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Forschungsinstitut Freie Berufe (FFB)

September 1995

FFB Forschungsinstitut Freie Berufe

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Discussion Paper No. 14

September 1995

ISSN 0942-2595

Paper prepared for the International Conference on 'Social Science Microsimulation: A Challenge for Computer Science', Internationales Begegnungs- und Forschungszentrum für Informatik, Schloß Dagstuhl, Wadern-Dagstuhl, May 1-5, 1995

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Summary

It is the growing societal interest about the individual and its behaviour in our and 'modern' societies which is asking for microanalyses about the individual situation. In order to allow these microanalyses on a quantitative and empirically based level microsimulation models were developed and increasingly used for economic and social policy impact analyses. Though microsimulation is known and applied (mainly by experts), an easy to use and powerful PC microsimulation model is hard to find.

The overall aim of this study and of ***MICSIM - A PC Microsimulation Model*** is to describe and offer such a user-friendly and powerful general microsimulation model for (almost) any PC, to support the impact microanalyses both in applied research and teaching. Above all, MICSIM is a general microdata handler for a wide range of typical microanalysis requirements. This paper presents the concept, developments and applications of MICSIM. After some brief remarks on microsimulation characteristics in general, the concept and substantive domains of MICSIM: the simulation, the adjustment and aging, and the evaluation of microdata, are described by its mode of operation in principle. The realisations and developments of MICSIM then are portrayed by the different versions of the computer program. Some MICSIM applications and experiences in research and teaching are following with concluding remarks.

JEL: C80, C81, D10, D30, D31, J20

Keywords: *Economic and Social Policy Analyses, Microsimulation (dynamic and static), Simulation, Adjustment and Evaluation of Microdata, PC Computer Program for Microanalyses in General*

Zusammenfassung

Das wachsende gesellschaftliche Interesse am Individuum und seinem Verhalten in unserer und in 'modernen' Gesellschaften fragt nach Mikroanalysen zur individuellen Situation. Um diese Mikroanalysen quantitativ und empirisch basiert durchführen zu können, wurden Mikrosimulationsmodelle entwickelt und zunehmend für ökonomische und sozialpolitische Wirkungsanalysen eingesetzt.

Ziel der vorliegenden Studie und von ***MICSIM - ein PC-Mikrosimulationsmodell*** ist die Beschreibung und das Angebot eines benutzungsfreundlichen und mächtigen generellen Mikrosimulationsmodells für (fast) jeden PC, um die Wirkungsanalysen sowohl in der angewandten Forschung als auch in der Lehre zu unterstützen. MICSIM zudem ist ein generelles Instrument für einen weiten Bereich typischer Mikroanalysen. Diese Studie präsentiert Konzept, Entwicklungen und Anwendungen von MICSIM. Nach Bemerkungen zur generellen Charakteristik der Mikrosimulation werden das Konzept und die inhaltlichen Bereiche von MICSIM: die Simulation, die Hochrechnung und Alterung und die Auswertung von Mikrodaten in ihrer prinzipiellen Arbeitsweise beschrieben. Die Realisationen und Entwicklungen von MICSIM werden dann mit den unterschiedlichen Versionen des Computerprogramms thematisiert. Einige MICSIM Anwendungen und Erfahrungen in der Forschung und in der Lehre folgen mit abschließenden Bemerkungen.

JEL: C80, C81, D10, D30, D31, J20

Schlagwörter: *Wirtschafts- und sozialpolitische Analysen, Mikrosimulation (dynamische und statische), Simulation, Hochrechnung und Auswertung von Mikrodaten, PC Computerprogramm für Mikroanalysen generell*

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0 Microsimulation for Research and Teaching

It is the growing societal interest about the individual and its behaviour in our and 'modern' societies which is asking for microanalyses about the individual situation. Economic and social policy analyses about the individual impacts of alternative policy measures, in particular, are an expression of this interest on the individual and of increased use in the political administration, business area, private and university institutes and consulting groups in general.

In order to allow these microanalyses on a quantitative and empirically based level microsimulation models were developed and increasingly used for economic and social policy impact analyses. The focus is on microunits as e.g. persons, families, households, tax units, firms or other disaggregated agents. The microunits are identified by their characteristics such as age, gender or labor force situation of a person, number of children in a family, income and transfers of a household, taxes and deductions of single tax units (if not identical with households), profits, losses, employment situation or specific stock or advertising strategies of a firm or single characteristics of any further individual agent.

Any microsimulation model is systematically changing the individual characteristics either via institutional regulations (individual taxes to be paid caused by a new tax scheme, say) or, more advanced, by behavioural impacts (e.g. changed labour supply with supplied working hours dependent on new taxes, transfers etc.) as the microunit's answer on an introduced new measure.

Meanwhile it is out of question that microsimulation models are a helpful and an imperative instrument for a wide range of policy analyses. In research, within the policy executive in the government administration, or within policy analysis in private and university research institutes, microsimulation is a (well) known and active tool. In teaching, however, there are until now only a few places which try to reach economic and social sciences students. Though microsimulation is known and applied (mainly by experts), an easy to use and powerful PC microsimulation model is hard to find.

The overall aim of this study and of ***MICSIM - A PC Microsimulation Model*** is to describe and offer such a user-friendly and powerful general microsimulation model for (almost) any PC, to support the impact microanalyses both in applied research and teaching.

This paper presents the concept, developments and applications of MICSIM. After some brief remarks on microsimulation characteristics in general, the concept and substantive domains of MICSIM: the simulation, the adjustment and aging, and the evaluation of microdata, are described by its mode of operation in principle. Although MICSIM has been developed under a static microsimulation perspective, MICSIM is also suited for dynamic microsimulation. Above all, MICSIM is a general microdata handler for a wide range of typical microanalysis requirements. MICSIM - Realisations and Developments, then describes the root within the Sonderforschungsbereich 3 (Sfb 3) 'Microanalytic Foundations of Social Policy' at the Universities of Frankfurt and Mannheim and its further developments and versions at my chair 'Statistics and Professions' within the 'Research Institute on Professions' (Forschungsinstitut Freie Berufe, FFB) of the University of Lüneburg. Some MICSIM applications and experiences in research and teaching are following with concluding remarks.

Since this paper as an overview has its focus on the concept, developments and applications of MICSIM, the newest Version MICSIM 3.x under Windows will be presented in detail in an extra paper to be followed.

1 Microsimulation - General Characteristics and Requirements

A brief characterization of economic and social policy analyses by microsimulation in general, static and dynamic microsimulation approaches, microsimulation applications and the more general 4M-strategy shall describe the substantial background and tasks for a microsimulation model. The extracted requirement profile thereof then forms the basis which all concrete microsimulation models, and MICSIM in particular, have to deal with.

1.1 Economic an Social Policy Analyses by Microsimulation

Economic and social policy analyses ask for the gains and losses of a planned or an active programme. The analyses are of interest for both groups, for the introducing policy agent (state, community, head of firms) with costs and revenues of a programme and/or for the microunits affected by with benefits and burdens by the economic or social policy under investigation. In either case, it is the indepth question about distributional impacts which are underlying aggregate figures.

The microsimulation approach is the very appropriate tool to answer this question by operating with individual microdata. Though the focus is on the microdata, it is always possible to compute aggregate means and information about groups or totals of interest. Although some other approaches might be more successful to forecast macro developments, however, those macro approaches never can come back to their individual roots.

As it is well-known, any simulation is the process of imitating the behaviour of system patterns as a goal-oriented model experiment to investigate the impacts of different alternatives. It is the prominent feature of (micro)simulation models that they allow scenario analyses to describe a certain bandwidth of a policy's possible direct and sometimes unforeseen side effects.

One point should be stressed: though in applied economic and social policy studies some microsimulation analyses are based on so-called typical cases. However imaginative a politician might be, it is unlikely that one could dream up the full range of typical cases and moreover in their relative frequency. As Sutherland 1995 elucidated, only four percent of the real families in the 1980 UK Family Expenditure Survey were represented by families of the same type as in the official government model family tables. Although there is the possibility to weight the typical case, a representative sample is the most wanted microdatabase to allow analyses with sufficient underlying information for the relative importance of single families and groups.

The concrete consequence for the construction of a microsimulation model like MICSIM thus is to allow a powerful management of survey data with a large amount of microunits.

Further general microsimulation aspects are discussed in the surveys by Merz 1991a, 1993a, 1994b, the references cited there and further information within the following microsimulation application chapter 1.3.

1.2 Static and Dynamic Microsimulation

There are two main types of microsimulation models: static and dynamic. In **static microsimulation**, certain institutional conditions and/or behavioural relations of a microdata based are systematically varied (e.g. variation of tax law characteristics to analyze its effects on the income distribution). The microdatabase usually is comprised of cross-sectional data often from a household budget survey at a certain point in time.

Temporal extrapolation to actualize or to forecast a sample, called aging of a sample, however, is done by re-weighting (adjustment, grossing-up) the microunits and by indexation of money values ('static aging'). Thus, the cross-section after simulation (t + v, v=0,1,2,...) contains the same number of microunits (n) as the cross-section before simulation (t), the sample size is not altered. Static microsimulation is relatively well-suited for short- and medium-range forecasts, provided it can be assumed that the characteristics of the population under examination do not change rapidly.

However, if the demographic structure fundamentally changes, which is particularly likely in the longer run, the use of 'dynamic aging' in the framework of dynamic microsimulation will be more appropriate. In **dynamic microsimulation** each microunit is aged individually by an empirically based survival probability. Thus, individual dynamic demographic aging will alter the size of the cross-section under investigation. In general, the cross-section after simulation (t + 1) does not contain the same number of microunits (n and associations thereof) as before. Whereas the *dynamic (cross-section) microsimulation* is individually forecasting all microunits of a given cross-section sample, *dynamic life-cycle or longitudinal microsimulation* creates a cohort of 'synthetic' microunits with complete life cycles from birth-to-death. This, for instance, is of interest for old-age pension analyses with life-cycles of earning patterns with both income from earlier gainful employment and, later, income from a pension security system. The primary advantage of static versus dynamic microsimulation models is that static models are less expensive.

A static microsimulation model may be connected to a dynamic microsimulation model in different ways. Static microsimulation might operate on forecasted cross-sections from a dynamic microsimulation model. And/or, a demographic structure forecasted by a dynamic microsimulation model may serve as future aggregate data for re-weighting initial sample weights in a microsimulation static model. In general, this will reduce computing expenses when compared to dynamic microsimulation alone.

The concrete consequence for the construction for MICSIM is to allow static as well as dynamic aging.

1.3 Microsimulation Applications

Since the seminal microsimulation work and paper by Orcutt 1957 until today there are a great number of household sector but only a few firm sector microsimulation models and applications.

Microsimulation application of the household and firm sector

The many centered static microsimulation models (household side) include: TRIM(2), MATH US family of microsimulation models, TAXMOD in the UK, SCP, ExpertiSZe, MICROS in the Netherlands, LOVMODEL in Denmark, BAFPLAN, Static Sfb3-Microsimulation Model, MICSIM in Germany ...

There are relatively few dynamic microsimulation models encompassing: DYNASIM(2), MICROSIM, MASS, CORSIM in the US, Dynamic Sfb3-Microsimulation Model (Dynamic Cross-section and life-cycle version), DEMOGEN in Canada, NEDYMAS, MIKROPOLIS in the Netherlands, HARDING in Australia ...

MOSES of Sweden is a prominent example of a firm side microsimulation model.

Recent developments in international activities, conferences and respective volumes testify a re-vitalized interest on microsimulation models in North America, Europe and Australia:

- Microanalytic Simulation Models to Support Social and Financial Policy (Orcutt, Merz, Quinke 1986), an international microsimulation conference of the GMD and Sfb 3, Bonn, Germany;
- OECD Comparative Study of Personal Income Tax Models (OECD 1988) and the OECD Panel on Microsimulation (OECD 1990);
- Simulation Models in Tax and Transfer Policy (Brunner and Petersen 1990), an international conference with different simulation approaches, Schloß Rauisch-holzhausen, Germany;
- Microsimulation Techniques for Tax and Transfer Analysis (Lewis and Michel 1990), a recent Urban Institute (early developer of DYNASIM) study;
- Improving Information for Social Policy Decisions: The Uses of Microsimulation Modeling, Vol. I and II (Citro and Hanushek 1991a,b), a panel by the National Research Council in the USA;
- STICERD/LSE Workshop on Developments in Microsimulation Modeling (Hancock and Sutherland 1992), Foundation of the new Microsimulation Unit at the University of Cambridge, UK;
- Microsimulation Session of the European Society of Population Economics (ESPE) Meeting (Gmunden, Austria 1992);
- Microsimulation in the Tax Policy (Spahn, Galler, Kaiser, Kassella and Merz 1992), a report to the German Ministry of Finance;
- Microsimulation part of the 49th Session of the International Statistical Institute (ISI) (Firence, Italy 1993);

- IARIW Special Conference on Microsimulation and Public Policy (at the new National Centre for Social and Economic Modelling, NATSEM, Canberra, Australia, Dec. 1993).

In addition, there are a many smaller meetings and microsimulation conferences like those in Europe of the Nordic states (yearly meeting), the 1995 ZUMA Softstat-Conference with a microsimulation session and the International Conference on 'Social Science Microsimulation: A Challenge for Computer Science' 1995 at Schloß Dagstuhl in Germany, or specific microsimulation meetings of government analysts in the US. A survey with some detailed information on recent applications is provided, for instance and as already mentioned by Merz 1991a, 1993a, 1994b.

PC microsimulation computer model developments

With regard to PC microsimulation computer model developments, as to the best of my knowledge, there are approaches at Statistics Canada (Wolfson 1990), at the Cornell University in Ithaca, USA (CORSIM, Caldwell 1993), at the Microsimulation Unit at the University of Cambridge, UK (POLIMOD, Redmond, Sutherland and Wilson 1995), at NATSEM at the University of Canberra, Australia, with SAS as the development tool (Static microsimulation model STINMOD, Paul, Percival, Cox and Lambert 1994), places in the Netherlands, or at the Technische Hochschule in Darmstadt, Germany (Heike and collaborators, with a strict object-oriented approach using SMALLTALK). I am sure, that there are many other places and developments with PC microsimulation developments. Because of constrained documentation and because of work with rather specific microsimulation interests information perhaps is scarce in general.

1.4 4M-Strategy: Microanalyses by Microtheory, Microdata, Microestimation and Microsimulation

What I call a 4M-strategy is to combine the respective theoretical approaches with the empirical findings for any analysis of economic or social programme problems (for details see Merz 1993a).

A 4M-strategy is naturally not restricted to a single (economic) theory or view but open to more general (socioeconomic) approaches. The following keywords focus on economics with emphasis on microeconomics and microeconometrics, the main theoretical and estimation background in many microsimulation models:

1. **Microtheory**: Microeconomic rational choice with duality of maximizing utility resp. minimizing the cost function; typical applications: labour supply, consumer expenditures.
2. **Microdata and Adjustment of Microdata**: Microdata as the empirical base, adjustment (re-weighting) to assure representativity and to age, actualize and forecast a cross-section by demographic (simultaneous) re-weighting or indexation of money values (economic aging).
3. **Microestimation: Microeconometrics**: Microeconometric methods to estimate the relationships in behavioural equations; discrete choice and limited dependent variable approaches to handle individual decisions and constrained variables (like labour force participation and hours of work etc.).
4. **Microsimulation** by Combining Microtheory, Microdata and Microeconometrics.

Thus, microsimulation as the encompassing instrument is pretty advanced if all 4Ms are respected in detail. The concrete consequences for a working microsimulation model is discussed with the following microsimulation requirement profile.

1.5 Microsimulation Requirement Profile

The requirement profile for a microsimulation model encompass

- preparation of a suitable microdatabase eventually with merging different databases and under consideration of necessary macrodata,
- development, construction and programming of micro- and macro modules, which allows changings on a substantial level by institutional regulations and/or behavioural relations with necessary microeconometric estimates,
- actual simulation as modification of the characteristics of micro- and macrounits (parameter variation),
- adjustment of microdata (before and/or after a specific simulation) to achieve representative totals, aging of microunits,
- evaluation of the simulation as of a single or as of a multitude of (stochastic or deterministic) simulation runs.

For each of these requirement dimensions the following superior aims have to be regarded

- easy and friendly usage,
- efficient internal storage and computations,
- computation of relationed (of hierarchical (e.g. persons in families and households) or other orderings) microdata,
- interaction with the microsimulation model on the substantive level alone.

Requirement Profile for a Microsimulation Model

1. Initial data - preparation and construction
    1. Microdata processing
    2. Macrodata processing
    3. Modification of initial data
    4. Statistical methods for matching (merging microdata)
    5. Construction of the initial file
    6. Extraction of subfiles (of observations and variables)
    7. Documentation: initial database, subfile(s)
2. Module construction
    1. Construction of micro modules
    2. Construction of macro modules
    3. Econometric and statistical methods for hypotheses testing and formulation
    4. Documentation: module construction
3. Modifications of model parameters - model operations
    1. Scenario formulation
    2. Parameter changes
    3. Module changes
    4. Handling of module sequence
    5. Linkage micro to macro or other models
    6. Testing
    7. Documentation: model operation
4. Aging/adjustment of microdata
    1. Demographic adjustment 'dynamic aging'
    2. Static aging
    3. Economic aging
    4. Stochastic changes and 'alignment'
    5. Sensitivity analyses and changing aggregate control data
    6. Statistical adjustment methods
    7. Documentation: adjustment
5. Evaluation of simulation
    1. Results of single simulation
    2. Results of several simulation runs
    3. Statistical methods for data analyses
    4. Documentation: total and particular evaluation

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6. Efficiency in processing
7. Ease of use

Figure 1: Requirement for a microsimulation model

Requirements of microsimulation modelling are summarized in Figure 1 in more detail and are discussed in Merz 1989, Hoschka 1986 and Müller 1986 among others.

When encompassing even microeconometric tools in the requirement profile and the built-in possibilities of a microsimulation model, a very advanced and enhanced view is followed. Usually microeconometric estimates of behavioural parameters lay outside a concrete model to allow program specific fast estimates with its iterative processes for non-linear relationships.

2 MICSIM - Concept and substantive Modules

In this chapter concept and substantive domains of MICSIM are presented by its philosophy and basic concept, and substantive domains and modules. With some concluding statements concerning MICSIM as a general instrument for microanalyses, the working mechanism, structure and ability of MICSIM is described herewith in principle. Chapter 4 then describes MICSIM in its different realized program versions.

2.1 MICSIM - Philosophy and Basic Concept

The most microsimulation models at least in the 70s and the 80s were realized in one of the former problemoriented programming languages like FORTRAN (77), or PASCAL etc. Naturally, conditional on the computer tools at hand, an enormous (wo-)man power had to put into the overall microsimulation handling code, in the institutional regulations programming (if then ...) in modules, and in the full data handling process with restricted storage facilities. Because of the individuality of each programmer, a final (if ever) microsimulation model could only be handled by those experts. Because many developers and users competed with computing time and space within the mainframe environment, work often was done at night ... (and a lot of further stories and tales about the microsimulation programming history).

It is not to say that night time work is all over now with nowaday facilities (may be research is always on the edge of the facilities just at hand), but the PC situation in the mid of the 90s provides relatively comfortable memory space and computing speed without the competitive environment. Moreover, the way of programming has changed and many new tools are now available. In particular, some of the new tools allow a protected operating of standardized tasks (like database handling) and circumvent (to some extent) an error susceptible individual programming.

In using the new tools, the MICSIM philosophy above all is

1. *concentration on the substantial demands only,*
2. *operation by protected programming,*
3. *efficient operation by a set-theoretical based approach*
3. *user-friendly interactive environment.*

At a first glance these principles seem to be a common advertising. But with the background of former larger microsimulation models' programming and handling, each single item is an enormous progress when realized.

ad. 1 Concentrating on the substantial demands only: in former microsimulation models substantials had to be coded within the source code, with additional compilation, linkage, table handling etc. MICSIM's philosophy is to deal with the substantials on the interactive level (not 'hard-wired') leaving any further management to the system. One example is the MICSIM adjustment procedure (see details in chapter 2.2).

ad. 2 Operation by protected programming: a good example is the overall database handling. Instead of an individual solution, MICSIM relies on the integrity of reliable and established databases and their tools, like ORACLE with its standardized query language SQL. In addition, within the progress of the single MICSIM versions further support on 'protected' programming is considered in using object-oriented program concepts and developments.

ad 3. Efficient operation by a set-theoretical based approach: In former microsimulation models complex if then coded statements and relations ask for certain allowed operations. MICSIM is following a set-theoretical based approach, where the system only considers and operates on those who are affected by a certain policy. A 'where'-clause of a relational database query language provides only those microunits and characteristics for operation which are of interest (certain eligible persons/households for a program (like child allowance, the elderly etc.) or certain variables and variable ranges of interest (like tax brackets in a new tax situation). This aspect is certainly connected with the foregoing 'protected programming' dimension.

ad 4. User-friendly interactive environment: Compared to former microsimulation models with a multitude of overall management of computer resources, MICSIM allows a user-friendly interaction supported by graphical interfaces in the newest version MICSIM 3.x under Windows.

2.2 MICSIM - Substantive Domains and Modules

Based on the above requirement and philosophy discussion for a microsimulation model and MICSIM in particular, this chapter discusses the substantive domains and modules of MICSIM in a principle and substantial manner. MICSIM program realisations in different versions are the focus of the following chapter.

The requirement profile for a microsimulation model finally encompasses

- actual simulation as modification of the characteristics of micro- and macrounits (parameter variation),
- adjustment of microdata (before and/or after a specific simulation) to achieve representative totals, aging of microunits,
- evaluation of the simulation as of a single or as of a multitude of (stochastic or deterministic) simulation runs.

With a cross-sectional additional tool the substantial microsimulation domains and modules for MICSIM then are:

1. Simulation of Alternative Policies
2. Adjustment and Aging of Microdata
3. Evaluation of Simulation Runs
4. Additional Tools

described in the following and summarized in Figure 2. Each module allows specific work independently of other modules, a specific advantage in the development as well as in the user's application.

2.2.1 Simulation of Alternative Policies

Simulation of alternative policies is the essential part of the microsimulation model, which, however, is very connected with its two other parts, aging and adjustment as well as evaluation of results. This topic will include three subtasks: simulation file and modules creation and altering, and the simulation itself.

Simulation File: Creation and Altering

The starting point of any simulation is the creation or altering of a simulation file. A simulation file consists of all observations and of all variables the whole analysis is concerned. Since a microsimulation analysis might not need an entire microdatabase (like the overall German Socio-Economic Panel, say) it is efficient for all following procedures to tailor a suitable overall simulation file.

The simulation file task, thus, is concerned with the preparation of a suitable microdatabase eventually with merging different databases and under considering necessary macrodata. This includes the definition of the relational type of data (e.g., household, family and/or individual data) to be investigated. To store and connect the later simulation results for each microunit, simulation variables have to be created. It is important that the variables themselves need to be defined only on the logical (substantive) level; their relations within the microdata file under investigation have to be organized internally by the system.

Modules: Creation and Altering

Any microsimulation task is living from the institutional regulations and behavioural relations which partly define the microunits' characteristics. Basic institutional regulations like the existing social assistance regulations, the overall tax and transfer schemes have to be programmed in own modules. If a programme alternative is quite complex, a complete new tax module, say, may describe the situation to be simulated.

Creating a (new) policy module might be an enormous task, because the database variable set has to be synchronized with all the single features of a policy or a given law. This task, however, is supported within MICSIM, by describing each individual institutional feature with an appropriate SQL-statement of the relational data base system with its inherent 'where'-clause. This follows the mentioned set-theoretical based approach to operate only with those who are affected by a certain regulation and, in addition, in a protected manner. MICSIM also allows to incorporate modules which are written in a higher programming language when this is more efficient.

Simulation

Simulation itself is changing the characteristics of the affected microunits and their characteristics (attributes, variables). If the alternative situation is more complex, it is wise to prepare a module as just discussed. If only some variables (characteristics, attributes) are under consideration, including the simulation variables of a microunit (like changing the proportion of indirect consumer taxes), the variables (called by names) have simply to be combined with algebraic operations. As a special feature of the set-theoretical based approach of the database system, the simulation may use merely a subset of microunits (selection) and/or variables (projection). Only a logical description of the selected filter characteristics has to be defined by the user; the chosen subset is controlled internally.

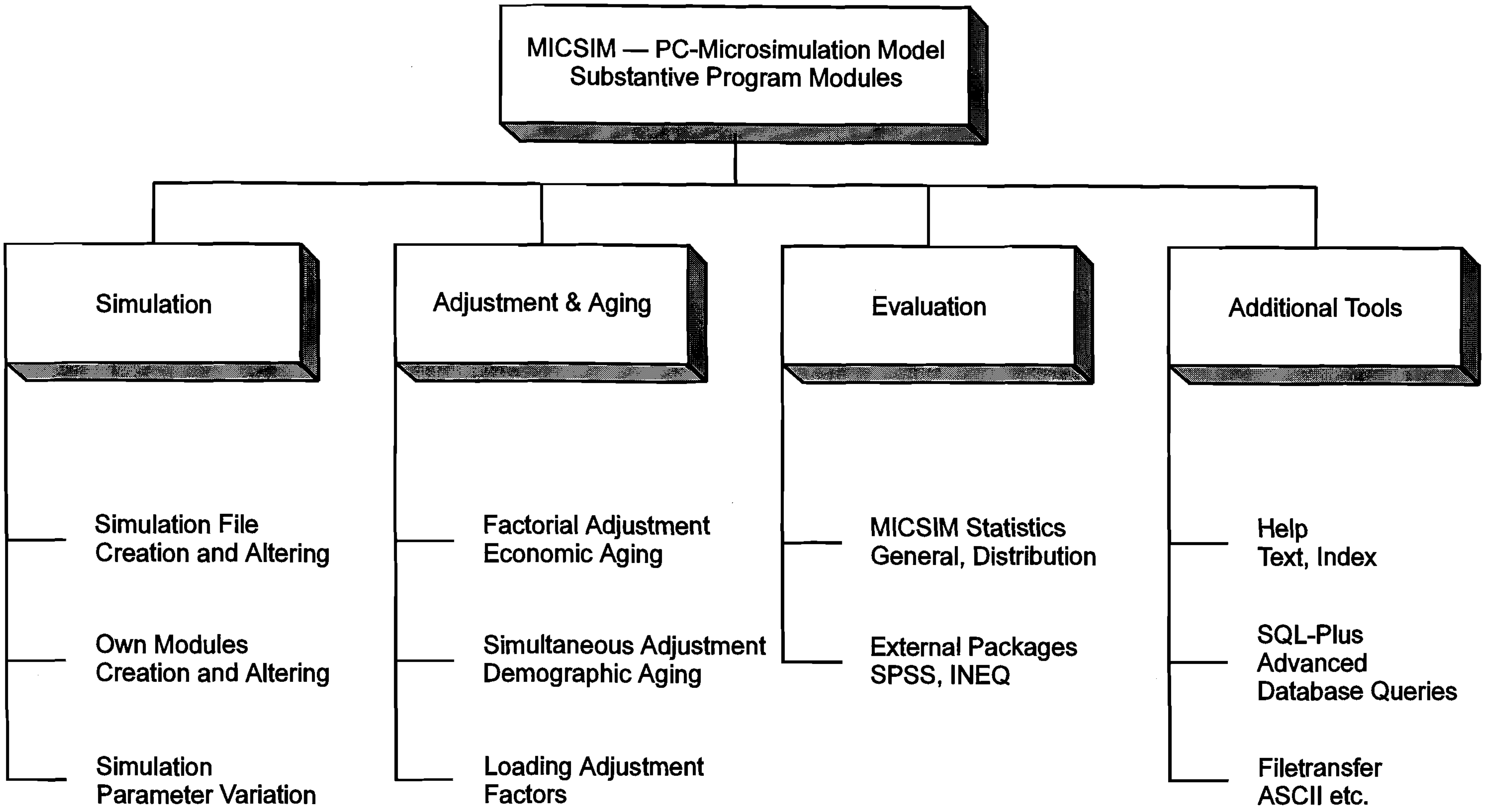

Figure 2: MICSIM substantive domains and modules

2.2.2 Adjustment and Aging of Microdata

Adjustment is the re-weighting (grossing-up) of non-aggregate microdata to fit given aggregate (control, total) data. An adjustment of a microdata file is necessary when the microdata sample is not appropriately representative. According to need, the microdata sample before and/or after simulation may be adjusted. Re-weighting is necessary both for so-called representative samples, which due to many short-comings in actual achieving a sample (non-response, under-reporting, etc.) might not be representative finally, or to typical cases, which despite the claim are almost typically not representative at all.

In addition, adjustment is the prominent instrument for any static microsimulation model, since *static aging* is done by re-weighting the sample under consideration. The actualized or forecasted totals to be achieved by the re-weighted sample may be derived from other statistics (including other aggregate sample information). Adjustment might also be of interest in itself, when a number of different totals will illuminate the sensitivity of the simulation results. A more indepth discussion of structural adjustment in microsimulation models is given in Merz 1986a.

There are two main adjustment tasks and features in MICSIM: a factorial and a simultaneous adjustment.

Factorial adjustment and economic aging

Economic variables, such as certain incomes and expenditures, may have to be inflated (weighted) by an 'economic multiplier' to reach the actual or forecasted situation. Economic aging is thus indexing some money values. An economic multiplier is simply the sample sum of weights divided by its total to be achieved. Therefore, this multiplier is one unique factor which is identical for all microunits.

Simultaneous adjustment and demographic aging

The task of a simultaneous adjustment is to compute single adjustment (weighting) factors different for each microunit which have to fit simultaneously all control data restrictions (of a sample's year or future totals) after aggregation. Such adjustment factors are dependent on each single microunit and are not longer unique for the whole sample. The typical setting is to simultaneous reach certain numbers of different household types and certain personal figures like a gender specific age distribution of the sample. When microdata from different hierarchical levels (like households, families and persons) are adjusted and regarded simultaneously, this application sometimes is called a *consistence adjustment*. If only demographic totals are of interest, then we have demographic aging. In general, however, simultaneous adjustment also might comprise other types of variables

A simultaneous adjustment is a challenging task, since sometimes some hundred totals (constraints) have to be considered simultaneously in one weighting factor for each microunit. In addition, there are often a large number of microunits in a sample. MICSIM uses the simultaneous adjustment procedure ADJUST which is based on information theory through the Minimum Information Loss (MIL) principle (Merz 1994c, 1993b). The nonlinear optimization problem subject to the aggregate constraints minimizes an entropy distance function between given old and desired new adjustment factors. This procedure in particular ensures positive new weighting factors. Since a demographic adjustment factor finally represents an actual number of microunits, positive (non-zero) resulting factors are important; zero factors would eliminate the respective microunits for further analyses.

The MIL principle leads to an optimization problem under constraints. The problem is solvable with a Lagrangian approach, leading to the solution of a nonlinear equation system. To adjust samples also with mass microdata, a fast modified Newton-Raphson procedure has been developed, where within a set of given steplengths a 'global exponential'-modification also takes into account a variable steplength. This modified procedure was able to reduce the computing expense for different sized microdatabases (e.g. with over 60,000 microunits and up to 250 simultaneous binding constraints) by over 75% compared to the regular Newton algorithm.

Before starting the adjustment, either as part of MICSIM or as a stand-alone package ADJUST (Merz 1993b), a so-called sample information matrix has to be created.

Generating the sample information matrix

An iterative process is necessary to solve the above optimization problem under constraints with its nonlinear equation system. For an efficient handling of the iterative process, a sample information matrix S has to be generated which consists only of the restriction characteristics of the microunits which are of adjustment interest (m rows), and as many observations (n columns) the microdata file consists of.

For each restriction the user has to define only the logical condition with database system commands (e.g. for a certain household type in one row, three person household with a blue-collar working head and a child less than 6 years, say) and the final total (margin) which has to be achieved after reweighting. MICSIM then has automatically to generate the rectangular information matrix with its specific characteristics. The sample information matrix is externally stored observation by observation to save operation time in the following iterative process.

Iterative solution of the nonlinear adjustment problem

After generating the information matrix, the FORTRAN 77 adjustment package ADJUST iteratively solves the nonlinear problem. After convergence of the procedure and respective statistics, the new set of adjustment factors is available and can be integrated into the microdata file when needed.

Loading Adjustment Factors

Adjustment factors for each microunit might be computed in different versions, for example, for different years or in the frame of an overall sensitivity analyses. The factors could be computed by MICSIM-ADJUST or from any other source. To connect these factors with the simulation file at hand, MICSIM should allow their loading. Within the loading procedure each microunit-id of the respective factor helps to correctly connect the new adjustment factor with the respective microunit of the simulation file.

Dynamic aging and other demographics

In case of a dynamic microsimulation model the sample/population is not altered by reweighting but by individual specific survivor probabilities. A microunit receives a certain probability to survive via transition tables or econometrically based probability equations. If a uniform pseudo random number drawn by the computer dice is less or equal the individual survivor probability then this microunit survives or otherwise dies in an application.

In dynamic microsimulation other demographic processes like the marriage market or births etc. have to be considered on an individual level. These demographic arrangements will typically form a demographic module, which could be handled in the respective own module simulation environment.

2.2.3 Evaluation of Microdata

After simulation or as a genuine interest on a microdata filework, the respective information has to be prepared. It is the task of several statistics to compress the mass data information including the differences between a base-line situation and the results of a simulation of alternative policies.

MICSIM provides two evaluation possibilities: MICSIM statistics and access to external statistical packages.

MICSIM Statistics

MICSIM's own general statistics is divided into two main areas: first, in a bundle of descriptive measures, second, in a set of distributional measures. The descriptive measures encompass mean, variance, frequency distribution and so on. Because microsimulation models are dealing with distributional impacts in particular, respective measures are important. The distributional measures compute median, quartiles and deciles and a set of inequality measures. This topic is a feature in the newest version MICSIM 3.x in particular.

As within other operations in MICSIM and following the set-theoretical based approach, the user is allowed to do conditional work; conditions with respect to the variables and to the subset of observations under consideration.

Statistic Packages

Access to external enhanced and more powerful statistic packages might be called to do advanced statistics. As a prominent and well-known statistic package SPSS should be available by call. In addition, another package for inequality analyses, INEQ (Cowell 1994), is available within the newest 3.x version. An enhancement is easily done by request.

There are two possibilities to handle the external statistic packages: direct call or providing a respective system file. Direct call allows immediate access of SPSS, say, and a later return to MICSIM. In the case of newer versions of external packages like SPSS (or SAS) the underlying MICSIM ORACLE microdata, are directly accessable by those external packages without any further arrangements. The system file management of MICSIM has to create an appropriate system file with all labels etc. by request.

In principle, this part of MICSIM could allow access to further packages for microeconometric analyses, like LIMDEP etc.

2.2.4 Additional tools

There are some further tools available in MICSIM which might be of cross-interest under all three discussed main substantive domains. This contains general help, SQL database operating for advanced users and file handling facilities.

Help

Help information is provided for all MICSIM operations. Though available in almost all MICSIM versions, the most user-friendly approach seems to be within the Windows framework in MICSIM 3.x (see next chapter). Via hypertext it is possible not only to read some general information about a certain topic but also to follow indexed information.

SQL - Database operating for advanced users

MICSIM relies on the powerful data management by the structured query language SQL (more in the next chapter). If there is an advanced user, who does not want the menu-driven support by MICSIM, then direct work with SQL respective SQL-Plus is supported. More about this in the next chapter.

Filetransfer

If microdata are needed for further microeconometric work with external packages like LIMDEP, the respective ASCII-data might be dumped MICSIM supported. Other data formats, eventually of interest for graphical packages, can be incorporated here.

In general, this section is open for any further additional tool.

2.3 MICSIM - A General Instrument for Microanalyses

As the above discussion has shown, MICSIM is a powerful microsimulator to process the three main substantive domains of a microsimulation model: simulation, adjustment and aging, and evaluation. Working with microdata includes selection of variables and demographic groups of interest, describing the situation by some statistics with appropriate weightings. These tasks can be done easily with the MICSIM features; MICSIM, besides the simulation possibilities, therefore is also a general instrument for microanalyses.

The modular concept of MICSIM allows to solve the tasks independently from one another. In addition, MICSIM is user-friendly and strictly oriented towards the substantial tasks. Since MICSIM supports the user in many dimension, any microdata analysis from now on should be an 'exciting pleasure'.

3 MICSIM - Realisations and Developments

MICSIM with its discussed substantive domains and tasks, is developed as a general microsimulation model and a general microdata handler. MICSIM is to provide the general management of the above tasks, the actual institutional regulations and behavioural relations of a certain analyzing interest have to be imported into the model by the user itself.

This chapter is about MICSIM program realisations and developments. After sketching the relational database system approach and overall programming aspects, the history of MICSIM is described with its root in the Sonderforschungsbereich 3 (Sfb3) 'Microanalytic Foundations of Social Policy' at the University of Frankfurt and Mannheim, financed by the German National Science Foundation (DFG), and the further development at my chair 'Statistics and Professions' within the Research Institute on Professions (Forschungsinstitut Freie Berufe, FFB) of the University of Lüneburg. MICSIM was firstly created with the idea to construct a static microsimulation model. With its development it becomes more flexible and is now a frame for static and dynamic microsimulation, and for microanalyses in general.

3.1 MICSIM - Relational Database System Approach and Overall Programming Aspects

When realizing the MICSIM requirements the fundamental new approach compared to former microsimulation models was to rely on a relational database system as the heart and working centre. Among other pros discussed in the following, it was the comfortable work with complex data structures of panel data, which strongly argues for a relational database system. The concrete impulse was the creation and work with the German Socio-Economic Panel (GSOEP) in our former Sfb3 at the Universities of Frankfurt and Mannheim.

A relational database system, above all, provides data integrity, centralized and uniform data storage, retrieval and handling as well as separation of the logical structure from the physical storage of data. A further advantage of such a system, together with a relatively easy and similar processing of different actual microdata files[1], is its user-friendly nature and its ability to represent hierarchical and other relational structures (e.g., individuals within families and/or households). Moreover, the relational data model is very flexible and redundancy-free in its storage procedures.

All these features are of great importance for complex microsimulation models, where for instance personal information is embedded in a family and household structure, or similar and other relational structures for firm simulations, where a microunit might connected to other units in a multitude of possibilities. The GSOEP, for example, at the former Sfb3 and at the FFB of the University of Lüneburg is stored under ORACLE with separated personal information, information about children and information about households, where respective id-numbers allows a multitude of interactions. Diemer (1989), for instance, further discusses the specific characteristics and pros and cons of relational database structures in general.

After all the pros at least one con should be mentioned: the protected work with a comfortable database system and its database query language needs additional computing costs. On the one hand, there are possibilities to circumvent such overhead costs like in the sample information file solution within the MICSIM-ADJUST iteration process (see above). On the other hand, since hardware costs are more and more diminishing, the more substantial arguments of a secure and overall powerful data management and operation do count.

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1 E.g., microdata files of official statistics, own survey data, or independently arranged microdata files (merged initial data, result files of dynamic/static microsimulations or synthetic cases).

Characteristics of a Relational Database System (ORACLE)

Relational Data Structuring

- Flexible program external relational data structure
- Data description file with type, length, range, structure of database, system parameters
- Relative easy structured queries of database describing tables (SELECT * FROM table, DTAB, CATALOG,...)
- Redundancy-free storage of related data

Data Integrity

- Input control (RANGE)
- Data protection: passwords and user-ids for the entire database or single attributes (variables)

Data Independence

- Separation of the logical structure from the physical storage of data
- Operating on a logical level (VIEWS)
- Reorganization of physical data without changing application programs

Flexible Operation via SQL

- Structured Query Language for flexible and powerful data operations (market standard: SQL, SQLPLUS)
- Interface to different C versions via a pre-compiler (Pro*C) and other programming languages for complex analyses
- ORACLE data directly accessable by other packages like SPSS or SAS
- Complex conditional analyses allows set-theoretical based based operation (SELECT ... WHERE, Subqueries: SELECT ... SELECT)
- Operation on data subsets (selection: subsct of objects, projection: subset of attributes)
- Join of different databases (tables) via a common attribute (JOIN)
- Linkage of relational levels (like persons, families and households)
- Insert/Delete and update of records (INSERT, DELETE, UPDATE)
- Prepared logical operation (VIEW)
- Sort (ORDER BY)
- Aggregate descriptive functions (COUNT, AVG, MAX, MIN, SUM, STDV)

Figure 3: Characteristics of a relational database system (ORACLE)

ORACLE as the Relational Database System behind MICSIM

In comparison with other database systems, ORACLE belongs to the most efficient ones. Many experiences within the Sfb3 and elsewhere have shown that ORACLE is well suited to administer mass microdata with complex structures. Protected access both on the database itself as well as on single variables allows operations also with sensitive data.

ORACLE runs under different operating systems like DOS, OS/2 or UNIX providing a far reaching portability (as other database systems now do too), and has grown from the 80s on to a successful market standard. The essential characteristics of a relational database system in general and ORACLE in particular are summarized in Figure 3.

MICSIM 3.x, our newest development, is opening its background to allow the use of other relational database systems like INGRES.

SQL: Standardized System Query Language

Meanwhile SQL is the standardized query language for relational database systems; SQL-Plus is the respective ORACLE version. A relative easy handling with a powerful conditional working ('where'-clause) among others allows the pronounced set-theoretical based approach in MICSIM. Thus, SQL is the underlying programming language and interface to the relational database system (ORACLE) in MICSIM.

C /Pro*C: Overall Programming Language

The overall programming language of MICSIM is C. C offers most of all the advantage of high processing speed, great flexibility and possibilities in the scope of the statements, a good portability as well as the support of structured programming above all in the newest object-oriented graphical version Visual C++; MS Visual C++ is the development platform for the actual MICSIM 3.x version.

The precompiler Pro*C serves as the interface between the C (and further C versions) main program, with its windowing and interactive menu-driven handling, and the relational database system ORACLE in embedding SQL statements into the source code of the C main program. In MICSIM any microsimulation task then is processed as follows: the substantial task is captured in a respective string via C and is connected then with the respective SQL statement, which is translated into the C code via the precompiler or as embedded SQL.

The MICSIM general programming structure is summarized in Figure 4.

MICSIM General Programming Structure

Main Program:	C, Visual C++
Database Interface:	SQL via Pro*C
Relational Database System:	ORACLE, ...

Figure 4: MICSIM general programming structure

3.2 MICSIM Root: The Static Sfb 3 - Microsimulation Model - Mainframe, FORTRAN 77 and SYSTEM 1022 (Sfb3)

Within the mentioned Sonderforschungsbereich 3 (Sfb3) static and dynamic microsimulation models were developed and applied for economic and social policy analyses like the German Pension Reform in the 80s. Galler 1994 provides an overview of Sfb3 policy analyses with microsimulation models (the Dynamic Sfb3 - Microsimulation Model is described in Galler and Wagner 1986). A general overview of the overall approaches and results of the Sfb3 (1979-1990) is given in the two final Sfb3 volumes Hauser, Hochmuth and Schwarze 1994 and Hauser, Ott and Wagner 1994.

With the Sfb3 experience and background and of my work within the Sfb3 project 'Microsimulation' (B-3), the Static Sfb3 - Microsimulation Model was developed (Merz 1994a, 1986b, 1985). This microsimulation model had already many of the main features described above and might therefore be called the root of MICSIM. The model is a mainframe version and was developed in the 80s within a DEC 1091 environment. The simulation control program was written in FORTRAN 77. While the former Dynamic Sfb3 - Microsimulation Model was entirely written in FORTRAN, the Static Sfb3 - Microsimulation Model already relied on a relational database system, the SYSTEM 1022 (Softwarehouse 1987). SYSTEM 1022 provided the essential features of a relational database system (see the discussion above and Figure 3). Besides possibilities for selections, projections and flexible linkages and relational operations SYSTEM 1022 incorporated a statement-interpreter (PL1022) for programming purposes. Access to other higher program languages like FORTRAN 77, ASSEMBLER and COBOL were possible and allowed efficient operation on subfiles. A detailed description is given in Merz 1984 and 1985.

Figure 5 provides an overview of all MICSIM realisations/versions.

3.3 MICSIM 1.x: C 5.0/ORACLE 5.1A (Sfb 3)

Within the 80s mini- and microcomputers grow in their potential and overall significance. A PC, above all, delivers the opportunity to be disentangled from the mainframe computing situation with all its dependencies. This was the time also to bring microsimulation nearer to the user, both in research and teaching.

The first MICSIM PC-Version, MICSIM 1.x, was developed within my former Sfb3 project 'Market and Non-Market Activities of Private Households' (C-7) (Merz 1987) by Merz and Buxmann 1990. MICSIM 1.x was strictly developed for the PC environment (IBM compatible) using the Microsoft C 5.0 Compiler and ORACLE 5.1A.

The fundamental MICSIM paper 'MICSIM - A PC Microsimulation Model for Research and Teaching, Realized with C and the Relational Database System ORACLE' (Merz and Buxmann 1990) explains in detail the MICSIM handling from a user's view and gives concrete hints on how the connection with the overall C programming language and ORACLE with its precompiler Pro*C was programmed. As I remember, we had problems with the PC memory capacity, though we could use the protected mode ORACLE version.

MICSIM 1.x was mainly used to handle microdata of the German Socio-Economic Panel and for microsimulation analyses based on the Sfb3 - Secondary Occupation Survey, the microsimulation application within my postdoctoral thesis ('Habilitation') *'Market and Non-market Activities of Private Household - Theory, Representative Microdata, Microeconometric Analysis and Microsimulation of economic and social political measures for the Federal Republic of Germany'*. The microsimulation focus was on the German 1990 tax reform impacts on multiple paid and un-paid (domestic) work (Merz 1989).

MICSIM Realisations and Developments

MICSIM root: The Static Sfb3 - Microsimulation Model

- FORTRAN 77
- Relational database system SYSTEM 1022
- Developed in the Sonderforschungsbereich 3 (Sfb3): 'Microanalytic Foundation of Social Policy' at the Universities of Frankfurt and Mannheim (Merz 1985)

MICSIM 1.x

- C 5.0
- PRO*C
- ORACLE 5.1A / SQL
- Developed in the Sfb3-project 'Market and Non-Market Activities of Private Households' (Merz 1987), (Merz and Buxmann 1990)

MICSIM 2.x

- SAA
- C 5.0
- PRO*C
- ORACLE 5.1A / SQL
- Developed in the Research Institute on Professions (Forschungsinstitut Freie Berufe, FFB) of the University of Lüneburg, Chair 'Statistics and Professions' (Merz, Kuschel and Peist 1992/1993)

MICSIM 3.x

- MS Windows
- VISUAL C++ Graphic Interfaces
- Embedded SQL
- ORACLE 6 / SQL-Plus
- Developed in the Research Institute on Professions (Forschungsinstitut Freie Berufe, FFB) of the University of Lüneburg, Chair 'Statistics and Professions' (Merz and Willenbockel 1995)

Figure 5: MICSIM realisations and developments

3.4 MICSIM 2.x: SAA Architecture (FFB)

The next version of MICSIM was developed at my new chair 'Statistics and Professions' within the Research Institute on Professions (Froschungsinstitut Freie Berufe, FFB) of the University of Lüneburg since 1992. The overall aim was to further develop MICSIM's user-friendlyness and efficiency and to apply for policy analyses in the firm sector, professionals and self-employed.

The main new MICSIM 2.x development was connected with new DOS versions and the new SAA compatible interface. SAA, System Application Architecture, was introduced 1987 by IBM for a better exchange between the different computer worlds (mainframe and PC) with common hardware and communication protocols, and user- and program-interface unifications. There were three main areas of standardization: the common programming interface (CPI, interfaces between program and system resources), common communication support (CCS, communication between different computer systems), and common user access (CUA, construction and usage of user interfaces). The standardized user-interface allows progressive interactive mechanism like windowing, pull-down menues and file-select boxes without individual programming.

To be compatible with other computer systems and to communicate with other operating systems in the new SAA standard, MICSIM 2.x got a new SAA interface (using SAA power tools in C by Tischer 1991) with additional help features (Merz, Peist, Kuschel). At the same time, this was a step further in protected programming with regard to the C control program.

MICSIM 2.x was presented at the CeBit '93 computer fair in Hannover. MICSIM 2.x frame, with its adjustment procedure in particular, was the microsimulation tool for analyzing the determining factors of successful and not-successful firms (Widmaier, Niggemann and Merz 1994). This microsimulation application was done in collaboration with the Sonderforschungsbereich 187 of the Ruhr University Bochum.

3.5 MICSIM 3.x: Visual C++/ORACLE 6 under Windows (FFB)

MICSIM 3.x is the newest version developed at my chair at the University of Lüneburg. Several reasons were responsible to change substantial parts in a relative short period in time. The overall basic concept with C and ORACLE, however, is still valid. This concept is even more promising than it could be expected within the 80s, when the fundamentals of MICSIM were developed.

What is new is the graphic oriented user-interface and a general different and object-oriented construction of the main control program under Windows and Visual C++. Above the visuality argument, the relatively easy memory administration above 640 KB by the system circumvents the memory problems of the former MICSIM versions. In addition, there is now an overall increased using comfortability including, among others, new help (hypertext) facilities with overall instructions and indexed help via key-words.

Windows and MICSIM 3.x: there were several reasons to re-built MICSIM under Windows:

- graphic user-interface for a comfortable and visually pretentious service,
- relative easy memory administration above 640 KB,
- broad acceptance and ability in using Windows interactions, comfortable user expected work environment,
- transparency of working mechanism,
- many other Windows applications allow easy multiple working without finishing one program,
- portability with regard to Windows' general development (Windows NT, Windows '95),
- portability to other operating systems like OS/2.

With the turn of the year 1992/1993 Microsoft supplied a new graphic oriented Windows tool: Visual C++ and its integrated development environment. Microsoft Visual C++ is a tool for building and debugging Windows-based applications and libraries in an integrated Windows environment. Visual C++ makes it much easier to tackle the complex job of developing applications for Windows by incorporating high-level C++ application framework classes with integrated Windows-hosted development tools (Visual Workbench, AppStudio with AppWizard and ClassWizard).

Visual C++ and MICSIM 3.x: Reasons to use Visual C++ for the new MICSIM 3.x may be summarized as:

- powerful development environment for Windows-programming (Microsoft Foundation Classes as object classes for Windows-programming),
- object-oriented program paradigm (interface strictness),
- easy development of user-interfaces (visual development with AppStudio, user interface builder),
- market standard with many connectable products (ODBC),
- consequent allocation and deallocation of memory in the programming process
- rapid prototyping
- new embedded SQL possibility.

MICSIM relies (because of the good performance) on the C and relational database system ORACLE connection and does not follow an entire object-oriented concept, where each microunit is an object itself (but see e.g. the Heike group microsimulation development at the TH Darmstadt with such a broad object-oriented concept). Nevertheless, MICSIM 3.x uses object-oriented features within the Visual C++ MICSIM control program.

Object-oriented features in the MICSIM 3.x control program:

- ***Inheritance***:
- Standard foundation classes (MSFC) can be transmitted to new user classes (used e.g. in MICSIM for the user-interface creation),
- specific data classes and codes can be transmitted to other applications (used e.g. in MICSIM for the class database access for further connections with other database systems),
- polymorphism (one method allows manipulation of many objects)
- ***Encapsulation***:
- data within objects are only allowed to be altered by well defined methods
- enhanced data security with only well-defined side effects
- ***Maintenance***:
- the segmentation of the program-code in classes makes it easier to maintain the program
- new functions can easily be adapted in the menu.

MICSIM 3.x is - in the middle of year 1995 - just under development (Merz and Willenbockel); a prototype was presented by Merz at the 1995 ZUMA Softstat Conference in Mannheim and at the international conference on 'Social Science Microsimulation: A Challenge for Computer Science' 1995 at Schloß Dagstuhl in Germany. A detailed description of MICSIM 3.x will follow in a separate paper including hints about our UNIX approaches.

4 MICSIM - Applications

Whereas some modules of MICSIM as stand alone versions are used by external groups and institutions, MICSIM entire system applications were always run at the Universities of Frankfurt and Lüneburg. It is planned to offer MICSIM to a broader interested public, when the Windows-version is ready.

A prominent part of MICSIM is the adjustment of microdata by ***ADJUST***, also available as a stand-alone package (Merz 1993b). ADJUST is an efficient PC program written in FORTRAN 77 to achieve representative results of a microdata file by re-weighting the microunits. There are now several external users of ADJUST: The London School of Economics (LSE) (Prof. Anthony Atkinson), London UK, NATSEM at the University of Canberra, Australia (Prof. Ann Harding), the German Statistical Office in Wiesbaden, Prof. Dr. A. Schäffer at the University of Köln, the Sonderforschungsbereich 187 at the University of Bochum (Prof. Dr. U. Widmaier) and the German Institute for Economic Research (Deutsches Institut für Wirtschaftsforschung, DIW) in Berlin.

4.1 MICSIM - Research Applications

There are several MICSIM research applications including the microsimulation of the already briefly mentioned German Pension Reform, time allocation impacts of the 1990 German tax reform and a recent investigation of how successful firms do act in the engineering industry.

Microdata adjustment and microsimulation of the German Pension Reform

The system of retirement pensions including dependents and disability allowances had to be reformed in Germany in 1984 in response to a Constitutional Court's decision on gender discrimination. Political parties therefore sought to restructure the system not only to make it conform to the constitution, but also to improve the social security of married women, in particular by recognizing child rearing and family support as a genuine contribution to a society's welfare. In addition, the reform was to achieve greater equality between social groups with regard to the relation between the contributions paid to and the benefits received from the pension system.

To analyze the financial and distributional impacts of the pension reform alternatives the former Sonderforschungsbereich 3 (Sfb 3, Special Collaborative Program 3) 'Microanalytic Foundations of Social Policy' at the Universities of Frankfurt and Mannheim, financed by the German National Science Foundation (DFG), investigated a set of altogether 14 proposed pension reform alternatives by dynamic cross-section, dynamic life-cycle microsimulation with features of static microsimulation and additional group simulation (Krupp, Galler, Hauser, Grohmann and Wagner 1981).

Since statistical information for this investigation were present until 1978, the ex ante microsimulation starts at that time. However, the most comprehensive microdata base available and suitable for a starting point of the pension reform microsimulation analysis was from 1969. The Sfb 3 microsimulation model therefore uses a data base which has been produced by extrapolation from the starting data base of the year 1969 by means of the microsimulation model and additional information up to the year 1978.

Several ***adjustments as part of the Static Sfb3 - Microsimulation Model (the MICSIM root)*** were carried out within this pension reform microsimulation to achieve representative results: the first application adjusted the initial data base 1969. The second used the newest available information 1978 to be as near as possible to the actual situation with n=47,805 microunits (households) and m=154 household, family and personal totals. A third adjustment re-weighted a microsimulation resulting file with n=65,175 microunits and m=234 simultaneous household and personal restrictions. All of these adjustment tasks were done by a former ADJUST version, a prominent part of the Static Sfb3 - Microsimulation Model. Further information is given in Dworschak and Merz 1982 and in Merz 1994a.

Combined static and dynamic microsimulation of 1990 German Tax Reform impacts on market and non-market activities of private households

In the economic and social-political discussion on incentives and disincentives of taxes and transfer payments, aspects of the formal as well as the informal economy are causing increasing interest. The shadow economy resulting thereof is considered an alternative economy to increase disposable income and the family resources. Within the frame of my Sfb-3 project 'Market and Non-Market Activities of Private Households', a combined static and dynamic microsimulation approach with behavioural response was chosen to analyze 1990 German tax reform impacts on time allocation in multiple market (paid) and non-market (unpaid) labour supply in the formal and informal economy (see Merz 1989, 1990, 1993c, and Merz 1991b, Merz and Wolf 1993 with focus on illicit work and Merz and Wolff 1994 with an overview of our project work in general).

The combined static and dynamic microsimulation used the simulated demographic structure from the above mentioned Sfb3 Dynamic Cross-section Microsimulation Model to adjust the original Secondary Occupation Survey of 1984 to the 1990 and 2000 demographic situation. Static microsimulation by ***MICSIM 1.x*** then compared the respective baseline supplied hours of work with the hours supplied according to the new individual tax situation in the respective family and household association via the microeconometric estimated behavioural equations.

Microsimulation on the success of firms in the German engineering industry

In a recent firm side microsimulation approach using data from the NIFA firm panel, Widmaier, Niggemann and Merz follow the question 'what makes the difference between unsuccessful and successful firms in the German mechanical engineering industry'. This project is embedded in the Sonderforschungsbereich 187 (Sfb 187) 'New Information Technology and Flexible Working Systems: Development and Evaluation of CIM-Systems on the Basis of Partial Independent Flexible Production Structures' at the University of Bochum and an offspring of our interest to widen our microsimulation approach to firm behaviour.

With the background of rising costs and increasing competition it becomes more and more difficult for small and middle sized firms to be economically successful. In this study the hypothesis is analyzed, that product and market strategies as well as the internal mode of operation and organization differs significantly between firms doing economically well and less well.

Microdata adjustment is the central microsimulation instrument in this investigation to analyze different levels of success in capacity utilization according to those factors ***(MICSIM 2.x-ADJUST)***. The concrete objective of the adjustment by ADJUST of n=1,440 firms is to answer the question, how often a firm should exist under the restrictions of different strategies of product innovation, degree of vertical integration of production, technology employed, flexibility, and object principle in production. Weighting with the respective scheme and the linkage to the sample's structure then allows to evaluate strategies with higher success.

The results, published in Widmaier, Niggemann and Merz 1994, were also presented by the authors at the 1994 XIIIth Sociology World Congress at the University of Bielefeld, Germany.

4.2 MICSIM - Teaching Applications

Microsimulation in the teaching process is almost worldwide in an infant stage. Although within some economic policy lectures simulation tools are regarded, however, they are more concentrated on macromodelling and macrosimulation, if at all, than on microsimulation.

Within my and my collaborators teaching activities the microsimulation idea is briefly sketched in my first semester statistics lecture at our Department of Economics and Social Sciences of the University of Lüneburg. Within the graduate studies and as a part of the new area on empirical economic and social research, microsimulation is a seminar topic with concrete exercises and using MICSIM.

It is planned to widen the students' knowledge and ability by concrete experiences of the microsimulation approach with MICSIM in further workshops and lecture accompanied exercises.

5 Concluding Remarks

To allow quantitative microanalyses in general and in the economic and social policy area in particular, microsimulation has shown to be of increased interest and use. However, user-friendly and easy manageable computer models are scare. MICSIM, a PC-microsimulation model was developed to improve the situation.

MICSIM aided by a relational database system is developed to be a user-friendly powerful microsimulator able to process the three substantive domains of a microsimulation model: simulation, adjustment and aging, and evaluation. Describing MICSIM's general microsimulation background, its concept and substantial domains, its realisations and developments in different versions, and its application in research and teaching was the concern of this study. As pointed out, MICSIM is a general microsimulation model and a general microdata handler. It becomes a living instrument with the concrete data of interest, and above all, with the actual institutional regulations and behavioural relations, which have to be implanted into the model by the user itself. MICSIM is supporting this process, too.

Since improving microsimulation is an ongoing task and work I want to emphasize that any comment and hint for a better modeling is very welcome.

It is my general wish and conviction that the microsimulation approach in general will further illuminate the consequences of planned or executed policies of any government or business agent. MICSIM is developed to support this overall object.

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