

SUMMARY BASED ON THE FINAL PROJECT REPORT OF THE DYNAMIC MICRO- SIMULATION MODEL OF THE CZECH REPUBLIC

Deloitte, Actuarial & Insurance Solutions

Jiří Fialka, Partner, jfialka@deloittece.com

Aleš Krejdl, Senior Manager, akrejdl@deloittece.com

Petr Bednařík, Manager, pbednarik@deloittece.com

1 Table of contents

1	Table of contents	2
2	Pension models search	4
2.1	Pension models taxonomy	4
2.1.1	General classification.....	4
2.1.2	Standard models.....	4
2.1.3	Micro-simulation models	5
2.1.4	Models review	7
2.2	Models used in the Czech Republic.....	8
2.2.1	Regularly updated models	9
2.2.2	One-off studies	9
3	Data sources search	10
3.1	Data sources and their owners	10
3.1.1	Sources of data on pension rights acquired in basic pension insurance	10
3.1.2	Sources of data on pension rights consumed in basic pension insurance.....	10
3.2	Sources of data on acquired pension rights.....	10
3.2.1	Personal pension insurance bills	10
3.2.2	Database of non-contributory period documents.....	13
3.3	Sources of data on consumed pension rights	14
3.3.1	Data sources.....	14
4	Data Analysis	16
4.1	Introduction.....	16
4.2	Basic definition of data requirements for dynamic micro-simulation model.....	16
4.3	Inputs of the dynamic micro-simulation model.....	17
4.4	Overview of data requirements for the model points and data sources.....	18
4.4.1	Data requirements	18
4.4.2	Sources of data for model points	20
4.5	Overview of data requirements for the decision-making processes and data sources	21
4.5.1	Data requirements	21
4.5.2	Data sources for the decision-making processes.....	23
5	Dynamic micro-simulation model	25
5.1	Modelled objects – model points.....	25
5.2	Model calculations.....	25
5.2.1	Events	25
5.2.2	Career paths	26
5.2.3	Family relations.....	27

5.2.4	Cash flows	27
5.2.5	Salary modelling	28
5.2.6	Fund pillar modelling.....	28
5.3	Model assumptions	28
5.3.1	Macroeconomic assumptions	29
5.3.2	Assumptions for the fund pillars	29
5.4	Main output variables of the model	29
5.5	Brief description of the preparation of model points.....	31
5.5.1	Output variables – structure of the model point.....	31
5.5.2	Implementation	33
6	Illustrative results of the model	34
6.1	New cohort results	34
6.1.1	Model setup	34
6.1.2	Career trajectories	34
6.1.3	Salary modelling	36
6.1.4	Pension eligibility	38
6.1.5	Service and contribution years	39
6.1.6	Average pension base	40
6.1.7	New pensions	41
6.1.8	Implicit debt.....	43
6.1.9	Case study – change of reduction limits.....	43
Annex A.	List of the output variables.....	46
Annex B.	List of abbreviations.....	49
Annex C.	Bibliography	50

2 Pension models search

2.1 Pension models taxonomy

2.1.1 General classification

The summary of the pension system taxonomy is based on a study by Gál, Horváth, Orbán, & Dekkers (2009). The chart below provides an overview of the basic types of models used in various EU countries for pension system modelling.

Model type	Subtype	Description	Countries where it is used
Standard	Cohort	Use of cross-sectional information, no or limited use of individual data	Poland, Lithuania, Spain, Czech Republic, Slovakia, Austria, etc.
	Typical agent	Simulation of selected fictive individuals, no or limited use of individual data	Czech Republic, Slovakia, Greece, etc.
Micro-simulation	Static	Use of individual data (large quantity of individuals), comparative statics, non-existence of historical time	Belgium, Denmark, Luxembourg
	Dynamic with static ageing	Use of individual data (large quantity of individuals), shift in time by means of weight changes	Netherlands
	Dynamic with dynamic ageing	Use of individual data (large quantity of individuals), complete history of lives of real individuals over time	UK, Sweden, France

Table 1

Source: drafted according to (Gál, Horváth, Orbán, & Dekkers, 2009).

2.1.2 Standard models

2.1.2.1 Cohort model

This type of model is based on up-to-date cross-sectional information regarding the labour activity and social security contributions by various social groups (cohorts) that can be further broken down by gender, position in the labour market and demographic characteristics (such as family status and achieved level of education). The input information is made up of averages within certain population groups, i.e. the model is based on aggregate data for the cohort concerned which are then further broken down by pension type and benefit. Geographical differences and ethnic origin are included in some countries. An important feature of cohort models is forming of subgroups (usually cohorts, groups structured by gender and, as the case may be, other criteria) and assumptions regarding their future behaviour.

Standard models of this type differentiate gender, age and type of pension, but some of them also use other data (such as ethnic origin). This type of model may come with explicit inclusion of the calculation of newly awarded pensions.

The most important outputs from a cohort model are aggregate incomes and expenditures, number of contributors to the system and number of pensioners. The key sustainability indicators are pension system deficit and e.g. implicit debt of the pension system.

2.1.2.2 “Typical agent” model

This model projects the lives of fictive individuals as a base for pension amount calculation. This approach provides a sophisticated estimate of the replacement ratio based on country-specific legislative parameters. The acquisition of pension entitlements can be properly modelled, because the entire history of the individual is available. This model is suitable for the evaluation of incentives regarding e.g. later retirement, for the exploration of the actuarial neutrality of the pension system, etc.

The models may differ in the key features and life characteristics of the typical agent. Furthermore, there are various approaches to the collection of results provided by the typical agent.

The key outputs are the replacement ratio plus, as the case may be, other micro-financial criteria (implicit tax, comparison of life-long contributions and benefits, etc.).

2.1.3 Micro-simulation models

Models of this type simulate changes in a large sample of individuals (e.g. thousands, hundreds of thousands, sometimes even millions of individuals). The information regarding the sample concerned is usually acquired in two ways.

- Administrative database – data provided by various government organisations (such as revenue office or social security administration office). This data is reliable and accurate but may not include all necessary information.
- Selective surveys – this method provides the model with more information, but such data may be less reliable and is usually available for a limited population sample. If they cover only a small part of the population, they may pose a problem in terms of representativeness.

We can differentiate between two types of information in terms of the time dimension.

- Cross-sectional data is acquired across all cohorts at a certain time.
- Panel (generation) data also include the individual's history.

Furthermore, the input data for micro-simulation models is usually further broken down based on whether such information regards

- individuals (usually the administrative databases approach) or
- households (usually the selective surveys approach).

2.1.3.1 Static model

The simplest form of micro-simulation model – compares two “states of the world” or two different institutional arrangements.

In contrast with dynamic models, this type does not include historical time, and population ageing therefore cannot be set up.

2.1.3.2 Dynamic model with static ageing

Cross-sectional characteristics are updated with exogenous future data – time can be seen as a series of different statuses.

The model first works with individual cases in order to adapt the sample according to the projected demographical development and labour market development. As the second step, the aggregate results are further updated with certain exogenous development indicators (such as economic growth).

2.1.3.3 Dynamic model with dynamic ageing

Dynamic models with dynamic ageing create the complete history of each individual in a data set.

This group of models can be further broken down to:

- Cross-sectional models – individuals (one after another) are moved over time while their attributes are being updated. The advantage of this approach is that it simply admits the existence of relationships between individuals (such as wedding or death of the partner).
- Generation (cohort) models – project the entire life cycle of an individual from their birth to their death and only then proceed to another individual.

Dynamic models with dynamic ageing can be further differentiated by other criteria. Such models are then:

- Deterministic – based on best estimates of input parameters (e.g. probability of transfer) and simultaneous modelling of all statuses;
- Stochastic (e.g. Monte Carlo simulation) – based on random simulation of one status path for the individual concerned.

Deterministic models

Transfers between statuses (e.g. between employment, unemployment, exit from the labour market, etc.) are all modelled simultaneously. The life path of one modelled individual or group of individuals gradually branches out. The result (e.g. insurance period, newly awarded pension) is achieved by averaging across all life paths. In such case it is not possible to explore extreme life paths and it is also not possible to satisfactorily identify e.g. the number of pensioners threatened by poverty. With a large number of model points, the model is only able to identify a poverty threat caused by a low income. A poverty threat caused by interrupting the work career (insufficiently long period of insurance) cannot be modelled without additional information and adjustments made to the model.

Simplification or averaging is necessary in cases where non-linear life path dependencies occur in the pension formula (e.g. minimum pension, minimum numbers of years of work, etc.). Some extreme situations can be addressed by establishing a new status, but that makes the model more complex and again, the calculation is only approximate. With proper availability of data, it is possible to use the whole structure for selected parameters (primarily insurance period), but it is both calculation- and memory-consuming.

On the other hand, the advantage of the deterministic approach is the fact that it is easier to ensure consistency with external outputs, e.g. population projection and macroeconomic scenario of average-wage growth. Yet it may be necessary to calibrate the model even in this case. For example, to ensure consistency with an external macroeconomic projection, it is necessary to calibrate salary growth over the career.

Stochastic models

Transfers between statuses are modelled based on random parameters (generating a random number). At one moment in time, each model point corresponds with just one status. The transfer between defined statuses depends on a random number and its comparison with the transfer probability.

One model point has exactly one random career. As a result, the insurance period and other variables occurring in the pension formula are known exactly at the point of retirement, which makes it possible to perform exact modelling of pension formula non-linearities in extreme lines.

The data requirements are the same as with the deterministic model (probability of transfers). If more detailed data are available, it is easy to use them and adapt the structure of the model.

To achieve stable overall results, it is necessary to use a sufficient number of model points or simulations (with multiple simulations, the result is the average across the respective simulations). The need for a larger number of model points or simulations makes the calculation time longer. That, on the other hand, is compensated by simpler calculation, because it is not necessary to calculate all life paths simultaneously and average them.

Due to randomness, the results do not exactly correspond with the external outputs (population projections, macroeconomic projections), but if the number of model points or simulations is sufficient, the degree of consistency is very good.

The main benefit of the stochastic approach is the possibility of exact modelling of all non-linear elements in the pension formula. The results thus include even extreme lines and it is possible to explore cases of individuals threatened by poverty. It is possible to integrate more statuses into this type of model, and so it can be used also to model other types of benefits (unemployment, child,

sickness benefits). On the other hand, establishing an additional status in a deterministic model makes the model highly complicated.

Some properties of stochastic models may be unusual for the users. Some outputs, especially those associated with transfers between statuses such as number of deaths, number of newly employed individuals etc., are “noised”. That corresponds to the observation of reality, but the users may be used to “smooth” results.

To achieve stable results, it is necessary to have a large number of model points or simulations. The more parameters are generated stochastically, the higher is the number of simulations required to ensure convergence.

2.1.4 Models review

The chart below presents a summary of key advantages and drawbacks of each type of pension model.

Model	Strengths	Weaknesses
Cohort model	<p>Provides aggregate outputs (such as projections of revenues, expenditures, balance and debt, replacement ratio)</p> <p>Lower demands for input data</p> <p>Lower cost of implementation, speed of implementation (weeks)</p> <p>Easier to make the model consistent with macroeconomic expectations</p> <p>High calculation speed</p>	<p>No modelling of the entire history of individuals' lives</p> <p>Does not make it possible to model pension calculation non-linearities (reduction of assessment bases, dependency of the accrual factor on the insurance period, caps, etc.), which may distort the results as a consequence</p> <p>Does not make it possible to reflect pension award requirements (e.g. minimum insurance period)</p> <p>Limited outputs (overall replacement ratio, no pensions break-down)</p> <p>It is not possible to explore the pensions break-down, the number of pensioners under the poverty limit, etc.</p> <p>Does not make it possible to identify differences between generations if using only status probabilities (cross-sectional data)</p>
Typical agent	<p>Models the entire history of individuals' lives, either using status or transfer probabilities or neglecting them (OECD)</p> <p>Makes it possible to reflect all legislative parameters (i.e. even non-linearities, etc.)</p> <p>Evaluation of actuarial aspects of the pension system (e.g. incentives for later retirement)</p> <p>High calculation speed</p> <p>Lower demands for input data</p> <p>Relatively simple implementation</p>	<p>Limited outputs, does not provide aggregate outputs (revenues, expenditures, debt, replacement ratio)</p> <p>Simulation does not represent existing individuals (in terms of income, work careers and changes therein over time); uses only fictive individuals</p> <p>If the work career is not modelled, the resulting pension/replacement ratio may be substantially distorted (women on maternity leave, interrupted careers)</p>
Dynamic micro-simulation model	<p>Models the entire history of individuals' lives</p> <p>Makes it possible to use all available information and individual data (exact calculation of pensions for individuals approaching the retirement age)</p> <p>Makes it possible to reflect all legislative parameters (i.e. even non-linearities, etc.)</p> <p>Comprehensive outputs (non-deviated aggregate results, individual results and pensions structure, poverty indicators)</p> <p>Evaluation of actuarial aspects of the pension system</p> <p>Can be extended to cover other social benefit systems and used as a consistent tool in creating the social policy</p>	<p>Higher costs of model implementation (software, experience, team) and maintenance</p> <p>Higher calculation demands (both software and hardware requirements)</p> <p>Long calculation time</p> <p>High demands for input data and the preparation of assumptions for the model</p> <p>Higher demands in terms of ensuring consistency with other assumptions (macro scenario, population projections)</p>

Table 2

2.2 Models used in the Czech Republic

Pension system models in the Czech Republic are regularly used primarily by two government institutions – Ministry of Labour and Social Affairs (MPSV) and Ministry of Finance (MF), and although we have seen some other attempts to model the Czech Republic's pension system, these are mostly one-off projects and studies which purpose is to analyse specific aspects of the system rather than long-term use.

2.2.1 Regularly updated models

The chart below provides a basic overview of models regularly updated and used in the process of modelling the Czech Republic's pension system. With each of the models, the chart specifies its owner, what type of model it is, what data sources it uses and the key outputs from the model.

Institution	Type of model	Data sources	Outputs
MPSV	Standard, cohort	Aggregate ČSSZ statistics (number and amounts of paid and awarded pensions by gender, age and type of pension) ČSSZ data on the dependency of the assessment base and the insurance period Labour force survey (LFS), macro scenario, population projections	Aggregate outputs (revenues, expenditures, balance and debt of the pension system, overall average replacement ratio)
MPSV	Standard, typical agent	LFS, macro scenario, death rate charts	Micro-financial indicators (replacement ratio, internal revenue percentage, implicit tax)
MF	Standard, cohort	Aggregate ČSSZ statistics (number and amounts of paid and awarded pensions by gender, age and type of pension) LFS, macro scenario, population projections	Aggregate outputs (revenues, expenditures, balance and debt of the pension system, overall average replacement ratio)
OECD	Standard, typical agent	OECD assumptions (salary growth, inflation), death rate charts	Micro-financial indicators (gross and net replacement ratio, gross and net pension wealth, progressiveness of the pension formula and relevance between pension and income)

Table 3

2.2.2 One-off studies

The projects outlined below are examples of one-off studies concerning the modelling of the Czech Republic's pension system:

Author	Title	Comments
Vladimír Kreidl	Penzijní reforma v ČR (1998) (Pension Reform in the Czech Republic)	Does not provide information about the model. Probably a simplified cohort model. The main focus of the study is on a description and comparison of impacts of several reforms as proposed.
Vladimír Bezděk	Penzijní systémy obecně i v kontextu české ekonomiky (současný stav a potřeba reformem) (2000) (Pension Systems in General As Well As in the Context of the Czech Economy (Current situation and the Need for Reforms))	Model description not included in the article. Probably a simplified cohort model. Presentation of results of various economic and reform scenarios.
David Marek	Penzijní reforma v České republice (model důchodového systému s kombinovaným financováním) (1998) (Pension Reform in the Czech Republic) (Pension System Model with Combined Financing)	Model with overlapping generations (OLG) with Cobb-Douglas production function for long-term simulations of trends in basic economic variables and the pension system. Explores the impacts of parametrical adaptations to the existing system and the establishment of the funds pillar.

Table 4

3 Data sources search

3.1 Data sources and their owners

There are two basic sources of data on pension rights acquired and consumed in the basic pension insurance system, (i) a database of source documents for pension insurance claims containing information on acquired pension rights and paid pension benefit records and (ii) a statistical pensions database containing information on consumed pension rights. Both these data sources are owned and administered by the Czech Social Security Administration (ČSSZ).

3.1.1 Sources of data on pension rights acquired in basic pension insurance

Data on acquired pension rights (history of insurance periods, non-contributory periods and assessment bases) are included in a database of source documents for pension insurance claims that is owned and administered by the Czech Social Security Administration.

The database of source documents for insurance claims contains information on insurance periods and assessment bases for both employees and self-employed individuals (OSVČ). Furthermore, it contains information on non-contributory periods (mainly maternity leave, child care, unemployment, protection period, student, job applicant, army service). Due to a high diversity of source documents for insurance claims used over the last forty years, this is ČSSZ's largest and most complex database.

The personal pension insurance bills (ELDP) are the key source of information. The format of the personal bills was subject to many changes in the past, which is why the process of exploiting information from ELDPs is rather complex. The current format of ELDP, valid since 2004, has been integrated into the database of employees' insurance periods and assessment bases (STATMIN VZ). This is an administrative database that contains panel data (in the time dimension) on insurance periods and assessment bases. The basic displayed unit is an individual.

The situation regarding non-contributory period records is even more complicated. The information comes from various sources, and its completeness can currently be checked only if the insured individual concerned requests a statement from their record or when they file for a pension. To a large extent, data on non-contributory periods exist in the database of source documents for insurance claims but they have not been systematically processed so far. Some of the non-contributory periods data (child care) are implicitly contained in the STATMIN VZ database, but only for employees.

3.1.2 Sources of data on pension rights consumed in basic pension insurance

The basic information on consumed pension rights is provided by paid benefit records owned by ČSSZ. The data received from these records take the form of an administrative database containing primarily cross-sectional data on paid pension benefits. The basic displayed unit is an individual.

The basic source of information on consumed pension rights (paid pension benefits) for ordinary generation of output reports is a statistical pensions database (D_STAT). ČSSZ retrieves data from this database to generate reports and overviews sent to MPSV.

3.2 Sources of data on acquired pension rights

3.2.1 Personal pension insurance bills

3.2.1.1 Data availability and relevance

The paper database of personal pension insurance bills (ELDPs) has been built by collecting personal bills since 1950. The current ELDP database has been created by computerisation the paper database, using OCR systems. Despite the computerisation of this database, there is no integrated

application software for its processing. Moreover, these data include a number of errors, and so it is necessary to perform logical checks before processing the data.

The database includes two types of data information:

- Source data sentences (ZDV) – this is data from scanned documents that have been computerised by means of OCR; the data of this type includes all available information. This information has not been tested for the presence of logical errors caused both by the OCR application and in the process of issuing the document concerned.
- Unified data sentences (JDV) – primarily, this is new data that was generated in electronic form or by testing selected ZDVs; this data has been checked for logical errors. Its contents has been adapted to comply with the requirements set forth in 2004 – they represent the current data collection format; if older ZDVs (pre-2004) were to be unified, the respective data intersections would have to be maintained.

The entire ELDP database built since 1950 is thus currently unavailable in aggregate form. However, the ELDP database data for the 2004-2008 period have been further processed as part of the STATMIN VZ project performed by Siemens. This project focused exclusively on the processing of personal bills of the current type (valid since 2004). With this type of personal bill, the evaluation of data and their quality (logical correctness checks) is simpler. This data has been checked for logical correctness.

The data sources are available with a considerable delay (data for 2009 are going to be available in 2011). Some ELDPs are provided in paper form. Using a scanner, printed texts are digitised (OCR). That usually takes until the autumn of the following year, i.e. ELDPs for 2009 are digitised in the autumn of 2010. Then the data has to be checked and processed. The completion of the data source processing depends on the volume of other tasks on ČSSZ's side and availability of the sources. These are the reasons why data for 2009 were not available for the current project.

3.2.1.2 Data collection and processing

At present, employers deliver ELDPs to the Social Security Administration in paper or electronic form. The Social Security Administration converts ELDPs in paper form to images and computerises them. Taking the form of data sentences, such ELDPs are then available in ČSSZ's system. The ZDVs (source data sentences) are then used for generating the STATMIN VZ statistics.

By the rule of law, every employer has to hand in its employees' personal bills once a year. If an employee has multiple employers within one year or multiple employments with the same employer, their employers have to hand in their personal bill for each of their employment. The same applies to employment changes.

The processing takes quite a long time. Personal bills arrive until mid-year, and ČSSZ needs approximately further six months for their processing.

3.2.1.3 Use of ELDPs

The current format of ELDPs, valid since 2004, has been integrated into the database of employees' insurance periods and assessment bases (STATMIN VZ). This is an administrative database that contains panel data (in the time dimension) on insurance periods and assessment bases. The basic displayed unit is an individual.

3.2.1.4 Contents of the STATMIN VZ database

The STATMIN VZ database contains all data from the source data sentences for the 2004-2008 period. The contents and definitions of the database fields are specified below:

Contents and definitions of database fields		
Item name	Item contents	Note
id_ELDP	anonymous identifier of ELDP	makes it possible to interlink multiple lines of one ELDP
id_osoba	anonymous identifier of the individual	anonymous identifier of the individual – makes it possible to interlink multiple ELDPs of the same individual in the particular year of pension insurance
Pohlavi	gender	code: 1 – male, 2- female
Roknar	year of birth	YYYY format
PSC	postcode as stated in the insured individual's address	serves for identification of the insured individual's region (later it is possible to use data from stem records)
KVC	gainful activity code	three-character code from the insurance history line identifying the type of gainful activity and providing a more detailed specification of the type of insurance period
Od	date of commencement of gainful activity	including completion of the year and conversion to the YYYY-MM-DD format
Do	date of end of gainful activity	including completion of the year and conversion to the YYYY-MM-DD format
Dny	insurance days	number of days of insurance on the particular gainful activity line
Vdoba	excluded time	excluded time on the particular gainful activity line (all periods of receiving sickness insurance benefits)
Odobaa	deducted time	deducted time on the particular gainful activity line (for working pensioners – periods of illness are deducted)
VZ	assessment base	assessment base on the particular gainful activity line
id_org	anonymous identifier of the organisation	anonymous identifier of the organisation – makes it possible to interlink multiple ELDPs issued by the same organisation
IXYEAR	year of the record	year to which the record relates
Typdokl	document type	the type of document has no relevance to the type of ELDP, this is an identification of the type of document that is the primary source of data (e.g. identifies a paper ELDP form used from a particular year that has been scanned in the usual way)

Table 5

3.2.1.5 Use of the STATMIN VZ database

We understand that so far the STATMIN VZ database has been used neither for the generation of statistics, nor for the generation of input data to be used for pension system modelling. This database was used as late as for the “Dynamic Micro-simulation Model” project.

3.2.1.6 STATMIN VZ database constraints

The STAMIN VZ database seems to be an ideal data source for the generation of model points entered to the micro-simulation pension model. However, the current design of the STATMIN VZ database has some major constraints:

- Does not contain data on employees' assessment bases and insurance periods before 2004 when different types of personal bills were in use.
- Does not contain data on self-employed individuals' assessment bases and insurance periods.

- Data on non-contributory periods are not part of ELDPs, and are therefore missing also in the STATMIN VZ database. The extension of STATMIN VZ with non-contributory periods would require retrieval of data from the database of source documents for pension right records regarding non-contributory periods. Such newly generated database would then have to be interlinked with the STATMIN VZ database.

Generally, supplementing STATMIN VZ with the pre-2004 periods is no problem. This data is already in the records of the central register, taking the form of OCM-computerised copies of paper ELs (personal bills). The reason why they were not processed already within the STATMIN VZ project was the diversity of ELDPs over the periods before 2004, i.e. higher demands in terms of checking the correctness of such data. To extend the STATMIN VZ database, it is necessary to set up further checks of logical correctness of data. As this would be a direct extension of the STATMIN VZ project, it will be possible to use all the applications prepared within this project.

Data for self-employed individuals are maintained by district social security administration offices. With some delay, this data is sent to central registers – at the point of drafting this Report, such data was available for the 1992-2008 period. In terms of the required content, the processing of data for self-employed individuals is therefore no problem, either. It would in fact be a certain extension of the STATMIN VZ project. We presume that the applications designed for the STATMIN VZ project could be used for this purpose.

We understand that ČSSZ currently does not have capacities to extend the STATMIN VZ database. Such extension would probably have to take the form of an outsourced project. The supplier of the STATMIN VZ database (Siemens Business Services spol. s r.o.) does not expect any serious problems as far as the possible extension of the database with the pre-2004 data and the data for self-employed individuals is concerned.

However, even if the database is supplemented as described above, it will not contain all data required for the generation of model points. An exact specification of the missing data and the possible ways of adding it forms a part of the following chapters hereof.

3.2.2 Database of non-contributory period documents

3.2.2.1 Data availability and relevance

The situation regarding non-contributory period records is much more complicated than that concerning ELDPs. The information comes from various sources, and its completeness can currently be checked only if the insured individual concerned requests a statement from their record or reaches the point of pension award.

It is apparent from the above that much of this data is not relevant and up-to-date. Its relevance can only be checked through personal interaction with the insured individual. In terms of data availability and relevance, it is now basically impossible to use the data on non-contributory periods for pension analyses and modelling purposes.

3.2.2.2 Data collection and processing

Longer update periods and longer processing times have to be taken into account as far as the statistics based on non-contributory period documents (IDV database) are concerned. Another problem may be the fact that the acceptability of some types of non-contributory periods for the purposes of pension insurance has changed dramatically over time.

The non-contributory period status has been changing alongside historical developments (e.g. army service has been abolished, university studies). For this reason, the non-contributory periods data have been recorded unsystematically, i.e. only over periods when such record-keeping was required by law. As a consequence, the data in the records of source information for insurance claims are insufficient. At present, non-contributory periods are checked as late as at the point of filing for a pension.

To ensure appropriate usability of information, the requirements for statistical outputs will have to be formulated exactly and explicitly. The minimalistic requirement is basic information to the extent of the type of non-contributory period and the non-contributory period duration, including the start and end of that period (i.e. the “from – until” data).

We understand that ČSSZ currently does not have capacities to implement the project of exploiting the non-contributory periods information. In all probability, this plan would therefore have to be implemented as an outsourced project.

3.2.2.3 Use of information from non-contributory periods documents

The information on non-contributory periods is currently not available in the form of an integrated individual database. For the purposes of the micro-simulation model, data on the actual scope and structure of non-contributory periods over an individual's life is not available. To make the use of this information possible for model simulations, STATMIN VZ would have to be extended with non-contributory periods. The implementation would be done in two steps. As the first step, it would be necessary to retrieve data from the database of source documents for insurance claims regarding non-contributory periods; as the second step, the database generated as described above would be linked with the STATMIN VZ database, using a unique identifier (birth certificate No.).

3.3 Sources of data on consumed pension rights

3.3.1 Data sources

3.3.1.1 Data availability and relevance

ČSSZ is responsible for the entire agenda relating to benefit administration processes (pension awards and calculations), payments of pension insurance benefits and data base administration. The operational systems thus include information on all pension benefits paid (i.e. old pension, disability pension, widow/widower pension and orphan pension benefits, including cases where widow/widower pension benefits are paid along with some other type of pension benefits) and the amounts thereof.

The basic source of information is the pension benefits register, hereinafter referred to as pension records. These records serve for identification of the current situation and for payments of benefits. They are updated by means of processing the assessment and post-assessment¹ agenda (including valorisations) and also as part of the respective work, payment and monthly cycles. The pension records provide up-to-date administrative data. The data retrieved from these records take the form of an administrative database that contains primarily cross-sectional data on the paid pension benefits (up-to-date information as at a particular date), and the basic displayed unit is an individual (more details in Chapter 3.3.1.4). The benefit payments history is available, too. The recipient's account includes the history since December 2006.

The basic source of information on the consumed pension rights (paid pension benefits) for ordinary generation of output reports is a statistical pensions database (D_STAT). ČSSZ retrieves data from this database to generate reports and overviews that are periodically sent to MPSV. The statistical pensions database file is updated once a month, using a file with information generated by processing the work and payment cycles. When the pension benefits are valorised, a file is generated from the pension benefit records that identifies the financial changes and is used to update the statistical pension database.

3.3.1.2 Use of information from the statistical pensions database

The outputs from the statistical pensions database are used routinely by MPSV and other institutions for pension analyses and pension modelling purposes.

The information from the statistical pensions database is not sufficient for the purpose of generating model points to be entered to the dynamic micro-simulation model.

¹ The post-assessment agenda includes, in particular, awards of additional pension benefits, recalculations, changes, establishment of deductions, termination of entitlements to benefits, child survivors, one-year widows, monitoring of deductions for overpayments, processing of death certificate copies, etc..

3.3.1.3 Use of information from the paid pension benefit records

The data from the paid pension benefit records has been used for generating a database for the needs of the micro-simulation pension model. The newly generated database was named STATMIN ANOD. When preparing data for the model, it is necessary to pay increased attention to the possibility of duplicities in the identification of individuals. Such duplicities may occur, as follows:

- A pensioner receives multiple pension benefits – the paid pension benefit records contain information broken down by paid pension benefit, i.e. does not display a combination of pension benefits paid to a single individual, e.g. widow pension and old pension benefits. As the model points always represent a single pensioner, it is necessary to correctly match that pensioner with the pension benefits he/she is entitled to. This problem is addressed by the design of the STATMIN ANOD database (see Table 6 for more details).
- Besides the paid pension benefit records, a particular pensioner may also be part of the database of source documents for insurance claims (STATMIN VZ). These two databases are used for the generation of model points for pensioners and for the productive population, respectively.

When generating model points, it is necessary to prevent duplicate presence of individuals in the STATMIN VZ and STATMIN ANOD databases, which is why it is always necessary to know the unique identification number of the pensioner concerned under which it is possible to find him/her in the STATMIN VZ statistics, provided that he/she appears (is displayed) in those statistics.

3.3.1.4 Contents of the STATMIN ANOD database

The STATMIN ANOD database contains data from the paid pension benefit records as at a particular point of time. Its structure is as follows:

Contents and definition of database fields		
Item name	Item contents	Note
id_osoba	anonymous identifier of the individual	anonymous identifier of the individual – enables interconnection with the STATMIN VZ database
Pohlavi	gender	male, female
Roknar	year of birth	YYYY format
Duchod_1	pension benefit amount	amount of direct pension benefit
Typ_1	pension type	type of pension (identification according to ČSSZ's statistical year book)
Duchod_2	pension benefit amount	amount of widow/widower pension benefit in combination with direct pension benefit (combination of pension benefits)
Typ_2	pension type	type of pension benefits combination (identification according to ČSSZ's statistical year book, V-KOMB, VM-KOMB)

Table 6

4 Data Analysis

4.1 Introduction

There is a number of data sources in the Czech Republic which can be used for the preparation of model points and to derive the assumptions regarding the behaviour of the participants of the pension system entering the micro-simulation pension model. The problematic fact is that the data is disseminated in several databases and statistical surveys which are not connected to each other. It requires deployment of significant resources for the preparation of model inputs, and there are problems with mutual consistency of the data.

The following facts, in particular, are limiting for the preparation of model points:

- Data in administrative databases (in particular STATMIN VZ) is incomplete. These databases do not include pre-2004 records and data on self-employed individuals. In addition, the existing version of STATMIN VZ includes also data on deceased people (and those who had emigrated), which should be excluded for the purpose of preparation of model points.
- Administrative databases include only a limited amount of information pertaining to the period insured and the assessment base. Information on marital status, education, and history of the statuses of an individual over the course of his/her life is missing completely.
- To add the missing information it is necessary to use information from other sources (population statistics and labour force survey). Due to the impossibility to interconnect the sources of this information it is necessary to allocate the missing information using the method of random allocation.

A number of data deficiencies can be rectified easily and relatively quickly. It concerns particularly the completion of the STATMIN VZ database by adding records from the period prior to 2004, adding information on self-employed individuals, and excluding deceased individuals.

Rectification of other deficiencies will require more time and conceptual work. An example is the feasibility study of interconnection of the administrative databases under the control of the Ministry of Labour and Social Affairs within the DASTIN project. It is envisaged that the unified database would include, on individual level, information on the economic activity of individuals and history of allowances drawdown. Implementation of this project would significantly expand the capabilities of the Ministry of Labour and Social Affairs in the area of quantitative analyses of allowance systems and modelling thereof.

Also if the DASTIN project is implemented some information pertaining to the marital status and education of an individual would remain unavailable. This would require interconnection of even greater number of databases, which will pose number of problems in the area of data protection, technological solution and availability of resources. The assumption is therefore that also in the future, in the preparation of model points, it will be necessary to extrapolate some information or generate it randomly from complementary statistics.

4.2 Basic definition of data requirements for dynamic micro-simulation model

Dynamic micro-simulation model works with detailed individual data. Every individual (or a very small group of individuals with the same characteristics) will have their future projected based on the initial situation and the entered probabilities of transfer, or probability of an event occurrence. These individuals or groups of individuals, as the case may be, are represented in the model by so-called model points which represent in the model an individual that is further indivisible.

In order to acquire quality outputs from the model it is therefore necessary to ensure the following:

- Input data for the preparation of model points, i.e., an individual database of persons including all relevant factors which directly and indirectly affect the amount of the future pension, e.g., age, gender, current wage, education, hitherto acquired pension rights, number of children.
- Decision-making processes, i.e., up-to-date information on the distribution of the relevant factors depending on the other known factors, e.g., fertility rate depending on age, number of children and education, or the probability of entering the labour market depending on the highest education level achieved.

A database of people containing the information on the previous course of life of an individual would be ideal for the provision of both inputs. This means information on:

- Socioeconomic situations which the individual has experienced in the course of life (studies and achieved education level, employment, illness, unemployment, taking care of child, disability, etc.);
- Time over which the individual remained in the particular situations;
- Marital status (single, married, divorced, widowed, childless/ number of children, etc.); and
- Time of occurrence of events which changed the marital status.

Such database could be used to prepare the model points carrying the information on the current status of the individual as well as an aggregate snapshot of the past (development of the assessment base, time insured, etc.), and also to derive the probabilities of transfer between the statuses (e.g., probability of employment for the specific time of duration of unemployment) and probabilities of an event occurrence (e.g., birth of child) for the modelling of the decision-making processes.

In the Czech Republic, there is a number of data sources but these sources are not interconnected in a single database containing the above-mentioned information. A project of the Ministry of Labour and Social Affairs called DASTIN envisages the interconnection of databases and utilization of a greater range of information on the course of life career of an individual, focusing on the drawdown of benefits. This project currently exists only in the form of a feasibility study, and specific steps toward implementation of this plan have not been initiated.

Currently there is a number of partial data sources for the preparation of model points and derivation of the inputs to the decision-making processes. They include particularly the following data sources:

- Database of pension right records of ČSSZ, in particular:
 - Personal pension insurance bills (ELDP); and
 - Documents containing information on non-contributory periods.
- Database of benefits paid, in particular:
 - Pension benefit records;
 - Statistic pension database;
 - Statistics of people receiving unemployment benefits;
 - Statistics of sickness insurance (separately sickness and maternity benefits);
 - Statistics of people receiving parental benefits; and
 - Statistics of people receiving care benefits.

In addition, there are other data sources which could be used either as alternative, or as complementary sources for the preparation of model points and deriving the inputs to the decision-making processes. They include in particular:

- Selective survey of labour (ČSÚ).
- Data from the census (ČSÚ).

4.3 Inputs of the dynamic micro-simulation model

The model works with two main types of input data:

- Model points and

- Decision-making processes (probabilities of transfer between statuses or probabilities of an event occurrence).

Model points

The basic input data for the model is the database of model points. One model point represents one particular individual and puts its input characteristics into the model, see Table 7.

Model points enter the model as a unified database of people who had one of the economic and marital statuses as of the projection date. Completeness and quality of the database has impact mainly on the first years of the projection because it describes the current situation. For example, the amount of pension is almost completely determined by the past development for pensions awarded shortly after the projection date (duration of insurance and average lifelong assessment base) and is virtually independent of the development modelled by the decision-making processes. The high-quality of the input data makes it possible to model the pension expenditures at the beginning of the projection very accurately.

Decision-making processes

The model generates the course of life of an individual (model point) that transfers between the individual economic statuses (studies, employment, illness, unemployment, taking care of a child, disability, old-age pension) and marital statuses (single, married, divorced, widowed) using the decision-making processes.

Each transfer between the statuses is called a decision-making process because in the model it is necessary to decide whether the individual will transfer to a different status or stay in the current status. Such decisions are generated based on the selected probabilities of transfer and probabilities of an event occurrence, depending on the previous course of life, i.e., on the probability-based distribution from which a random selection is made. These distributions are dependent on addition factors (i.e., the current economic status, its duration, and also on social statuses such as education, marital status, number of previous marriages, number of children, etc.).

Marital statuses can have direct impact on the pension entitlement and also help make the economic decision-making processes more accurate. Therefore every individual (model point) is assigned – in addition to the economic statuses – also marital statuses which are again stochastically simulated within the decision-making processes.

For each decision-making process it is necessary to know the probability-based distribution and the factors which affect it. Availability and quality of this data determines whether and, if applicable, in what quality the respective phenomena can be modelled. Projection of new system participants is mostly affected by the quality of these inputs.

4.4 Overview of data requirements for the model points and data sources

4.4.1 Data requirements

In the model, all model points have identical data structure although it is obvious that the information content in the model point will be different e.g., for pensioners, employed individuals or future participants of pension insurance.

Basic idea of the structure of the model point, which is used by the model, is presented in Table 7.

Ideally, it would be possible to get all information from a single general database, or – if applicable – by a merger of several databases with a unique identifier of the individual. Unfortunately, such general databases are currently not available. The most general information critical for the calculation of pension is available in the database of insurance periods and assessment bases of employees (STATMIN VZ). This database, however, only includes basic data on the insured people. When preparing the model points it is therefore necessary to work with some additional information and data sources. The procedure for adding the missing data is outlined in the last column of the following table.

Structure of data for the model point

Required data	Available data	Extrapolation/use of alternative sources
Gender	STATMIN VZ, STATMIN ANOD	
Age	STATMIN VZ, STATMIN ANOD	
Gross wage	STATMIN VZ	
Economic status (student/ employed/ unemployed/ taking care of a child/ disability/ old- age pension)	STATMIN VZ	ČSÚ – LFS, random assignment of status depending on known characteristics
Sub-status of the economic status (healthy/ ill)	STATMIN VZ	ÚZIS – numbers of ill people and distribution of illness duration, random assignment
Number of periods in the current status		Using model simulation
Number of periods in the current sub-status		Using model simulation
Annual assessment base 1 (for the current year)	STATMIN VZ	
Annual assessment base 2 (a year ago)	STATMIN VZ	
Annual assessment base 3 (two years ago)	STATMIN VZ	
...	STATMIN VZ	
Annual assessment base 30	STATMIN VZ	Data for the period 2004-2008, other data must be extrapolated
Total duration of insurance	STATMIN VZ	Data for the period 2004-2008, other data must be extrapolated
Duration of insurance 1 (for the current year)	STATMIN VZ	
Duration of insurance 2 (a year ago)	STATMIN VZ	
Duration of insurance 3 (two years ago)	STATMIN VZ	
...	STATMIN VZ	
Duration of insurance 30	STATMIN VZ	Data for the period 2004-2008, other historical data must be extrapolated
Duration of the non- contributory period		Using model simulation
Duration of the non- contributory period – unemployment		Using model simulation
Excluded period		Using model simulation
Education		ČSÚ – population, random assignment of status depending on known characteristics
Time of completion of studies		ČSÚ – LFS ÚIV – data on the number of students according to the type of education, and random assignment
Marital status		ČSÚ – population, random assignment of status

	depending on known characteristics of a model point
Marriage order	ČSÚ – population, random assignment of status depending on known characteristics of a model point
Age of the spouse	ČSÚ – population, random assignment of status depending on known characteristics
Education of the spouse	ČSÚ – population, random assignment of status depending on known characteristics
Number of children	ČSÚ – population, random assignment of status depending on known characteristics of a model point
Age of child 1	ČSÚ – population, random assignment of status depending on known characteristics of a model point
Age of child 2	ČSÚ – population, random assignment of status in
...	
Age of child 5	ČSÚ – population, random assignment of status depending on known characteristics of a model point
Gender of child 1	ČSÚ - population, random assignment of status depending on known characteristics of a model point
Gender of child 2	ČSÚ - population, random assignment of status depending on known characteristics of a model point
...	ČSÚ - population, random assignment of status depending on known characteristics of a model point
Gender of child 5	ČSÚ - population, random assignment of status depending on known characteristics of a model point
Amount of pension received	STATMIN ANOD
Type of pension received	STATMIN ANOD

Table 7

4.4.2 Sources of data for model points

Source data for the model points requires great detail in terms of the information of individual nature, marital status, education level achieved, economic activity status and, if possible, also records of the history of the individual (acquired pension rights in the form of history of assessment bases, insurance periods and other statuses constituting the non-contributory periods). A general database of the required characteristics is currently not available. Data for the preparation of model points must therefore be drawn from multiple data sources with very limited capability of interconnection. The basic source for the preparation of model points is the administrative databases of the Czech Social Security Administration (ČSSZ). Other owners of data relevant for this purpose are Ministry of Labour and Social Affairs (MPSV) and the Czech Statistical Office (ČSÚ).

4.4.2.1 ČSSZ

Pensions records system provides the basic information on the current pensions. The data contained therein has the form of an administrative database (STATMIN ANOD) which includes particularly cross-sectional data on the pension benefits paid. The basic displayed unit is an individual.

The database of entitlement information (STATMIN VZ) provides an overview of the assessment bases, insurance period and excluded periods. It is an administrative database which includes panel data on insurance periods and assessment bases. The basic displayed unit is the personal file (an individual in the given year with the given employer).

4.4.2.2 MPSV

The database "OK- dávky" is developed by collecting data from the databases of 98 local (formerly district) state social security offices. These local databases are used for the maintenance of records of the payment of state social security benefits, including but not limited to unemployment benefits and parental benefits provided the status of unemployment and care of a child.

Although it is an administrative database, due to the missing connection with the databases of the Czech Social Security Administration it is practical rather for acquiring information for the decision-making processes for the purpose of the micro-simulation model. .

4.4.2.3 ČSÚ

Some information necessary for the definition of the model point (e.g., education level achieved) is not included in any of the available administrative databases. This information must be randomly assigned to model points based on their known characteristics, e.g., amount of wage, gender and age determine education to a certain extent.

Similarly, the administrative databases do not maintain records of all groups of the population. For example, the database of entitlement information includes information on self-employed individuals but this information is not accessible for statistical processing. In addition, people who have not been employed or self-employed in the past are not included in the ELDP database at all. Model points representing these groups of people must be extrapolated, so that the number of input model points would correspond to the size of the population.

These are actually decision-making processes, although the decision on assignment of the appropriate characteristics is not part of the model, but rather of the preparation of model points.

The following sources are used for the preparation of model points or addition of missing information:

- Statistics of the population, and
- Statistics from the labour force surveys.

4.4.2.4 Additional sources

Other administrative databases, such as stem records or registry offices, cannot be currently used in terms of the micro-simulation model. The information contained therein would have to be merged with the other databases (in particular database based on the outputs from the database of entitlement information of ČSSZ). This would require detailed definition of the functionality of such system, data sharing processes, the merger thereof, and provision of all related activities. We understand that the feasibility study of the merger of these databases was prepared by Trexima within the DASTIN project.

4.5 Overview of data requirements for the decision-making processes and data sources

4.5.1 Data requirements

Ideally, the source of data for the calculation of the probabilities of transfer and event occurrence depending on the relevant factors would be a general (summary) database which would be used for the preparation of model points. Such database would include information on the past statuses of an individual, duration thereof, and transfer to different statuses. The calculation of transfer probabilities would then be reduced to sorting of the source data according to the relevant factors and calculation of the respective proportions. Consistency between the model points and the assumptions for the modelling of the decision-making processes would be ensured automatically.

A database with the above-described characteristics, however, is not available. It is therefore necessary to use data from narrowly specified selective surveys and the resulting statistics for the calculation of the probabilities depending on the given factors.

The model works with two types of decision-making processes:

- Probability of an event and
- Probability of transfer between working statuses.

Probability of an event

This is a probability that an event specified in the table below will occur:

Probability of occurrence of an event and sources for the calculation thereof	
Event	Source
Birth	Faculty of Natural Sciences of the Charles University, department of demography and geodemography: demographic projection, determined by a model point
Death (death rate tables)	Faculty of Natural Sciences of the Charles University, department of demography and geodemography: death rate tables
Completion of studies	ČSÚ: labour force survey, determined by a model point
Occurrence of disability (probability of occurrence of disability)	ČSSZ: statistical pension database
Change of disability degree (probability of transfer between different degrees of disability depending on the duration of disability)	ČSSZ: statistical pension database
Cessation of disability (probability of cessation of disability depending on the duration of disability)	ČSSZ: statistical pension database
Marriage (probability of marriage)	ČSÚ: population development statistics
Divorce (probability of divorce)	ČSÚ: population development statistics
Becoming a widow/widower (probability of death of the auxiliary individual according to death rate tables)	Consequence of spouse's death
Birth of a child (probability of child birth depending on the age of the mother and order of the child)	Faculty of Natural Sciences of the Charles University, department of demography and geodemography
Termination of child care (probability of termination of child care)	ČSÚ: labour force survey
Beginning and end of taking care of a family (probability of end of taking care of a family)	ČSÚ: labour force survey
Retirement	ČSSZ: STATMIN ANOD
Emigration (probability of emigration)	ČSÚ: population development statistics, Faculty of Natural Sciences of the Charles University, department of demography and geodemography
Change of the possibility of parallel employment and receipt of old-age pension	ČSSZ: STATMIN ANOD
Change of salary	MPSV: Average income information system (prepared by Trexima) ČSSZ: STATMIN VZ
Becoming / ceasing to be a self-employed individual	ČSÚ: labour force survey

Table 8

Probabilities of transfer between working statuses

In general, transfers between working statuses can be divided into two types:

- Transfers associated with an event, or

- Transfers without an event.

In the first case it involves mostly events which allow an individual to be inactive (such as beginning of a disability pension or old-age pension, studies, care of a child, and care of a family) and the transfer probabilities in such case represent a one-time response to a specific event. For example, at the time of becoming eligible for old-age pension benefits there a high probability of termination of employment and transfer to inactivity.

The second type represents transfers which occur all the time, independent of events. For example, for a pensioner who is also working this probability will represent transfer to inactivity. The probabilities are stated as annual probabilities.

The model works with the following probabilities of transfer between statuses:

- Probability of transfer from employment to inactivity associated with an event, according to the type of event (e.g., upon occurrence of disability, care of child or family, becoming eligible for old-age pension benefits),
- Probability of transfer from employment to inactivity without an event, according to the status (disability, care of a child, care of family, studies, old-age pension),
- Probability of transfer from employment to unemployment associated with an event, according to the type of event,
- Probability of transfer from employment to unemployment without an event, according to the status,
- Probability of transfer from inactivity to employment associated with an event, according to the type of event,
- Probability of transfer from inactivity to employment without an event, according to the status,
- Probability of transfer from inactivity to unemployment without an event, according to the status,
- Probability of transfer from unemployment to employment depending on the number of months unemployed,
- Probability of transfer from unemployment to inactivity associated with an event, according to the type of event,
- Probability of transfer from unemployment to inactivity without an event, according to the status,
- Distribution of sickness duration according to the age and gender,
- Probability of employment in the case of termination of care of family,
- Initial probabilities of the individual degrees of disability,
- Probabilities for the choice of the version of pension for working pensioners (full or half pension),
- Career-based salary increase.

4.5.2 Data sources for the decision-making processes

The following sources were particularly used for the determination of the assumptions for the decision-making processes (for more detail see Table 9):

- MPSV: Unemployment statistics (<http://portal.mpsv.cz/sz>);
- ČSSZ – sickness insurance benefits records;
- ČSÚ – labour force survey;
- ČSÚ – population development statistics; and
- ČSSZ – statistical pension database.

Probability of transfer and sources for the calculation thereof

Initial status	Resulting status	Source
Unemployed	Employed	MPSV: Unemployment statistics (http://portal.mpsv.cz/sz)
Unemployed	Inactive	ČSÚ: Labour force survey, further categorized according to the status (disability, care of a child, care of a family, studies, old-age pension) and whether an event changing the status occurred
Employed	Unemployed	MPSV: Unemployment statistics (http://portal.mpsv.cz/sz), ČSÚ: Labour force survey, further categorized according to the status (disability, care of a child, care of a family, studies, old-age pension) and whether an event changing the status occurred
Employed	Inactive	ČSÚ: Labour force survey, further categorized according to the status (disability, care of a child, care of a family, studies, old-age pension) and whether an event changing the status occurred
Inactive	Employed	ČSÚ: Labour force survey, further categorized according to the status (disability, care of a child, care of a family, studies, old-age pension) and whether an event changing the status occurred
Inactive	Unemployed	ČSÚ: Labour force survey, further categorized according to the status (disability, care of a child, care of a family, studies, old-age pension) and whether an event changing the status occurred
Sick	Healthy	ÚZIS: records of payment of sickness insurance benefits
Healthy	Sick	ÚZIS: records of payment of sickness insurance benefits

Table 9

5 Dynamic micro-simulation model

The model is implemented in a software system called Prophet developed by Sungard. A special library called “Liska”, which contains the entire code, has been developed specifically for the model. This chapter includes a non-technical description of the model structure, its logic, and a brief description of the preparation of model points.

5.1 Modelled objects – model points

The calculations are made on the level of the model point which represents an individual out of the population. As some cash flows depend not only on the life of the respective individual but also on his/her family, the family members are also taken into account in the calculations for the respective model point. Every model point, therefore, includes the main individual and several auxiliary individuals. Although it is possible to calculate cash flows also for some auxiliary individuals, the input for the overall and individual results is only the cash flows for the main individual because for every auxiliary individual there is a model point in which he/she is the main individual.

Full model calculations are always made for the main individual. The auxiliary individuals can be modelled either fully or in simplified manner. The model is set up such as the spouse of the main individual (husband/wife or potential husband/wife in the case of singles) is modelled fully. Children are modelled in simplified manner because the full career history of the children does not affect the cash flows of the main individual. The number of individuals modelled fully within one model point is the parameter which can be changed. The technical solution within the model is that every variable is a field depending on the order of the individual, and the size of this field can be adjusted. By selecting the PERSON dimension (and adding the required information to the model points) it is possible to change the number of people modelled fully in a single model point.

5.2 Model calculations

Model calculations can be divided into the following inter-connected groups:

- Events;
- Career paths capturing the economic (in)activity of an individual throughout his/her life;
- Family relations reflecting the marital status of an individual and number of children born and raised; and
- Calculation of cash flows consisting of modelling of the individual’s income (including the income of the husband/wife), payments to the pension system (pension insurance premiums), and payments of pension benefits.

5.2.1 Events

Major events in the life of the modelled individuals are modelled randomly on monthly basis based on the predefined probabilities of the specific events. The following events are modelled:

- Birth
- Death
- Termination of studies
- Occurrence of disability
- Change of the degree of disability
- Termination of disability
- Marriage

- Divorce/becoming a widow(er)
- Birth of a child
- Termination of care of a child
- Beginning and end of care of family
- Retirement
- Emigration
- Change of the possibility of parallel employment and receipt of old-age pension
- Change of salary
- Transfer between employee status and self-employed status

Status variables are set based on the event. The model uses the following status variables:

- Living (yes/no)
- Student (yes/no)
- Disability (yes/no)
- Married (yes/no)
- Taking care of a child (yes/no)
- Taking care of a family (yes/no)
- Pensioner (yes/no)
- In the pension system (yes/no)
- Degree of disability pursuant to the legislation
- Possibility of parallel employment and receipt of old-age pension pursuant to the legislation
- Self-employed individual (yes/no)

Life and career paths and family relations are built based on the events and status variables.

5.2.2 Career paths

A career path of an individual in the given model point is the sequence of statuses of economic activity / inactivity, and a change of a status is triggered by the occurrence of events. Statuses are defined in the input table and can be changed or added by the user. Statuses can be further divided into sub-statuses. Within the project, we consider the following statuses and sub-statuses:

- Employed
 - Healthy
 - Sick
- Unemployed
 - Individuals registered in the employment bureau (separately those who receive and those who do not receive unemployment benefits)
 - Other individuals without employment
- Inactive individuals
 - Individuals registered in the employment bureau (separately those who receive and those who do not receive unemployment benefits)
 - Individuals not registered in the employment bureau
- Individuals outside the pension system
 - Emigrants

- Armed forces

A special status is death which results in the termination of projection of the main individual. Projection of the auxiliary individuals, however, continues due to the possibility to model survivors' pensions.

Transfer from one status to another is a result of decision-making processes, random events (see 5.2.1), and the assessment of compliance with requirements for entry to the respective status (e.g., sufficient time of insurance period for eligibility for old-age pension, etc.).

For inactive individuals the reason for inactivity is determined based on the status variables. The reasons for inactivity are as follows:

- Taking care of a child
- Disability pensioner, degree 3
- Disability pensioner, degree 2
- Disability pensioner, degree 1
- Old-age pensioner
- Student/child
- Taking care of a family

5.2.3 Family relations

Another part of the calculations is related to the modelling of family relations of the main individual. In every model point the main individual has a spouse assigned at the beginning of the projection even if he/she is single or divorced. Marriages, divorces and re-marriages are modelled as random events based on the assumptions regarding the marriage rate and divorce rate. It is assumed that the spouse of the main individual is the same also in the case of re-marriage after divorce or widowhood.

Child birth is also modelled as a random event based on the fertility rates of the woman in the couple. Career paths of children are not modelled fully but only in simplified manner (age, death, orphan, having left the household).

5.2.4 Cash flows

Career path and family relation define the conditions of entitlement for the payment of benefits from the pension insurance system. Part of the model projecting the cash flows uses information on career path and marital status for the calculation of the contributions to the pension system and payments of benefits from the pension system. The following items are modelled in this part of the model:

- Gross monthly salary based on wage inflation and career-based salary increase. The individual's income in the respective month is then determined in combination with the information on the economic status;
- Contributions to the pension system according to the current legislation derived from the individual's income in the respective month;
- Contributions to fund pillar and accumulation of the fund derived from the individual's income in the respective month and information on participation in the fund pillar;
- Old-age pensions according to the current legislation (regular, permanently reduced, concurrence with gainful activity);
- Payment of annuity from the fund pillar and fund in the payment phase in the event of the individual's participation in the fund pillar;
- Disability pensions according to the current legislation (according to the degree of disability, concurrence with gainful activity);
- Widow/widower pensions according to the current legislation (permanent and temporary);
- Orphans' pension according to the current legislation; and

- Pensions in concurrence with another pension.

5.2.5 Salary modelling

The initial salary of an individual after completion of studies is defined in the model point and is derived from the distribution of salaries depending on the education level achieved. If the individual has been working prior to completion of his/her studies the model will use an age-dependent average salary defined in the table. Salary is increased once a year, and the increase consists of three components:

- Career growth
- Residual wage inflation (growth of the average wage due to general growth in productivity)
- Decrease of salary in the case of inactivity and unemployment

Residual wage inflation is the input of the model and should be calibrated together with the career growth, so that the total generated growth of the average wage would correspond with the wage inflation which also enters the model and is used for indexation.

Career growth can be modelled as follows:

- Stochastically based on the distribution of salary growth; or
- Deterministically based on average age-dependent growths; or
- Deterministically depending on education.

In the first two cases it is possible to take into account or not to take into account dependency on the amount of salary.

Decrease of salary in the case of inactivity and unemployment is driven by age-dependent assumption.

5.2.6 Fund pillar modelling

It is possible to model any quantity of fund pillars with several separate sub-funds. The following elements are modelled in the accumulation phase:

- Contributions based on wage growth
- Fee from the contribution
- Investment yield of the funds
- Fee from the amount of the fund
- Transfers between sub-funds

The following elements are modelled in the payment phase:

- Payment of the annuity (calculated based on the defined technical interest rate, indexation rate, and cost and profit margin)
- Calculation of the technical reserve
- Profit-sharing based on outperformance over the technical interest rate on the technical reserve
- Development of the annuity fund

5.3 Model assumptions

The model works with several types of assumptions:

- Decision-making processes which can be further divided into:
 - Probability of an event occurrence and
 - Probabilities of transfer between working statuses.

- Macroeconomic assumptions and
- Assumptions for the fund pillars.

The assumptions for the decision-making processes are described in section 4.5.

5.3.1 Macroeconomic assumptions

Macroeconomic assumptions include:

- Projection of CPI inflation,
- Projection of the growth of the average nominal wage,
- Risk-free interest rate.

Wage inflation is used for indexation of all fixed values in the model (e.g., basic part of the pension, minimum percentage assessment of the pension, etc.). A similar role could be played also by the CPI inflation but if the use of CPI inflation is not required by the legislation, the indexation of nominal values uses wage inflation due to preservation of the relative level. CPI inflation is the input value of the calculation of the coefficient for the valorisation of the pension benefits paid. Risk-free interest rate is used for discounting the implicit debt and it should also be used as a basis for deriving the performance of the fund pillar.

5.3.2 Assumptions for the fund pillars

These are assumptions used for the modelling of funds in the saving phase, calculation of the annuity and calculation of the profit sharing in the payment phase. The model uses the following assumptions:

- Performance of the respective fund in the respective pillar
- Performance of the annuity fund in the respective pillar
- Technical interest rate for the calculation of annuity in the respective pillar
- Indexation of annuity in the respective pillar
- Annual fee as a percentage from the fund (saving phase) for the respective fund
- Annual fee as a percentage from the fund (payment phase) for the respective pillar
- Fee from the contributions to the respective fund
- Profit margin used for the calculation of annuity in the respective pillar
- Costs in the annuity fund in the respective pillar
- Cost surcharge for the calculation of annuity in the respective pillar
- Percentage of outperformance of the annuity fund paid as a profit share in the respective pillar
- Percentage of transfer from one fund to another within the respective pillar

5.4 Main output variables of the model

Outputs for each variable used and possibly in a different level of aggregation can be extracted from the model. As the model includes several hundreds of variables, and the calculation is made on the level of each of the model points, of which there are several million, the user must carefully specify the required outputs.

In terms of the degree of aggregation, the following results are available:

- Overall aggregate results for the entire population, resulting from:
 - Addition over all model points (individuals in the population), or
 - Addition over all model points re-weighted to the size of the population in the event that a sample of model points was randomly selected from the set of all model points in order to speed up the calculation;

- Results by so-called SP codes (sub-product code used for division of aggregate results). An SP code can be created e.g., to define cohorts according to the year of birth and gender.
- Results by model points.

It is possible to consider the variables containing information on the marital status, economic status, typical status (including the reasons for inactivity), contributions to the pension system, amount of the pension, etc. to be the main output variables of the model. A more detailed table with the main output variables can be found in the annex, see Annex A.

On the aggregate level, the following indicators are of particular interest:

- Income of the pension system,
- Expenditures of the pension system categorized according to the type of pension as follows:
 - Expenditure for old-age pensions,
 - Expenditure for disability pensions, and
 - Expenditure for survivor's pensions.
- Balance of the pension system,
- Implicit debt of the pension system,
- Number of contributors to the system,
- Number of recipients of benefits according to the type of pension:
 - Number of old-age pensioners,
 - Number of disability pensioners,
 - Number of widow/widower pensions, and
 - Number of orphan's pensions.
- Average pension according to the type of pension:
 - Average old-age pension,
 - Average disability pension,
 - Average widow/widower pension, and
 - Average orphan's pension.
- Structure of the population according to the economic status:
 - Number of employed individuals,
 - Number of unemployed individuals, and
 - Number of inactive individuals according to the type of inactivity:
 - Studies,
 - Care of a child,
 - Care of family,
 - Disability (according to the degree),
 - Old-age pension

On the cohort level, interesting information is provided by the so-called implicit debt. It provides information for the generation of new entrants to the labour market on whether the respective cohort will be a new recipient or net payer to the system throughout the entire life. In other words, it informs whether the system is well set up in actuarial terms.

On the individual level, the following indicators are of particular interest:

- Distribution of old-age pensions paid, according to the amount,
- Distribution of newly awarded old-age pensions, according to the amount,

- Number of pensions below the set level (poverty level),
- Dependency of the newly awarded pension on the amount of the assessment base.

All these indicators can be acquired by processing of the individual results.

5.5 Brief description of the preparation of model points

Model points are prepared out of two source databases:

- **STATMIN VZ** – database of assessment bases and insurance periods of employees (in 2004 – 2008). Every employee has several records (one record is linked to one year and employer). The database includes e.g., anonymised identifier, year of birth, gender, postcode, period of employment, assessment base for the period of employment, insurance period, etc.
- **STATMIN ANOD** - pension database (for the period 2008 and 2009), including anonymised identifier corresponding with the database STATMIN VZ, year of birth, gender, amount of pension (even in concurrence) and its type.

The following information is drawn from the source data (STATMIN VZ and STATMIN ANOD):

- gender,
- age,
- assessment base (in the period 2004 through 2008),
- insurance period (in the period 2004 through 2008),
- excluded period,
- type of pension,
- amount of pension,
- partly also the economic status (employed, pensioner).

The following information is randomly generated based on the corresponding probability-based distributions. In order to estimate these distributions it was necessary to acquire data in the required structure from the addressed institutions (ČSSZ, ČSÚ, MPSV, ÚZIS ,ÚIV), see chapter 4.4. It includes the following information:

- economic status and typical position (except for old-age and disability pensioner who is known from the database STATMIN ANOD, it involves the status of a student, taking care of a child, taking care of family)
- type of unemployment,
- highest education level achieved,
- age when education completed,
- spouse's age,
- spouse's highest education level achieved,
- number of children, their age and gender,
- marital status, and
- number of marriages.

5.5.1 Output variables – structure of the model point

The following table includes a description of the output variables (i.e., structure of the model point) which are used as input to the micro-simulation model.

Structure of the model point

Variable	Description of the output variable
EDUCATION_FINISH_AGE	Age when education was completed for students; for others this variable is set to 0
EDUCATION_MAX	Highest education level achieved (or the future highest education level for students)
HIST_EXCLUDED_TIME	History of excluded periods since 1986
HIST_GRS_SAL	History of annual assessment bases since 1986
HIST_SERVICE_TIME	History of insurance period since 1986
INIT_AGE_MP	Current age of the existing individual; in the case of unborn individuals and immigrants an age from which the individual starts to be simulated in the model
INIT_ALIVE	If the individual is living the variable will be 1, otherwise 0 (also in the case of unborn individuals)
INIT_CHILD_CARE	Will be 1 if the individual takes care of a child, otherwise 0
INIT_CHILDREN	Current number of children for the respective individual
INIT_CHILDREN_AGE	Age of the children
INIT_CHILDREN_SEX	Gender of the children
INIT_CHILDREN_STATUS	Value -1 means an unborn child, 1 means dependent, 2 no longer dependent, 3 deceased, 4 orphan with the main individual deceased, 5 orphan with the secondary individual deceased, 6 orphan from both sides
INIT_CONTRIB_PERIOD	Total period of payment of premiums
INIT_CONTRIB_PERIOD_EXTERNAL	Total period of payment of premiums abroad for immigrants; for others 0
INIT_DIS_PEN_PERC	Percentage assessment of disability pension
INIT_DIS_PENSIONER	Set to 1 if the individual receives disability pension; otherwise 0
INIT_DISABILITY_LEVEL	Degree of disability for a disability pensioner; for others zero
INIT_DISABLED	Set to 1 if the individual is disabled; otherwise 0
INIT_FAMILY_CARE	Set to 1 if the individual is a homemaker; otherwise 0
INIT_FUND_ANNF	Starting value of an annuity fund
INIT_FUND_PEN_USED	Starting amount of the annuity paid
INIT_GRS_SAL	Current monthly salary; if the individual is still studying or is unborn it will be the entry-level salary (in current prices) and if the individual is a future immigrant it will be a monthly wage at the time of immigration (in current prices)
INIT_IN_PENSION_SYSTEM	Set to 1 if the individual is to be included in the pension system (payment of contributions, acquiring new rights); otherwise 0 (e.g., for emigrants, armed forces)
INIT_LAST_DIF_STATUS	The last economic status before the current status (e.g., for mothers taking care of a child – status before maternity leave: employed, unemployed or inactive)
INIT_MARITAL_STATUS	Marital status, 0 - single, 1 - divorced, 2 - married, 3 - widower/widow
INIT_MARRIAGES	Number of marriages (in the individual's history)
INIT_MARRIED	Will be 1 if the individual is married; otherwise 0
INIT_MEM_IF	Number representing the number of individuals in the respective model point

INIT_ORPHAN_PERC_PEN	Percentage assessment of the orphan's pension
INIT_PEN_PERC	Percentage assessment of the old-age pension
INIT_PEN_WORK_OPT	Initial choice of the possibility of concurrence of work and receipt of pension benefits for working pensioners; otherwise 0
INIT_PENSIONER	Set to 1 if the individual is an old-age pensioner; otherwise 0
INIT_SERVICE_EXTERNAL_TIME	Total insurance period abroad for immigrants; for others 0
INIT_SERVICE_TIME	Total insurance period
INIT_STATUS	Economic status (11 - employed, 21 - unemployed, 31 - inactive)
INIT_STATUS_DURATION	Initial duration of the current status in the case of durational and combined method of departure from the status Duration of summer job for working students; for others the value will be 999999; otherwise 0
INIT_STUDENT	Set to 1 if the individual is student; otherwise 0
INIT_SUB_STATUS	Sub-status of the economic status (for employed individuals: 1 - healthy, 2 – sick; otherwise: 1 – individuals receiving benefits, 2 – registered and not receiving benefits, 3 – not registered)
INIT_SUB_STATUS_DURATION	Total (including future) duration of sickness of the individual with the sub-status sick; in other cases 0
INIT_TIME_IN_CURRENT_STATUS	Time spent in the current economic status
INIT_TIME_IN_CURRENT_SUB_STATUS	Time spent in the current sub-status of the economic status
INIT_TIME_IN_PEN_WORK_OPT	For working pensioners it represents the hitherto acquired time under various possibilities of concurrence of work and pension (for the calculation of the percentage)
INIT_TIME_IN_STATUS	Time spent in the current work status at the beginning
INIT_TIME_IN_SUB_STATUS	Time spent in the current sub-status at the beginning
INIT_TIME_IN_UNEMPL_NO_BEN_AF_55	Time spent in unemployment without benefits after 55 years, at the beginning
INIT_TIME_IN_UNEMPL_NO_BEN_BEF_55	Time spent in unemployment without benefits before 55 years, at the beginning
INIT_UNEMPL_REQ_MTHS	Number of months insured for the last 3 years for the assessment of entitlement to unemployment benefits Total of the time insured or time of taking care of a child for the last three years
INIT_WIDOW_PENSION_TIME	Time of receiving widow's pension at the beginning
INIT_WIDOW_PERC_PENSION	Percentage assessment of the widow pension
INIT_YEARS_IN_DISABLED	Number of years spent in disability
MTHS_TO_SALE	Number of months remaining until the individual enters the model
SEX_MP	Gender of the individual
SPCODE	Sub-product code (used for division of aggregate results)

Table 10

5.5.2 Implementation

The entire preparation of model points takes place in the programme called Data Conversion System (DCS, supplied with the Prophet programme) and the SQL database systems.

6 Illustrative results of the model

6.1 New cohort results

6.1.1 Model setup

The results shown in this section represent the full cohort of people born in the year 2008. This amounts to 119 914 people at the start of the projection with ages between zero and one year. Each person is represented by one model point (i.e. no grouping is used). To enable the comparability of cash flows in different calendar years no inflation is assumed (CPI inflation and wage inflation are set to zero). The career salary growth used is deterministic and education dependant.

The people born in 2008 do not have any past career history and their entire career is determined by the model. The only information given in the model point files is the education, education completion age and initial salary after completing education. The model points also contain the initial information of the potential partners. These results therefore show how a new cohort is modelled and what the long term results converge to.

The results presented in this section show the development of one cohort in time. Results from different calendar years correspond to different ages of the cohort (the age is the same throughout the cohort at the end of each calendar year) and therefore the time dimension corresponds to age in this case. The age dependant graphs in this section show the results for the same people at different points in time.

6.1.2 Career trajectories

The following graphs illustrate the distribution of people according to their career status (see section 5.2.2) and how this changes with time (i.e. age).

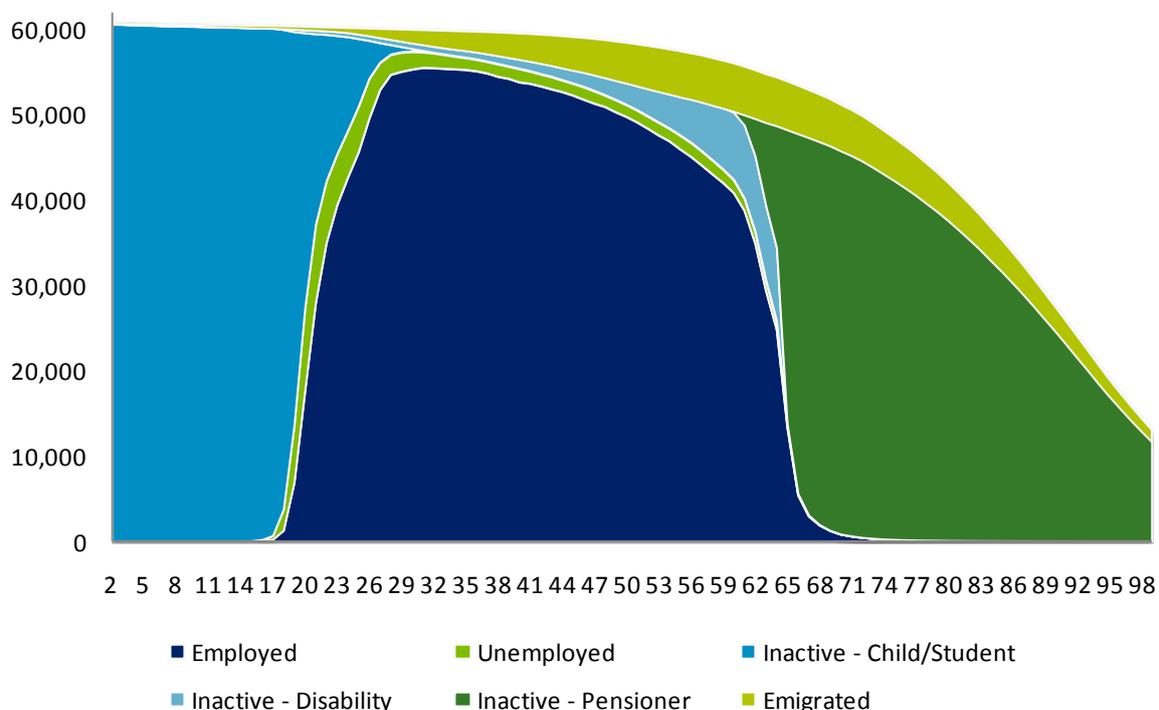


Figure 1: Number of people in given career status at given age – men

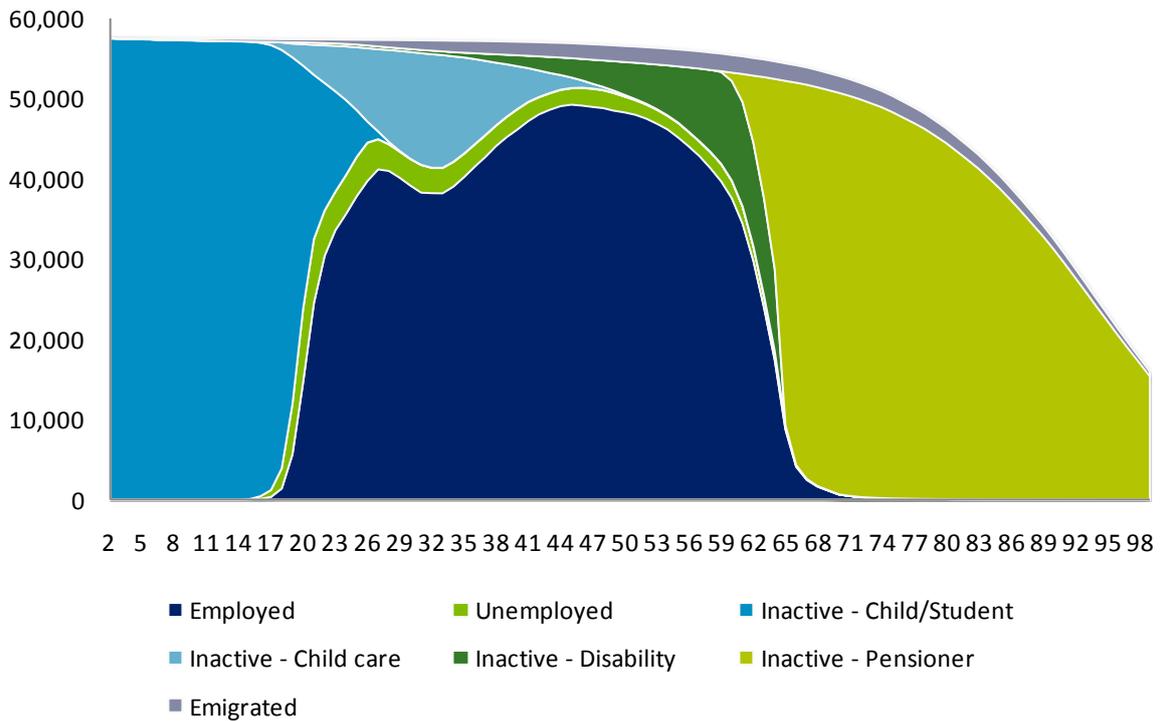


Figure 2: Number of people in given career status at given age – women

In the charts above (Figure 1 and Figure 2) only the inactive people are split according to the reason of inactivity. Therefore for example the total number of disabled people consists not only of the inactive disabled shown on the graph but also some employed and unemployed are at the same time disability pensioners. This is illustrated on the graph below which shows the split of disability pensioners into career statuses.

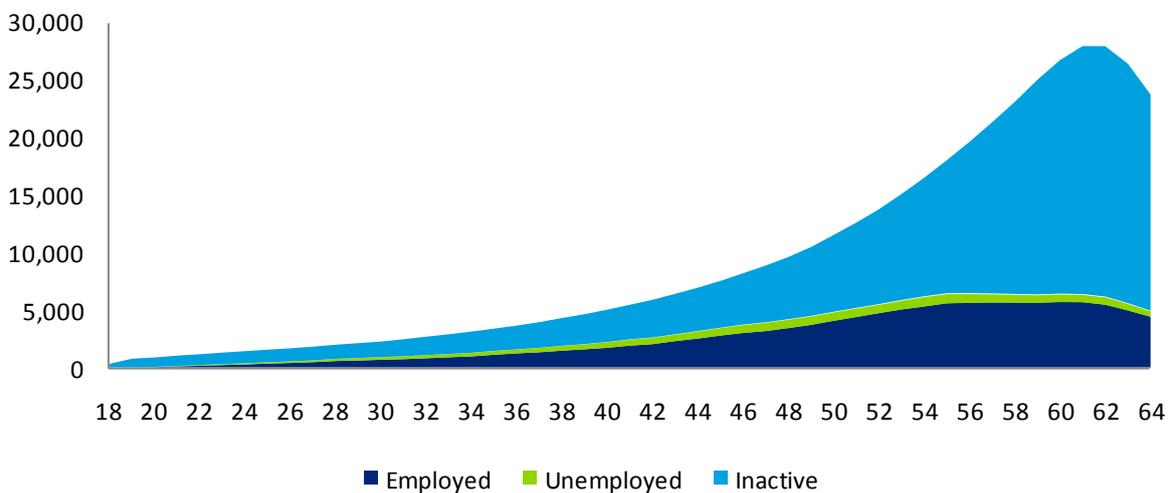


Figure 3: Number of disability pensioners at given age split according to career status

The following graph shows the number of sick generated by the model as a percentage of employed for each age.

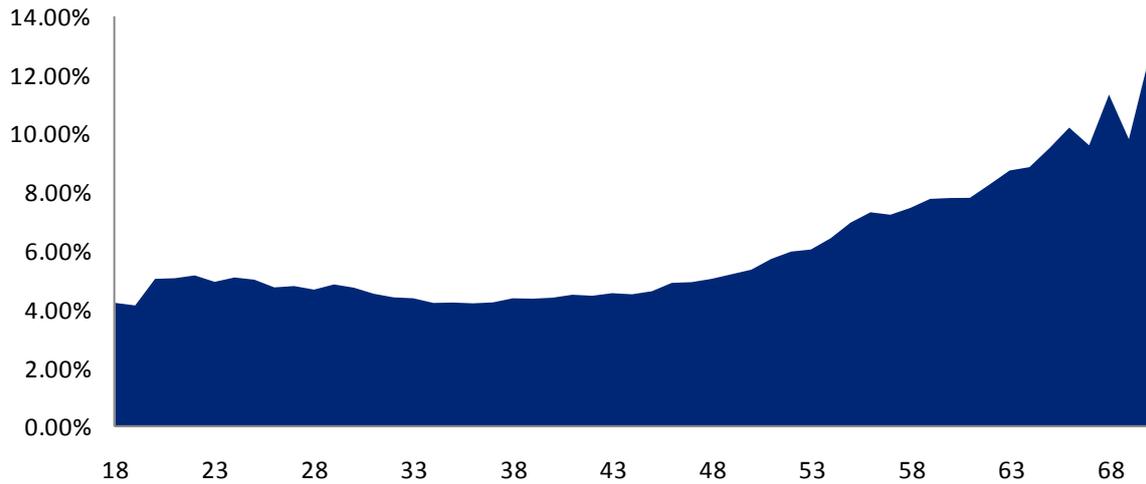


Figure 4: Number of sick as percentage of employed by age

6.1.3 Salary modelling

The modelled salary development will be presented in this section. The following graph shows the average modelled salary separately for men and woman. Please note that no wage inflation is assumed in this run and the changes over time are only due to career salary growth.

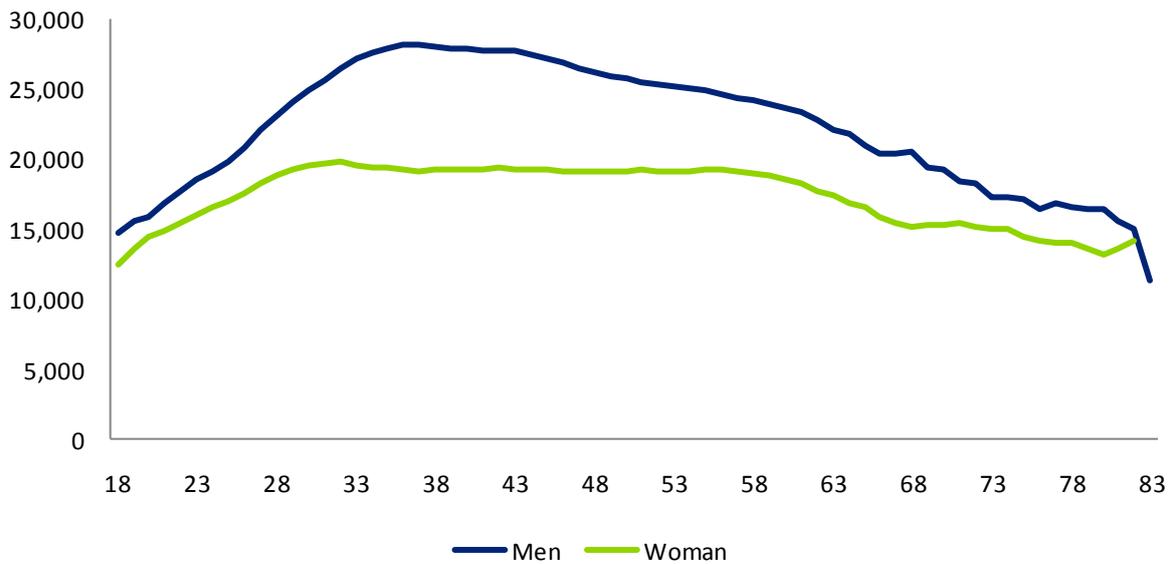


Figure 5: Average salaries by age and sex

On the next chart the dependency of the average salary on education is shown for the case of men.

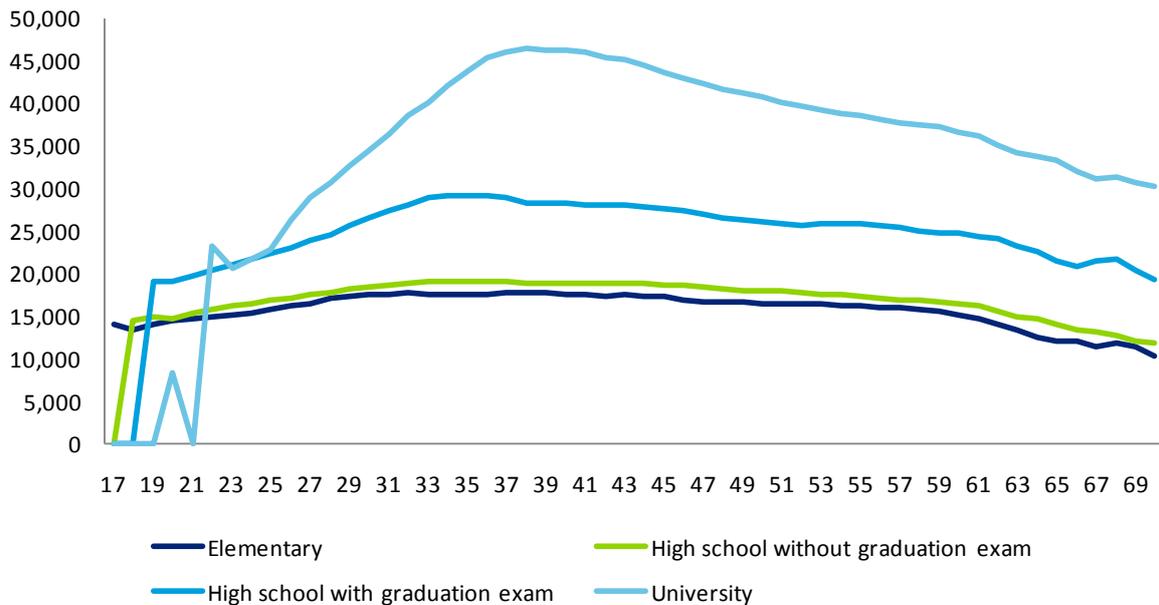


Figure 6: Average salaries of men by age and education

The following charts (Figure 7 and Figure 8) illustrate the distribution of salaries within a given age group. The charts are in fact histograms showing the number of people in a given salary interval. The salary intervals borders have been selected as multiples of CZK 500.

The blue line represents the output from the model while the green line is based on the cross-sectional data from the STATMIN VZ database. The differences especially in the low salary parts of the chart are caused by the fact that the STATMIN VZ database contains also part time jobs that cannot be recognized and excluded from the database.

The two charts below compare the salary distribution of men at 25 and at 50. A shift to higher salaries and increased tails in high salaries are the results of career salary growth.

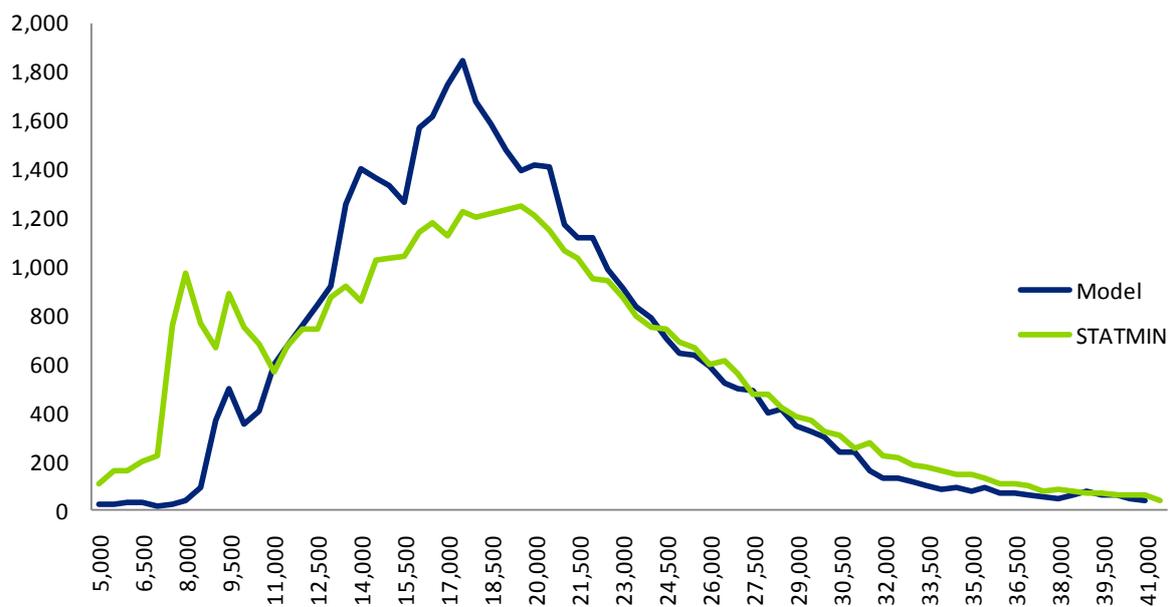


Figure 7: Number of people with salary in 500 CZK interval – men aged 25

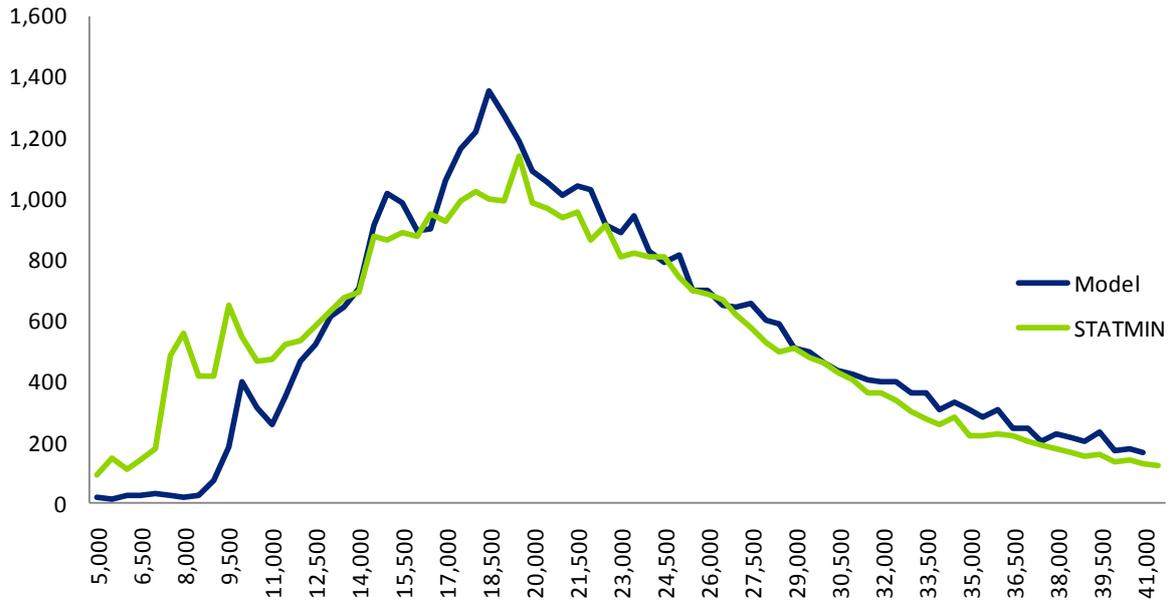


Figure 8: Number of people with salary in 500 CZK interval – men aged 50

6.1.4 Pension eligibility

This section will demonstrate the results of old-age pension eligibility conditions testing (in terms of age and service years). It can be seen that the number of people having the necessary number of service years for early retirement is high and there are very few people who are not eligible for an old-age pension at the normal retirement age. The eligibility is slightly lower for women mainly due to family care periods.

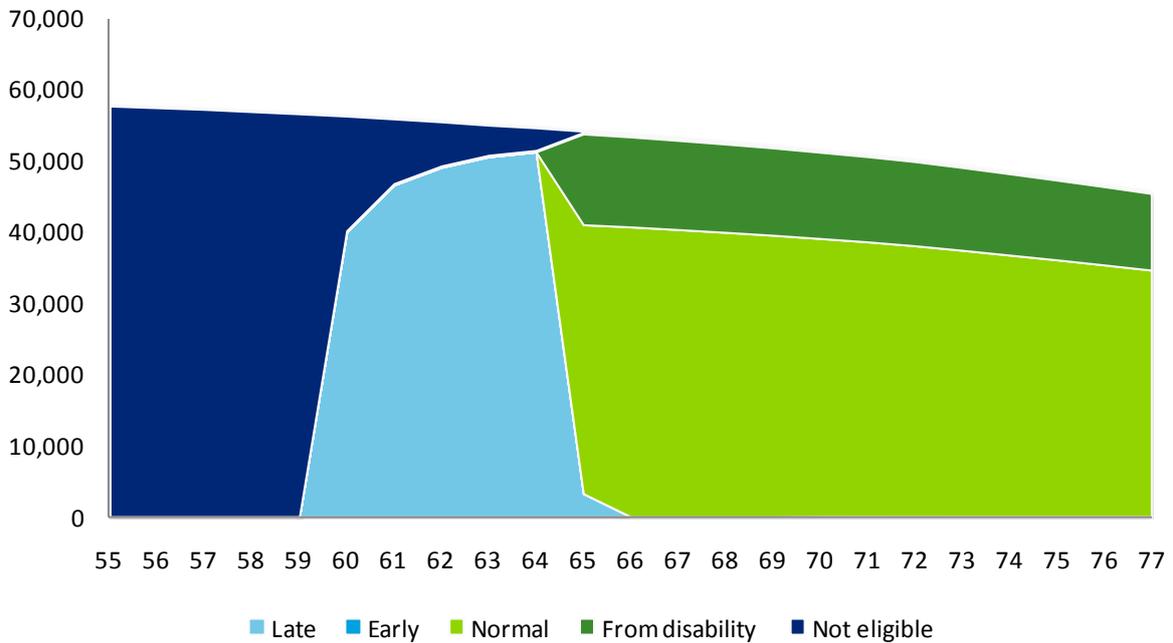


Figure 9: Number of people eligible for old-age pension - men

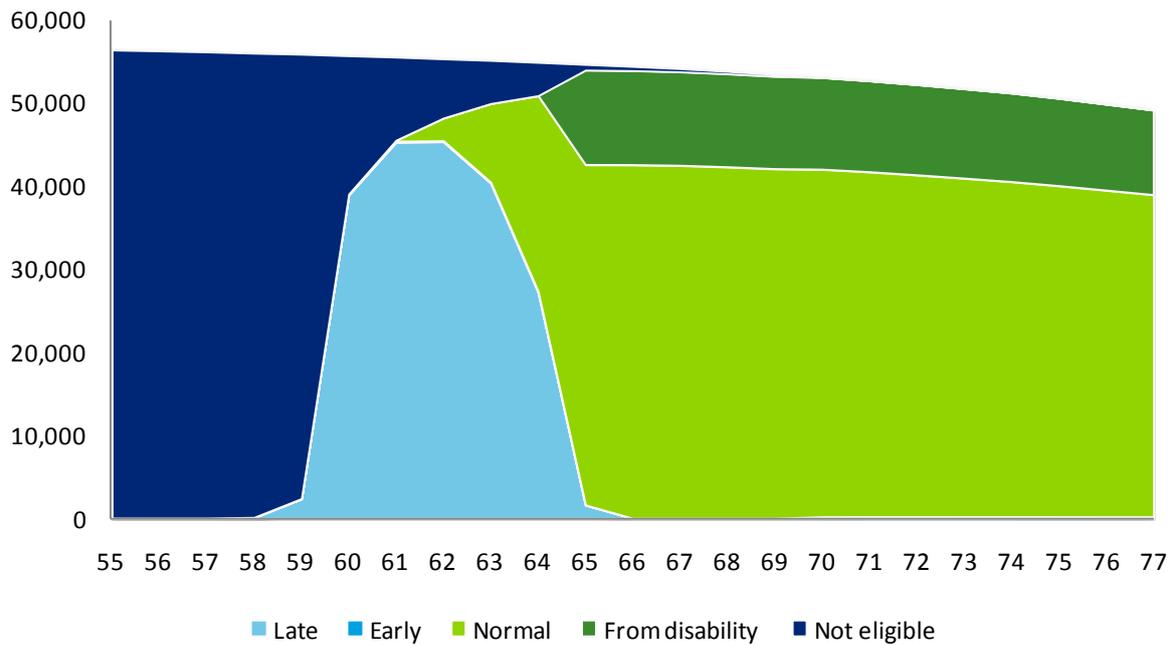


Figure 10: Number of people eligible for old-age pension – women

6.1.5 Service and contribution years

In this section the charts showing the distribution of service years at the time of retirement are presented. The distribution of service years (i.e. including all periods recognized for pension eligibility assessment) is compared to distribution of contribution years (i.e. including only periods when a person was employed and contribution paid). They are histograms showing the number of people with the given number of service and contribution years. For men the service years are quite close to the contribution periods but for women non-contributory service periods connected with child-care are a very significant part of their pension rights.

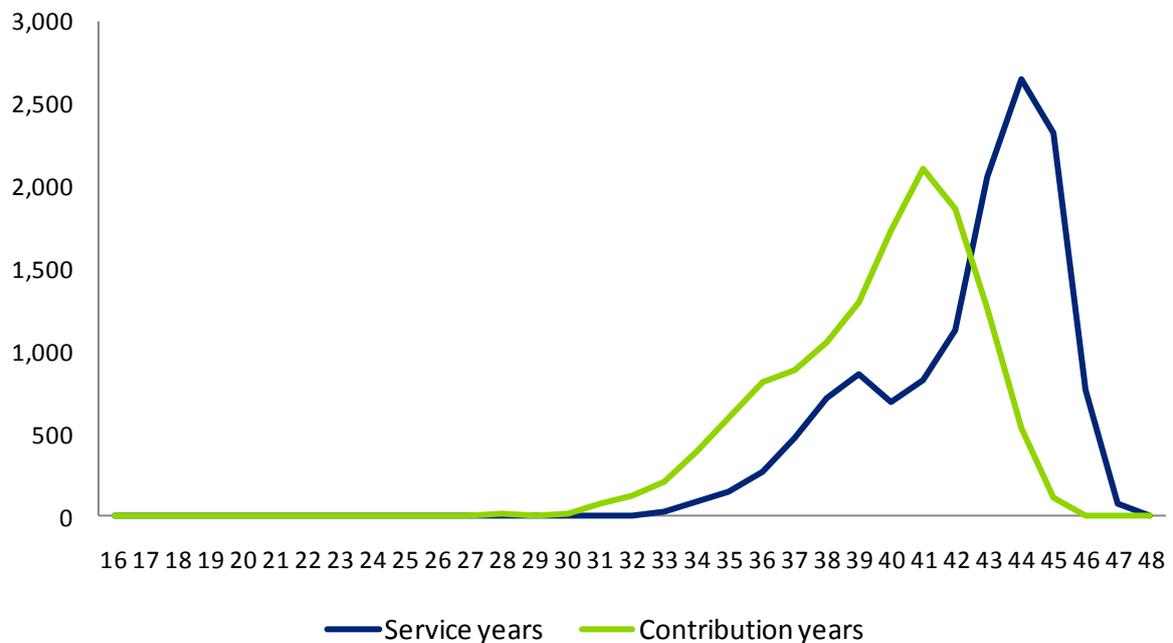


Figure 11: Number of people with given number of years – men, normal retirement at 65

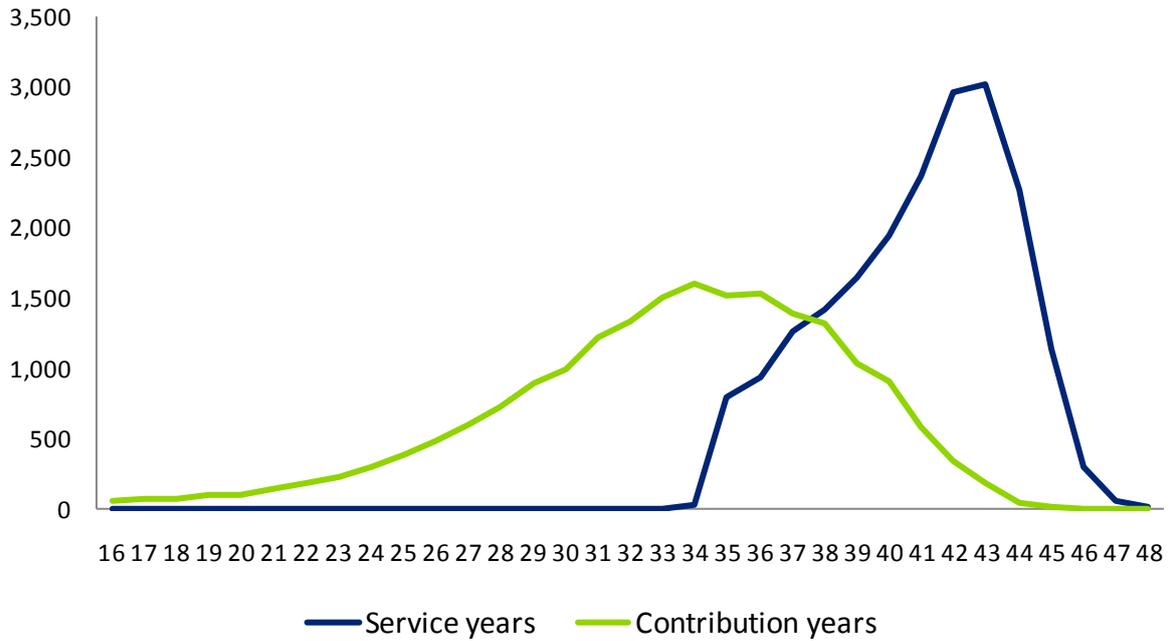


Figure 12: Number of people with given number of years – women, normal retirement at 65 and lower

6.1.6 Average pension base

The following graphs portray the average pension base at retirement calculated by the model. The average pension base is calculated as the average salary during the last 30 years before retirement and is also affected by excluded periods. The first chart shows the histogram of the average pension base before reductions. The first peak around CZK 6000 represents self-employed people who have significantly lower pension bases.



Figure 13: Histogram of average pension base before reduction at retirement - number of people in given CZK 500 interval

The second chart shows the histogram of average pension bases after reduction. These are the values used in the pension calculation. The high salary parts of the above chart (average salary before reduction in Figure 13) are compressed to the vicinity of the reduction limits due to reduction

coefficients set by legislation at very low levels. This illustrates the strong redistributive nature of the Czech pension system.

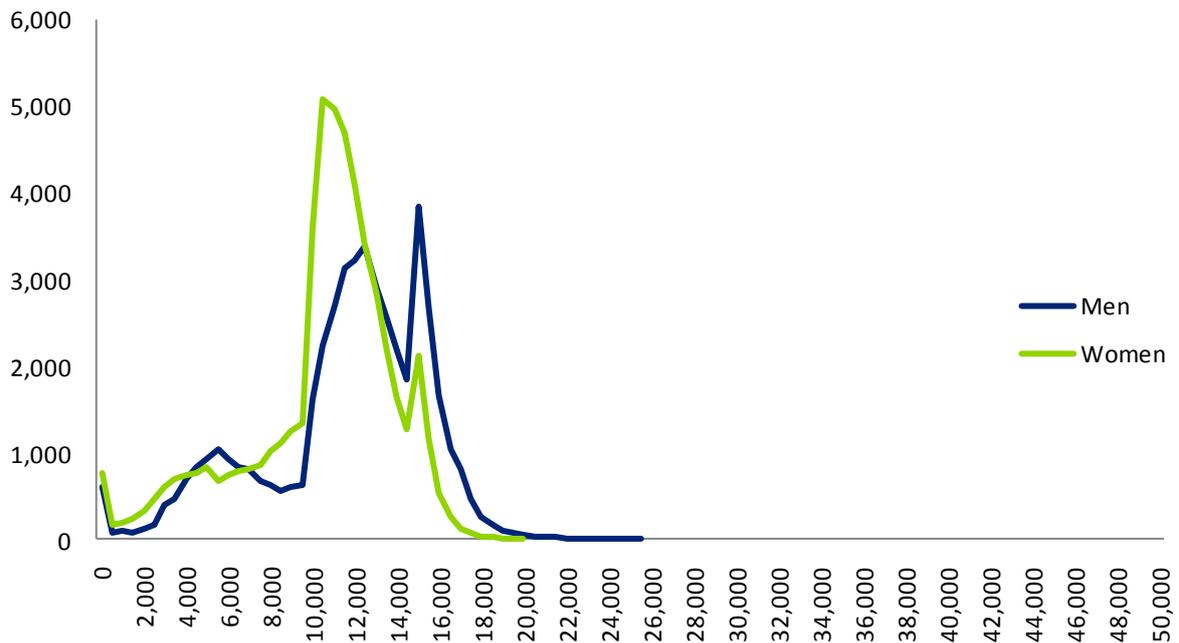


Figure 14: Histogram of average pension base after reduction at retirement - number of people in given CZK 500 interval

6.1.7 New pensions

This section shows new pension results. The first chart shows the histogram of new pensions. The significant peak in the vicinity of CZK 12 500 is caused by people transferring from the minimal disability pension to old-age pension.

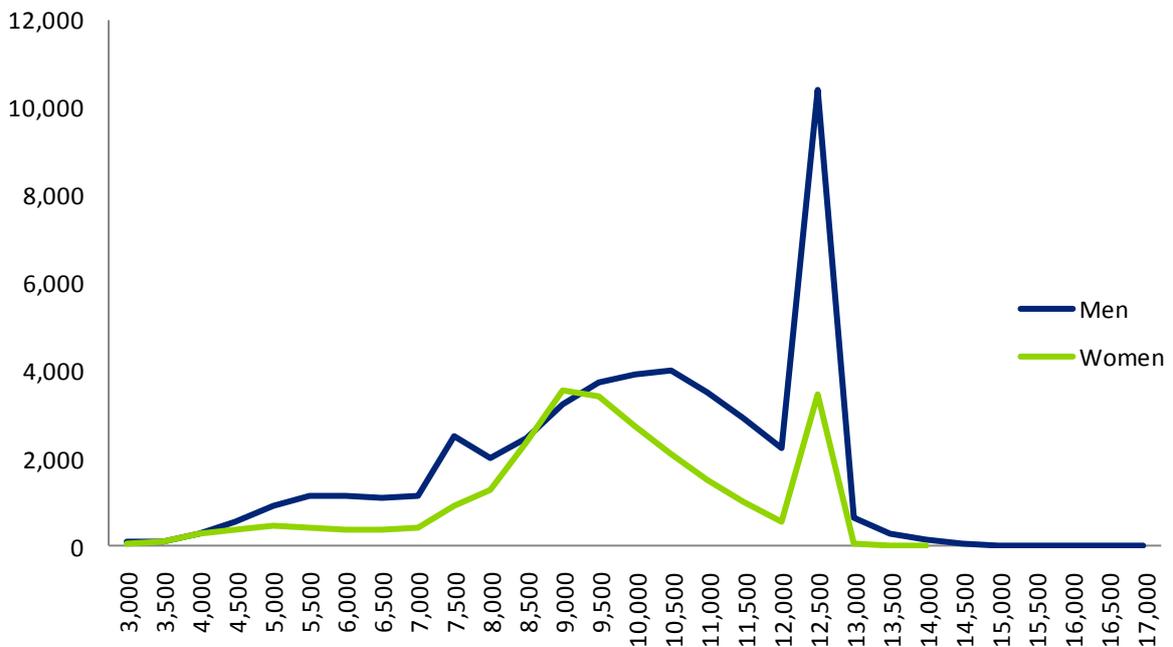


Figure 15: Histogram of new pensions - number of people with new pension in given CZK 500 interval

The next chart shows the histogram of replacement rates. The replacement rates are defined as the percentage of the new pension in relation to the average pension base before reduction (i.e. average

salary in last 30 years). From the graph it can for example be seen that women have significantly higher replacement ratios mainly due to child-care being a non-contributory service period.

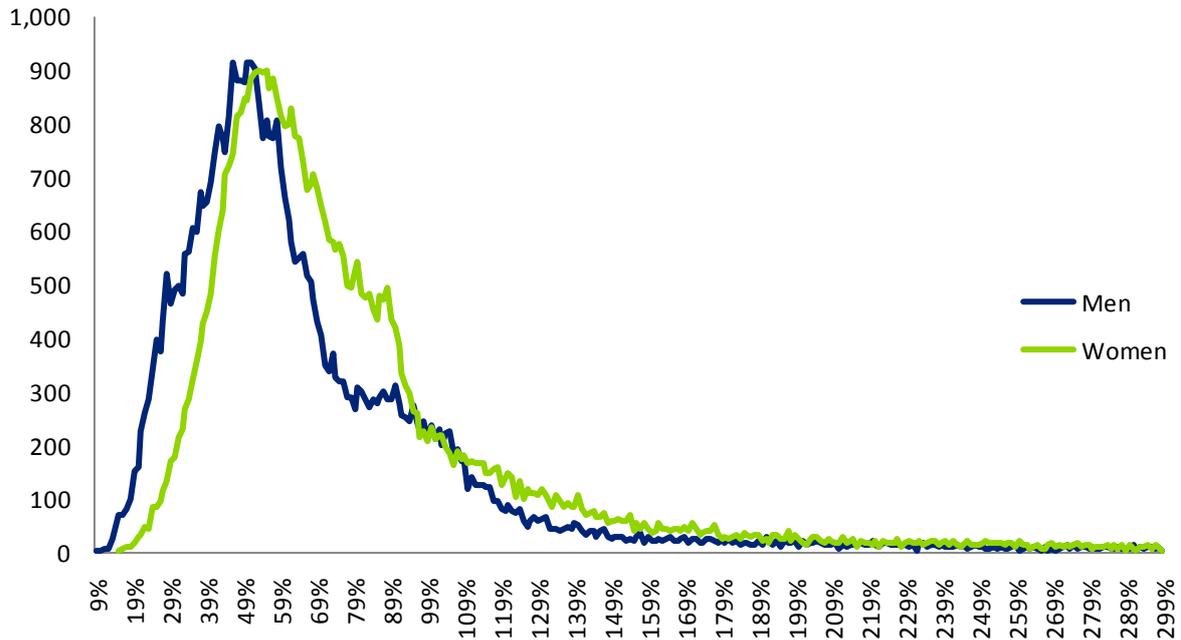


Figure 16: Histogram of replacement rates - number of people with given % of replacement rate (new pension as % of average pension base before reduction)

The last chart in this section shows the dependency of the replacement rate on the average pension base before reduction and illustrates the redistributive properties of the pension system. As can be seen the replacement rate strongly depends on the average salary and decreases rapidly with increasing salary due to the reduction limits and reduction coefficients. Variance of replacement rate in given salary interval reflects variance of service years.

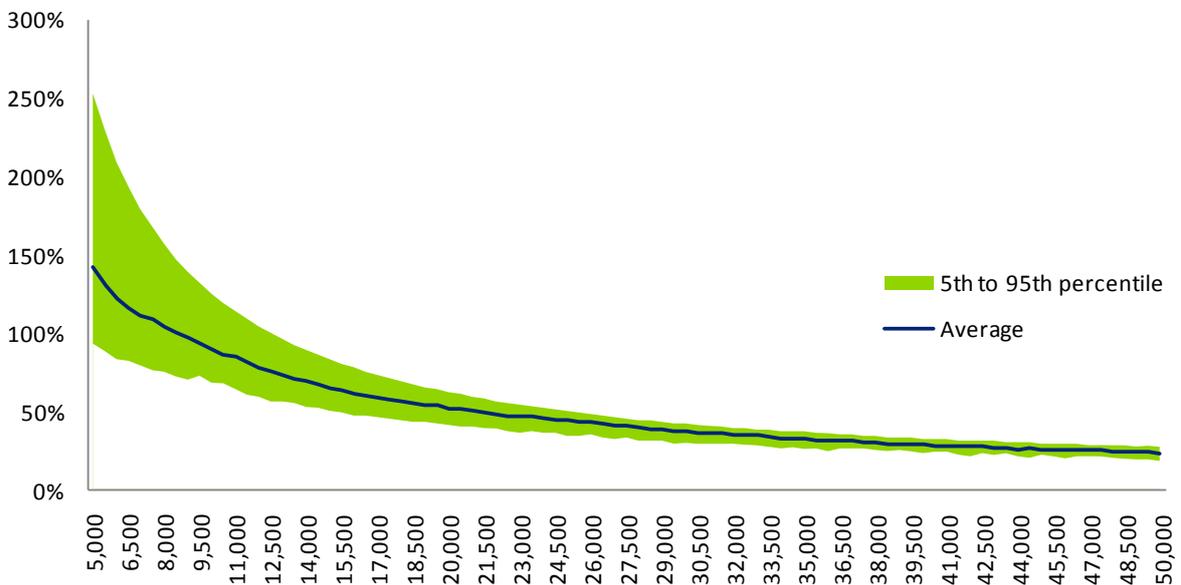


Figure 17: Average replacement rate dependant on average pension base before reduction and the 5th to 95th percentile

6.1.8 Implicit debt

The following graph shows the implicit debt per person. The values are shown in the wage level of the year 2008 (based on the assumed average wage growth). The implicit debt is calculated as the difference between the present value of future old-age pensions and the present value of future old-age pension contributions (assumed at the level of 20.5% of gross salary). The discount rate used was 4%.

The value at age zero (circa CZK 0.6 million) represents the additional contribution necessary at birth (at 4% interest rate) to cover the future pension payments according to the current legislation. The relatively high value means that the current system is not setup in a balanced way even for new cohorts (people get more from the system than they put into it) and the system would be in deficit in the long term even in the case of stable population.

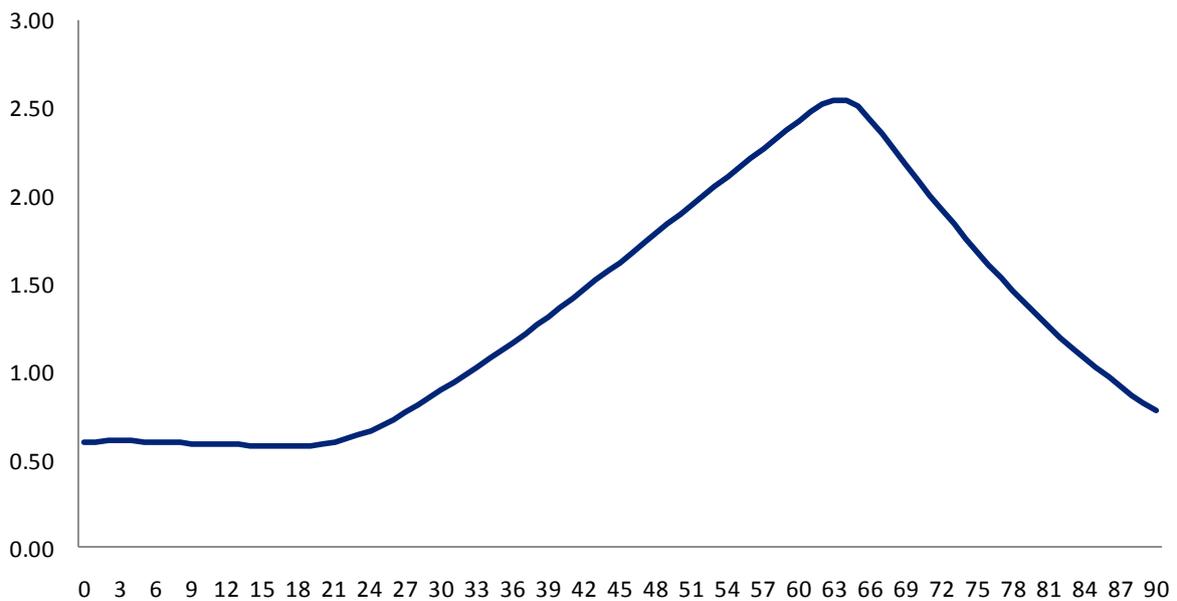


Figure 18: Implicit debt per person in CZK million by age

6.1.9 Case study – change of reduction limits

The results in this section illustrate the impact of the change in reduction limits which is one of points of the proposed pension reform. The impact of a gradual change from the current reduction limits (100% in the first interval, 30% in the second and 10% higher) to the reduction limits of the reform variant (100% in the first interval, 26% from the second interval to four times the average salary) is simulated. It is therefore a small decrease in the second interval and a substantial increase in the third interval. Salary above four times the average salary is not taken into account.

The changes in the reduction limits are shown in the following graph.

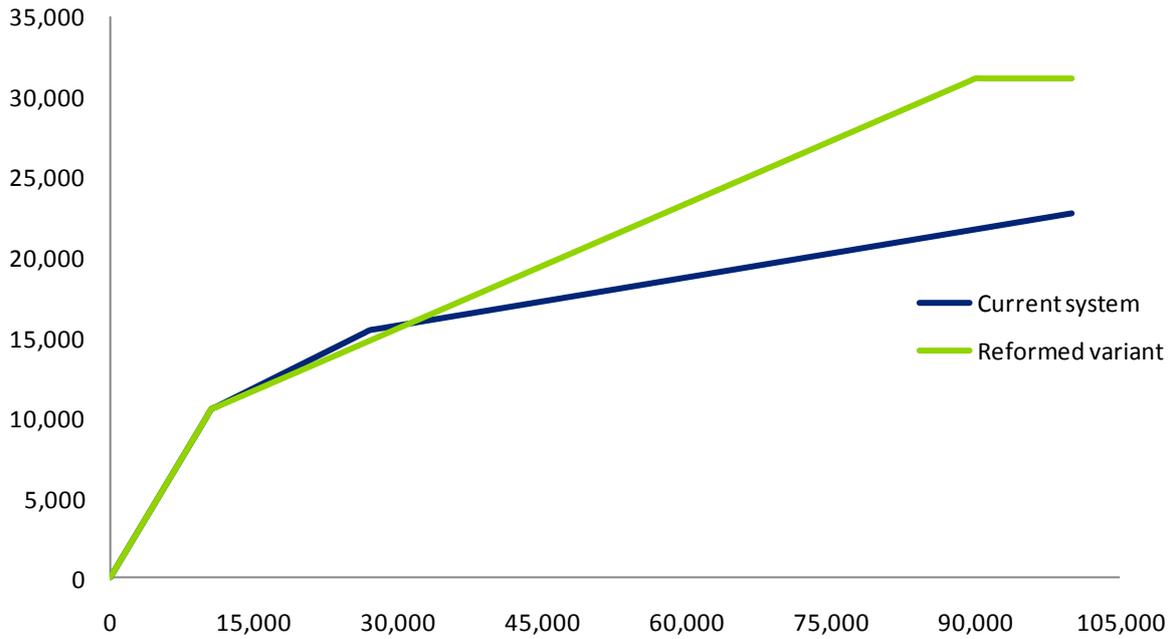


Figure 19: Reduction functions

The impact on the average pension base is shown on the following graph. Thanks to the small decrease in the second interval the distribution is slightly shifted to the left. Thanks to the increase of the percentage in the third interval there is a significantly heavier tail of the distribution.

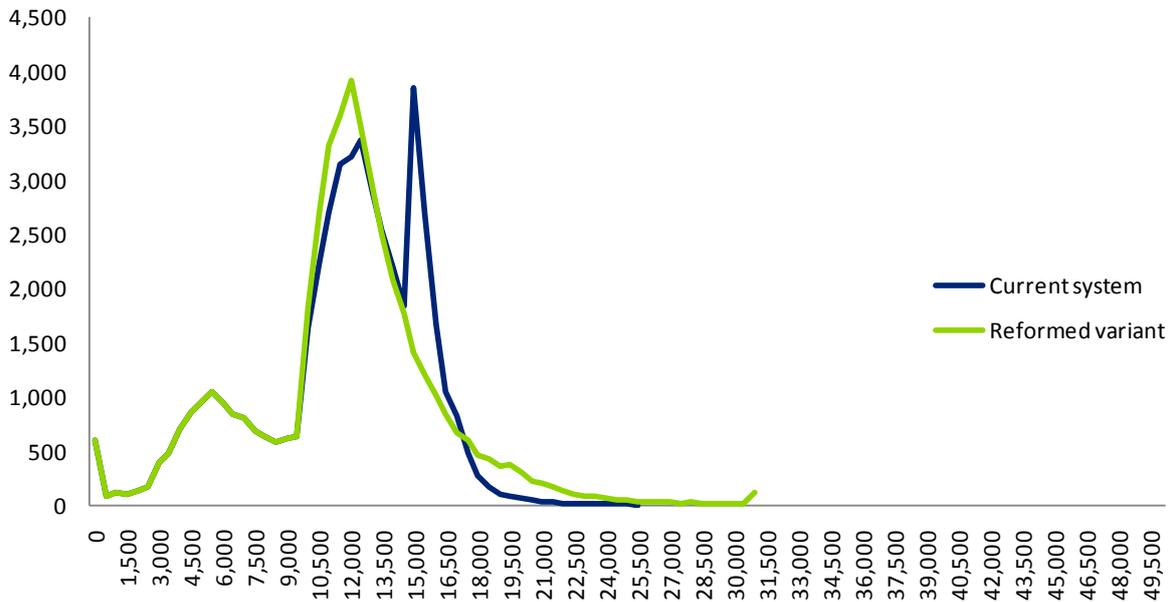


Figure 20: Histogram of the average pension base (after reduction) at retirement – number of people in given CZK 500 interval

The next graph shows the impact on the dependency of the average replacement ratio on the average pension base. There is a small decrease in the replacement ratio in the second interval and a substantial increase for higher pension bases.

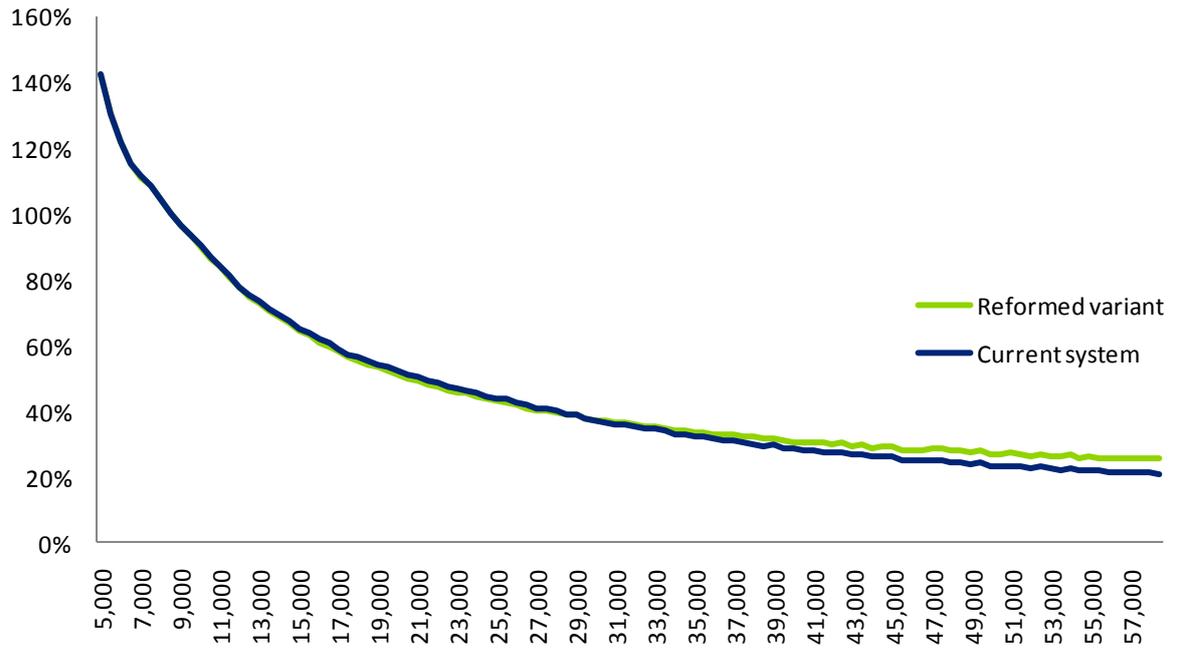


Figure 21: Average replacement rate dependant on average pension base before reduction

Annex A. List of the output variables

The following table describes the main variables of the aggregate outputs:

Output variables	
Variable name	Description
ALL_PEN_PAID (1)	Total of pension benefits paid to the respective individual (index 1 means the main individual) – used for the calculation of the indexation
CHILDREN_IF	Number of born children of living individuals
CHILDREN_IN_HOUSEHOLD_IF	Number of children in the household of living individuals
CHILD_BORN_IF	Number of born children
CONTRIB_PAID_IF (1)	Contributions paid
DISC_CONTRIB_OLDAGE_IF(1)	Current value of future contributions to old-age pensions
DISC_PEN_IF(1)	Current value of future old-age pensions
DIS_PEN_PAID_IF (1)	Disability pension benefits paid
DIS_PEN_PAID_PER_LEVEL_IF (1:1)	Disability pension benefits paid according to the degree – 1 st degree
DIS_PEN_PAID_PER_LEVEL_IF (1:2)	Disability pension benefits paid according to the degree – 2 nd degree
DIS_PEN_PAID_PER_LEVEL_IF (1:3)	Disability pension benefits paid according to the degree – 3 rd degree
FUND_CONTRIB_PAID_IF (1:P:F)	Contributions to fund F in pillar P
FUND_PEN_PAID_IF (1:P)	Annuities paid from the fund pillar P
FUND_EM_IF(1:P:F)	Value of fund F of pillar P as at the end of the month
FUND_SM_IF(1:P:F)	Value of fund F of pillar P as at the beginning of the month
GRS_SAL_IF (1)	Gross salary
IMPLICIT_DEBT_IF(1)	Implicit debt of the old-age pension system
NO_DIS_PEN_IF (1:1)	Number of disability pensioners at the end of the month according to the degree - 1 st degree
NO_DIS_PEN_IF (1:2)	Number of disability pensioners at the end of the month according to the degree - 2 nd degree
NO_DIS_PEN_IF (1:3)	Number of disability pensioners at the end of the month according to the degree - 3 rd degree
NO_DIVORCED_EM (1)	Number of divorced individuals
NO_MARRIED_EM (1)	Number of married individuals
NO_MEM_BIRTH (1)	Number of newly born individuals – according to newly entering model points

NO_MEM_DTH (1)	Number of deaths
NO_MEM_IF (1)	Number of members of the system (including emigrants, etc.) as at the end of the month
NO_MEM_IFSM (1)	Number of members of the system (including emigrants, etc.) as at the beginning of the month
NO_MEM_IMIG (1)	Number of new immigrants - according to newly entering model points
NO_MEM_INACT_PERIOD_EM (1:1)	Number of inactive individuals according to the reason for inactivity as at the end of the month – care of a child
NO_MEM_INACT_PERIOD_EM (1:2)	Number of inactive individuals according to the reason for inactivity as at the end of the month – disability, 3 rd degree
NO_MEM_INACT_PERIOD_EM (1:3)	Number of inactive individuals according to the reason for inactivity as at the end of the month - old-age pensioner
NO_MEM_INACT_PERIOD_EM (1:4)	Number of inactive individuals according to the reason for inactivity as at the end of the month - students
NO_MEM_INACT_PERIOD_EM (1:5)	Number of inactive individuals according to the reason for inactivity as at the end of the month – care of family
NO_MEM_INACT_PERIOD_EM (1:6)	Number of inactive individuals according to the reason for inactivity as at the end of the month – disability, 1 st degree
NO_MEM_INACT_PERIOD_EM (1:7)	Number of inactive individuals according to the reason for inactivity as at the end of the month - disability, 2 nd degree
NO_MEM_INACT_PERIOD_EM (1:8)	Number of inactive individuals according to the reason for inactivity as at the end of the month - other
NO_MEM_IN_PEN_SYS_EM (1)	Number of people in the pension system (in the Czech Republic, net of armed forces) as at the end of the month
NO_MEM_IN_POP_DTH (1)	Number of deaths in the population
NO_MEM_IN_POP_EM (1)	Number of people in the population as at the end of the month (i.e., people in the Czech Republic)
NO_MEM_IN_POP_SYS_LEAVE (1)	Number of people in the population who are leaving the system - emigration
NO_MEM_IN_STATUS_EM (1:1)	Number of employed individuals as at the end of the month
NO_MEM_IN_STATUS_EM (1:2)	Number of unemployed individuals as at the end of the month
NO_MEM_IN_STATUS_EM (1:3)	Number of inactive individuals as at the end of the month
NO_MEM_IN_SUB_STATUS_EM (1:1:1)	Number of employed individuals – healthy
NO_MEM_IN_SUB_STATUS_EM (1:1:2)	Number of employed individuals – sick
NO_MEM_IN_SUB_STATUS_EM (1:2:1)	Number of unemployed individuals – registered, receiving benefits
NO_MEM_IN_SUB_STATUS_EM (1:2:2)	Number of unemployed individuals – registered, not receiving benefits
NO_MEM_IN_SUB_STATUS_EM (1:2:3)	Number of unemployed individuals – not registered

NO_MEM_IN_SUB_STATUS_EM (1:3:1)	Number of inactive individuals - registered, receiving benefits
NO_MEM_IN_SUB_STATUS_EM (1:3:2)	Number of inactive individuals - registered, not receiving benefits
NO_MEM_IN_SUB_STATUS_EM (1:3:3)	Number of inactive individuals – not registered
NO_MEM_OUT_PEN_SYS_EM (1)	Number of people outside the pension system as at the end of the month (emigrants, armed forces)
NO_MEM_OUT_POP_DTH (1)	Number of deaths outside the pension system
NO_MEM_OUT_POP_EM (1)	Number of people outside the population (emigrants)
NO_MEM_SYS_LEAVE (1)	Number of people leaving the system - emigration
NO_ORPHAN_DBL_PENSIONS_TOT_SM_IF	Number of two-sided orphan's pensions
NO_ORPHAN_PARTNER_PENSIONS_TOT_SM	Number of one-sided orphan's pensions
NO_PEN_IN_PEN_SYS_SM (1)	Number of old-age pensioners in the pension system (in the Czech Republic, not armed forces)
NO_PEN_OUT_PEN_SYS_SM (1)	Number of old-age pensioners outside the pension system (emigrants, armed forces)
NO_SINGLE_EM (1)	Number of singles
NO_WIDOWED_EM (1)	Number of widowed individuals
NO_WIDOW_PEN_IN_PEN_SYS_SM (1)	Number of widow pensions in the pension system
NO_WIDOW_PEN_OUT_PEN_SYS_SM (1)	Number of widow pensions outside the pension system
ORPHAN_PENSION_DOUBLE_PAID_TOT_IF_IF	Two-sided orphan's pensions paid
ORPHAN_PENSION_PARTNER_PAID_TOT_IF	One-sided orphan's pensions paid
PEN_PAID_IF (1)	Old-age pensions paid
PEN_PAID_IN_PEN_SYS_IF (1)	Old-age pensions paid in the system
PEN_PAID_OUT_PEN_SYS_IF (1)	Old-age pensions paid outside the system
WIDOW_PENSION_PAID_IF (1)	Widow pensions paid

Table 11

Annex B. List of abbreviations

ČSSZ	Czech Social Security Administration
ČNB	Czech National Bank
ČSÚ	Czech Statistical Office
EL	Personal bill
ELDP	Personal pension insurance bill
FF	Fund-financed pillar
KVC	Gainful activity code
LFS	Labour force survey
MF	Ministry of Finance
MPSV	Ministry of Labour and Social Affairs
OCR	Optical character recognition
OECD	Organisation for Economic Co-operation and Development
OLG	Overlapping generation
OSVČ	Self-employed individuals
PAYG	Pay As You Go system
PTJ	Individual type based on income
PSČ	Postcode
STATMIN ANOD	Anonymised individual database of pensions paid
STATMIN VZ	Statistics of insurance periods and assessment bases acquired by ELDP processing
VČ	Gainful activity
VZ	Assessment base

Annex C. Bibliography

- Bezděk, V. (2000). Penzijní systémy obecně i v kontextu české ekonomiky (současný stav a potřeba reformem). Praha: ČNB, VP No. 25.
- Česká správa sociálního zabezpečení. (2010). www.cssz.cz.
- ČSSZ. (2010). STATMIN ANOD.
- ČSSZ. (2010). STATMIN VZ.
- ČSSZ. (2010). Všeobecné zásady pro vyplňování ELDP platné od 1. 1. 2009.
- ČSÚ. (2010). Načteno z Zaměstnanost a nezaměstnanost podle výsledků VŠPS: <http://www.czso.cz/csu/csu.nsf/kalendar/2010-zam>
- ČSÚ. (2010). Načteno z Průměrné mzdy: <http://www.czso.cz/csu/csu.nsf/kalendar/2010-pmz>
- Gál, R. I., Horváth, A., Orbán, G., & Dekkers, G. (2009). Monitoring pension developments through micro socioeconomic instruments based on individual data sources: feasibility study.
- Kreidl, V. (1998). Penzijní reforma v ČR. Finance a úvěr , 48 (1), pages 36-54.
- Krejdl, A., & Štork, Z. (2005). Modelling the Czech Pension System. Praha.
- Marek, D. (2007). Penzijní reforma v České republice (model důchodového systému s kombinovaným financováním).
- MPSV. (2010). Načteno z Přehled o vývoji částek minimální mzdy: <http://www.mpsv.cz/cs/871>
- Siemens. (2009). Realizační návrh STATMIN VZ. Statistika vyměřovacích základů zaměstnanců .
- Trexima. (2010). Studie proveditelnosti DASTIN. Využití registru pojištěnců ČSSZ pro statistiky a analýzy. Praha: MPSV.
- Ústav pro informace ve vzdělávání. (2010). www.uiv.cz.
- Ústav zdravotnických informací a statistiky ČR. (2010). www.uzis.cz.
- Výkonný tým Bezděkovy komise. (2005). Příjmově typizovaný jedinec (PTJ).
- Výkonný tým Bezděkovy komise. (2005). Schéma modelu duchodového systému.

Deloitte refers to one or more of Deloitte Touche Tohmatsu Limited, a UK private company limited by guarantee, and its network of member firms, each of which is a legally separate and independent entity. Please see www.deloitte.com/cz/about for a detailed description of the legal structure of Deloitte Touche Tohmatsu Limited and its member firms.

Deloitte provides audit, tax, consulting, and financial advisory services to public and private clients spanning multiple industries. With a globally connected network of member firms in more than 150 countries, Deloitte brings world-class capabilities and deep local expertise to help clients succeed wherever they operate. Deloitte's approximately 170,000 professionals are committed to becoming the standard of excellence.

© 2011 Deloitte Czech Republic