

A BIOGRAPHIC/DEMOGRAPHIC ANALYSIS OF THE RELATIONSHIP BETWEEN FERTILITY  
AND OCCUPATIONAL ACTIVITY FOR WOMEN AND MARRIED COUPLES<sup>2</sup>

Herwig Birg  
Universität Bielefeld  
Institut für Bevölkerungsforschung und Sozialpolitik  
Postfach 8640  
4800 BIELEFELD 1  
Germany

### 8.1. Introduction and outline

In this paper the analytical tools of the biographic theory of fertility are applied to the analysis of interdependencies of life course events which are usually treated separately by sociologists on the one hand and economists on the other hand.

First it will be shown that the relation between decisions concerning fertility and decisions concerning occupation describes a dynamic decision process (section 2). The general characteristics of dynamic decision processes will be elaborated. Section 3 outlines the main theoretical elements of the biographic approach. Following a general introduction (section 3.1) the terminology (section 3.2) and central hypotheses of the biographic approach (section 3.3) will be described. In section 3.4 the interaction between the man's and woman's biography is analysed. Section 4 contains the empirical results obtained from a biographic survey. Finally, the main conclusions of the theoretical and empirical part are outlined in section 5.

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<sup>2</sup> This paper is based on the theoretical concepts used in the research project "Labour Market Dynamics and Reproductive Behaviour" which I am directing since 1984 and which was funded by the German Research Society. The "biographic approach" propounded here arose out of this project within the framework of which a survey of 1,576 biographies was made and the theory applied. The results presented in this paper are confined to those which serve to illustrate the main parts of the theory. A full report on the empirical results will be published by my colleagues and myself in the near future. Thus, although solely responsible for the theoretical content of this paper, I would like to take this opportunity of thanking E.-J. Flöthmann and I. Reiter for their empirical work, in particular for that included here.

## 8.2. Dynamic decision processes

All the contributions to this book have a theoretical starting-point in common, namely that of a "preference-restrictions-behaviour scheme". This scheme implies two basic assumptions. The first of these is that there exist clear situations between which an individual can choose. For example, a woman can choose between having a paid occupation or being a housewife. The second is that the individual has certain preferences with respect to the given situations. The theoretical basis of the "preference-restrictions-behaviour scheme" therefore obviously relies on the fundamental prerequisite that restrictions and preferences can be clearly distinguished from each other. Even if it is recognized that restrictions and preferences can change in the course of time, the prerequisite that everything that belongs to the concept of "behaviour" can be uniquely separated into preferences on the one hand and restrictions on the other still has to hold good.

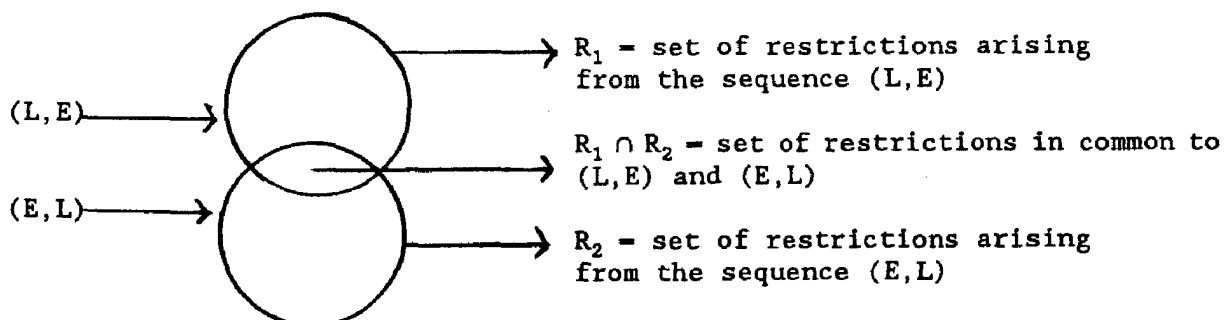
But is it always possible to realize such a separation? When a woman marries and then has a child this could be interpreted in the sense that the marriage and the financial security provided by the husband's income are restrictions, or boundary conditions, which, once satisfied, allow the woman to realize her preference for a child. But it could also be that the woman has chosen her husband from among a number of possible candidates so that her "restriction", namely that of wanting to have a child, is automatically satisfied in that the future husband is in full agreement. The question of what is a restriction and what a preference is hardly possible to answer for the observer. Even if the person concerned is carefully interviewed, the question is still difficult to answer, since it is perfectly possible that the woman herself doesn't know exactly.

Another everyday example serves to emphasize how difficult the problem posed generally is. When planning a holiday abroad for which the country is not definitely fixed, it is clear that a choice has to be made. Let us say that there is a preference for Spain but that other countries could also come into question. A travel catalogue is obtained in which a whole range of possibilities is presented. The catalogue has perhaps 100 pages and let us suppose that in order to find the place where the holidays in Spain begin the catalogue has to be opened somewhere and leafed through, either forwards or backwards after looking in the index. It can now happen that on the first page opened a most interesting holiday in place X is presented, interesting enough that

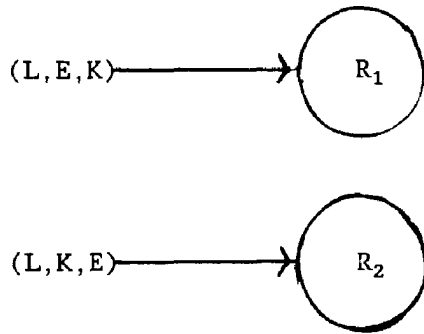
this possibility is thoroughly read about before proceeding to look further for Spain. It can also happen that the holiday advertised is so interesting that the original preferences change and Spain is forgotten about completely. This process can be interpreted as follows: the restriction of having to search through the catalogue for Spain is transformed into the objective; the original objective, namely "Spain", was simply a step in defining a new objective so that, effectively, the old objective had the function of a boundary condition, or restriction. This exchange of objective (preference) and restriction will be called here the "*objective-restriction inversion*".

Objective-restriction inversions occur frequently in dynamic decision processes. But two further complications arise when applying preference-restrictions-behaviour schemes to dynamic decision processes. The first of these is that of the learning capacity of human beings, who later have views and acquire opinions that they never even thought of earlier. For instance, if a woman learns, or suddenly realizes, that having children and a profession or occupation do not necessarily contradict each other in attaining her objectives of, for instance, self-realization, widening personal horizons or of making an investment for the future -objectives which were previously thought to be only attainable on the basis of a profession or occupation- then both children and an occupation suddenly appear to be means of attaining the same goal. It is then possible that children are produced to attain objectives which previously were thought to be best attainable with a profession. This process will be called *attainment-means conversion*.

The second complication lies in the simple fact that the very order of previous decision relevant phases or events in life is important in later dynamic decision making processes. Let it be supposed that a decision process is preceded by phases L and E where L is the phase of professional or occupational training in some form and E is a phase of exercising an occupation. Then the sequence (L, E) in general involves a different set of restrictions (R) for future decisions than the sequence (E, L). Schematically:

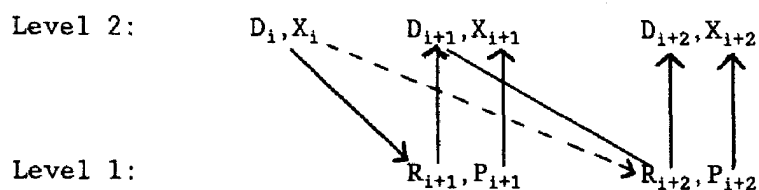


Additional events can occur which have such a strong effect on the sets of restrictions that the intersection  $R_1 \cap R_2$  is empty. Such events will be called *key events* (K). Schematically:



Even when, as illustrated, the phases L and E occur in the same order, a differently interposed key event K can lead to restriction sets without any common element. Having a child, passing final (occupational or professional) examinations, finding a new, or separating from a previous, loved one frequently act as key events. Different sequences do not only have effects on the restriction sets arising but also affect the creation of preferences. The above schematic description is equally well applicable to the preferences as well as to the restrictions occurring in the course of the process.

Summarizing all the above, two levels can be distinguished in a dynamic decision process. The preferences and restrictions belong to level 1 and the actual decisions resulting from them can be said to belong to a level 2. The decisions arising out of a situation  $i$  influence the restrictions and preferences prevailing in a following decision situation  $i+1$  (and possibly also influence the preferences and restrictions relevant for even later situations  $i+2, \dots$ ). The decisions ( $D_i, D_{i+1}, \dots$ ) that can be registered by an observer in various situations and the restrictions ( $R_i, R_{i+1}, \dots$ ) and preferences ( $P_i, P_{i+1}, \dots$ ) belonging to the psychological world of the subject, together with exogeneous factors ( $X_i, X_{i+1}, \dots$ ) outside the control of the individual, form a process which can be schematically illustrated as follows:



The decision sequence illustrated can be either long or short. When the sequence is long, or when the decision  $D_i$  has effects not only on the restrictions and preferences relevant for the next situation  $i+1$  but also on those relevant for later situations, the nomenclature *long-term commitment* will be used instead of "decision" or "choice". Since long-term commitments in general determine the directions of whole processes the expression *biographic commitment* will also be used synonymously. The concept of "biographic commitment" includes both sides of the preference-restrictions-behaviour scheme, namely the subjective side to which preferences belong and the objective side to which can be counted the restrictions involved. Nearly all important decisions in life have a moral dimension. The concept of "biographic commitment" includes not only economic (financial) commitment but also moral commitment. Moral commitments always have long-term effects. But there is a significant difference between the long-term effects of moral commitments and the long-term effects of economic commitments. Economic commitments are usually only practically irreversible, in principle they are reversible. Moral commitments, however, are *irreversible in principle* - thus the term "commitment" is particularly suitable for moral decisions.

Choice of profession or occupation, of long-term partner, decisions for or against having a child, choice of place of residence and of work are all typical long-term commitments in life. These various types of commitment will be allocated to different decision levels. To do this the level 2 of the previous scheme is split up into sublevels. The intertemporal sequences described can now occur at each sublevel but can be complicated by interactions between the sublevels. When a certain decision influences decisions at other sublevels a *hierarchical decision process* is said to occur. A good example of this is the choice of profession which is usually made when quite young. This decision influences the choice of location of employment and the location of employment influences the choice of place of residence. The biographical survey to be described in the section 4 was designed for the identification and analysis of hierarchical decision processes. The survey shows clear evidence of the *existence of hierarchical interval structures*.

In the extended scheme, the various decision levels can be so arranged that the number of long-term commitments decreases from top to bottom. Thus at the lowest level it can be supposed that the fewest decisions involving particularly persistent and irreversible commitments are made. Without discussing the complicated cause and effect patterns arising between the

decision levels in detail, the following conceptual differentiation between decision levels can still be postulated: if decisions are made at level (i) on the basis of decisions made at the lower levels (1, 2, ..., i-1) then the decision process is said to be *statically dominated*. On the other hand, if decisions at the level (i) depend on decisions at the higher levels (i+1, i+2, ...) then the process is said to be *dynamically dominated*.

Looking at the entire decision pattern, it is difficult to identify all the relevant restrictions applying to a particular decision at a particular level, e.g. to having the second child. It is even more difficult to separate restrictions from preferences. But even if it would be possible to identify and separate all relevant restrictions and preferences, the problems of objective-restriction inversion and attainment-means conversion would still have to be solved before the topic of this paper, the relationship between fertility and the labour market behaviour of women, could be analysed on the basis of a preference-restrictions-behaviour scheme. If restrictions can replace preferences and vice versa, the theoretical basis of such a scheme becomes somewhat doubtful. However, such a pessimistic view is luckily not always justifiable. The preference-restrictions-behaviour scheme stands in doubt because decisions are regarded as being dynamic, but regarding decisions as dynamic processes itself provides a means of retaining the usefulness of the scheme. The solution is simple. It is based on the fact that the various elements of the decision process, whether or not they are interpreted as restrictions or preferences, must build a certain temporal *sequence*. Once the decision is made with which a sequence starts, the sequence cannot begin with any other element, i.e. the commitment is *irreversible*. It can be assumed that the first decision influences all that follow. The same argument can be made for the second element of the sequence, except that the second element cannot influence the first. Every human being obviously must not only express preferences in life about the things he wants to achieve but must additionally build preferences on the *order* of achievement desired. The biographic approach can be said to be a method of applying the basic principles of the preference-restrictions-behaviour scheme to the problem of biographic *sequences*.

### 8.3. A biographic approach

#### 8.3.1. General introduction

The term "biography" is used in the following in both a wide and in a narrow sense. Which sense is always clear in its context. However, "biography" in its widest sense is synonymous with "story of life" which has three elements: firstly, the *experience* of the individual as part of his *inner world* which cannot be directly observed from outside; secondly, the history of the events and situations in the life of the individual which are obviously observable, and, thirdly, the history of opportunities in the individual life. The history of opportunities comprises those paths which were possible at various times but which were not realized.

The survey work performed concerns principally those elements of a biography which can be identified by means of a scientifically designed and conducted interview. These elements include the history of events and situations but also the sense of values, the attitudes, preferences and objectives of the individual. Most social scientists believe that external observation of the accessible aspects of a biography is a far too narrow view and that the more important aspects can only be determined by means of methods of hermeneutical interpretation. However, criticism of the quantitative methods mostly overlooks the fact that communication is always based on the interpretation and conversion of observable "signs" to only indirectly observable facts and implications. Writing is such a system of signs with which the most complicated phenomena of inner life can be communicated. Another system is that the simple symbols for notes on the basis of which the incredible world of music can be communicated. Both of these systems rely on an easily understandable but effective principle of communication. Everything that is communicated, however complicated, is based on the sequencing of a limited number of symbols. The biographic approach is analogous - biographies, however complicated, are comprised of ordered sets or sequences of a limited number of basic constitutive elements.

A biography therefore is not the simple sum of its constitutive elements, the sequence of the elements expresses much more. The objective of a biographic approach is to try to extract the hidden implications and content of the sequences. The following terminology should serve to develop a key with the aid of which the "language" of biographic sequences can be read.

### 8.3.2. Some terminology

#### *Biographic elements*

Biographic elements comprise, firstly, the various more or less temporally *extensive phases* in life which can be delineated by some means and, secondly, the *events* which occur at given points in time. Examples of phases are those of the various stages of human development (childhood, puberty, maturity, old age), the states of economic standing in life (education, active occupation, retirement) and those role sequences differentiated by sociologists such as child, teenager, marriage partner, mother or father, grandmother or grandfather, spinster or bachelor, etc. Examples of events are the successful completion of schooling (or breaking-off schooling) of various types, changes in occupation, changing residential location, acquiring permanent personal relationships (marriage), divorces, becoming a mother or father, etc. The definition of what a biographic element is therefore appears to be somewhat open. Indeed, the definition has to be orientated on the analytical job at hand. To a large extent, however, society defines the elements through its institutional and legal structure, social norms, codes of accepted behaviour, common ethical beliefs, etc. As an example, the implications of a marriage do not depend solely on the marriage partners but are, in some areas, largely determined by the society. The social definition (and production) of biographic elements is of great importance for the application of a preference-restrictions-behaviour scheme: *we select alternatives but we don't normally choose the alternatives that are available for selection.*

#### *Biographic sequence and biographic universe*

A biographic sequence is a listing of the constitutive events, situations and phases in the life of an individual ordered according to their time of occurrence. The biographic universe is the set of all biographic sequences that can be constructed by *permutation, variation or combination* from a given set of biographic elements with or without repetition of the elements. With only two elements, 1 and 2, the biographic universe constructed by permutation without repetition consists of just two sequences (1,2) and (2,1). Three elements provide a universe with six sequences (1,2,3), (1,3,2), (2,1,3), (2,3,1), (3,1,2) and (3,2,1). Four elements lead to a universe with  $4! = 24$  sequences, five elements to one with  $5! = 120$  and six give a universe with  $6! = 720$  sequences. With only 10 elements the universe contains 3.6 million



different sequences. The use of the expression universe is intended to convey the multiplicity and astronomical size of the number of possible sequences. The biographic universe is a theoretical construction used only for analytic purposes.

#### *Virtual biography*

The virtual biography is a subset of the biographic universe. The virtual biography consists of those sequences which come, or have come, into consideration in the build-up of the factual biography of an individual. Every individual has certain preconceptions of the biographic sequences he may want to follow, of those which are possible and of those which - after certain commitments have been made - are no longer possible. All these preconceptions can affect biographical decisions, even if they are based on false arguments, inadequate information or errors of judgement. In the same way that every individual has his personal "inner world" he also has his own virtual biography. The virtual biography therefore changes with time through experience, gains in knowledge and understanding as well as by means of external influences. The factual biography is only one of the many elements of the virtual biography and perhaps is not the most important one at that.

#### *Risk involved in long-term commitments*

Every decision on the order of the biographic elements implies an irreversible commitment. Because of this irreversibility commitments contain an element of risk. Marriages, partnerships, changes of job, having children, are commitments with far-reaching consequences for the whole biography which are difficult to estimate. The less orientation there is on standardized patterns of life and the more the individual wants to "go his own way" - bearing the negative consequences if necessary -, the more consciousness there will be of the risk associated with long-term commitments. The generally increasing awareness of this risk is leading to an increasing reluctance to make long-term commitments. Marriage and having children are long-term commitments par excellence. These are being delayed or avoided altogether, and occupational commitments are being preferred which cannot be really avoided anyway in modern societies.

The risk associated with long-term commitments can be theoretically defined and numerically calculated for any virtual biography whose sequences comprise permutations of a given  $n$  biographic elements. Consider, for example, a virtual biography of which 720 sequences are comprised of six biographic

elements. The factual biography arises from six commitments. With each commitment (except the last) a number of possible sequences are (implicitly or explicitly) rejected:

Commitment	Number of sequences rejected by the commitment:
1	600 = 5 * 5!
2	96 = 4 * 4!
3	18 = 3 * 3!
4	4 = 2 * 2!
5	1 = 1 * 1!
6	0 = 0 * 0!
	— 719

From the 720 initial possible sequences, 719 are successively rejected by the commitments made, leaving only one, namely the factual biography. If the risk of a long-term commitment is defined as the quotient  $q$  of the number of sequences rejected by the commitment  $i$  to the total number of sequences still available at the time of commitment, then:

$$q(i,n) = \frac{(n-i)(n-i)!}{(n-i+1)!} = \frac{n-i}{n-i+1} \quad (1)$$

The risk thus associated with the first commitment in the above example is  $600/720 = 0.833$  and with the second is  $96/120 = 0.800$ . The risk decreases with successive commitments, at the beginning of the biography it is much larger than in later phases. In investigating the historical long-term decrease in fertility rates it is important to realize that the risk of commitment increases with increasing  $n$ . The larger the number of different opportunities in life grew through industrialization, urbanization and the growth in tertiary activities as well as due to the decreasing influence of religious and social restrictions, the larger the number of biographic degrees of freedom became, with the result that the risk associated with long-term commitments also increased. The decrease in fertility was an immanent consequence of this historical process.

#### *Biographic age*

The biographic approach provides an opportunity to redefine the concept of age which is central to demography and which, until now, has usually been measured

in terms of calendar time. *Biographic age* is a theoretical concept which expresses the experience gained by making biographic commitments. Experience gained is much more important for the explanation of fertility, of readiness to marry, mobility and all other relevant demographic behaviour than simply the passing of time. If the biographic age  $A^*$  of an individual is defined as the cumulative number of sequences in his virtual biography that have been effectively rejected because of the biographic commitments already made, then:

$$A^*(i,n) = \sum_{j=1}^i (n-j)(n-j)! = n! - (n-i)! \quad (2)$$

The individual's virtual biography comprises all the permutative sequences of  $n$  biographic elements, where  $i$  is the number of commitments made.

The biographic age in the phase  $i$  (the phase occurring after  $i$  commitments) is highly dependent on  $n$ , the number of biographic elements. In the biographic sense one is old when one has made a lot of commitments and has no (or few) alternatives left. Of course, this can happen at a young age in terms of years. On the other hand, people who live in communities or regions which are backward with respect to the general level of development, age more slowly in the biographic sense than those who live in prosperous areas where the variety and number of opportunities for different paths in life is much larger (Birg, 1987, pp. 85 and 95). On this basis the well known differentials in regional fertility can be interpreted and explained (Birg *et al.*, 1990).

#### *Biographic divergence*

The actual biography of an individual seldom coincides with his wishes. The difference between the actual and the desired sequence is called *biographic divergence* ( $d$ ) or *separation*. For a virtual biography made up of the set of all permutational sequences of  $n$  biographic elements, the divergence or separation between any two of the sequences is defined as the number of phases that must be traced back from their respective ends until the two sequences become the same (Birg, 1987, p. 78).

#### *Biographic opportunity costs*

The concept of "biographic opportunity costs" is used analogously to that of economic opportunity costs. If a given commitment rules certain sequences out of the virtual biography, this implies that certain degrees of freedom have been lost and certain styles of life are no longer possible. The possibilities

lost are termed the biographic opportunity costs of the commitment. Biographic opportunity costs include the economic, but not vice versa.

### 8.3.3. Central hypotheses of the biographic approach

With the expressions and concepts now defined it is possible to present the basic substantive hypotheses of the biographic approach. Let  $U$  be the set of sequences of the biographic universe,  $V$  the set of sequences of the virtual biography and  $X = U - V$  the set of sequences that is in the universe but not in the virtual biography. Let  $u$ ,  $v$  and  $x$  be the number of sequences that are elements of the correspondingly labelled sets;  $u = v + x$ . The probability ( $p$ ) of a long-term commitment in the phase  $i$  of a virtual biography with  $v$  sequences is a function of  $i$ ,  $v$  and  $d$  and therefore of  $u$ ,  $x$  and  $d$ :

$$p(i, v) = p_i(u, x, d) \quad (3)$$

In terms of this equation the following three hypotheses can be formulated.

#### *Hypothesis 1*

The more sequences that are contained in the biographic universe  $U$  and/or in the virtual biography  $V$ , the greater is the risk to be associated with long-term commitments and so - *ceteris paribus* - the smaller is the probability  $p$  of long-term commitment:

$$\frac{\Delta p}{\Delta u} < 0 \quad , \quad \frac{\Delta p}{\Delta v} < 0 \quad (4)$$

#### *Hypothesis 2*

The greater the divergence between the actual and the desired biographic sequence the smaller is the probability (*ceteris paribus*) of long-term commitment:

$$\frac{\Delta p}{\Delta d} < 0 \quad (5)$$

*Hypothesis 3*

If at a decision mode the risk of biographic commitment for two different decisions is the same, then the commitment will be made for the alternative that brings the most benefit with it. This hypothesis is directly relevant for the analysis of the connection between fertility and labour market behaviour. The implication is, for example, that if a woman has the choice of ordering the three elements L = vocational training, E = working and F = family phase including bearing her first child, then she will usually place vocational training before working and working before having a family, i.e. she will choose the sequence LEF. Firstly, the benefit of training, of gaining qualifications, before working is obvious; secondly, training is much easier at a younger age than later due to the regulations of and the conditions imposed by the educational and post-educational training systems. There is also a general concensus that training should occur without too much of a gap directly after schooling. Divergence from this rule is generally disadvantageous. The sequence LEF therefore has more benefit associated with it than the sequences FLE and FEL.

According to the above hypotheses, the probability of a long-term commitment such as marriage or having a child must show a decreasing tendency with industrialization simply because the general process of development has steadily increased the number of biographic opportunities and degrees of freedom of the individual. However, every country comprises a number of different regional entities at a given point in time and the effects of long-term commitments are likely to be different in variously structured regions in a given period of time. If in one region the labour market is better than in others, the biographic opportunity costs will be higher there and so the less likely it will be that biographical long-term commitments will be made. Thus the probabilities of marriage and births are lower in the large, prosperous centres.

Still according to the hypotheses, it is improbable that an automatic tendency towards an increasing birth rate will occur in the industrialized countries. It is more probable that birth rates will remain at their presently low levels or decrease even further, although of course; some temporary fluctuations, induced perhaps by the business cycle or by surprisingly favourable family policies and subsidies, will occur.

#### 8.3.4. Analysis of the biographies of couples

The biographies of the man and the woman in a (married) couple are mutually interactive. Such connected biographies are called "pair biographies". The basic concepts of section 3.2 apply also to pair biographies. However, the construction of the principal hypotheses requires considerably more differentiation than those for individuals. In the following it will be shown how the biographies of a couple interact and what the consequences are for the fertility rate. The discussion is restricted to a very simple case with the following assumptions:

- A1. The sequences of the biographic universes of both the man and the woman are built up of permutations of the four biographic elements:
  - 1 = vocational, occupational or professional education;
  - 2 = exercising an occupation;
  - 3 = the establishment of a permanent relationship (e.g. by marriage);
  - 4 = having the first child.
- A2. The personal relationship is mutual and occurs in binding form for both at the same time.
- A3. The man and the woman have the same school education (not university education) but are not necessarily of the same age.
- A4. The virtual biographies are derived from the biographic universe by deleting certain sequences according to the following rules:
  - CI: Occupational training comes before exercising the occupation (1 before 2) and the child comes after the establishment of the relationship (3 before 4).
  - CII: Both training and a working phase occur before the child is born (1 and 2 before 4).

The individual biographic universes contain  $4! = 24$  sequences. CI eliminates 18 of these and CII a further 3. Three sequences (1,2,3,4), (1,3,2,4) and (3,1,2,4) remain open as possibilities for the individual man and woman. These biographies of the man and the woman are connected by the element no. 3, the establishment of the personal relationship. Initially there were  $24 \cdot 24 = 576$  combinations of biographies possible but CI and CII got rid of most of them leaving, in fact, only 9 combinations. In three of these (schematically presented in table 1 in the top left) the age of the man and the woman should

be approximately the same because the sequences are synchronized. In the pair biographies  $P(3,1)$  and  $P(3,2)$  the man's occupational training begins after that of the woman is completed; this implies that the man is probably younger than the woman. If this situation is unusual in the society concerned, the number of feasible pair biographies is reduced to seven.

The further analysis is not restricted to these nine (or seven) cases but is extended firstly by omitting the element 2 (the working phase), then the element 1 (occupational training) and finally both. Table 1 therefore presents in total 64 possible pairs of sequences. The following resulting comments can be made:

(I) Although the biography matrix of table 1 is symmetrical with respect to the man and the woman, not all the symmetrical elements of the matrix are equally probable. As already mentioned, those pair biographies in which the man is younger than the woman, e.g.  $P(3,1)$ :

Man			3	1	2	4
Woman	1	2	3	-	-	4

are not usual. Improbable are also those pair biographies in which the woman works while the man does the housework and looks after the child. Not quite so improbable are those cases where the woman has profession qualifications but the man not. Nevertheless, of the 64 cases presented only the 24 in the first three rows seem to be realistic in terms of numerical significance. Four of these,  $P(3,1)$ ,  $P(3,2)$ ,  $P(3,4)$  and  $P(3,6)$ , imply situations in which the woman is older than the man. It can therefore be concluded that the majority of actual pair biographies - despite the multiplicity of other combinatorial possibilities - are distributed among approximately 20 realistic biographic sequence pairings.

(II) Conflicts can additionally arise between the biographic sequences of the man and the woman, for example, as in  $P(1,2)$ :

Man	1	2	3	-	4
Woman	1	-	3	2	4

Table 1. Combinations of biographic sequences of men and women in a pair biography matrix.

		The biography of the woman ...							
		contains all 4 elements in the order ...		does not include element 2 (working phase)		does not include element 1 (vocational training)		... not 1 and 2	
Man	Woman	1 2 3 4	1 3 2 4	3 1 2 4	1 3 4	3 1 4	2 3 4	3 2 4	3 4
		1 2 3 4	1 2 3 4	P(1,1) 1 2 3 4 1 2 3 4	P(1,2) 1 2 3 - 4 1 - 3 2 4	P(1,3) 1 2 3 - 4 3 1 2 4	P(1,4) 1 2 3 4 1 - 3 4	P(1,5) 1 2 3 - 4 3 1 4	P(1,6) 1 2 3 4 2 3 4
1 3 2 4	1 3 2 4	P(2,1) 1 - 3 2 4 1 2 3 - 4	P(2,2) 1 3 2 4 1 3 2 4	P(2,3) 1 3 2 - 4 3 1 2 4	P(2,4) 1 3 2 4 1 3 - 4	P(2,5) 1 3 2 4 3 1 4	P(2,6) 1 3 2 4 2 3 - 4	P(2,7) 1 3 2 4 3 2 4	P(2,8) 1 3 2 4 3 - 4
3 1 2 4	3 1 2 4	P(3,1) 3 1 2 4 1 2 3 - - 4	P(3,2) 3 1 2 4 1 3 2 - - 4	P(3,3) 3 1 2 4 3 1 2 4	P(3,4) 3 1 2 4 1 3 - - 4	P(3,5) 3 1 2 4 3 1 - 4	P(3,6) 3 1 2 4 2 3 - - 4	P(3,7) 3 1 2 4 3 - 2 4	P(3,8) 3 1 2 4 3 - - 4
1 3 4	1 3 4	P(4,1) 1 - 3 4 1 2 3 4	P(4,2) 1 3 - 4 1 3 2 4	P(4,3) 1 3 - - 4 3 1 2 4	P(4,4) 1 3 4 1 3 4	P(4,5) 1 3 - 4 3 1 4	P(4,6) 1 3 4 2 3 4	P(4,7) 1 3 - 4 3 2 4	P(4,8) 1 3 4 3 4
3 1 4	3 1 4	P(5,1) 3 1 4 1 2 3 - 4	P(5,2) 3 1 4 1 3 2 4	P(5,3) 3 1 - 4 3 1 2 4	P(5,4) 3 1 4 1 3 - 4	P(5,5) 3 1 4 3 1 4	P(5,6) 3 1 4 2 3 - 4	P(5,7) 3 1 4 3 2 4	P(5,8) 3 1 4 3 - 4
2 3 4	2 3 4	P(6,1) 2 3 4 1 2 3 4	P(6,2) 2 3 - 4 1 3 2 4	P(6,3) 2 3 - - 4 3 1 2 4	P(6,4) 2 3 4 1 3 4	P(6,5) 2 3 - 4 3 1 4	P(6,6) 2 3 4 2 3 4	P(6,7) 2 3 - 4 3 2 4	P(6,8) 2 3 4 3 4
3 2 4	3 2 4	P(7,1) 3 2 4 1 2 3 - 4	P(7,2) 3 2 4 1 3 2 4	P(7,3) 3 - 2 4 3 1 2 4	P(7,4) 3 2 4 1 3 - 4	P(7,5) 3 2 4 3 1 4	P(7,6) 3 2 4 2 3 - 4	P(7,7) 3 2 4 3 2 4	P(7,8) 3 2 4 3 - 4
3 4	3 4	P(8,1) 3 4 1 2 3 4	P(8,2) 3 - 4 1 3 2 4	P(8,3) 3 - - 4 3 1 2 4	P(8,4) 3 4 1 3 4	P(8,5) 3 - 4 3 1 4	P(8,6) 3 4 2 3 4	P(8,7) 3 - 4 3 2 4	P(8,8) 3 4 3 4

Explanation: The first row in each element of the matrix is the sequence of the man, the second is that for the woman. Definitions: 1 = vocational training, 2 = working phase, 3 = mutual permanent relationship established, 4 = birth of first child. Initially there are 24 (= 4!) sequences for the man and 24 for the woman. Of the resulting 576 pair biographies the 64 are presented here that satisfy the conditions (i) training before working (i before 2) and permanent relationship before child (3 before 4), (ii) the child arrives after training and working (1 and 2 before 4) and (iii) the relationship occurs mutually which implies that the element 3 for man and woman must align.



It is not very likely that this pair will come together because the man enters into a binding relationship only after working and the woman before working. On the other hand, because the occupational training has taken place together the potential partners are likely to be of the same age. The two situations are therefore only compatible if the woman does absolutely nothing (in the sense of this analysis) for quite a while during which the man is working and deciding whether to enter into a permanent relationship or not. Similarly, the case P(1,3):

Man	1	2	3	-	-	4
Woman			3	1	2	4

implies a situation in which the woman is much younger than the man. These examples serve to demonstrate that the *timing* of entering into a permanent personal relationship plays a *key role* in the creation of compatible and successful pair biographies and therefore finally for the fertility rate of the population.

(III) Finally, the examples demonstrate to which extent individual and pair biographies are usually restricted by quite simple considerations. Let  $n$  be the number of biographic elements that permutationally build the sequences and  $h$  be the number of elements that - due to restrictions - have to occur in a given order ( $h \leq n$ ). The number of sequences without restrictions is  $n!$  and with restrictions it is:

$$s = \frac{n!}{h!} \tag{6}$$

If a further restriction implies that another  $k$  elements also have to have a given order, then:

$$s = \frac{n!}{h!k!} \tag{7}$$

If the sequences of the man contain  $m$  elements and those of the woman  $n$  elements and if  $m_1$  elements for the man and  $n_1$  elements for the woman have to occur in a given order, then the number of pair biographies becomes:

$$s_{m,n} = \frac{m!}{m_1!} * \frac{n!}{n_1!} \tag{8}$$

The reductions effected by restrictions are much more significant for pair biographies than for individual biographies. If  $m = n$  and  $m_1 = n_1$ , then the reduction factor for the individual biographies is  $1/m_1!$  but it is  $1/(m_1!)^2$  for the set of pair biographies. This implies that the difficulties of planning the future are much greater for pairs when restrictions are introduced at individual level on *both sides*. The restriction that both the man and the woman should have occupational training before they work is much more difficult to fulfill at the pair level than for the separate individuals.

#### 8.4. Application

##### 8.4.1. A biographic survey

In order to test the biographic theory developed, a survey of 1,576 biographies was made. The sampling was random under the condition of a 50/50 composition of men and women. The survey was restricted to the cohorts of 1950 and 1955. The cohorts of 1950 entered into the labour market around 1970, i.e. into a situation of full employment when the official unemployment rate stood at a miraculous 0.8%. Those born in 1955 entered into the labour market around 1975 when, due to the oil crisis, unemployment had risen to approximately 5%. Although born only five years apart, the two groups were faced with significantly different conditions in planning their careers.

In addition, regional differences in the labour market situations of those interviewed imposed restrictions at least as strong as those generally existing between the cohorts. The survey sample was distributed over communities of three types of regions, namely over

- *regions type 1* with favourable labour market conditions (the cities of Düsseldorf and Hannover),
- *regions type 2* with unfavourable conditions (the coal and steel areas Bochum and Gelsenkirchen) and
- *regions type 3* (the rural communities of Ahaus, Vreden, Gronau and Leer).

Approximately 10% of the interviews were of couples. The single interviews also contained questions for the partner - if the randomly chosen person in fact had a permanent partnership.

The interview technique used will not be discussed in detail here except to note that the standardized questionnaire was moduled to accommodate a large variety of biographies. The questionnaire was essentially job-oriented, i.e. for each place of employment a separate module (sub-questionnaire) was used with the implication that the interview for a person who had had only three jobs in life was much shorter than that for someone who had had 10 or 20. A further characteristic of the questionnaire was that the questions to the *occupational biography*, the *family biography* and the *residential biography* were not separately grouped but posed intermingled with the deliberate intention that memory in one area would refresh - if necessary - memory in the others. On average each biography produced approximately 2,000 or even more pieces of information of both quantitative and qualitative natures. Although the analysis of this data began only recently, a number of significant results have already been obtained.

#### 8.4.2. Empirical results

Without doubt the most important result is that the principal hypothesis held good that the fertility levels of the two cohorts should be significantly different and that the regional variations are at least as important (table 2).

The question as to whether the type of the biographic sequences has the expected considerable effect on fertility and occupational behaviour is extremely important. Although empirical analysis has only just started, there

Table 2. Fertility rates cumulated up to the age of 31, by region, cohort and birth order.

	Cohort 1950				Cohort 1955			
	first born	second born	third born	total	first born	second born	third born	total
Region 1	658	336	82	1096	516	252	45	813
Region 2	740	397	75	1219	754	366	77	1204
Region 3	875	694	208	1833	786	414	171	1386
Total	734	431	104	1291	659	327	82	1074

Note: the table lists the number of births of order n per 1000 women.

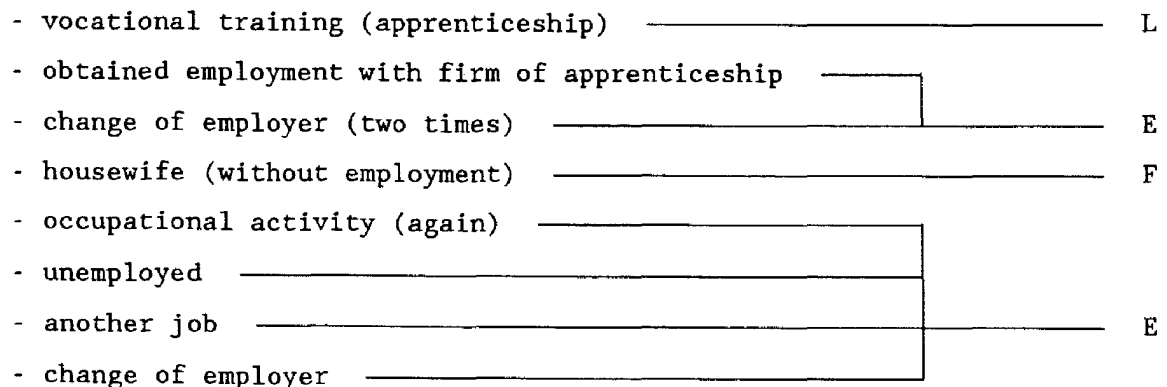
seems to be strong evidence that the structure of the sequence of the biographic elements actually does have significant effects. How varied these sequences can be, is illustrated by the fact that the list of biographic elements contains 30 different positions. In addition to these, the various places of residence, the occasions of marriage and similar family events also have to be considered. Even if only 10 of the 30 elements are considered for building sequences, the resulting number of sequences is still almost astronomical. For the first analysis the 30 positions were therefore aggregated to only three, namely:

L = professional/occupational/vocational training

E = phase of work

F = family phase

The period of employment E includes not only actively working but also periods of unemployment and the phase of maternity leave. All possible forms of occupational training were aggregated into L. How this aggregation was made can be illustrated by an example. A married woman, born in 1950, and living in Hannover left school at the age of 16 and then went through the following phases:



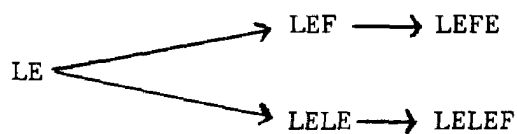
This sequence was aggregated as shown, giving the sequence LEFE which was then carried forward in the analysis. To this can be matched the sequences of places of residence (M) and of other significant elements such as marriage and the birth of children in order to carry out some of the more important extensions (Birg and Flöthmann, 1990).

The sequence given as an example above contains by definition only the elements L, E and F. By these elements various biographic sequences can be

modeled using the mathematical techniques of permutation, variation and combination. For the following the mathematical technique of variation is adopted. For the empirical analysis two restrictions are applied: (1) Each element can occur more than once in a sequence but without following one another in position. (2) Each sequence has a maximum number of 6 elements. It can be shown that the biographic universe of this model consists of exactly 189 sequences (Birg *et al.*, 1989, pp. 9 and 24). This model serves as a theoretical basis for the interpretation of the following empirical results.

*(I) Sex specific differences of biographic sequences*

According to the theoretical model 189 types of sequences are possible. In reality, however, only 57 different types occur (table 3). Women show a much greater variety of types than men (table 4). Approximately 50% of women's sequences concentrate on the two types LE and LEF, whereas 60% of the men's sequences concentrate on the only type LE (table 4). The root LE and the following four extensions of this root made up the biographies of 67% of the women interviewed; for men this was 77%:



Because of the double responsibility of having to earn money and manage the home with children, women have more differentiated and more complicated biographies. The family phase occurs more frequently the longer a sequence is. For sequences with 6 phases this was 81%, with two phases 18%. When an F occurs in a woman's sequence it is nearly always in the last or next to the last position. For economically active women with children the elements E and F very often occur at the same time. In the big cities (Region 1 and 2) about 50% of the women with children had the double element E/F (F combined with E), in the rural communities (region 3) the proportion was about 40%.

*(II) Cohort and parity specific differences of fertility between regions*

The differences in cohort and parity specific fertility rates between regions exceed more than 200% (table 2). These differences are due to the different sequence structures of the region and cohort specific biographies.

Table 3. Dendrogram of the biographic sequences of women of cohort 1950, by region.

No.	Type of Sequence	Frequency of Sequence			%		
		Region 1	Region 2	Region 3	Region 1	Region 2	Region 3
1	LELELE	3	3		2.1	2.1	
2	LELEL	1	2		0.7	1.4	
3	LELELF						
4	LELE	8	7		5.5	4.8	
5	LELEF	5	4	3	3.4	2.8	4.3
6	LELEFE	2	2		1.4	1.4	
7	LEL	3			2.1		
8	LELFLF						
9	LELF	2			1.4		
10	LELFE	2			1.4		
11	LE	35	25	15	24.0	17.2	21.4
12	LEFLE						
13	LEFLEF			1			1.4
14	LEFLF						
15	LEFLFE		1			0.7	
16	LEF	33	38	25	22.6	26.2	35.7
17	LEFELE						
18	LEFE	21	20	4	14.4	13.8	5.7
19	LEFEF	3	11	3	2.1	7.6	4.3
20	LEFEFE	5	9	2	3.4	6.2	2.9
21	L						
22	LFLE	2			1.4		
23	LFLEF	1			0.7		
24	LFL						
25	LFLFLE			1			1.4
26	LFLFL						
27	LF		3	2		2.1	2.9
28	LFELEL						
29	LFE	4		1	2.7		1.4
30	LFEFL						
31	LFEF						
32	LFEFE			1			1.4
33	LFEFEF			1			1.4
34	ELELE		1			0.7	
35	ELELEF			1			1.4
36	ELEL						
37	ELE	4	1	2	2.7	0.7	2.9
38	ELEF	2			1.4		
39	ELEFE	1			0.7		
40	EL						
41	ELFLE						
42	ELFL						
43	ELF						
44	ELFE						
45	E	7	1			4.8	0.7
46	EFLFE						
47	EF	2	6	3	1.4	4.1	4.3
48	EFE		5	2		3.4	2.9
49	EFEF		1	1		0.7	1.4
50	EFEFE		2			1.4	
51	FLELEF			1			1.4
52	FLE						
53	FLFEF			1			1.4
54	FLFEFE		1			0.7	
55	F		1			0.7	
56	FEF		1			0.7	
57	FEFEF						
Total		146	145	70	100.0	100.0	100.0

L = professional training, E = phase of work and F = family phase  
 About 40-50% of the elements E are combined with F. See text.

Table 4. Relative frequencies of the various types of biographic sequences for cohort 1950 (in %).

type of sequence	Women Cohort 1950			Men Cohort 1950		
	Region 1	Region 2	Region 3	Region 1	Region 2	Region 3
LELE	5.5	4.8	-	26.8	21.2	23.1
LELEF	3.4	2.8	4.3	-	-	-
LE	24.0	17.2	21.4	61.3	65.8	53.8
LEF	22.6	26.2	35.7	-	-	-
LEFE	14.4	13.8	5.7	-	-	-
LEFEF	2.1	7.6	4.3	-	-	-
LEFEFE	3.4	6.2	2.9	-	-	-
LFE	2.7	-	1.4	-	-	-
ELE	2.7	0.7	2.9	5.6	4.1	7.7
E	4.8	0.7	-	0.7	1.4	3.1
Others	14.4	20.0	21.4	5.6	7.5	12.3
Total	100.0	100.0	100.0	100.0	100.0	100.0

Note: About 40-50% of the elements E are combined with F, see text.

For example, in region 1 only 60% of the women's sequences of cohort 1950 beginning with LE ... contained the element F, in regions 2 and 3 this proportion was 69% and 70% respectively.

### (III) Fertility and migration

A complete residential history biography is existing for each individual. With these biographic data it is possible to subdivide the population of each region into a native and an immigrated population. The natives are defined as being that population which was born in a certain region and has never lived in any other region. The data show that the regional fertility differentials are mainly based on fertility differentials of the *native population*. Consequently, the regional fertility differentials cannot be exclusively attributed to migration (Birg *et al.*, 1989).

### (IV) Re-entry effect

The average number of children of women who re-enter the labour market after a family phase is approximately 30% lower than that of women (belonging to the

same cohort and region) who do not re-enter the labour market. This *re-entry effect* ( $r$ ) can be calculated as follows:

$$r = \frac{\text{children per woman of sequence LEFE}}{\text{children per woman of sequence LEF}}$$

The re-entry effect is highest for women with a high level of education: Low level of education:  $r=0.66$ , medium level of education:  $r=0.79$ , high level of education:  $r=0.59$ . In addition, the re-entry effect is greater in cities with favourable labour market conditions than in rural communities: Düsseldorf (0.62), Hannover (0.67), Bochum (0.87), Gelsenkirchen (0.71), rural region 3 (0.74).

(V) *Conditional birth probabilities and long-term commitments*

The large regional fertility differentials support the central hypothesis of the biographic approach. The analysis of the regional nuptiality differentials gives further support (Birg *et al.*, forthcoming). The results, however, will not be illustrated here due to limited space. Support can also be drawn from the analysis of cohort and parity specific fertility rates, which are now available for all cohorts of the FRG after the Second World War (Birg *et al.*, 1990, pp. 34-37). These data enable a calculation of conditional birth probabilities. It appears that the conditional probability for a woman to have her second child is *higher* than the conditional probability for a woman without children to have her first child. Referring to the biographic theory this important fact can be interpreted as follows: More biographic alternatives are eliminated from the biographic choice set at birth of the first child than at birth of the second child. For that reason the biographic risk is bigger (and the birth probability smaller) at birth of the first child than at birth of the second child. This is the reason why an *increasing polarization of the population* can be observed in two groups with and without children.

### 8.5. Conclusions

Biographies can be regarded as the outcome of dynamic decision processes. In these processes preferences and restrictions can change their parts. In that case phenomena like "objective-restrictions inversion" and "attainment-means conversion" will appear. People make choices between alternatives, but they



do not choose the alternatives which are available for selection. Whether a preference to have a child develops at all depends on the previous commitments in the occupational biography. On the other hand a commitment regarding the birth of a child can influence future occupational preferences. The *concept of biographic commitments* includes both sides of the preference-restrictions-behaviour scheme, namely the subjective side to which preferences belong and the objective side to which the restrictions involved can be counted. The biographic approach can be said to be a method of applying the principles of the preference-restrictions-behaviour scheme to the problem of biographic sequences.

Long-term biographic commitments are associated with a greater risk the larger the number of alternatives and options in life that is eliminated by the commitments. The bigger the risk of a commitment is, the less likely it is that it will be entered into. Industrialization and urbanization processes have multiplied the number of occupational opportunities available to everyone but in particular for women through the creation of jobs in the service sector. The decrease in the fertility rate to be observed in all countries is the most marked in the prosperous service centre cities where the majority of employment opportunities for women are to be found.

In rural areas and in regions with unfavourable labour market conditions a biographic commitment in the form of having a child implies less loss of opportunity than in areas with favourable conditions. The frequency of births is therefore higher in depressed areas than in areas of economic growth. In societies whose economic and social systems are based on the competition principle, family and occupational objectives are difficult to reconcile. The decrease in the completed fertility rate in nearly all the so-called developed countries can be traced to this inherent conflict. Economic prosperity and demographic stability - if this is defined as maintaining the present level of population - appear to be mutually exclusive as macro-economic and macro-demographic objectives in the same way that price stability, economic growth and balance of international trade are mutually exclusive. The "magic triangle" of the economists has now to include demographic effects and so be extended to a "magic polygon".