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Microsimulation as an instrument for tax policy analyses

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The paper deals with microsimulation - an increasingly popular instrument used for policy analysis, especially in the field of individual and corporate income taxation. The aim of the paper is twofold. First, it discusses some key aspects of microsimulation with a particular focus on its types and implementations in tax policy research. Secondly, it presents a microsimulation analysis of the effects of unlimited inter-period loss offset in corporate income tax. The investigation is based on a panel of 222 corporations active in Poland, which was derived from the InfoCredit database. The microsimulation is carried out in a multi-period setting (2007-2012). It considers a perspective of taxpayers with a particular focus on individual tax burden and distributional effects of taxation. The analysis shows that the expected overall consequences of the tax reform in question would be rather moderate, however the size of the effects would vary strongly across firms.

JEL Classifications: C53, H24, H25, H32, K34

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Introduction

Actions carried out by economic agents can potentially have far-reaching consequences which are observed both at the micro level, across single entities and at the macro level, as a change in economic aggregates. It is of great importance to anticipate the expected effects of decisions made by households, businesses and the state *before* particular actions are actually taken. A proper method for such investigations in the field of economic and social research are simulations. Although they have been used for many decades, currently we face an increasing interest in simulation approach and its vast applications. A simulation method which is currently gaining in popularity and used in diverse areas of economic research is microsimulation.

Microsimulation is an instrument for analyzing economic issues proposed initially by G. Orcutt in his seminal articles from the late 50ies of the 20th century (Orcutt, 1957; 1960). Then, it was used and gradually developed mainly by two groups of interested parties: academic researchers and policy analysts working for different institutions. Except for economic studies, microsimulation has been employed also in such areas as demographic, traffic and crime analyses. Microsimulation is based on micro data on single economic agents such as household or firms. As a research tool, it allows to conduct detailed analyses and to account for subjects' characteristics relevant to the study.

The motivation of this paper is connected with the fact that microsimulation becomes increasingly important in economic research. It provides interesting research opportunities

due to the fact that it enables to observe single entities with their individual features. There are improving opportunities to get access to databases containing detailed information about micro entities. The availability of such data can contribute significantly to the development of microsimulation across countries.

The aim of the paper is twofold. First, it discusses the key aspects of microsimulation with a particular focus on its types and implementations in tax policy research. Secondly, the paper presents a microsimulation analysis which concentrates on the question of inter-period loss offset in corporate income tax in Poland. The current rules on tax loss carry forward in Poland are quite restrictive. It is worth investigating whether the advantages for Polish corporations would be significant if tax losses are carried forward without any restrictions relating to time and amount of the deduction. Simultaneously, it is also analyzed how the distribution of the tax burden would change in case of such a reform. The microsimulation is based on empirical data derived from InfoCredit database. It is carried out from a perspective of taxpayers.

The paper contributes to the ongoing discussion both in its descriptive as well as its empirical part. First, it gives an overview over current applications of microsimulation. The paper points out at different types of this instrument used in tax policy research, with a particular focus on taxation of individual and company income. Second, a microsimulation analysis for Polish taxpayers of corporate income tax is carried out. The paper gives insights not only into the usefulness of microsimulation for tax policy analyses but also into the effects of an unlimited tax loss carry forward. To the best of author's knowledge, such an investigation has not been conducted so far. It is also in line with the current discussion on the concept of a common corporate tax base in the European Union.

The paper proceeds as follows. The first part provides some general characteristics of simulations used in social sciences, comparing them to experiments. It discusses various types of simulation and moves on to static and dynamic microsimulation. The second part of the paper is devoted to the author's own microsimulation analysis. Motivation of the study, underlying data, research methodology and results are presented. Some conclusions according to microsimulation as an instrument for tax policy research are drawn in summary.

Simulations in economic research

There is a considerable demand for simulation research which deliver *ex ante* information about possible reactions of economic agents to various policy changes *before* particular measures are actually taken. Such results are used for economic forecasting as well as for estimating effects of changes in law caused by different reform options. However, it is hardly possible (and it could even be seen as immoral) to conduct real economic experiments in order to obtain information about its potential effects. Despite the fact that there were some examples of social experiments in the past[1], they are rather exceptional. When a research problem can be summarized with a question: "*what would happen if?*" simulation is an adequate method of analysis.

Simulations in economics are sometimes compared to experiments in natural sciences although the former face more limitations (Petersen, 1992; Owsiak, 2002). The main

[1] For instance, Petersen (1992) points out that natural experiments with negative personal income tax were conducted in the United States of America in the 60ies and 70ies of the 20th century.

difference between them is that in case of a typical experiment, for instance in chemistry, the object of observation is controlled by the person who undertakes certain actions with it. Such an experiment can be repeated until conclusions are drawn up and connections between different factors, features and phenomena are identified (Czarny, 2007). In an economic simulation all operations are carried out within a model. A model, however, always provides a simplification of the real world, no matter how complex it is. Simplified assumptions are inherent to economic models. It is crucial to set up reasonable assumptions and to decide which factors are going to be embodied in the model and which are going to be omitted. Even those variables which are excluded from simulation model should be kept in mind when interpreting the results. At the same time, it is of great importance to keep a reasonable balance between too far-reaching simplifications on the one hand and too great precision which may obscure the results on the other hand. Gilbert and Troitzsch convey the idea of simulation in economics in the following way: "*Every model will be a simplification - sometimes a drastic simplification - of the target to be modeled. The most difficult step in designing a model is to decide what needs to be left out and what needs to be included. (…) What one hopes for is a model that embodies the minimum number of assumptions, but which applies as generally as possible to many different circumstances*" (Gilbert and Troitzsch, 1992).

Background of microsimulation approach

The criterion most often applied to classify simulation methods implemented in socio-economic analysis is based on how aggregated is the data used. A classical approach was proposed by German researchers (Spahn et al., 1992) and (Merz; 1993) and it encompasses three main types of simulation:

1. Simulation models based on macroeconomic information (aggregated data). The data is derived mostly from national accounts and considers for instance households' consumption and savings. Macroeconomic models as well as general equilibrium models are counted to this group;
2. Simulation models based on partially aggregated data which is grouped according to certain features of the analyzed subjects - as for example their age or income. Groups built that way are relatively homogeneous so the method is called group simulation;
3. Simulation models based on disaggregated data about single economic agents such as individuals or firms - microsimulation.

Despite the fact that group simulations and microsimulations use data which is disaggregated to a different extent the both instruments are jointly called microeconomic simulation models. Microsimulation in turn is also classified as microanalytical simulation (Petersen, 1992). A similar definition was formulated by the International Microsimulation Association.

Microeconomic simulation models originate from seminal works of G. Orcutt from the late 50ies of the 20th century (Orcutt, 1957; 1960). Orcutt noted: "*It is also true, but not so widely noticed, that current models of our socio-economic system only predict aggregates and fail to predict distributions of individuals, households, or firms in single or multi-variate classifications*" (Orcutt, 1957). The microsimulation models are based on datasets in which the smallest recognizable entity is a single economic agent. Orcutt pointed out that simulation based on micro level data (on households, natural persons or firms) are exacter and more informative. Moreover, they allow to design the analysis for different cross sections, an

advantage which is not present in simulations based on aggregated data. Then, calculations are carried out for every single entity and only then the results are generalized.

As it has already been mentioned, group simulation also belongs to microeconomic simulation models and as such it is sometimes recognized as a simplified version of microsimulation. It is based on the information about groups of entities classified according to their diverse features, often more than one feature at once. It can be for instance: employment, gender, income with reference to individuals or sales, assets, profitability with reference to businesses. In that way groups are built (also called cells). In every group an average (alternatively median) entity is identified and treated as a representative for the entire group. An underlying assumption has to be formulated that groups are homogeneous and, as a consequence, single entities are rather similar within each group (Petersen, 1992).

It is of great practical importance that group simulation reveals smaller data requirements according to the degree of detail than microsimulation. An additional advantage is that it is expected to be less time consuming and it can be carried out not with a tremendous amount of effort. In turn, the limitation connected with lacking adequacy can be mitigated through taking into account a greater number of groups. However, it is also crucial to balance the detail of the analysis to avoid a situation when an increasingly complex simulation design is accompanied by an inadequate rise of costs (Petersen, 1992). The use of microsimulation enables to avoid potential shortcomings which emerge when aggregating the information (Bardazzi et al., 2004). Moreover, one has to bear in mind that the greater number of cells distinguished within a group simulation the smaller number of entities in every cell. This is problematic both with respect to falling anonymity and even empty cells[1]. Additionally, it has to be mentioned that different criteria of grouping may lead to diverging results (Spahn et al., 1992).

Due to the fact that the data used in microsimulations encompasses as a rule large number of entities analyses are often based on a sample. An alternative approach is to identify typical entities and to simulate the effects of certain economic actions for them (Peichl, 2005). Microsimulation is also more flexible than group models since it enables analyses referring to different criteria and diverse features of the agents. Forecasting of tax policy results can be seen as an interesting example for that. Gilbert and Troitzsch point out that the effects of changes in tax rules can often be simulated only based on micro data: *"We must instead go back to the individual cases, calculate their taxes due before and after the tax revision, and reaggregate the tax revenue."* (Gilbert and Troitzsch, 1999).

Static versus dynamic microsimulation

Both the current development of computation tools and the more and more common access to empirical data collected by professional databases' providers contribute to the fact that simulation models are characterized by increasing complexity. This is connected also with the opportunities to develop models which diverge from each other in respect to

[1] For instance, this limitation is faced by a researcher using data provided by the Polish Central Statistical Office which is subject to secrecy rules: „Aggregated data shall not be published or disseminated if it could be linked to or can identify natural persons or business entities. This means that data characterizing economic activity of business entities cannot be disseminated, if the aggregated data consist of less than three entities or the share of one entity in the compilation is higher than the three-fourths of the total." (Główny Urząd Statystyczny).

the length of the considered period. According to this criteria we can distinguish between static and dynamic microsimulations.

In accordance with a distinction proposed by (Petersen, 1992) and continued by (Brehe, 2007) microsimulations are static provided the assumption is made that economic agents do not change their behavior over time. In other words, such a model does not consider potential effects in such areas as for instance: work supply, households' savings, firms' investment etc. In such a case a short-term perspective is considered and a researcher is able to observe immediate, direct results of particular actions - the so called *first round effects*[1].

As far as tax research is concerned, taking into account the first order effects means that the formal tax incidence is the object of the analysis - as opposite to the effective tax incidence which in turn reflects also behavioral changes of taxpayers' actions (Hüther, 1992; Bach et al., 2008). Another author mentions that: *"Static models are often viewed as gigantic 'accounting' models, where the relationships showed are essentially mechanical in nature and behavioral change is usually assumed to be non-existent"* (Harding, 2000). Nevertheless, they are an appropriate instrument for short term analyses.

Dynamic microsimulation enables to analyze medium or long term effects of a reform. Undoubtedly, it is a more complex approach since it requires to make detailed assumptions about the way agents' behavior changes over time (Brehe, 2007; Gilbert and Troitzsch, 1999; Spahn et al., 1992; Merz, 1993). Some authors define as dynamic such models which account for endogenous changes in the structure of the investigated population (e.g. age structure). Other authors understand under dynamic such microsimulations approaches which reflect certain characteristics of an individual (as for example income, job activity, number of children, health status) over his or her whole lifetime and follow a "life history" of every analyzed person (Andreassen and Texmon, 2000; Gupta, 2000).

The ways microsimulations are classified according to the criterion of the data used in a model as well as the criterion of the period of time in question are summarized in Table 1.

TABLE 1. TYPES OF MICROSIMULATION IN THE CONTEXT OF OTHER SIMULATION APPROACHES

CRITERION (2): PERIOD	CRITERION (1): LEVEL OF DATA AGGREGATION		
	Aggregated data	Partially disaggregated data	Single entity-level data
Static approach	*Traditional macroeconomic models*	*Static group simulation*	*Static microsimulation*
Dynamic approach	*General equilibrium models*	*Dynamic group simulation*	*Dynamic microsimulation*

Source: Own elaboration.

Microsimulation in tax policy research

Nowadays the use of microsimulation models is widespread in social sciences. To the areas explored with that instrument belong: tax system and tax policy, social security, pensions, poverty and inequality, demographic changes, aging, health care, crime and

[1] Alternative terms used in literature: *first-order* and *morning-after effects*.

urban studies[1]. Table 2 presents selected microsimulation models developed in several countries divided by research area and type (static versus dynamic).

TABLE 2. SELECTED MICROSIMULATION MODELS CLASSIFIED ACCORDING TO THE RESEARCH AREA AND THE APPROACH APPLIED*

No.	Research area	Static microsimulation models	Dynamic microsimulation models
1.	Tax system, tax policy, social contributions, social policy	- 19 European countries - EUROMOD, - Australia - STINMOD - Belgium - STATION - Spain - GLADHISPANIA, - Canada - SPSD/M - The United States - MATH, ITEP, SSS, TRIM, POLIMOD, - The United Kingdom - Virtual Economy	- Canada - LifePaths - The United States - CBOLT, POLISIM
2.	Social security, pension payments		- Australia - APPSIM - The United States - GEMINI, PENSIM, MINT - Sweden - SESIM
3.	Demographic changes		- The United States - SOCSIM, SSASSIM - Sweden - SVERIGE - The United Kingdom - SAGEMOD
4.	Health care		- Canada - POHEM
5.	Justice		- Australia - JJS
6.	Urban development		- The United States - URBANSIM

Note: * According to the information given by the International Microsimulation Association on its website in 2012.
Source: Own elaboration based on International Microsimulation Association.

M. Gruszczyński points out that the use of micro level data becomes increasingly popular in economic research (Gruszczyński, 2012). Analyses based on single entities' level data are counted to the financial microeconometrics. They are applied in corporate and households' finance, banking, investment banking and accountancy. Questions connected with public finance, with a particular focus on tax policy and effects of taxation on economic decisions of taxpayers, can be added to that list. They embrace diverse types of taxes, especially indirect taxation (e.g. value added tax and excise duties in the context of their regressive effects) and direct taxation (e.g. taxes levied on personal income and on business profits).

According to (Wilkins, 2000), first microsimulation models dealing with the effects of taxation were constructed in the 60ies of the 20th century. In an OECD report from 1988 merely four member states (from twenty four in that time) had such models on their disposal at the central administration level. Several years later there were fourteen countries applying microsimulation for tax analyses but only few models were designed to take behavioral changes into account. The United States of America, Australia, Canada and western European countries have been leading in implementing microsimulation for a long time. For many years, Germany has had a strong position in that respect with numerous different models developed. Since 2004 the majority of EU member states have their own models (Lelkes, 2007), but there is still a room for further developments.

[1] Analyses of these problems were subject of the 4th General Conference of the International Microsimulation Association in 2013. About research areas investigated with microsimulations see also (Socha and Wincenciak, 2007).

It is necessary to stress that both microsimulation and group simulation in tax research have been used for a long time first of all for analyzing taxation of individuals. In particular, analyses considering concentration of the tax burden and changes in revenues as consequences of certain reform options were carried out. Calculations were often based on individual tax returns which were relatively easy to access for research purposes. In contrast with that, microsimulations of the effects of potential reforms in the area of business taxation were by far harder to apply in recent decades. The main reason for this situation was a limited access to proper micro-level data. Tax returns of companies are by nature sensitive because even if they are anonymized it is thinkable that certain entities can be recognized. As far as financial statements are concerned not all corporations are obliged to make them public. Moreover, far-reaching differences between financial and tax accounting can be observed. The above mentioned limitations were faced by numerous researchers (Wilkins, 2000; Spahn et al., 1992; Merz, 1993; Petersen, 2008). It was relatively easier to obtain households' data because many statistical offices collect such information regularly. Currently, the situation is gradually improving. The information gathered in Table 3 shows a relatively large number of analyses of business taxation which use microsimulation[1].

TABLE 3. MICROSIMULATION ANALYSES OF INCOME TAXES FOR SELECTED COUNTRIES

Type of income tax	Countries and studies
Personal income tax	- Denmark: (Pedersen; 2000) - Germany: (Petersen et al., 2005; Merz and Zwick, 2006; - Bach et al., 2008; Peichl, 2008) - United Kingdom: (Barry and Keenay, 2000) - EU member states: (Paulus and Peichl, 2008)
Corporate income tax	- Belgium: (OECD, 2007) - Canada: (McGrath and McCann, 2000) - Italy: (Bardazzi et al., 2004; Oropallo and Parisi, 2005) - Germany: (Bach et al., 2008; Reister, 2009; Oestreicher et al., 2014) - United Kingdom: (Eason, 2000) - EU member states: (de Mooij and Devereux, 2009)

Source: Own elaboration.

Such projects are, especially in developed countries, carried out by research institutes and special sections in governmental institutions (Maithert, 2006). It becomes common that data required for simulations, e.g. financial statements, are collected and provided by private companies. Additional opportunities offers combining data from different sources. Such an approach was applied in (Flotyńska, 2011) who analyzed joint information from the Polish Ministry of Finance and financial statements of single companies to simulate tax burden effects of a hypothetical reform of corporate income tax.

Microsimulation is an appropriate instrument to measure different kinds of effects of certain actions (reforms, law changes etc.). In fiscal policy, several research areas can be distinguished, which are relevant both to personal and corporate taxation. They are presented in Table 4.

Applying microsimulation approach in tax policy research enables to analyze potential revenue effects of certain reform proposals - a question which concerns tax authorities most. If there is an expected loss in revenue some measures for financing the gap should

[1] The list is not comprehensive, however it provides good examples of microsimulation analyses considering direct taxation.

be identified. Other important issues refer to the level of taxpayers. First, changes in the tax burden can be simulated. They are measured both by the amount of the tax due increase or decrease and by some relative measures. The nominal tax rate comes from the tax rules and it is a rather simple indicator. Effective tax rates (average and marginal) are more accurate since they take into account items influencing the tax base. Second, in a wider social context it is also crucial to simulate whether the concentration of the tax burden across taxpayers changes.

TABLE 4. EFFECTS OF TAXATION ANALYZED WITH MICROSIMULATION

Research perspective	TYPE (1): TAX AUTHORITIES	TYPE (2): TAX PAYERS	
Effects	Revenue	Tax burden	Distribution of tax burden
Research question	*What is the expected change in revenue after the reform?*	*What is the expected change in the tax burden of taxpayers after the reform?*	*Who is to gain and who is to lose from the reform?*
Measurement of fiscal effects	Increase (loss) in revenue	Tax due Nominal tax rate Effective tax rate	Concentration of the tax burden

Source: Own elaboration.

This approach enables to identify who is expected to lose and to gain from particular reform projects. Microsimulation models applied in tax policy research can be both static and dynamic, although the former still predominate. It is a proper instrument to analyze fiscal and other economic consequences of tax regulations.

Application of microsimulation for analysis of the effects of a change in corporate income tax - research problem, data and methodology

At this stage, it is important so present a possible application of microsimulation approach in the field of tax policy research. The motivation of the analysis refers to the classification presented in Table 4 which distinguishes between two research perspectives - that of tax authorities and of taxpayers. Microsimulation analysis presented in the paper considers the effects of corporate income tax from the point of view of a taxpayer.

A common problem inherent in taxation of corporate income is an asymmetric treatment of profits and losses. In fact, this asymmetry is present in Polish tax system since corporations face two kinds of restrictions relating to loss carry forward. First, the length of the period in which tax losses can be carried forward is limited to five years. Second, there is also a restriction relating to the amount of loss which can be deducted. Even if firm's profit is sufficiently high to subtract the entire loss, maximum 50 per cent of the initial loss can be deducted each year. A consequence of these regulations is that in case of poor profitability or other allowances companies cannot be able to use the loss carry forward opportunity or they use it only to a limited extent. According to (Stiller, 2011), this in turn may distort investment decisions.

In fact, this asymmetric solution in the Polish tax system is very restrictive especially when compared to many EU member states which allow for more generous treatment of tax losses (Spengel and Zöllkau, 2012). Interestingly, according to the draft Council directive on a common consolidated corporate tax base (CCCTB) losses can be carried forward infinitely and without restrictions according to the amount deducted each year (European

Commission, 2011). Bearing in mind the above context, motivated by the recent developments in the debate about corporate income tax, the aim of the analysis is to investigate, using microsimulation, whether the advantages for Polish corporations would be significant if tax losses are carried forward without any restrictions relating to time and amount of the deduction. Simultaneously, it is also analyzed how the distribution of the tax burden would change in case of such a reform.

The microsimulation analysis is based on the information obtained from single financial statements. In an ideal case data on tax losses of single tax payers as presented in tax returns should be used, however it is impossible since tax statements are not available publicly. As a consequence, it has to be assumed that the amount of tax loss equals the amount of negative profit before tax as calculated in line with financial accounting rules.

The analysis is based on the data on corporations active in Poland. A panel of 222 firms (joint-stock and limited liability companies) is used. The data was randomly selected from the InfoCredit database, which provides detailed financial information on the population of companies in Poland. The simulation covers a period of 5 years (2008-2012). However, also data on 2007 is used since it enables to identify losses for this year which can potentially be carried forward[1]. Altogether it gives 1.332 firm-year observations.

An analysis of the effects of modified tax loss carry forward provisions requires a multi-period setting[2] to be applied. It is appropriate to cover timing effects of tax regulations which emerge with respect to inter period loss offset. Simulation carried out on a single entity level allows to observe changes in financial items over time. In a first step of the analysis losses are carried forward within the period in question according to existing corporate tax regulations. Then, the tax due for every observation is calculated using the nominal tax rate[3]. In order to cover timing effects the future value of the annual taxes for the end of 2012 is calculated[4]. In a second step the procedure is repeated for the reform scenario according to which losses can be carried forward without any restrictions relating to time and amount of the deduction. Then, changes in the individual annual tax liabilities are analyzed.

Results

In a first step it is crucial to identify the number of firms incurring losses since only such firms can be affected by the simulated reform. The data shows that 117 firms do not incur losses within the analyzed period. It means that nearly 53% firms would not benefit from more generous loss carry forward rules - within the first years after the reform the modified tax regulations would be neutral to them. Obviously, it is still possible that these firms incur losses and use the opportunity to carry them forward without restrictions in later periods. It is, however, beyond the scope of the analysis.

In order to analyze the extent to which the tax base and the tax duty of single corporations are reduced by the unlimited tax loss carry forward the results are presented for two groups of companies (two cross-sections). To the first group belong all investigated firms. The second group includes only enterprises for which the carry

[1] Tax bases and tax liabilities of some firms may still be overestimated since losses from years prior to 2007 are not contained in the underlying dataset.

[2] A multi-period microsimulation approach is used for instance in (Reister, 2009).

[3] Nominal corporate tax rate in Poland is 19% in the entire period.

[4] The annual percentage rate is derived from Polish treasury bonds.

forward of losses is possible within the analyzed period, i. e. periods in which firms incur losses are followed by periods with profits.

The first cross section enables to identify the share of enterprises for which more generous rules on loss carry forward are relevant. Table 5 shows the effects of the reform for the entire group of investigated firms.

TABLE 5. EFFECTS OF THE REFORM FOR THE ENTIRE GROUP OF FIRMS

Effects	Number of firms	Percentage of firms
Increase in tax	0	0
No change	171	77
Reduction in tax	51	23
Total	222	100

Source: Own calculation.

Since rules providing for an unlimited tax loss carry forward are more generous compared with the current low it is obvious that there are no firms which would face an increase in tax burden. However, the average reduction in tax amounts to merely 0.25%. It is caused by the fact that the corporate tax of only 23% firms would be reduced whereas it would remain unchanged for 77% enterprises. To the latter group belong entities which incur no losses within the analyzed period as well as entities which do not benefit from greater deductions since their initial tax bases are not high enough or because periods with losses are not followed by profitable ones within the analyzed period. Table 6 enables a more detail insight into the distribution of the reduction in tax.

TABLE 6. DISTRIBUTION OF REDUCTION IN TAX (IN %) FOR THE ENTIRE GROUP OF FIRMS*

Percentile	1%	2%	3%	4%	5%	7%	10%	15%	20%	50%	75%	100%
Reduction in tax *	-100%	-100%	-21.9%	-8.9%	-6.1%	-2.2%	-1.2%	-0.4%	-0.1%	0.0%	0.0%	0.0%

Note: * Percentage change in future value of corporate income tax of firm *i* for years 2008-2012.
Source: Own calculation.

For 10% firms the corporate income tax is reduced by 1,2% or more. However, this subgroup is heterogeneous with regard to the scale of the reduction. There are single companies with a zero tax as a consequence of the simulated reform (five entities which constitute about 2.3% of the sample). Microsimulation enables to analyze them in more detail. Four of five firms incur losses in more than one period. All of them are negatively affected by the current restrictions relating to the amount of losses which is allowed to be deducted each year. Since these firms can potentially benefit from greater deductions the more generous rules on loss carry forward have a significant positive effect on them. Firms between 15th and 20th percentile face a slight reduction in tax which is lower than 0.5%. As mentioned above, tax of 77% corporations remains unchanged.

TABLE 7. EFFECTS OF THE REFORM FOR FIRMS ABLE TO CARRY LOSSES FORWARD

Effects	Number of firms	Percentage of firms
Increase in tax	0	0
No change	22	30
Reduction in tax	51	70
Total	73	100

Source: Own calculation.

The second cross section provides insights into the problem of to what extent more generous rules on loss carry forward can in fact be used by corporations within a period of several years after the reform. In other words, this part of the simulation enables to investigate how many firms which are potentially expected to benefit from the reform become really better off. In this step, only firms who are able to deduct losses in following years within the analyzed period are concerned.

After firms for which periods with losses are followed by periods with profits are selected from the initial sample the average reduction in corporate income tax increases to 2.35%. However, the average reduction in tax is still influenced by firms which do not face any change in tax liability despite the more generous rules on loss carry forward. As Table 7 shows, 30% firms are unable to take advantage of unlimited deduction of losses within analyzed period due to insufficient profits. Results considering distribution of the reduction in tax are presented in Table 8.

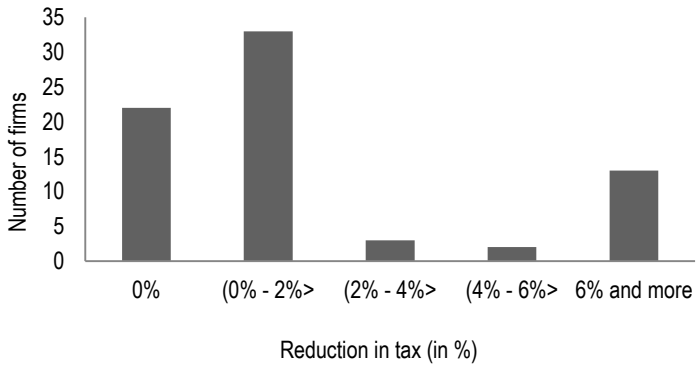
TABLE 8. DISTRIBUTION OF REDUCTION IN TAX (IN %) FOR FIRMS ABLE TO CARRY LOSSES FORWARD*

Percentile	1%	5%	7%	10%	15%	20%	50%	60%	69%	75%	100%
Reduction in tax *	-100%	-100%	-23.5%	-12.9%	-6.4%	-4.4%	-0.4%	-0.13%	0.0%	0.0%	0.0%

Note: * Percentage change in future value of corporate income tax of firm *i* for years 2008-2012.
Source: Own calculation.

Due to the fact that the initial group is narrowed down to firms able to carry losses forward (73 firms) the share of firms benefiting from a zero income tax increases to 6.8%. For 10% corporations the unlimited inter-period loss offset causes a reduction in a multi-period tax burden of 12.9% or more. In general, 70% entities take advantage of the reform, however the extent of reductions varies strongly across them. Firms between 50th and 60th percentile face only a slight reduction in tax of less than 0.5% whereas for firms about 69th percentile the decrease in multi-period tax burden can be neglected.

FIGURE 1. DISTRIBUTION OF REDUCTION IN TAX FOR FIRMS ABLE TO CARRY LOSSES FORWARD



Source: Own calculation.

Additionally, the distribution is presented in the histogram below (Figure 1). It shows that the majority of firms benefiting from the more generous rules on tax loss carry forward face a slight reduction in the tax burden of no more than 2% of the initial amount of tax

(33 entities). For 13 firms the reduction amounts to 6% or even more; to this group belong also 5 firms with a reduction of 100%.

There are 22 firms who remain unaffected by the reform despite the fact that after years with losses their financial situation improves and they obtain profits again. It is caused by insufficient profitability. In such cases the tax base after deduction is lowered to zero even under the current restrictive regulations on loss carry forward. Of course, such firms can still benefit from the reform in future periods which are not covered by the simulation. In case their future profits will be high enough they will be able to benefit from (additional) tax shields on losses. However, it has to borne in mind that it is in general advantageous to firms to deduct losses as soon as possible. The more postponed the deduction, the greater the disadvantage to a firm caused by the fact that no percentage rate is used for loss carry forward[1].

Conclusion

The microsimulation analysis presented in the paper shows that the advantages for Polish corporations in case tax losses could be carried forward without any restrictions relating to time and amount would be rather moderate. However, the size of the effects varies strongly across entities. This makes the analyzed tax reform attractive. It would by far mitigate the asymmetric treatment of profits and losses. An important aspect of the corporate tax system would be simplified. Some companies would be better off compared with the current situation, whereas the moderate reduction in tax should be still acceptable for tax authorities.

The microsimulation approach enables to look into detailed characteristics of single taxpayers. As a consequence, it is possible to identify taxpayers for which the more generous loss offset provisions are relevant and to verify whether these entities take advantage of the reform to a full or only to a limited extent. It is also plausible to calculate tax savings across companies. The analysis could be enriched by taking into account further firms' characteristics, for instance size. It would be also advisable to use data on a larger number of years, provided it is accessible, as well as to use information derived from tax returns in order to avoid distortions caused by book-tax differences. The questions analyzed in the study are typical for investigations carried out from a perspective of a taxpayer. However, microsimulation is often based on larger datasets and it is used to investigate revenue effects as well.

Since the first publication of G. Orcutt microsimulation models have been developed in many directions and they are still gaining in popularity. The microsimulation approach is commonly used i. a. in the United States, the United Kingdom, Australia, Germany and it has a good chance to become increasingly popular also in other countries. Application of microsimulation can be expected in countries in which this approach has not been widely used so far. Several factors of the development can be identified.

The access to empirical data has improved in recent years. Besides countries' statistical offices there is an increasing number of institutions and private companies which establish their own databases and make them accessible to interested public. This tendency is especially visible within tax policy research where the development and directions for further analyses are connected e. g. with multinational groups, profit shifting and

[1] From that perspective, tax refund could be a solution to the problem of asymmetric treatment of profits and losses. It is, however, not used in practice.

investment decisions investigated from a long term perspective. There is also an increasing demand for information about potential effects of different measures of the economic policy. Many countries apply some strict rules in order to analyze possible consequences of changes in law before they are actually undertaken. Such analyses should have not only qualitative and descriptive but also quantitative character. Moreover, they should enable to draw up conclusions relevant for diverse types of economic agents. This is a prerequisite for a "good law". Policymakers should be obliged to have knowledge about possible consequences of their actions before particular decisions are made. This, in turn, is in line with the requirements of the "law and economics" (the economic analysis of law) since microsimulation analyses provide *ex ante* information relevant for policy makers. Undoubtedly, the subject raised in the paper is important both from a research perspective and for real economic life.

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