilon} E\left[\frac{\omega L^S}{E(\omega L^S)}\left(1 - \frac{\Gamma'(V)}{\lambda}\right)\right]$$

where t is the tax rate, ε is the elasticity of labour supply, $\frac{\Gamma'(V)}{\lambda}$ is the normalised change in the social welfare function if the income of a social group is increased (degree of concern for inequality) and $\frac{\omega L^S}{E(\omega L^S)}$ is income of a social group in comparison to the average income (inequality in pre-tax wages). Using this equation we can derive the optimal income tax rate. For example, in the case of the Rawlsian social welfare function (where all the weight in the social welfare function is put on the poorest person) and unitary elasticity of the labour supply, the optimal rate is 50 %.

As mentioned before Caminada and Goudswaard found that in the Netherlands, a 27.7% linear rate would be fiscally neutral. It is difficult to make any suggestions to Slovakia, but because the Slovak proposal aims for overall fiscal neutrality (not just PIT) using also other higher taxes, a rate lower than 27.7 % should be expected to be neutral.

In 2007 the Slovak government introduced a "millionaire tax" with a view to generate extra revenues. The additional burden of the tax stems from gradually decreasing the maximum amount of the non-taxable personal allowance down to zero. **Figure 3** illustrates the effect of the additional tax on the marginal rate in the second half-year 2010. Due to the millionaire tax, the effective marginal tax rate excluding social security contributions is increased by 25% as each euro of additional income decreases the non-taxable allowance by € 0.25[8]. The marginal rate eventually decreases down to 19% as all the social security contributions ceilings are attained. It can be noted that currently in Slovakia, the middle and upper-middle class of employed people is the group which is most heavily taxed both in terms of average and marginal total tax rates on labour. This creates a possible threat of brain drain of highly qualified labour especially in case the high taxation is not accompanied by provision of quality public services relevant for this social group.

[8] The highest marginal rate is 32.9%, calculated as (1 – 12%) × 19% × (1 + 25%) + 12%. The calculation reflects the fact that social security contributions are not included in the tax base and that the ceiling for the sick-leave insurance at this level of income has already been reached.

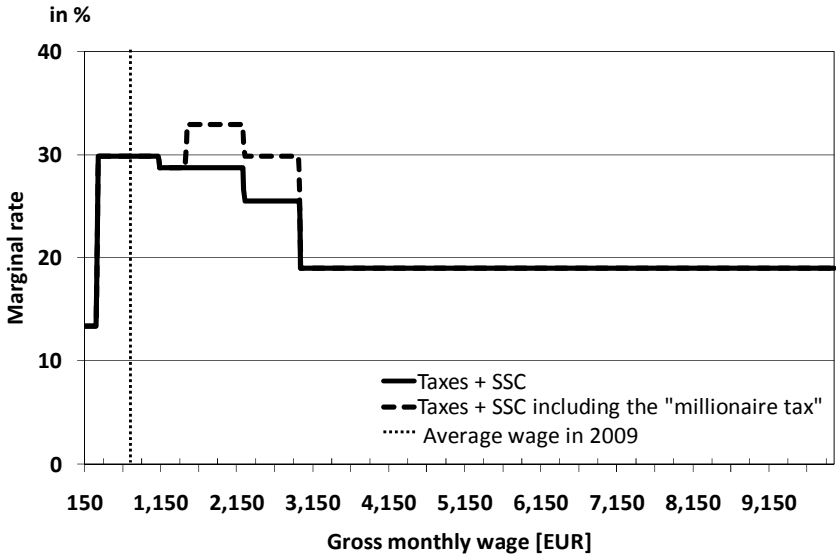

Figure 3 – *The effect of the millionaire tax in the second half-year 2010 (an employee with no dependent children and spouse)*

Over the past decade policymakers have often resorted to cuts in labour taxes that are targeted to the bottom end of the wage scale in order to boost employability of low skill workers (European Commission, 2010). **Figure 4** gives an EU-27 perspective of the tax wedge (the difference between labour costs to the employer and the corresponding net take-home pay of the employee) for a single example worker at two-thirds of average earning. Overall, the tax wedges are very high which creates a barrier for employment. The level for Slovakia is high as well (36% in 2008), although it decreased in 2005 due to the introduction of mandatory privately managed fully funded pension pillar[9]. Introducing a personal allowance also for social security contributions would be a measure to move the tax wedge more closely to the level of employment-friendly countries such as Malta (18%), Ireland (15%) or Cyprus (12%)[10].

[9] As already noted, the 9% of gross earnings contribution to the private pillar is not being booked as government revenue.
[10] The data is taken from European Commission (2010), the figure for Malta is for 2008; the data for 2007 is used for the other two countries.

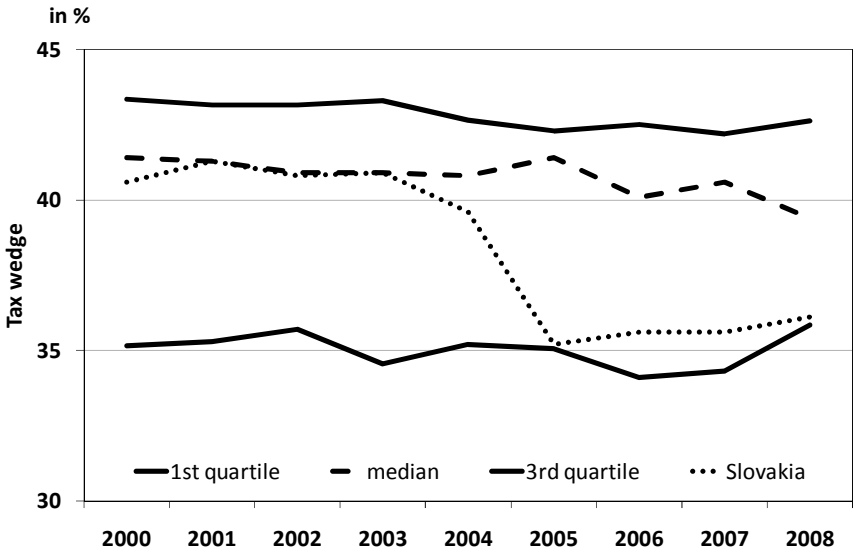

Figure 4 – *Tax wedges for a single worker at two-thirds of average earnings in EU-27 (data from European Commission, 2010)*

Figure 5 shows that the implicit tax rate on labour[11] in Slovakia increased in the recent years and currently it is just below EU-27 median level. A natural employment enhancing strategy would be to shift a part of the tax burden either to consumption or capital.

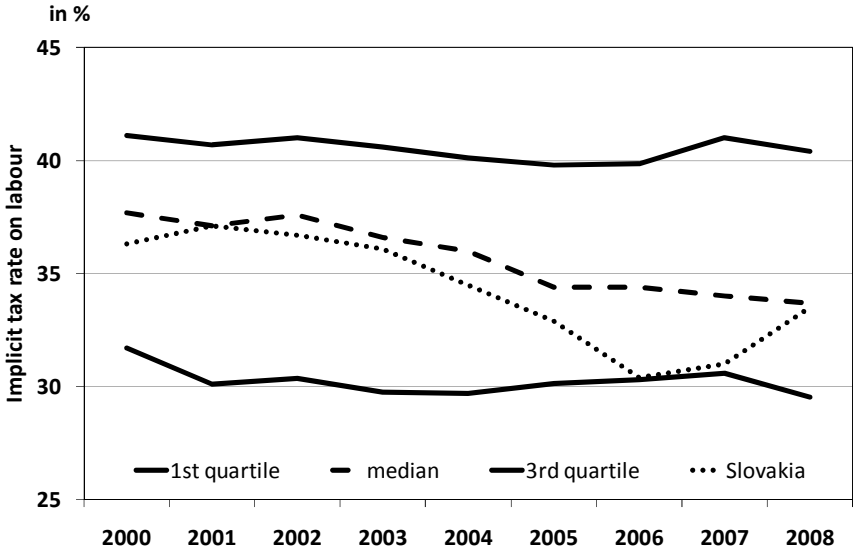

Figure 5 – *Implicit tax rates on labour in EU-27 (data from European Commission, 2010)*

[11] The implicit tax rate on labour is defined as the sum of all direct and indirect taxes and employees' and employers' social contributions levied on employed labour income divided by the total compensation of employees working in the economic territory (Economic Commission, 2010).

2.7 Taxes on capital

Developing countries usually apply multiple rates of CIT, differentiated along sectored lines. This is, however, detrimental to the proper functioning of market forces and distorts the sectored allocation of resources (Tanzi, 2000). In the case of Slovakia, a single rate of 25 % already existed for corporations before 2004. The problem of the old system was in the significant difference between the CIT and top marginal rate of the PIT (38 %). The difference distorted business decisions – doing business purely for avoiding high PIT. Tanzi argues that equalising the CIT and the marginal PIT rate is a preferable way to remove this distortion.

There is an obvious discrepancy, however, in the total tax burden on capital and the total taxes levied on labour due to social security contributions which are not paid from capital income[12]. This creates an incentive to set up legal business entities rather than work as an employee in order to reduce social security contributions. Full inclusion of capital income in the tax base of social security contributions would remove this distortion. **Figure 6** depicting implicit tax rates on capital[13] in EU-27[14] shows that taxation of capital in Slovakia has been lowered to quite low levels so an increase might be reasonable even though capital is a highly mobile factor.

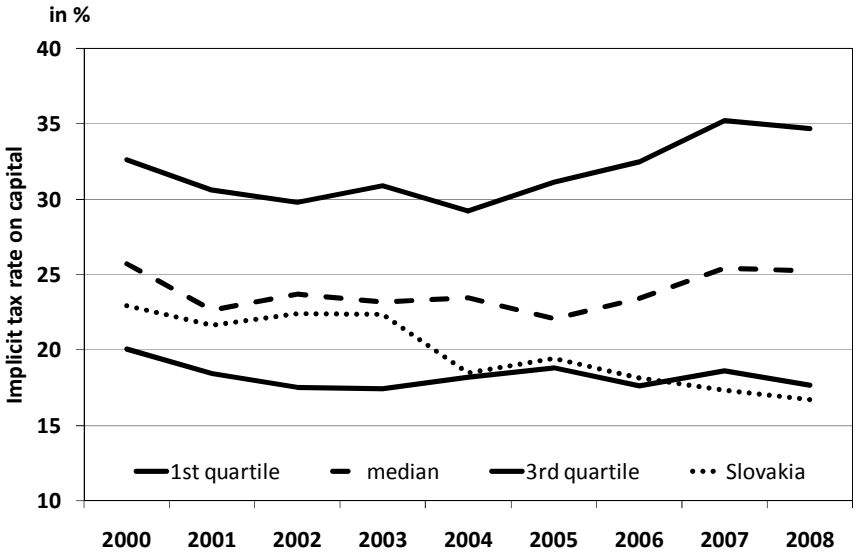

Figure 6 – *Implicit tax rates on capital in EU-27 (data from European Commission, 2010)*

[12] Sole entrepreneurs' income unlike profit shares and dividends for owners of limited liability and joint stock companies is subject to social security contributions. Moreover, there is a draft law to include rental income in health insurance tax base.
[13] The implicit tax rate on capital is computed as the ratio between revenue from all capital taxes, and all (in principle) potentially taxable capital and business income in the economy (Economic Commission, 2010).
[14] The figure excludes data for Bulgaria, Luxembourg, Malta and Romania which are not available.

2.8 Taxes on consumption

The theory on optimal taxation quotes analysis by Ramsey (1927). Under the assumption, that demand for particular goods is independent of the price of other goods; he derived an 'inverse elasticity rule': goods with higher price-inelastic demands should be taxed more heavily. The rule has wide influence and its basic rationale – that the taxation of inelastic goods yields more revenue, because demand only falls slightly – is probably responsible for the taxation of alcohol, tobacco and petrol all over the world.

A different perspective was shown by Corlett and Hague (1953), who looked on the situation where there are two consumption goods taxed at the same rate and asked whether efficiency could be improved by introducing some non-uniformity (raising the tax on one good and lowering the tax on the other). They showed that, if the goods differed in their degrees of complementarity or substitutability with leisure, efficiency could be improved by increasing the tax rate on the goods that were most complementary (or least substitutable) with leisure and reducing the tax rate on the other goods. Heady (1987) showed, these two views are consistent (if demands are independent) because the goods which are most complementary to leisure will also be the goods with the most inelastic demand curve (e.g. alcohol). The Slovak tax reform (and also the old system) uses these principles in the form of excise tax on alcohol, tobacco and petrol.

Heady (1993) argues complementarily with leisure could not be the only reason for such high rates as they are used in most countries. The justification must be found in terms of externalities that the consumption of these goods imposes on other people or on basis of a paternalistic concern for the consumer's health. Taking into account these aspects high special rates on this kind of consumption is legitimate. The proposed increase in the excises (generally above the directives of the EU) also seeks a revenue purpose. The overall decrease in income tax may, especially in the short run, lead to a budget shortfall, and an increase in excises is a remedy.

Turning away from "externality producing commodities", the important notion that has to be added to the inverse price elasticity rule (or leisure complementarily) is the question of the income elasticity. While the former deals with efficiency (the highest revenue to be collected), the latter handles equity. Many goods with low price elasticity also have low-income elasticity (therefore, they are necessities), so raising the tax rate will hurt low-income individuals. Hence, goods requiring different tax treatment would have to be divided into clusters by their

income elasticity. Necessities would be taxed lower than luxuries (goods with higher income elasticity). Indeed, most OECD countries have at least two rates, the standard rate and the reduced rate. Deaton and Stern (1986) showed that it is better to give households direct payments, than to reduce tax on particular goods, because the reduction in the tax will benefit the rich more, as they buy higher quantity of that good. Ján Tóth noted: "State should subsidise neither electrical heating of swimming pools nor the price of bread for the rich citizens." (Jaroš, 2003). Cnossen (1998) adds that exemptions on social, health, education, social and cultural services violate the neutrality criterion and should not be used. However, he also argues that dual VAT is preferable for low-income countries, which face major constraints in low administrative capacity to tax personal income and to operating income support programs. Low-income countries often have dualistic economies with class-differentiated consumption patterns that lend themselves more easily and effectively to the alleviation of the regressive impact of consumption. On the other hand, in high-income countries, reduced rates are not an effective way of alleviating the tax impact on the poor. The consumption patterns of low and high-income groups have converged, so that reduced rates benefit more the rich. Differentiated VAT rate structures, moreover, greatly increase administrative and compliance costs, particularly of small businesses[15].

The EU countries have to follow the 2006/112/EU directive which in Annex III lists supplies of goods and services to which the reduced VAT rates may be applied. The list includes 18 categories such as foodstuffs, supply of water, admission to zoos, street cleaning, and cremation services. The Slovak government succumbed to the temptation of using this list and re-introduced a reduced VAT rate of 10% on (1) medicines and certain other medical / pharmaceutical products in 2007 and (2) books in 2008. Additionally, in 2010 a reduced VAT rate of 6% was introduced on some agricultural products sold directly by farmers[16]. As concluded by Cnossen (2002): "invariably, the exemptions and special schemes violate production and tax collection efficiency". Moreover, in the case of medicines and medical devices, the government in Slovakia has in hands a far more better tool to influence amounts to be paid by consumers by setting reimbursement levels from mandatory health insurance.

[15] For instance in the UK the following factors had to be considered for food: place of consumption, timing of consumption, temperature, saltiness, number, volume, concentration, sugar content, alcoholic content and use of fingers in consumption (Cnossen, 2002).
[16] The 2006/112/EU directive grants farmers a special treatment separate from the Annex III list of exceptions.

Figure 7 confirms that although the tax reform of 2004 shifted the taxation toward taxes on consumption, in the recent years the implicit rate on consumption[17] in Slovakia has decreased. As already suggested, increasing taxes on consumption and decreasing taxes on labour might be an employment enhancing option.

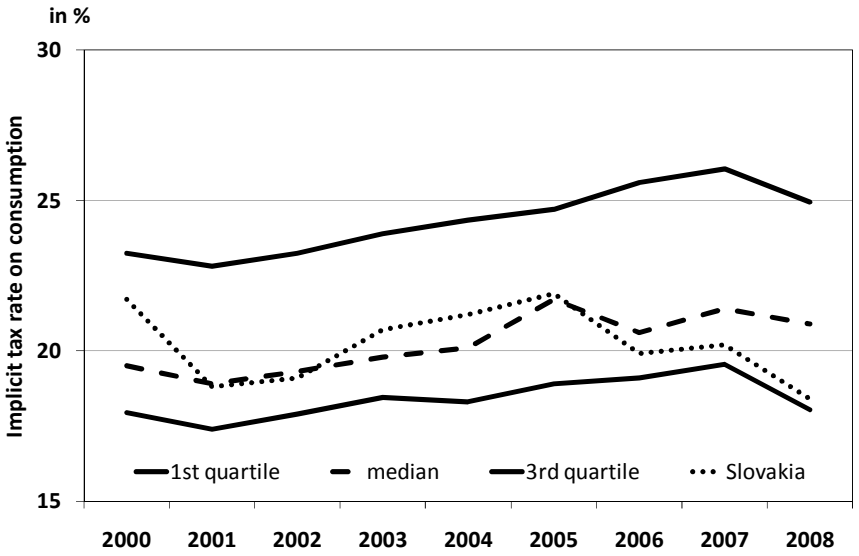

Figure 7 – *Implicit tax rates on consumption in EU-27 (data from European Commission, 2010)*

2.9 Other issues of tax reform

One of the theories of the tax reform is that perception of tax fairness influence the extent of tax avoidance. This thesis can be viewed as the extension of Musgrave (1959) 'spite effect'. As he proposes, imposing an unfair tax may call forth a feeling of anger, a desire to hit back and inflict losses on the government. In the original argument people react by reducing one's work effort and hence one's tax base. However, other different ways of revenge are imaginable – evading taxes either by creative accounting, improper reporting of income or simply by not paying taxes. As the tax level decreased substantially (PIT from 38 % and CIT from 25 % to 19 %), they are popular with taxpayers. According to the polls before the reform was put in practice, more than three quarters of Slovaks thought the old tax system should be reformed (Javorský, 2003).

Slemrod and Sorum (1984) elaborate on administrative costs of tax systems, which may be quite high (e.g. 7 % of tax revenue in USA). The current overgrown legislation is hard to process

[17] The implicit tax rate on consumption is defined as all consumption taxes divided by the final consumption expenditure of private households on the economic territory (Economic Commission, 2010).

even for better motivated people, than tax officers. Complicated legislation is also ambiguous and many issues had to be resolved either at the discretion of tax officers or by the courts. Also in this area, the reform may be a positive step forward: uniform income tax and a single VAT rate are consistent with the desire to decrease administrative complicatedness and hence to decrease administrative costs.

Similarly, the corporate income tax rate is important from the international perspective. Lower rates can attract more capital to Slovakia and increase tax revenues. Although other countries (following prisoners' dilemma scenario) will most likely also decrease their tax the rates in future, Slovakia may still take advantage of its leadership until they do so.

The important issue to consider is the effect of the reform on particular social groups, tax incidence. With a proposed single 19% VAT, it is obvious that while an average taxpayer may pay the same taxes, the group effects may be different (some people will pay higher taxes). However, since the Gini coefficient measuring the inequality of income is inherently low (among OECD countries approaching the most equalitarian Scandinavian states (Human Development Reports, 2003)), the change that may generate greater inequality based on desert principle is justifiable.

2.10 Conclusion

We have examined the Slovak reform of the tax system from 2004, using current optimal taxation principles. As previously concluded (Chalupka, 2004) the adoption of a flat personal-income-tax rate and uniform VAT rate was viewed as in line with the optimal taxation theory, and the projected lessening of administrative costs and degree of tax evasion was also positively evaluated. In this paper we have additionally analysed the development in the period 2005 – 2010. We suggested shifting the burden away from taxes on labour to higher taxation of consumption and capital. Particularly, we proposed decreasing the tax wedge of low income workers by introducing a non-taxable personal allowance on social security contributions and abolishing reduced VAT rates on pharmaceuticals and books.

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3 Improving Risk Adjustment in the Czech Republic

Abstract

This paper analyses possible options 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 policy makers. Based on experience from other countries we point to a problem of risk selection if the changes are not accompanied by a tighter regulation, specifically in the form of an improved risk adjustment formula.

Keywords: Risk adjustment, health insurance, Pharmaceutical Cost Groups, Czech Republic

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

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3.1 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 for 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*[18] in consumption of health care services is considered to be more important, which makes functioning of health care markets more difficult.

One of possibilities aimed to achieve adequate level of efficiency and equity envisioned by Enthoven (1988) is *managed competition*[19] with a role of insurers[20] 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 into account both production level and costs. [21] Equity (or solidarity[22]) within the framework of competing insurers can be achieved by a system of *risk adjustment*[23]. Under a system of risk adjustment, premiums[24] 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;

[18] More details to equity in health care can be found for instance in Wagstaff (2000).
[19] 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 (2007).
[20] 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, 2007), basic health insurance and supplemental insurance can be currently 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.
[21] 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).
[22] Van de Ven (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).
[23] 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).
[24] Three different expressions are encountered in the literature – *risk adjusted premiums, risk adjusted payments* or *risk adjusted capitation*.

insurers insuring people with higher expected[25] 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. [26] Van de Ven (2000) summarises 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, 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[27], 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*[28] (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, 2003). The risk selection can take various forms, from the most visible forms such as refusing selected potential enrolees[29] 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.

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

[25] 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.
[26] 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.
[27] In the Czech Republic insurers have no discretion to set insurance premium as it is set by the legislation.
[28] Newhouse (1996) defines *selection* as actions (not including risk rating) by consumers and sickness funds to exploit unpriced risk heterogeneity and break pooling arrangements.
[29] 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, 2007).

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. **Section 3.4** presents a theoretical model which captures basic issues and principles of risk adjustment. Throughout the paper we claim that PCGs are a feasible option to make the system in the Czech Republic better so in **Section 3.5** 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 **Section 3.6**, 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 section.

3.2 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 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, 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 or Ash, 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 (1985) argues, 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 typically based on expected costs). As argued by van Barneveld (2001) although risk sharing[30] 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, 1996);
- The Diagnostic Cost Group (DCG) family of models, developed at Boston University and Health Economics Research (Ash, 1989 and 1998; Ellis, 1996; Pope, 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[31];
- The Disability Payment System (DPS) developed primarily for the U.S. Medicaid[32] program disabled enrolees (Kronick, 1996).

All these nomenclatures attempt to group diseases into a 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.[33] 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 utilisation 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.

[30] 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).
[31] Federal system in the U.S. established to finance health care for the elderly, disabled and people suffering from end-stage renal disease (ESRD).
[32] Federal system in the U.S. established to finance health care for the poor.
[33] 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.

Another alternative is to use automated pharmacy data as a proxy for diagnosis. Clark (1995) uses information about prescribed drugs to assume chronic conditions that are correlated with higher future costs. Lamers (2004) built on this classification and adjusted it to the Dutch situation. Twenty two chronic conditions (Pharmaceutical Costs Groups – PCGs) are identified based on relevant prescription of a particular ATC group[34]. 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 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). [35]

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, 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.[36]

[34] 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.

[35] This disadvantage can be mitigated as argued by Lamers (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).

[36] Van de Ven (2000) distinguishes 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 overutilisation or ineffective care in certain regions (N-type factor) but also by higher input costs (possibly S-type factor).

3.3 Health insurance market and risk adjustment in CR

3.3.1 Czech health insurance market

In the Czech Republic health insurance enrolment is mandatory for every person working or having residence in the country. Error! Reference source not found. provides overview of money flows in the health insurance market between the four major players (consumers, providers, insurers and a sponsor). Sickness funds[37] collect health insurance tax (a fixed percentage[38]) levied on gross income[39] 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 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 (16.6% as of 2008). [40]

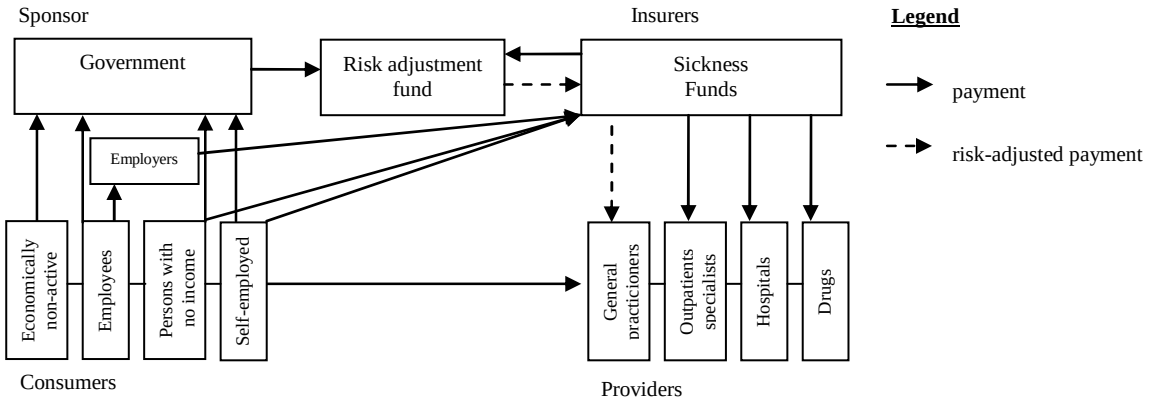

Figure 8 – *Mandatory health insurance system in the Czech Republic*

[37] In the Czech Republic the sickness funds are named *health insurance companies* and currently they do not provide supplemental health insurance.
[38] 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.
[39] We term this contribution also as *insurance premium.*
[40] The figure is based on ÚZIS (2009). The percentage increased from 14.6% in 2007 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 prescription of a different drug). Other health care expenditures borne by consumers include primarily costs of not fully reimbursed drugs and medical devices.

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 private entities[41] started to apply for a licence to provide mandatory health insurance as a consequence of undergoing health care reform at that time. [42] Entrance of new players 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.

	Operation	Original industry specialisation	Share on total number of enrolees (2008)	Share on total insurance premium [a] (2008)
Všeobecná zd avotní pojišťovna ČR	Countrywide	General	62.6%	66.8%
Vojenská zdravotní pojišťovna ČR	Countrywide	Armed forces	5.3%	4.9%
Hutnická zaměstnanecká pojišťovna [c]	Regional	Steelmaking	3.5%	3.1%
Oborová zdravotní pojišťovna zaměstnanců bank, pojišťoven a stavebnictví	Countrywide	Financial services, construction	6.5%	5.7%
Zaměstnanecká pojišťovna ŠKODA	Regional	Automotive	1.3%	1.2%
Zdravotní pojišťovna MV ČR	Countrywide	Police	10.5%	9.3%
Revírní bratrská pokladna, zdravotní pojišťovna	Regional	Mining	3.7	3.0%
Zdravotní pojišťovna Metal-Aliance	Countrywide	Steel and engineering	3.6%	3.0%
Česká národní zdravotní pojišťovna [c]	Countrywide	General	3.0%	2.7%
Zdravotní pojišťovna Agel [b]	Regional	General	0.1%	0.1%
Zdravotní pojišťovna MÉDIA	Countrywide	General	new	new

[a] Based on the current risk adjustment mechanism using age/gender risk factors.
[b] Started to operate as of 1 April 2008, as of 1 July 2009 it merged with Hutnická zaměstnanecká pojišťovna.
[c] As of 1 October 2009 the sickness funds merged into one entity (Česká průmyslová zdravotní pojišťovna).

Table 2 – *Sickness funds registered in the Czech Republic in 2009 (annual reports of sickness funds for 2008)*

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, standardised mortality in one sickness fund in certain years was very low compared to the national average. As

[41] Nonetheless, all Czech sickness funds still have a special legal status, they have no owners, the institutions are governed by a board composed of equal representation from the Ministry of Health Care, employers and insured.
[42] Two new insurers applied for the licence in 2007 and 2008; several others expressed their intentions to enter the market but stopped their efforts due to discontinuance of the healthcare reform and global financial turmoil.

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 (measured by total defined daily doses) 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[43]. Entrance of private players naturally increases the motivation to earn extra profit. Therefore, we argue that the current trends in the health care market should be accompanied by tighter regulation to avoid risk selection. A better risk adjustment system is one of the steps to be taken.

3.3.2 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 9**). 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

[43] 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.

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.

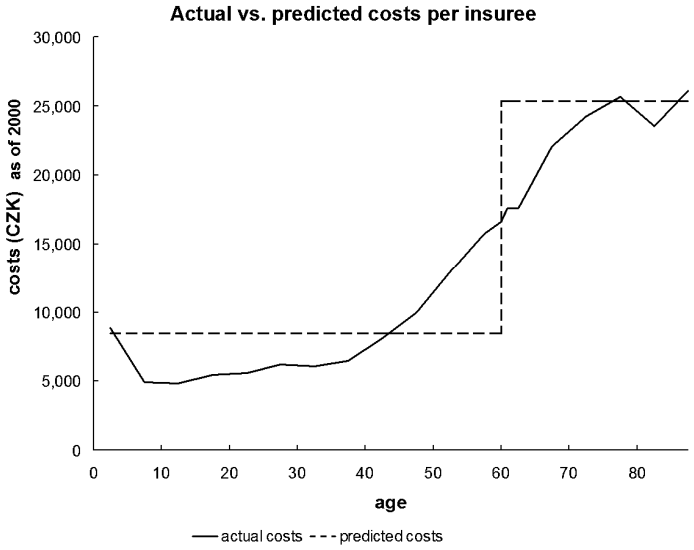

Figure 9 – *Actual vs. predicted costs using risk adjustment used in the Czech Republic until 2005 (Hroboň, 2007)*

The first step toward a better risk adjustment system was taken in 2005 when risk adjustment according to gender and age groups was implemented. [44] The entire insurance premium collected[45] from enrolees and the amount from the state is now redistributed based on 18 age indices for men and the same for women (**Figure 10**). This eliminates the predictable losses for a given age group if a sickness fund has members with average morbidity.

[44] 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.).

[45] 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.

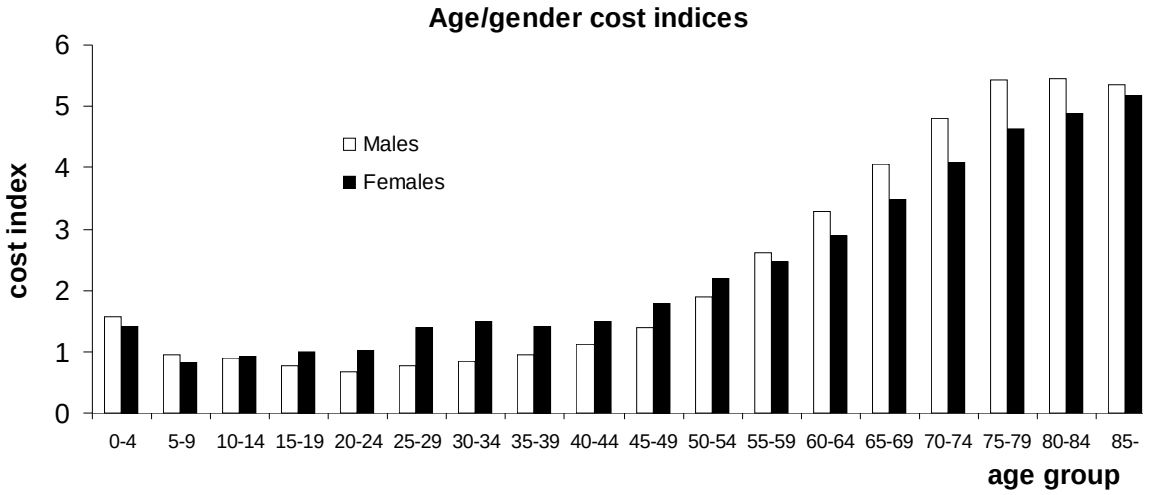

Figure 10 – *Cost indices for age/gender groups used in the Czech Republic for the year 2010 (Decree No. 391/2009 Coll.)*

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.

3.4 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 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.

3.4.1 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.

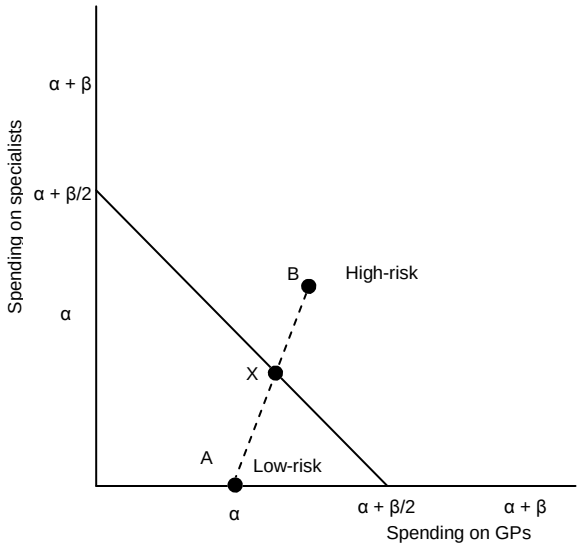

Figure 11 – *No risk adjustment when quantities of each service supplied are exogenous*

This situation is depicted in **Figure 11** 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.

3.4.2 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 (2000) examines exogenous imperfect signals. [46] 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 12** 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.

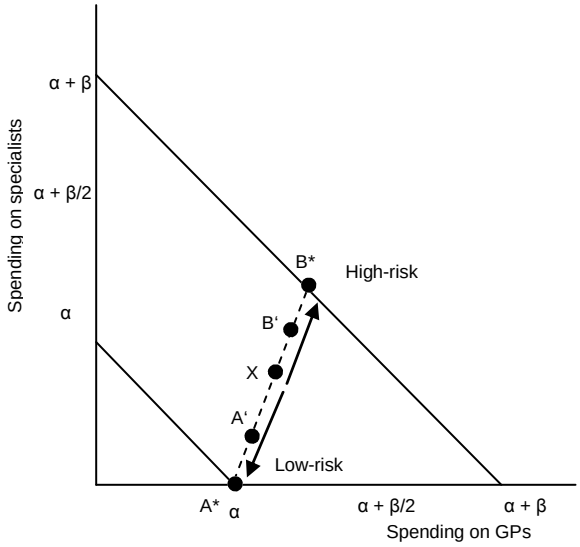

Figure 12 – *Perfect (A*, B*) and imperfect (X, A', B') risk adjustment*

3.4.3 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

[46] 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 13**, 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.

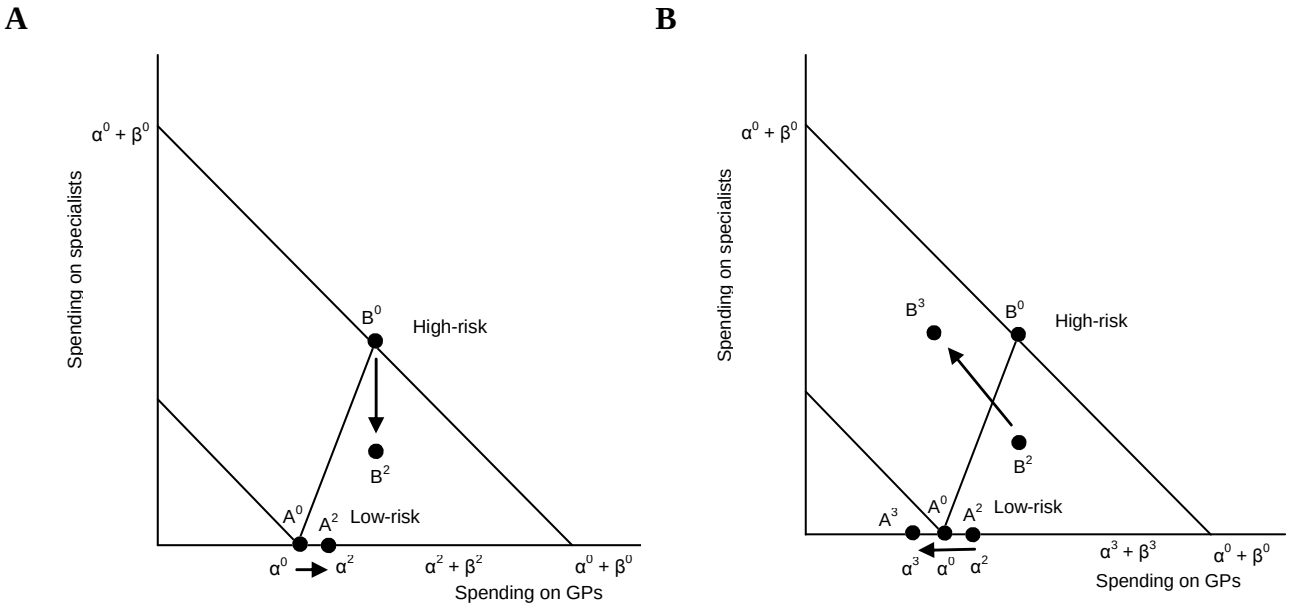

Figure 13 – *Conventional (panel A) and optimal risk adjustment (panel B) with quantities of services strategically determined*

Glazer (2000) introduces 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 13**, 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.

3.5 Empirical analysis of PCGs in 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.

3.5.1 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. The comparison of the data sample with the distribution of age/gender groups in the Czech Republic is presented in **Figure 14**.

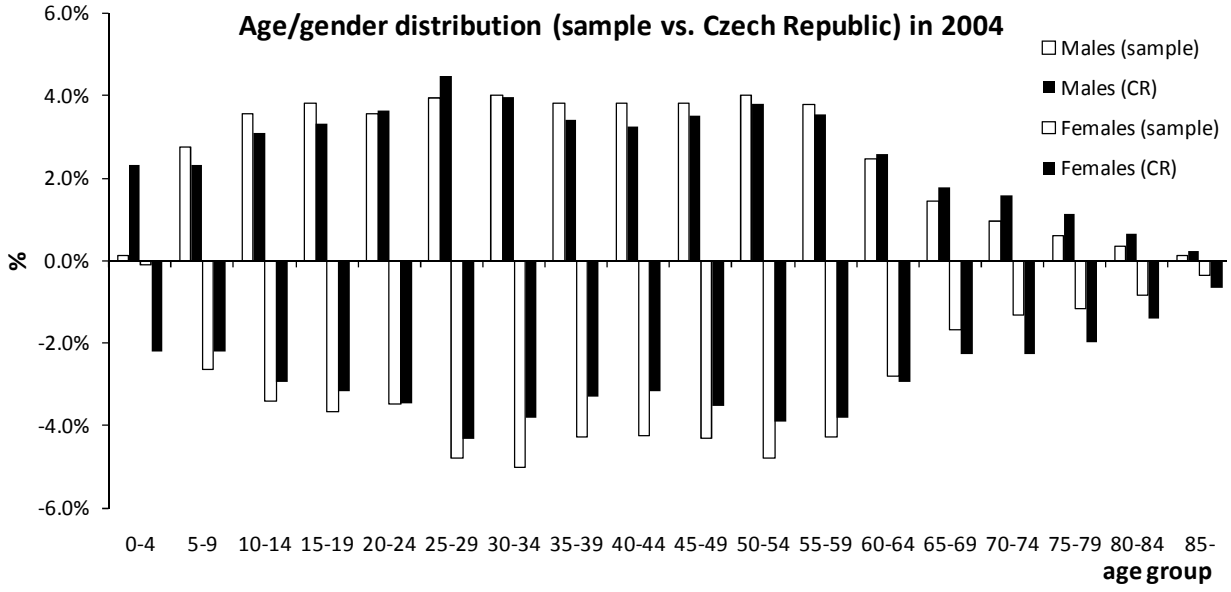

Figure 14 – *Age/gender distribution of the sample data and the Czech Republic (ÚZIS, 2004) in 2004*

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, 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.

	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[47], the prevalence of chronic conditions generally increases and the number of those without any condition decreases from 89.6% to 86.2%.

[47] 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[48] 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)[49] and PCG model with all 19 PCGs and no co-morbidity (54 dummy variables). To assign every enrolee to at most

[48] E.g. if a person is in the sample for 6 months in the period *t+1*, the annualised expenditures are twice the actual ones.
[49] Not included in the results, yielded similar performance to the other PCG model.

one PCG, the iteration procedure to rank PCGs according to decreasing costs was used as described in Lamers (2003).

3.5.2 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 15 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.

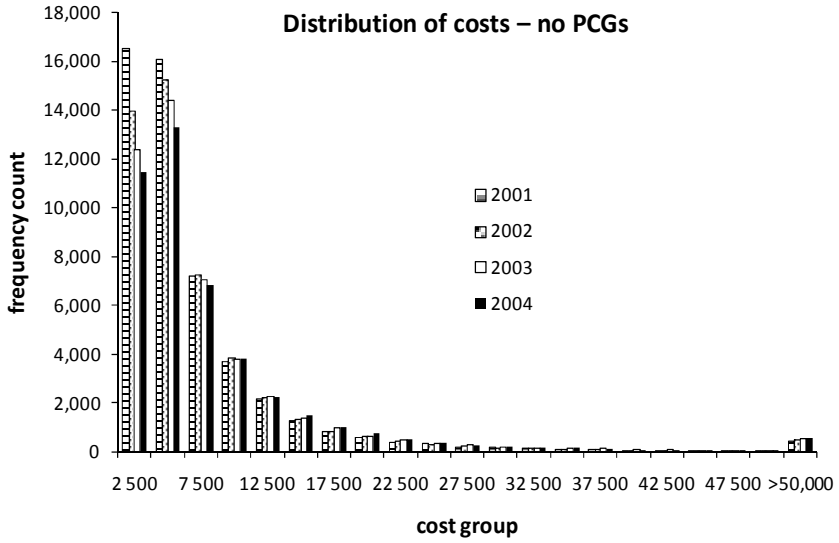

Figure 15 – *Histogram of costs for the insured without any PCG (2001 – 2004) based on our data sample*

As an example of a chronic condition with relatively homogenous costs we have chosen thyroid disorders (**Figure 16**). 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.

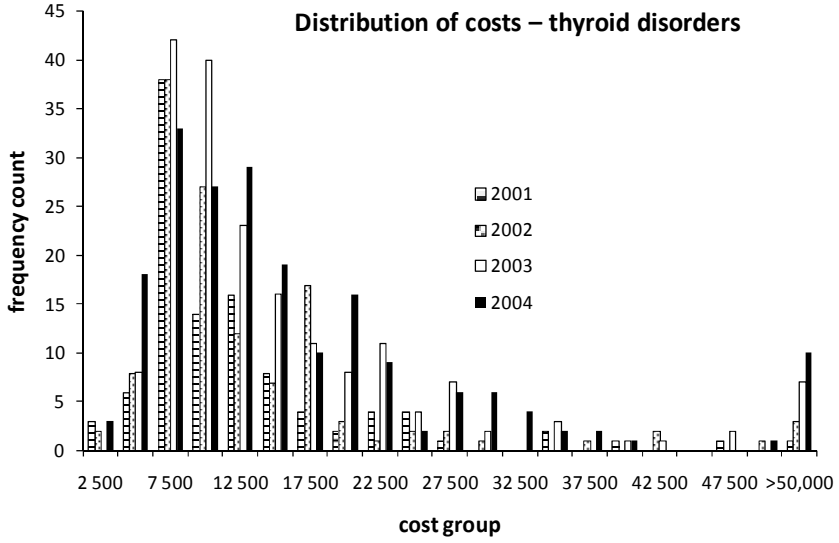

Figure 16 – *Histogram of costs for the insured with thyroid disorders (2001 – 2004) based on our data sample*

On the other hand, the costs of diabetes type I (people using insulin) are spread over much wider range (**Figure 17**). 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.

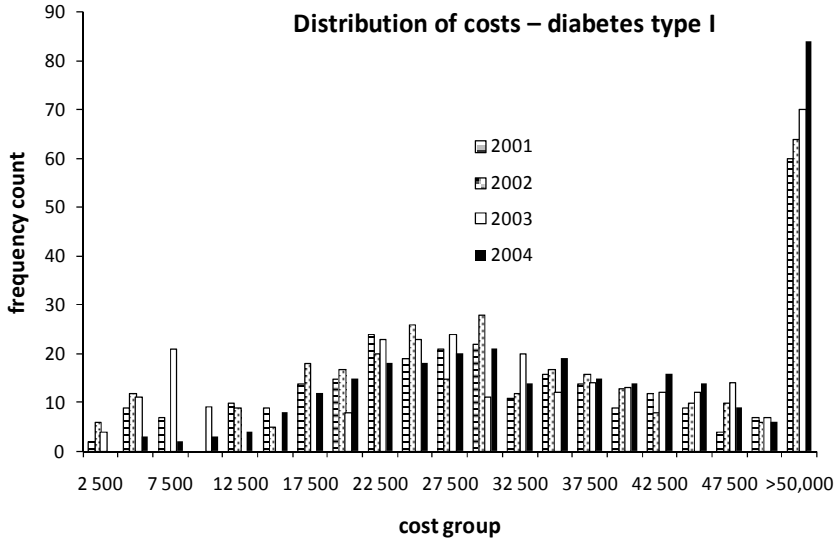

Figure 17 – *Histogram of costs for the insured with diabetes type I (2001 – 2004) based on our data sample*

The last pattern we would like to point out is a distribution of costs for glaucoma (**Figure 18**). 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.

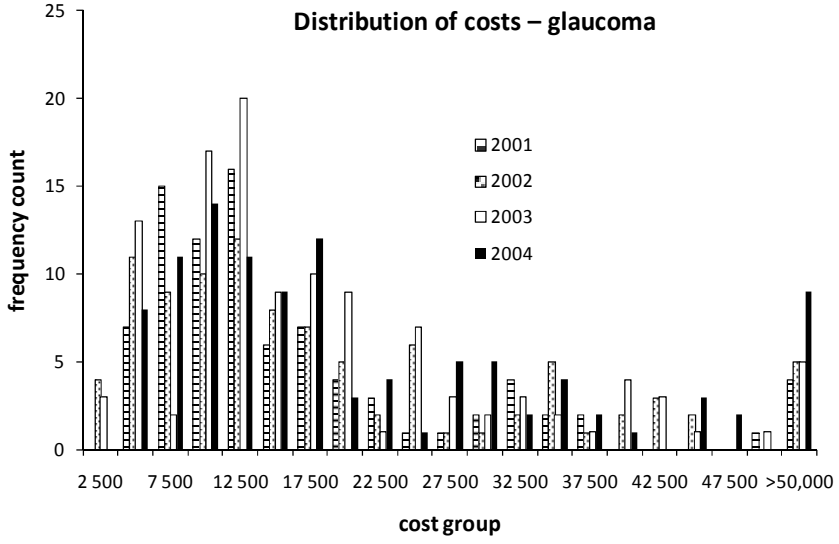

Figure 18 – *Histogram of costs for the insured with glaucoma (2001 – 2004) based on our data sample*

We can conclude that different chronic conditions[50] 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 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.

3.5.3 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 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

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

consistently worse than both the demographic model and the no model case[51]. 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 R2
		0 – 10%	10 – 20%	20 – 30%	30 – 40%	40 – 50%	50 – 60%	60 – 70%	70 – 80%	80 – 90%	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

[51] If no model is applied, the costs are predicted by the overall average.

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)*

3.5.4 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[52] 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[53], 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.

The actual redistribution of funds due to introduction of PCGs 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.

3.6 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 and attempt to draw relevant policy conclusions. In our analysis we focus primarily on the trends

[52] 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.
[53] Mean absolute error is the average of the absolute values of the differences between forecast and the corresponding observation.

to introduce manage competition in the Czech Republic. We start with the country comparison presented in the **Table 8.** As argued by van de Ven (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, 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, 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[54] is very broad in the Czech Republic and it leaves little room for voluntary health insurance. However, proposed plans of some health policy makers 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 new 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, 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, 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

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

(such as 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[55] 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).

3.7 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 policy makers. 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 new insurers is expected, which will make the system more competitive and possibly more profit oriented. Although these changes aim to

[55] 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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4 Outlier Risk Sharing in Competitive Health Insurance – Pitfall of Simple Formula

Abstract

Outlier risk sharing is used in competitive health insurance schemes as a tool to mitigate incentives for risk selection. A simple alternative of outlier risk sharing, however, is not budget neutral to each of risk groups and hence it might significantly distort an allocation of financial resources between insurers. The study employs a Monte Carlo simulation to show on a set of real health care data to what extent is such distortion quantitatively important and what steps might be taken to tackle this issue.

Keywords: outlier risk sharing, health insurance, risk adjustment, Monte Carlo

JEL classification: G22; I10; I11; I18

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4.1 Introduction

To promote efficiency in competitive health care markets, competing health insurers[56] in many countries receive prospective capitation payments based on expected individual health care expenditures of their members (enrolees). This mechanism known as risk adjustment or risk equalisation[57] is generally supplemented by a risk sharing[58] arrangement in which the insurers are reimbursed retrospectively for a part of actual costs. The alternative currently used in the Czech Republic and other countries is a combination of proportional risk sharing and outlier risk sharing in which the insurers are reimbursed a proportion of actual costs above a unique threshold set for all individuals. This arrangement provides an option-like payout, an insurer keeps a full difference between a prospective payment and actual costs if the costs are lower than the threshold; however, if the costs are higher, the insurer is accountable only for a portion of this difference. As we will show later in the paper, an outlier risk sharing financed internally[59] is not budget neutral to each of the risk groups[60]. Low-cost risk groups are net contributors whereas high-cost enrolees are net beneficiaries, what distorts an original allocation of financial resources. A refined financing method proposed in van Barneveld (2001) suggests a different threshold for each risk group distinguished in the capitation formula so that the risk sharing is budget neutral to each of these groups.

As far as we know, the effect of such distortion has not been studied. The contribution of our study is hence twofold. Firstly, we propose a simple methodology to analyse quantitative extent of simple outlier risk sharing distortion accompanied by an empirical analysis on a set of actual data. Our results show that under realistic assumptions simple outlier risk sharing can result in significant distortion, so as our other contribution we discuss possible options to cope with this issue.

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[56] Similarly to van Barneveld (2001), in this paper the term "insurer" represents an entity that bears some or all the financial risk associated with the variation of individual health care expenditures. It might be a primarily insurance entity such as sickness funds in several European countries, an entity combining insurance and health care provision such as health maintenance organisations in the US or a health care provider such as primary practitioners bearing some of health care costs of their registered patients.

[57] For a detailed overview of the *risk adjustment* concept, the reader is referred to van de Ven (2000) or Ellis (2008), the issues relevant to the Czech Republic can be found in Chalupka (2010).

[58] As noted by Bovbjerg (1992) risk sharing differs from reinsurance in two ways. Risk sharing is mandatory for all plans and it is not (fully) risk-rated, whereas reinsurance is voluntary and risk-rated.

[59] Under internal financing, prospective capitation payments are decreased by the sum of costs that are redistributed under a risk sharing arrangement, so the overall budget stays the same.

[60] A risk group is a group of individuals in a risk adjustment arrangement that receives a uniform capitation payment such as employed men aged 46–50 with no chronic condition.

Our paper is organised as follows. The next section summarises the risk sharing literature, **Section 4.3** describes the methodology used; **Section 4.4** and **Section 4.5** present results of the simple outlier risk sharing distortion and policy implications, respectively. The concluding remarks are stated in the final section.

4.2 Literature overview

Van Barneveld (2001b)[61] studies five risk sharing options, two of them currently applied in practice (proportional risk sharing[62] and outlier risk sharing[63]) and three alternative options (risk sharing for high costs[64], risk sharing for high risks[65] and using prior costs as an additional risk adjuster) and tries to answer the question which of them yields the best trade-off between incentives for efficiency and preferred risk selection[66]. He concludes that any of the options is preferable to no risk sharing even though part of efficiency has to be sacrificed. Risk sharing mitigates incentives for risk selection created by an imperfect risk adjustment scheme. This is consistent with Marchand (2003) who claims that it is always welfare improving to use prior expenditures as a risk adjuster.

In a parallel paper Van Barneveld (2001a) further argues that the optimal extent of risk sharing depends on the weights the regulator assigns to the objectives of increasing production efficiency and preventing risk selection. Based on an empirical analysis[67] he further claims that although outlier or proportional risk sharing are used by some countries to supplement risk adjustment, other forms of risk sharing yield better tradeoffs between selection and efficiency.

Van de Ven (2007) compares risk adjustment systems in five countries (Belgium, Germany, Israel, the Netherlands and Switzerland) and analyses risk selection determinants and the current situation. He claims that risk selection is increasingly becoming a serious concern in each of these countries although the risk adjustment systems have improved. Except for Switzerland, all countries use a form of risk sharing, either by reimbursing insurers for actual costs (Belgium and

[61] For earlier studies of the same author(s) see van de Ven (1992), van de Ven (1994), van Barneveld (1996) or van Barneveld (1998).
[62] Under proportional risk an insurer is reimbursed for a proportion of all actual costs of all enrolees as suggested by Newhouse (1986) who argues that until better risk adjusters are developed a blend of capitation and fee-for-service payments should be used.
[63] Outlier risk sharing assumes reimbursement of insurers for enrolee expenditures above a certain threshold as inspired by Beebe (1992) who argues for removing the most expensive enrolees from the risk adjustment system and paying them separately.
[64] In this type of risk sharing an insurer is reimbursed ex post for actual costs of a certain percentage of the most costly enrolees.
[65] This risk sharing option assumes that an insurer ex ante chooses a certain percentage of enrolees whose actual costs will be fully reimbursed.
[66] Newhouse (1996) defines selection as actions (not including risk rating) by consumers and sickness funds to exploit unpriced risk heterogeneity and break pooling arrangements.
[67] Other studies empirically analysing different risk sharing options include Beebe (1992) and Keeler (1998).

the Netherlands), through an outlier risk sharing arrangement (Germany and the Netherlands) or by providing ex-post fixed payments for specific high-cost conditions (Israel[68]).

Apart from the already mentioned countries risk adjustment and the related issue of risk sharing is topical in the United States especially in their federal systems of Medicare[69]. Before the introduction of their currently used CMS-HCC risk adjustment model[70] there had been serious concerns about fairness of the adjusted average per capita costs (AAPCC) system. Risk sharing was offered as one of the options to improve the situation (e.g. Gruenberg, 1986 and Wallack, 1988).

4.3 Data and methodology

In this section we analyse the impact of using a simple form of outlier risk sharing on ex-post distribution of income among insurers. As we outlined in the introduction, risk adjustment with the simple outlier risk sharing offers an option-like payout[71] which can considerably distort the original risk adjustment allocation if values of these options differ significantly for individual insurers. We use a sample of real health care data to measure this deformation employing Monte Carlo simulation[72]. Our data set consists of total health care costs of more than 50,000 insured of an anonymous Czech sickness fund in 2004. The total pool of enrolees is split into three subpopulations (young group aged 0–19, middle aged group 20–59 and elderly group aged above 60) to make the analysis more illustrative.

To show quantitative significance of the distortion, we examine two different settings in which outlier risk sharing in health care sector might be used. The first case involves the situation in which the insurers are relatively big such as sickness funds operating in the Czech Republic[73]. In order to attract high number of enrolees, big insurers cannot specialise solely on very small target

[68] The sickness funds receive a fixed payment for each person who is diagnosed with one of the following 'severe diseases': End stage renal failure requiring dialysis, Gauche, Talasemia, Hemophilia and AIDS (Shmueli, 2003).
[69] The situation for privately insured is much more complex with a complex set of institutions providing health care (Ellis, 2008).
[70] For details see Ash (2000), Ellis (1996) or Pope (2000).
[71] We can use an analogy using stock option terminology; if all costs above a threshold are reimbursed to an insurer, the payout to the insurer is equivalent to the payout of holding a put option with a zero premium, capitation payment received by the insurer being the strike price of the option.
[72] Monte Carlo methods are utilised to price path-dependent options such as Asian or barrier options which in general cannot be valued by the Black Scholes formula (for details see e.g. Benninga, 2008). However, we use Monte Carlo not because the payout of the option is complicated but because the distribution of health care costs is problematical.
[73] The minimum size of insurers is limited by the legislation; a sickness fund must have at least 50,000 insured (Act No. 280/1992 Coll.) to facilitate spreading out of total costs among more people and thus diversify insurance risk.

groups[74]. The other case assumes an insurance system with small insurers who can specialise on specific groups of enrolees[75]. In this setting the difference in expected costs among insurers is generally higher than in a system in which only big insurers operate.

For each of these two settings, we assume a model situation. The first model supposes five small insurers each having 1,500 enrolees[76]. The first insurer is set to have insured only from the young subpopulation ('insurer of the young'), the second, the third and the fourth to have middle aged enrolees ('insurer of the middle-aged') and the fifth insurer is set to insure only old enrolees ('insurer of the old'). The numbers of each type of insurers were set to roughly correspond to the overall distribution of young, medium aged and old insured in the Czech Republic.

The other case presumes a system of two big insurers, each of them having 50,000 enrolees. Costs of the first insurer (the 'low-cost insurer') are simulated from subpopulations of young, medium aged and old enrolees in a respective ratio of 3:6:1. The other insurer (the 'high-cost insurer') has a pool of insured simulated by a ratio of 1:6:3. These ratios were chosen to match the upper limit of the difference between share on total costs and share on total number of insurers in the Czech Republic[77].

We run 10,000 and 1,000 simulations for small and big insurer models, respectively. In each run we use empirical sampling[78] to simulate costs of a corresponding number of insured. This allows us to reproduce sample distributions of highly skewed health care cost data. For each run we set a threshold for outlier risk sharing as a multiple of average costs of all insurers in a given run:

$$threshold = multiple \times \frac{1}{mn} \sum_{j=1}^{m} \sum_{i=1}^{n} x_{ij}$$

where n is the number of enrolees of each insurer (1,500 or 50,000), m is the number of insurers and x_{ij} are actual costs of each enrolee.

[74] However, absence of adequate risk adjustment mechanism makes focusing on or distracting of certain groups (risk selection) still very attractive.
[75] The small insurers can attract specific groups intentionally (for instance small insurers in Switzerland or Germany) or not intentionally (for example general practitioners who serve a specific group such as children or elderly living in a certain location).
[76] This number corresponds to a typical number of registered patients for a general practitioner in the Czech Republic and it is also encountered for small insurers for instance in Switzerland (Beck, 2003). These two examples, however, have different implications since general practitioners are typically held responsible only for a fraction of total health care costs of their registered patients.
[77] In our sample, the ratio of 3:6:1 from the young, medium aged and old subpopulation, respectively, corresponds to the 42% share on total costs, the 1:6:3 ratio corresponds to the 58% share. As each insurer is assumed to have the same number of enrolees, the difference of 16% was calculated as (58% – 50%) / 50% or (50% – 42%) / 50%. The difference in the Czech Republic ranged 7–18% in 2007 (calculated using data in Table 2 of Chalupka, 2009).
[78] We randomly picked actual costs from our data sample (allowing for repetitions) of each insured.

We use different multiples to investigate the effect of changing the threshold, in the result tables the minimum is five and the maximum is set as a thirtyfold[79] multiple of average costs. Additionally, we study the effect of combining the outlier risk sharing with proportional risk sharing. Under full proportional risk sharing, insurers are reimbursed for 100% of costs above the threshold[80] (i.e. 0% financial accountability). We experiment with different levels of proportional risk sharing; the result tables show figures for 0%, 20%, 40%, 60% and 80% of insurer financial accountability.

In each simulation run we set unadjusted capitation payment for each enrolee at the level of average costs of a given insurer[81]:

$$unadjusted\ capitation_j = \frac{1}{n}\sum_{i=1}^{n} x_{ij}$$

Costs above a threshold are fully/partly risk-shared in accordance with a percentage of financial accountability:

$$risk\ shared\ costs_{ij} = \max(0, x_{ij} - threshold)(1 - \%\ of\ \ financial\ accountability)$$

A total risk-shared costs percentage is calculated as the sum of all risk-shared costs divided by the sum of all costs of all insurers:

$$total\ risk\ shared\ costs\,(\%) = \frac{\sum_{j=1}^{m}\sum_{i=1}^{n} risk\ shared\ costs_{ij}}{\sum_{j=1}^{m}\sum_{i=1}^{n} x_{ij}}$$

Unadjusted capitation for each insured is decreased by a complement percentage of total risk-shared costs to arrive at adjusted capitation of each insurer[82]:

$$adjusted\ capitation_j = unadjusted\ capitation_j\,(1 - \%\ of\ total\ risk\ shared\ costs)$$

Financial result for each enrolee is then computed as a difference between actual costs and adjusted capitation increased by risk-shared costs:

$$financial\ result_{ij} = actual\ costs_{ij} - (adjusted\ capitation_j + risk\ shared\ costs_{ij})$$

[79] This multiple is currently used in the Czech Republic to set the threshold for outlier risk sharing at the country level in the mandatory health insurance (Decree No. 644/2004 Coll.).
[80] Under proportional risk sharing, costs both below and above a certain threshold can be risk-shared. However, for our purpose we only assume that costs above a threshold are considered for proportional risk sharing.
[81] If capitation payments are set prospectively, this condition assumes perfect risk adjustment formula. We used this assumption to get the effect of simple outlier risk sharing separately from the effect of imperfect risk adjustment. Moreover, this simple formula does not differentiate risk groups used (the young, medium and old) as we study distortion effects at the level of insurers only.
[82] This is the condition of internal financing of risk sharing, consistent with the current practice in the Czech Republic and several studies such as Van Barneveld (1998, 2001a, 2001b) and Keeler (1998). Beebe (1992) assumes external financing of risk sharing.

The distortive effect of outlier risk sharing is measured by a financial result of each insurer which is calculated as a quotient of financial results of all the insurer's enrolees and the insurer's actual costs:

$$financial\,result_j = \frac{\sum_{i=1}^{n} financial\,result_{ij}}{\sum_{i=1}^{n} x_{ij}}$$

As a final point, percentages of total risk shared costs in each model and financial results for each group of insurers are averaged across all simulation runs to get a robust estimate of each figure.

4.4 Results

Before presenting the results of the Monte Carlo simulations, we firstly show distribution of the data using box plot[83]. As box plots do not assume any particular distribution they are very suited to depict highly skewed health care data. **Figure 19**[84] shows the distribution for the model with small insurers. Although the maximum of the data is not shown, because the figure would be unreadable, a high skewness of data is apparent. The 25th percentile is almost the same for both the insurer of the young and the insurer of the middle-aged but both the median and the 75th percentile are significantly higher. For the insurer of the old, the whole distribution is shifted significantly toward high costs.

[83] For a reference see e.g. McGill (1978).
[84] The costs on the vertical axis are scaled to smaller units to preserve confidentiality of the data.

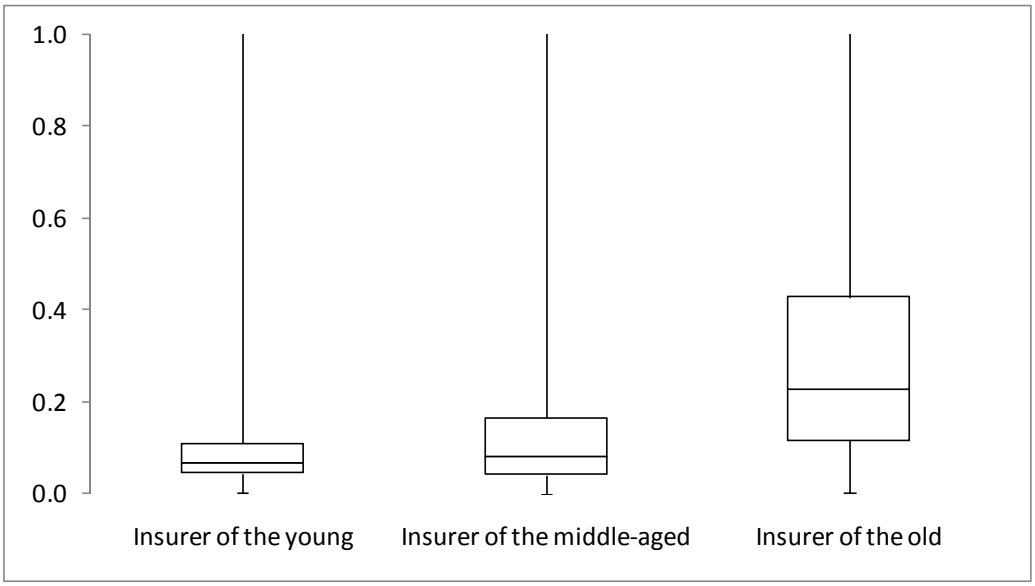

Figure 19 – *Box plot for the model with small insurers (1,500 enrolees), showing minimum, maximum and 25%, 50% and 75 percentiles of data*

The difference between medium of the distribution between the two insurers in the model with big insurers is naturally smaller than in the previous case. Nevertheless, the data is highly skewed also in this case.

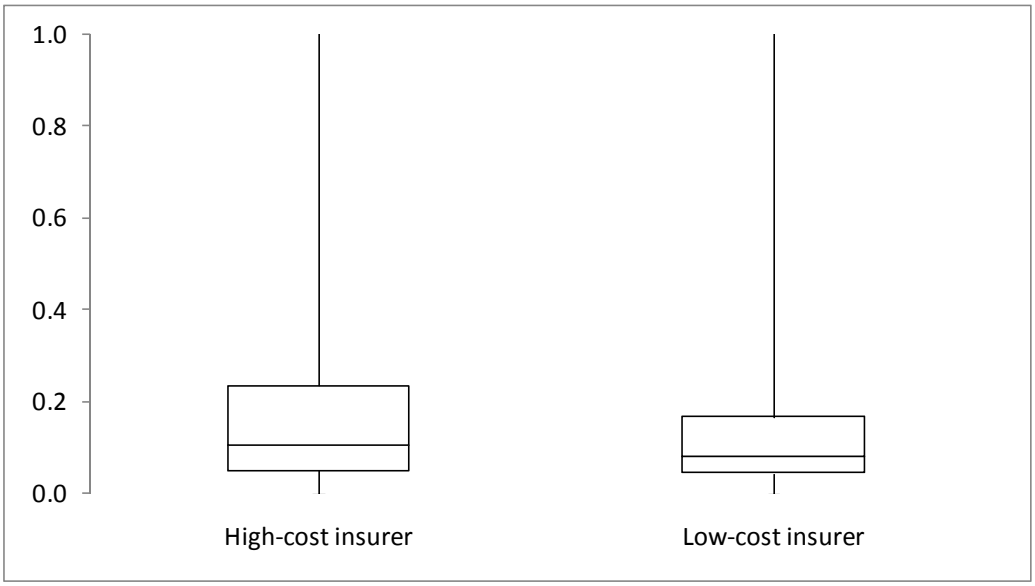

Figure 20 – *Box plot for the model with big insurers (50,000 enrolees), showing minimum, maximum and 25%, 50% and 75 percentiles of data*

The tables below show the results of Monte Carlo simulations for the model with small insurers. The percentage of risk shared costs (**Table 9**) ranges from 0.7% if the highest threshold is applied and the insurers are accountable for 80% of costs above the threshold to 18.1% with the lowest threshold and no financial accountability.

Risk-shared costs		**Insurers' financial accountability above a threshold**				
		0%	**20%**	**40%**	**60%**	**80%**
Threshold	**5x**	18.1% (14.0 – 24.6%)	14.5% (11.2 – 19.7%)	10.9% (8.4 – 14.8%)	7.2% (5.6 – 9.9%)	3.6% (2.8 – 4.9%)
	10x	10.7% (6.7 – 18.0%)	8.5% (5.4 – 14.4%)	6.4% (4.0 – 10.8%)	4.3% (2.7 – 7.2%)	2.1% (1.3 – 3.6%)
	15x	7.3% (3.7 – 15.0%)	5.9% (2.9 – 12.0%)	4.4% (2.2 – 9.0%)	2.9% (1.5 – 6.0%)	1.5% (0.7 – 3.0%)
	20x	5.5% (2.1 – 13.2%)	4.4% (1.7 – 10.6%)	3.3% (1.3 – 7.9%)	2.2% (0.8 – 5.3%)	1.1% (0.4 – 2.6%)
	25x	4.3% (1.3 – 12.1%)	3.5% (1.0 – 9.7%)	2.6% (0.8 – 7.3%)	1.7% (0.5 – 4.8%)	0.9% (0.3 – 2.4%)
	30x	3.6% (0.8 – 11.3%)	2.8% (0.7 – 9.0%)	2.1% (0.5 – 6.8%)	1.4% (0.3 – 4.5%)	0.7% (0.2 – 2.3%)

Table 9 – *Risk shared costs for the model with small insurers (1,500 enrolees), 95% confidence interval in brackets*

High percentages with negative sign (net contribution) are obtained if the financial result of the insurer of young subpopulation is investigated (**Table 10**). The distortive effect of outlier risk sharing is evident for all cells. The broad confidence intervals of financial result in a given year reflect the fact that there is only one insurer of the given type. Averaging results over more insurers would make the intervals tighter.

Financial result ('insurer of the young')		Insurers' financial accountability above a threshold				
		0%	**20%**	**40%**	**60%**	**80%**
Threshold	**5x**	-15.3% (-22.5 – -9.7%)	-12.2% (-18.0 – -7.8%)	-9.2% (-13.5 – -5.8%)	-6.1% (-9.0 – -3.9%)	-3.1% (-4.5 – -1.9%)
	10x	-9.7% (-17.2 – -5.1%)	-7.8% (-13.7 – -4.1%)	-5.8% (-10.3 – -3.1%)	-3.9% (-6.9 – -2.0%)	-1.9% (-3.4 – -1.0%)
	15x	-7.0% (-14.8 – -3.1%)	-5.6% (-11.8 – -2.5%)	-4.2% (-8.9 – -1.9%)	-2.8% (-5.9 – -1.3%)	-1.4% (-3.0 – -0.6%)
	20x	-5.4% (-13.2 – -2.0%)	-4.3% (-10.6 – -1.6%)	-3.2% (-7.9 – -1.2%)	-2.2% (-5.3 – -0.8%)	-1.1% (-2.6 – -0.4%)
	25x	-4.3% (-12.1 – -1.3%)	-3.5% (-9.7 – -1.0%)	-2.6% (-7.3 – -0.8%)	-1.7% (-4.8 – -0.5%)	-0.9% (-2.4 – -0.3%)
	30x	-3.6% (-11.3 – -0.8%)	-2.8% (-9.0 – -0.7%)	-2.1% (-6.8 – -0.5%)	-1.4% (-4.5 – -0.3%)	-0.7% (-2.3 – -0.2%)

Table 10 – *Financial result ('insurer of the young') for the model with small insurers (1,500 enrolees), 95% confidence interval in brackets*

The insurer with old enrolees, on the other hand, benefits from this scheme as the average financial result is positive[85] (**Table 11**). However, due to small number of enrolees and high volatility of costs, the 95% confidence interval is relatively broad and encompasses also negative financial results for all but the lowest threshold.

Financial result ('insurer of the old')		Insurers' financial accountability above a threshold				
		0%	**20%**	**40%**	**60%**	**80%**
Threshold	**5x**	8.1% (1.5 – 14.2%)	6.5% (1.2 – 11.4%)	4.9% (0.9 – 5.7%)	3.2% (0.6 – 5.7%)	1.6% (0.3 – 2.8%)
	10x	4.9% (-1.6 – 11.9%)	3.9% (-1.2 – 9.5%)	2.9% (-0.9 – 7.2%)	2.0% (-0.6 – 4.8%)	1.0% (-0.3 – 2.4%)
	15x	3.4% (-2.5 – 10.7%)	2.8% (-2.0 – 8.6%)	2.1% (-1.5 – 6.4%)	1.4% (-1.0 – 4.3%)	0.7% (-0.5 – 2.1%)
	20x	2.8% (-2.7 – 10.2%)	2.2% (-2.2 – 8.1%)	1.7% (-1.6 – 6.1%)	1.1% (-1.1 – 4.1%)	0.6% (-0.5 – 2.0%)
	25x	2.4% (-2.6 – 9.8%)	1.9% (-2.1 – 7.8%)	1.4% (-1.6 – 5.9%)	0.9% (-1.1 – 3.9%)	0.5% (-0.5 – 2.0%)
	30x	2.1% (-2.4 – 9.4%)	1.7% (-2.0 – 7.6%)	1.3% (-1.5 – 5.7%)	0.8% (-1.0 – 3.8%)	0.4% (-0.5 – 1.9%)

Table 11 – *Financial result ('insurer of the old') for the model with small insurers (1,500 enrolees), 95% confidence interval in brackets*

For the 'insurer of the middle-aged' the setting on average turns into net contribution, although for all cells the 95% confidence interval covers both positive and negative values (**Table 12**).

[85] The percentages are lower because the denominator (average costs of old insured) is higher.

Financial result ('insurer of the middle-aged')		Insurers' financial accountability above a threshold				
		0%	20%	40%	60%	80%
Threshold	5x	-4.0% (-11.1 – 2.1%)	-3.2% (-8.9 – 1.7%)	-2.4% (-6.7 – 1.3%)	-1.6% (-4.4 – 0.8%)	-0.8% (-2.2 – 0.4%)
	10x	-2.5% (-9.6 – 3.3%)	-2.0% (-7.7 – 2.6%)	-1.5% (-5.7 – 2.0%)	-1.0% (-3.8 – 1.3%)	-0.5% (-1.9 – 0.7%)
	15x	-1.8% (-8.9 – 3.5%)	-1.4% (-7.1 – 2.8%)	-1.1% (-5.3 – 2.1%)	-0.7% (-3.5 – 1.4%)	-0.4% (-1.8 – 0.7%)
	20x	-1.5% (-8.4 – 3.3%)	-1.2% (-6.8 – 2.7%)	-0.9% (-5.1 – 2.0%)	-0.6% (-3.4 – 1.3%)	-0.3% (-1.7 – 0.7%)
	25x	-1.4% (-8.2 – 3.0%)	-1.1% (-6.5 – 2.4%)	-0.8% (-4.9 – 1.8%)	-0.5% (-3.3 – 1.2%)	-0.3% (-1.6 – 0.6%)
	30x	-1.2% (-7.9 – 2.8%)	-1.0% (-6.3 – 2.2%)	-0.7% (-4.7 – 1.7%)	-0.5% (-3.2 – 1.1%)	-0.2% (-1.6 – 0.6%)

Table 12 – *Financial result ('insurer of the middle-aged') for the model with small insurers (1,500 enrolees), 95% confidence interval in brackets*

Also the results for the other model (**Table 13**) illustrates that outlier risk sharing can significantly distort allocation of financial resources. The proportion of risk shared costs ranges from 1.0 to 18.9%. The tighter 95% confidence intervals stem from the higher number of enrolees of each insurer and hence higher risk diversification.

Risk-shared costs		Insurers' financial accountability above a threshold				
		0%	20%	40%	60%	80%
Threshold	5x	18.9% (17.7 – 20.2%)	15.1% (14.1 – 16.2%)	11.4% (10.6 – 12.1%)	7.6% (7.1 – 8.1%)	3.8% (3.5 – 4.0%)
	10x	11.7% (10.4 – 13.1%)	9.4% (8.3 – 10.5%)	7.0% (6.2 – 7.9%)	4.7% (4.1 – 5.2%)	2.3% (2.1 – 2.6%)
	15x	8.5% (7.1 – 9.9%)	6.8% (5.7 – 8.0%)	5.1% (4.3 – 6.0%)	3.4% (2.8 – 4.0%)	1.7% (1.4 – 2.0%)
	20x	6.7% (5.3 – 8.2%)	5.4% (4.3 – 6.6%)	4.0% (3.2 – 4.9%)	2.7% (2.1 – 3.3%)	1.3% (1.1 – 1.6%)
	25x	5.6% (4.3 – 7.1%)	4.5% (3.4 – 5.7%)	3.4% (2.6 – 4.3%)	2.2% (1.7 – 2.8%)	1.1% (0.9 – 1.4%)
	30x	4.9% (3.5 – 6.3%)	3.9% (2.8 – 5.1%)	2.9% (2.1 – 3.8%)	2.0% (1.4 – 2.5%)	1.0% (0.7 – 1.3%)

Table 13 – *Risk shared costs for the model with big insurers (50,000 enrolees), 95% confidence interval in brackets*

These costs are again distributed very unevenly in favour of the 'high-cost insurer' (**Table 14**), though the differences are naturally not so pronounced as in the situation with small insurers.

Under the current situation in the Czech Republic (30x threshold, 20% financial accountability above the threshold), the distortion is 0.6% of average costs for the high-cost insurer.

Financial result ('high-cost insurer')		**Insurers' financial accountability above a threshold**				
		0%	**20%**	**40%**	**60%**	**80%**
Threshold	**5x**	2.2% (1.0 – 3.4%)	1.8% (0.8 – 2.7%)	1.3% (0.6 – 2.0%)	0.9% (0.4 – 1.3%)	0.4% (0.2 – 0.7%)
	10x	1.4% (0.2 – 2.6%)	1.1% (0.2 – 2.1%)	0.9% (0.1 – 1.6%)	0.6% (0.1 – 1.1%)	0.3% (0.0 – 0.5%)
	15x	1.1% (-0.1 – 2.3%)	0.9% (-0.1 – 1.8%)	0.7% (-0.1 – 1.4%)	0.4% (0.0 – 0.9%)	0.2% (0.0 – 0.5%)
	20x	0.9% (-0.2 – 2.1%)	0.8% (-0.2 – 1.7%)	0.6% (-0.1 – 1.3%)	0.4% (-0.1 – 0.9%)	0.2% (0.0 – 0.4%)
	25x	0.8% (-0.3 – 2.0%)	0.7% (-0.3 – 1.6%)	0.5% (-0.2 – 1.2%)	0.3% (-0.1 – 0.8%)	0.2% (-0.1 – 0.4%)
	30x	0.8% (-0.4 – 1.9%)	0.6% (-0.3 – 1.5%)	0.5% (-0.2 – 1.1%)	0.3% (-0.1 – 0.8%)	0.2% (-0.1 – 0.4%)

Table 14 – *Financial result ('high-cost insurer') for the model with big insurers (50,000 enrolees), 95% confidence interval in brackets*

The results for the 'low-cost insurer' (**Table 15**) show the mirror picture. The average values are negative and higher due to smaller denominator (lower average costs) for this insurer.

Financial result ('low-cost insurer')		**Insurers' financial accountability above a threshold**				
		0%	**20%**	**40%**	**60%**	**80%**
Threshold	**5x**	-3.1% (-4.8 – -1.3%)	-2.4% (-3.9 – -1.0%)	-1.8% (-2.9 – -0.8%)	-1.2% (-1.9 – -0.5%)	-0.6% (-1.0 – -0.3%)
	10x	-2.0% (-3.8 – -0.3%)	-1.6% (-3.0 – -0.2%)	-1.2% (-2.3 – -0.2%)	-0.8% (-1.5 – -0.1%)	-0.4% (-0.8 – -0.1%)
	15x	-1.5% (-3.3 – 0.1%)	-1.2% (-2.7 – 0.1%)	-0.9% (-2.0 – 0.1%)	-0.6% (-1.3 – 0.1%)	-0.3% (-0.7 – 0.0%)
	20x	-1.3% (-3.0 – 0.3%)	-1.1% (-2.4 – 0.3%)	-0.8% (-1.8 – 0.2%)	-0.5% (-1.2 – 0.1%)	-0.3% (-0.6 – 0.1%)
	25x	-1.2% (-2.9 – 0.4%)	-0.9% (-2.3 – 0.3%)	-0.7% (-1.7 – 0.3%)	-0.5% (-1.2 – 0.2%)	-0.2% (-0.6 – 0.1%)
	30x	-1.1% (-2.7 – 0.5%)	-0.9% (-2.2 – 0.4%)	-0.6% (-1.6 – 0.3%)	-0.4% (-1.1 – 0.2%)	-0.2% (-0.5 – 0.1%)

Table 15 – *Financial result ('low-cost insurer') for the model with big insurers (50,000 enrolees), 95% confidence interval in brackets*

4.5 Policy implications

In this section we would like to summarise options to cope with the problem associated with the simple outlier risk sharing. The first option of tackling the distortion is to do nothing. If the distortion is relatively small, overpaying high-risk and underpaying low-risk individuals might be desirable. Glazer (2000) introduces the concept of "optimal risk adjustment" in which the sponsor's goal[86] is to maximise consumer welfare rather than just to break even. Under imperfect signals and conventional risk adjustment the insurers might try to distract some of true high-risks for instance by offering lower quality of highly specialised health care services consumed predominantly by this group. Overpaying high-risk signals, however, could encourage competition for these high-risks thus decreasing motivation for risk selection and increasing consumer welfare.

Secondly, the sponsor can decide to adjust the risk adjustment formula for the distortive impact of risk sharing. This option is feasible especially in the case when there are relatively few insurers with small number of enrolees so that the Monte Carlo computation can be accomplished without excess burden of data. However, in such setting and assuming high volatility of health care costs for which the insurers are held responsible, effects of such adjustment should be carefully analysed before application. Small insurers are the most prone to risk selection and adjusting for the simple outlier risk sharing distortion might exacerbate the problem.

Thirdly, risk sharing might be designed at the level of each risk factor or group of risk factors with relatively homogenous expected costs. Different threshold for each group as suggested by van Barneveld (2001) removes the distortion of the simple outlier risk sharing and might be preferable if there are many individuals in each of the risk sharing groups. Moreover, it is easier for implementation as there is no need to simulate the costs using Monte Carlo.

We would like to conclude this section with an argument that although the sponsor can eventually choose any of the options suggested, it is always recommended to analyse the extent of the distortion when the simple outlier risk is considered.

[86] The sponsor is the organiser of health insurance such as governments in Europe or employers in the U.S. private health insurance.

4.6 Conclusion

In this study we pointed to the pitfall of the outlier risk sharing which might distort a risk adjustment system. Provided that there is only one threshold for all enrolees in the system and the system is financed internally, high risks insured on average receive more than they contribute to the system. The distortion is higher for lower threshold and lower financial accountability of the insurers. On the sample of real health care data we showed the quantitative significance of this distortion measured as a financial result of an insurer under two model situations. We suggested three different option of coping with this issue, neglecting the effect in line with the optimal risk adjustment notion, adjusting the risk adjustment formula or using a different threshold for each risk group.

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