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Titel

# "The Composition of Couples According to Education and Age.

# An Analysis in the Context of the FAMSIM+ Family Microsimulation Model for Austria"

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**working papers have only received limited review**

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## Content

## Abstract

The central aim of this paper is to reveal structures in the formation of married couples and couples living in cohabitation, such as differences in age and education. In view of the fact that in the last decades an extensive educational expansion has occurred, especially among women, one can expect changes in the marriage market according to education, which are assumed to have a direct effect on couple formation. As far as married couples are concerned, it is of interest to what extent marriage age has an effect on age difference. Furthermore, the question arises if age differences of couples have changed over the time. Besides a descriptive analysis, this paper provides the groundwork for the partner matching module that will be employed in the FAMSIM+ microsimulation project, currently being developed at the Austrian Institute for Family Studies.

# 1 Introduction

The modeling of partnership formation is of key importance in the context of the FAMSIM+, the Family Microsimulation Model. Partnership developments highly interact with other life course events, such as job careers and fertility. In the FAMSIM prototype model (Wolf, 1997; Neuwirt & Spielauer, 2001), five partnership transitions between three partnership states - single, married, unmarried cohabitation - were modeled. In contrast to the fully female prototype model, where men were only simulated as attributes of women having no individual characteristics, we follow a different approach in the development of the FAMSIM+ model. By basing the model on a much larger starting population, derived from micro census data, we follow a closed population framework and explicitly introduce the matching of partners, represented by individual data records. As the scope of FAMSIM+ will include policy simulations, income characteristics of individuals and families are included in the model as well. Therefore, the modeling of the 'right match' becomes a key task in the model development. Finding appropriate matches is of great importance, e.g. for obtaining a reasonable household income distribution. Appropriate distributions are not only important in a cross-sectional view, but also influence the prediction power regarding future dynamics. Many partners eventually become parents which, in turn, has some effect on the behavior of their children. This can clearly be seen in the transition processes regarding educational attainment, as studied in a previous paper on educational attainment in the context of the FAMSIM+ (Schwarz, 2002). Besides age, education is one of the most frequently used variable in the simulation of partner matching. In this paper we investigate partner matching according to these two variables in Austria, based on micro census data. This analysis constitutes the base for the modeling of the 'right match' in the FAMSIM+ model.

## 2 Data and Variables

The data source for our evaluation was the special program of the Austrian micro census from June 1996, which contained a questionnaire on education history, marriage, and biography of births. For our analyses the questions of interest were:

- Date of birth
- Date of first marriage
- Date of second marriage
- Highest level of education completed

In contrast to the basic program of the micro census, the special program is voluntary. Since for various reasons individuals refuse to answer the questions, e.g. due to embarrassment or lack of interest, we have to consider a systematic error. Because of the subject of the program one can expect non-respondents to be mainly individuals with a lower educational background and/or without children.

Prior to the actual analyses, a matching procedure of the data of married couples and couples living in cohabitation had to be performed, where for females and males separate variables were created and aggregated over the break variable family number. This family number clearly distinguishes one family and was built out of the district number, apartment number, household number and the number of the family members in this household. In order to avoid the matching of child-parent, only persons who stated to be 'head of the household' or 'spouse/cohabitee' were selected. The marriage age was calculated by marriage date minus date of birth, which had to be $\geq$16. After a careful examination of couples' age differences, cases outside the 99.5% inner percentile range were defined as extremes and, therefore, excluded. Consequently, we got an age difference range from –188 months (male 15.7 years younger) to 302 months (male 25.2 years older). In this way, a new data file with 12 017 married couples and 946 couples living in cohabitation was created. Around 60% of those 26 000 respondents answered the questions of the special program. The variables are shown in Table 2.1.

**Table 2.1: Variable description**

| Variable | Description | Type |
|---|---|---|
| *fam_no* | Family number | Integer |
| *educ_f* | Education of females | Categorical<br>1 Compulsory<br>2 Apprenticeship<br>3 Vocational School<br>4 Matura1<br>5 University |
| *educ_m* | Education of males | cf. *educ_f* |
| *educ_dif* | Educational difference | Categorical<br>1 Educ male lower<br>2 Equal<br>3 Educ male higher |
| *birth_f* | Date of birth of females in month from 1900 | Continuous |
| *birth_m* | Date of birth of males in month | Continuous |
| *mardat_f* | Marriage date of females in months | Continuous |
| *mardat_m* | Marriage date of males in months | Continuous |
| *agedifmo* | Age difference of age of male minus age of female in month | Continuous |
| *agedif_y* | Age difference of the married-couple in years | Age difference in months divided by 12 and rounded. |
| *weight* | Adjusted weight by the population structure of the total population of Austria | Continuous |

[1] In Austria, the “Matura” (or “Reifeprüfung”) is the final exam in upper level academic secondary schools and secondary technical and vocational colleges, usually taken after 12 or respectively 13 years of education. Matura also grants admission to universities or Fachhochschulen (colleges).

# 3 Formation of Couples According to Education

It is well known that individuals with a similar social background are more likely to come together and form a partnership than individuals with dissimilar social backgrounds. In this context, education plays a crucial role - not only because people meet each other in schools, colleges, universities and apprenticeship places, but also because individuals with similar educational backgrounds often have similar interests, carry out similar social activities and stay in similar social environments. Consequently, many times the circle of friends and colleagues consists of people with a comparable educational level.

It is the purpose of this paper to look into this issue further and reveal structures in the educational constitution of couples. The following questions arise: To what extent does education affect couple formation? Who lives with whom according to education? Do changes in educational composition within couples occur over the time, and what are the reasons for these changes? Do differences exist between married couples and couples living in cohabitation as far as education is concerned? To examine the formation of married couples according to education, we analyzed the conditional distribution of the education of males in dependency on the education of females P(educ_male | educ_female). Since in our model females select males (as it is most likely in reality), *education of male* is assigned as dependent variable. In order to uncover first structural changes over the time, we analyzed the educational formation of couples who married in the 60's and 70's and couples who married in the 80's and 90's. The reason for favoring marriage dates over birth dates lies in the importance of the point of time when couples met each other.

First, we look at individuals who married in the 80's and 90's. Table 3.1 clearly shows the influence of education on couple formation. One can see that females with an apprenticeship training as their highest education mainly established partnerships with males with the same education (71.6%), whereas only 2.7% married a university graduate. The same applies to females with university education, where 59.8% married a university graduate, whereas only 3.2% came together with a male who did not have any degree at all. A different picture occurs for females having a Matura degree where 32.2% married a male likewise having a Matura degree, but 33.7% formed relationships with males with an apprenticeship training only. Because of the small number of male vocational school graduates, only 16.4% of females who graduated from a vocational school married a male with the same education, whereas 54.3 % married males with an apprenticeship training. Moreover, females having compulsory education only, also predominantly chose males with an apprenticeship training. The reason for this particular preference lies in the substantially higher number of males with an apprenticeship training. Besides this fact, females tend to prefer males with the same education or one educational level higher, if the marriage market allows it. Consequently, the selection of a partner according to education not only depends on preferences and social contacts, it is also a matter of the market.

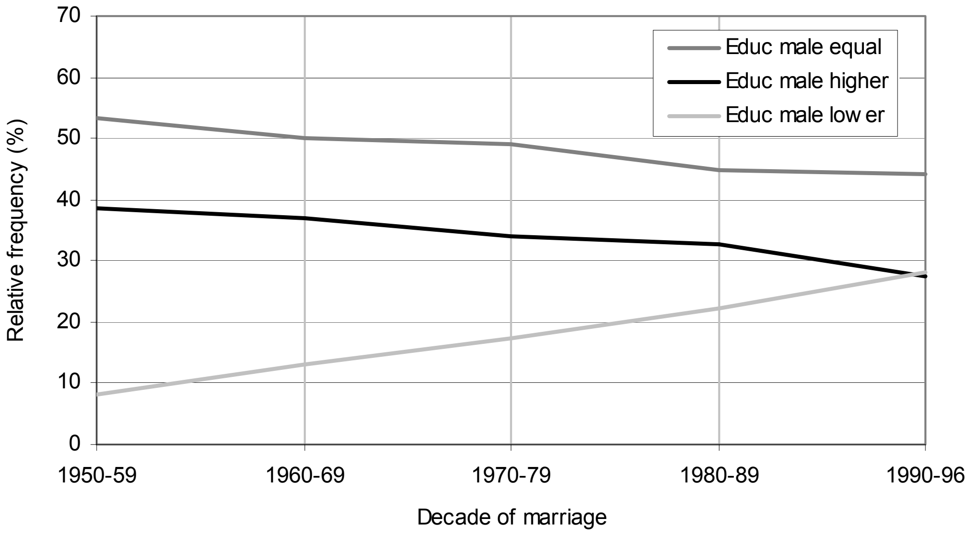
**Table 3.1: Education of males in dependency on the education of females for couples who married between 1969-79 and 1980-96 respectively (in percent)**

| | | Education of male | | | | |
|---|---|---|---|---|---|---|
| Year of marriage | Education of female | Compulsory | Apprentice-ship | Vocational school | Matura | University |
| 1960-1979 | Compulsory (n=1978) | 47.8 | 43.2 | 4.7 | 3.2 | 1.1 |
| | Apprenticeship (n=1254) | 11.1 | 68.2 | 7.3 | 9.3 | 4.0 |
| | Vocational School (n=603) | 10.9 | 43.2 | 17.0 | 19.7 | 9.2 |
| | Matura (n=342) | 7.1 | 23.8 | 7.7 | 37.1 | 24.3 |
| | University (n=154) | 1.3 | 18.2 | 3.5 | 10.9 | 66.2 |
| 1980-1996 | Compulsory (n=902) | 29.9 | 58.7 | 4.4 | 6.0 | 1.1 |
| | Apprenticeship (n=1222) | 7.8 | 71.6 | 9.0 | 8.9 | 2.7 |
| | Vocational School (n=620) | 6.2 | 54.3 | 16.4 | 15.4 | 7.8 |
| | Matura (n=531) | 7.6 | 33.7 | 8.8 | 32.2 | 17.7 |
| | University (n=271) | 3.2 | 9.6 | 4.8 | 22.5 | 59.8 |

This can clearly be seen when we compare the educational formation of couples who married in the 60's and 70's with the educational composition of couples who married in the 80's and 90's. While in the 60's and 70's 66.2% of females with university education married a male with the same educational level, only 59.8% did so if they married in the last two decades. In contrast, the proportion of female university graduates who married a male with a Matura degree rose from 10.9% to 22.5%. Similar effects can be seen for females who hold a Matura degree. While in the early comparative period 37.1% of them married a male with a Matura degree and 24.3% with a university education, only 32.2% or 17.7% respectively did so if they married during the last twenty years. As a consequence of these decreases, the proportion of females with a Matura degree who married males with an apprenticeship training increased from 23.8% to 33.7%. Another change is noticeable in the educational constitution of females with compulsory education. In the 60's and 70's 47.8% of these females married a male with no further education, whereas in the 80's and 90's only 29.9% did so. In contrast, marriages with males with an apprenticeship training rose from 43.2% to 58.7%, and marriages with males with a Matura degree doubled from 3.2% to 6%.

Changes in the educational formation of couples are more evident when comparing the differences in the categories 'education male higher', 'education male equal' and 'education male lower' to the educational level of females. Figure 3.1 shows a substantial increase (from 8% to 28%) of the proportion where the male has a lower education than the female. In contrast, the proportion where males have an equal or higher education decreased.

**Figure 3.1: Differences in the education of married couples in dependency on the marriage date over 10-year marriage cohorts**




Explanations for these considerable changes can be found in the educational development. Figure 3.2 and Figure 3.3 show the progress in education of females and males over the last five decades. Among females substantial improvements can be observed. The proportion of women with no education beyond compulsory education has decreased from about 65% to 20%. In contrast, the proportion of female apprentices has risen from around 15% to more than 30%, the number of female university graduates has profoundly increased from around 3% to 10%, and the proportion of female Matura graduates has tripled from around 7% to 21%. Only minor changes have occurred within vocational school graduates. While education among women has considerably improved over the last decades, less progress has been made in the educational expansion among males, since their starting situation was much better anyway. Nevertheless, the decrease of males with compulsory education from 40% to 14% is enormous, and the doubling of male Matura graduates from around 10% to 20% is likewise marked. On the contrary, the growth of the proportion of university graduates is negligible.

Consequently, the marriage market has changed over the time, because more and more females have had access to better education. In the past females predominately had compulsory education only; nowadays females have the same chances of obtaining higher education than males. Since the initial educational situation of women was much lower than the one of men , the educational progresses. among women are much more noticeable These changes have had a substantial impact on the marriage market: the number of males with higher education was soon depleted and, as a result, females had to scale down their preferences, accepting also males with lower education. This concerned especially females with higher education.

**Figure 3.2: Educational development of females over five-year-birth-cohorts**

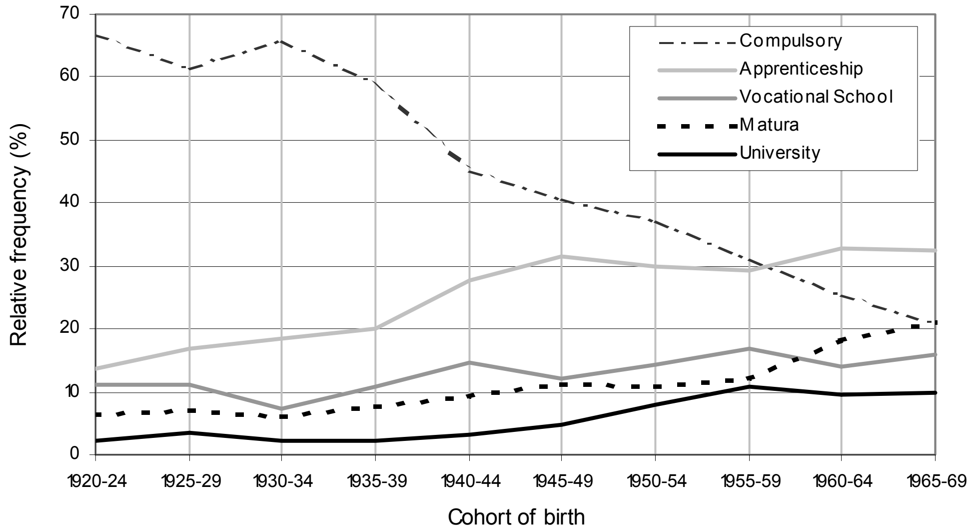
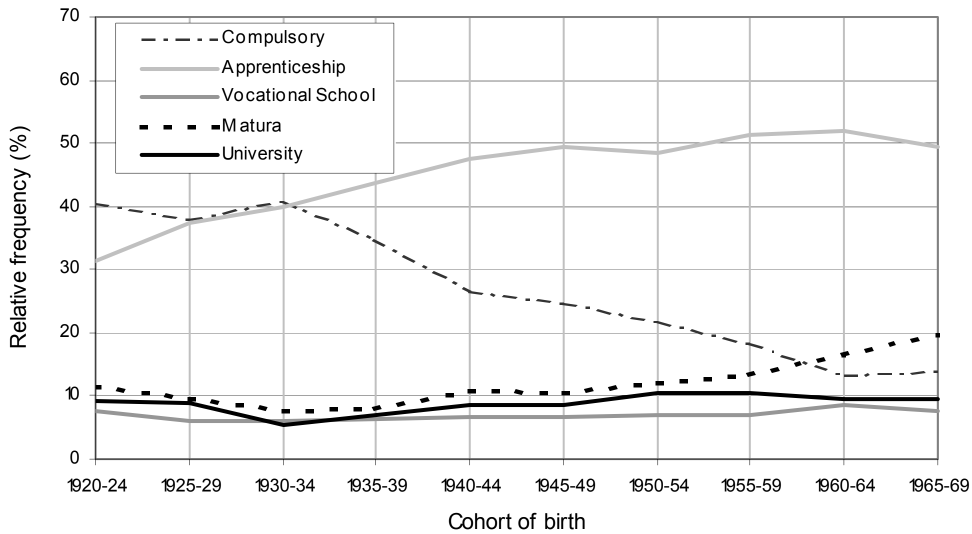
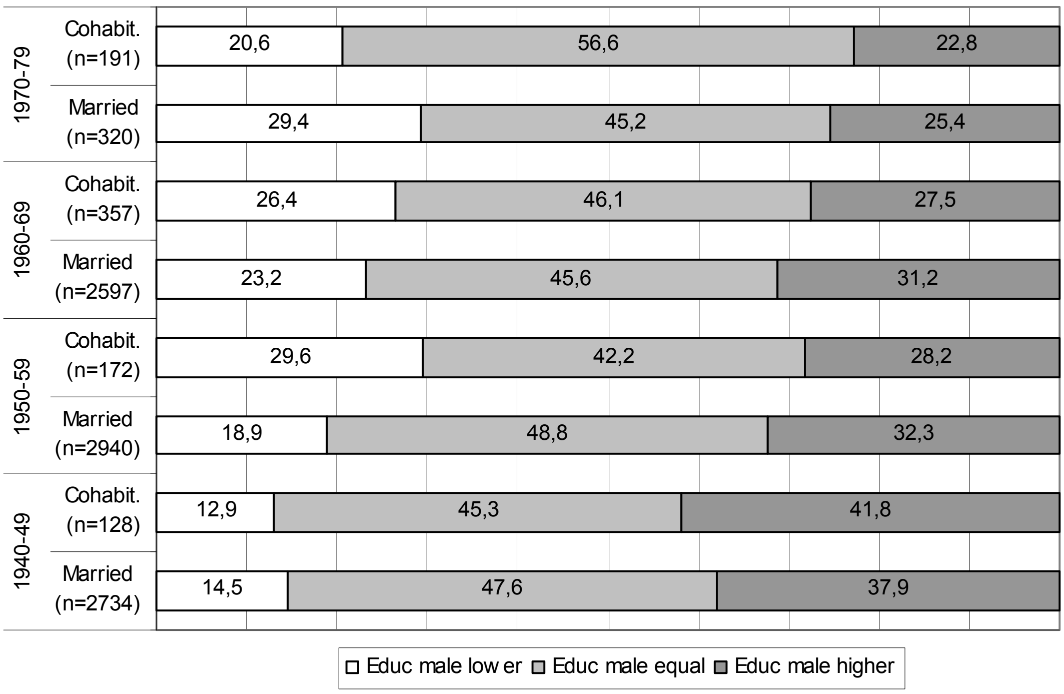



**Figure 3.3: Educational development of males over five-year-birth-cohorts**




Since in the Family Microsimulation project FAMSIM+ couples who live in cohabitation are also processed, we have to consider their distribution too. One assumes that the behavior concerning couple formation shows similarities to married couples; therefore, differences between these two distributions should be minor. Figure 3.4 shows the educational differences of married couples and couples living in cohabitation for 10-year-birth-cohorts of females. We had to switch to birth cohorts because of lack of a date or age when cohabitees met or moved together. For all birth cohorts the proportion of the educational constitution of married couples and couples living in cohabitation is very similar, except for the last birth cohort (1970-79). While 56.5% of the females live together with a male with a lower education, only 45.2% do so, if couples are married. In contrast, the proportion of males with lower education differs from 20.6% and 29.4% between individuals living in cohabitation and married couples. For all other cohorts this relation is the reverse, that is, the proportion of males with lower education is slightly lower for married couples than for couples living in cohabitation. The differences within the cohort 1970-79 can probably be traced back to the fact that, in contrast to females, many males living in cohabitation have not yet finished their education..

**Figure 3.4: Educational constitution of married couples and couples living in cohabitation for 10-year-birth-cohorts of females**



# 4 Age Differences of Married Couples

In order to analyze age differences of married couples, we had to look into the distribution of this variable first. We realized that the variable *age difference* not only deviates significantly from a normal distribution but also alters shape and variation in dependency on the marriage age Therefore, we could not use parametric models but had to apply non-parametric (rank) methods that generally yield less significant results. We were not able to calculate a mean or a standard deviation or perform a regression analysis. In addition, we had to consider that age differences of married couples eventually changed over the last decades.

As already mentioned in Chapter 2, values outside the 99.5% inner percentile range were defined as extremes and thus excluded. Nevertheless, the distribution is still heavily afflicted with outliers, which increases sampling fluctuations. These outliers cannot be removed from the data set, since large age differences of couples are a fact in our society. As we use rank methods however, outliers are not of that great magnitude.

## 4.1 Age Differences and Changes over Time

It is a well-known fact that in couple formation men tend to be older than women. Yet, two questions arise in this context: How does the distribution of age differences look like exactly; and has location and variation of this distribution changed over the last decades?

**Table 4.1: Age differences of married couples in months (age male minus age female) over 10-year-marriage-cohorts from 1950 to 1996**

| Decade of marriage | n | Percentiles | | | | | Inter-quartile range[2] | Skew-ness[3] | Mean[4] |
|---|---|---|---|---|---|---|---|---|---|
| | | 0.05 | 0.25 | Median | 0.75 | 0.95 | | | |
| 1950-1959 | 689 | -39 | 9 | 34 | 63 | 122 | 54 | 0,074 | 35.8 |
| 1960-1969 | 2061 | -23 | 11 | 36 | 64 | 128 | 53 | 0,074 | 41.8 |
| 1970-1979 | 2263 | -28 | 11 | 34 | 61 | 119 | 50 | 0,057 | 38.5 |
| 1980-1989 | 2416 | -40 | 8 | 30 | 61 | 131 | 53 | 0,080 | 36.8 |
| 1990-1996 | 1130 | -41 | 10 | 34 | 69 | 151 | 59 | 0,170 | 41.3 |

Table 4.1 shows essential rank measures for the distribution of the age difference of married couples over 10-year-marriage-cohorts. The median is around 34 months age difference, except for the cohort 1980-89, where a reduction to 30 months occurs. The percentiles of the years of marriage 1990-96 are noticeable. While the 5% and 25% percentiles have about the same values as during the decade before (about 40 months), the 75% and 95% percentiles are significantly higher. This affects the inter-quartile range, which increased from around 53

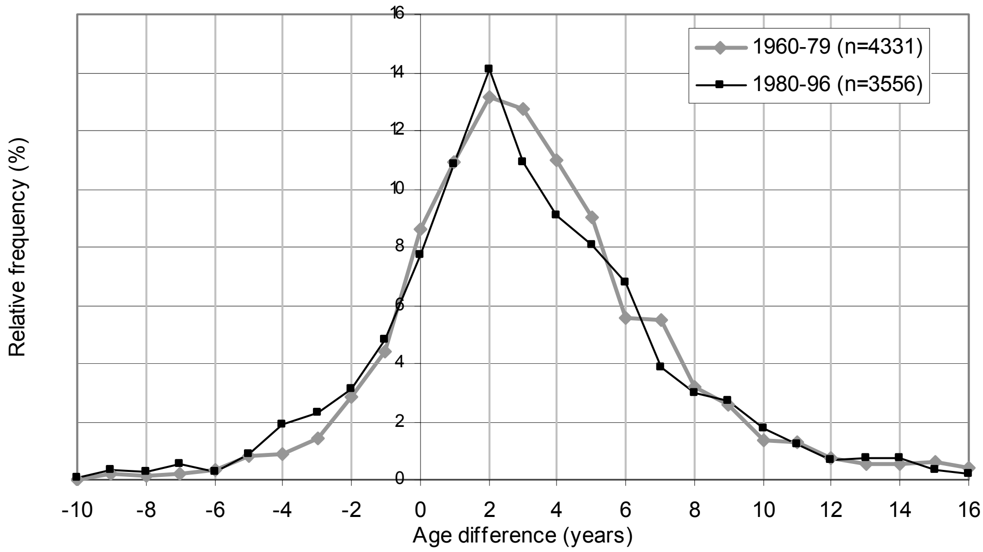
[2] $x_{0.75} - x_{0.25}$

[3] Quartile-coefficient of skewness $\gamma_{0.25} = [(x_{0.75} - \tilde{x}) - (\tilde{x} - x_{0.25})] / (x_{0.75} - x_{0.25})$

[4] Since the distribution is not symmetric and additional afflicted with outliers, the moments such as the mean and the variance are not an appropriate measure. The mean serves here just for comparison with the median.

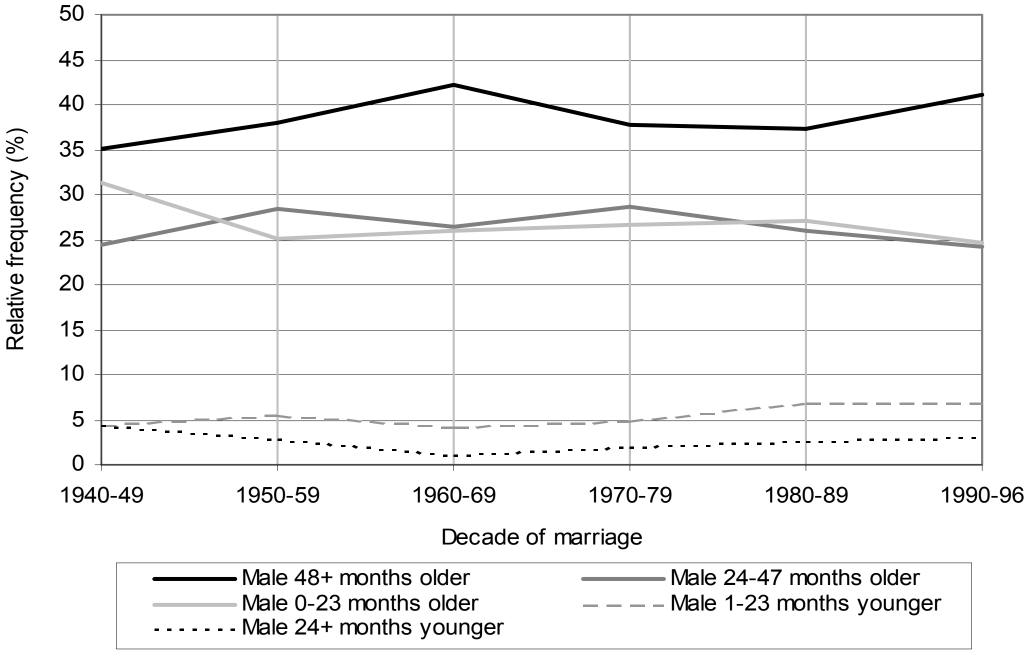
to 59 months. The inter-quartile range can be seen as a measure for the variation of a non-parametric distribution. The quartile-coefficients of skewness show that the distributions are slightly skewed on the right hand side. Over the time, the skewness rose slightly. In general, however, changes over the time are minor. This is shown in Figure 4.1 as well, where the distribution of the age difference of couples who married in the 60's and 70's is compared with the distribution of couples who married in the 80's and 90's. Within both, the modus of the age difference is two years; only the kurtosis for couples who married in the 60's and 70's is slightly smoother.

**Figure 4.1: Age difference in years for couples who married between 1960 and 1979 and 1980 and 1996 respectively**



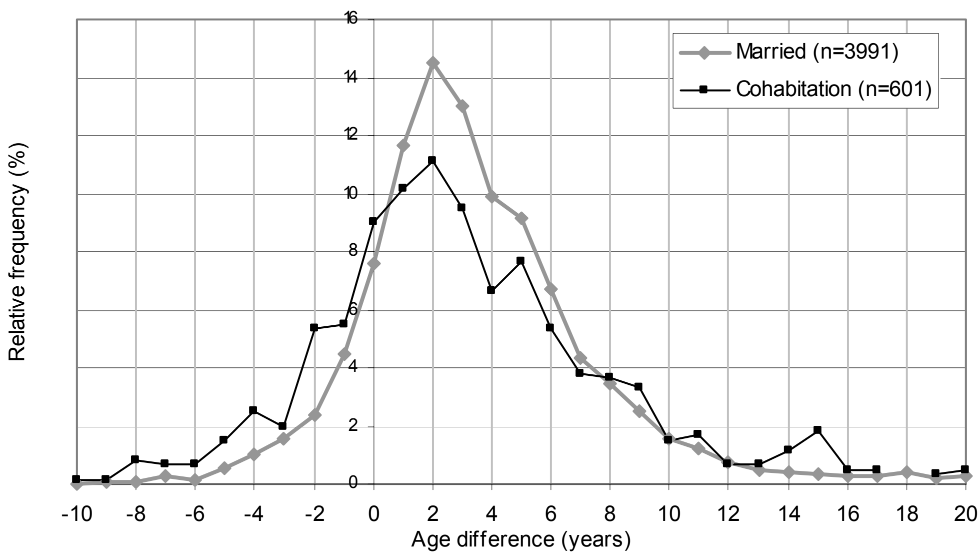

To evaluate changes over the time for the last six decades, we classified the age differences into several categories of age differences, shown in Figure 4.2. Changes over the time are likewise negligible.

**Figure 4.2: Age difference of married-couples over 10-year-marriage-cohorts**




For the comparison of the distribution of married couples and couples living in cohabitation, we were not able to use an age that defines when couples moved together, like marriage age. For this reason, we had to switch to the age of females. Here, it is reasonable to look at young females, aged 20 to 39. As we already mentioned in the previous chapter, we assume some similarities between these two subgroups, since the behavior in couple formation is presumed to be comparable, and a high number of couples living in cohabitation may eventually marry. To some extent Figure 4.3 disproves this assumption. Although similarities can be seen, such as the same modus, the distribution of cohabitations varies stronger and the kurtosis is more even. However, one has to consider the small sample size as well.

**Figure 4.3: Age difference (age of male minus age of female) for married females and females living in cohabitation aged 20 to 39 years**



## 4.2 Effect of Marriage Age on Age Difference

When females marry very young, they do not have much choice in the selection of younger males; hence, these young women predominately marry males who are more or less older than they are themselves. On the contrary, older women have the opportunity to marry younger men as well. This example gives the first hint that the distribution of age differences is subject to marriage age and to the age when couples meet each other. However, to what extent is the age difference of couples affected by the marriage age of females?

**Table 4.2: Age difference of married couples in months subject to marriage age of females**

| Marriage age | n | Percentiles | | | | | Inter-quartile range[5] | Skew-ness[6] | Mean[7] |
|---|---|---|---|---|---|---|---|---|---|
| | | 0.05 | 0.25 | Median | 0.75 | 0.95 | | | |
| 16-19 | 1932 | 4 | 29 | 46 | 73 | 119 | 44 | 0,227 | 53.3 |
| 20-24 | 4496 | -15 | 12 | 33 | 61 | 122 | 49 | 0,143 | 40.3 |
| 25-29 | 1704 | -47 | -4 | 21 | 52 | 131 | 56 | 0,107 | 28.8 |
| 30-34 | 505 | -83 | -26 | 14 | 62 | 183 | 88 | 0,091 | 23.4 |
| 35+ | 356 | -137 | -41 | 18 | 87 | 195 | 224 | 0,078 | 25.4 |

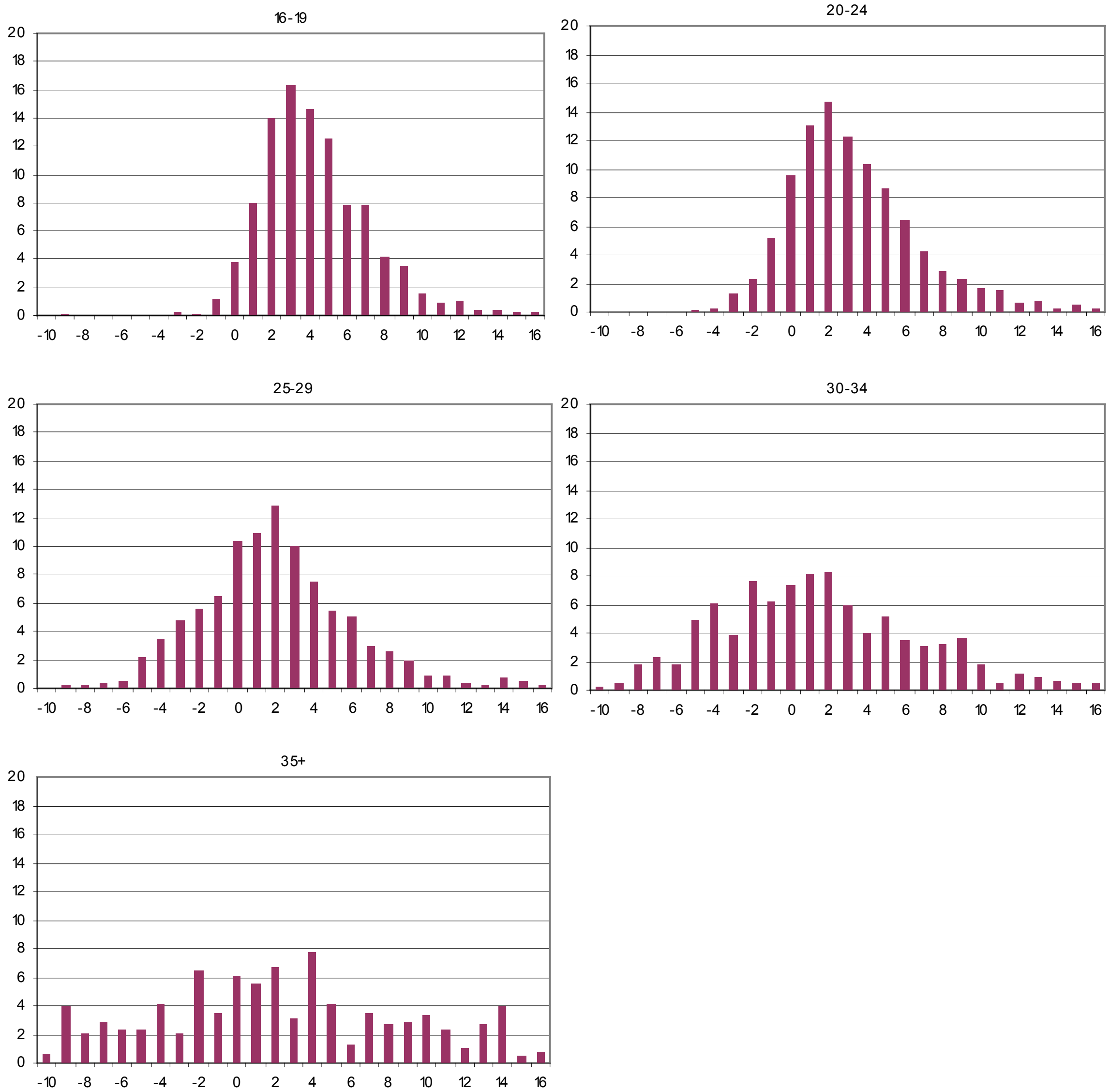
Considering the median of the age differences in Table 4.2, one realizes the strong influence of the females' marriage age. While for couples where females married at the age of 16-19 the median is 46 months age difference, it is just 18 months for couples where the female married at the age of 35+. The diversity in the inter-quartile range is noticeable, which increases from 44 months for couples where females married at the age of 16-19 to 224 months for couples where females married at the age of 35+. The skewness shows some effects as well; whereby the skew at the right hand side reduces, the later females marry. The changes in age differences illustrated in Figure 4.4 are more marked. For females who marry young, the distribution of the age difference is very steep and varies only at the right hand side to higher values. The more advanced in age females are when getting married, the more irrelevant the age differences become; therefore, the distribution is more even.

[5] $x_{0.75} - x_{0.25}$

[6] Quartile-coefficient of skewness $\gamma_{0.25} = [(x_{0.75} - \tilde{x}) - (\tilde{x} - x_{0.25})] / (x_{0.75} - x_{0.25})$

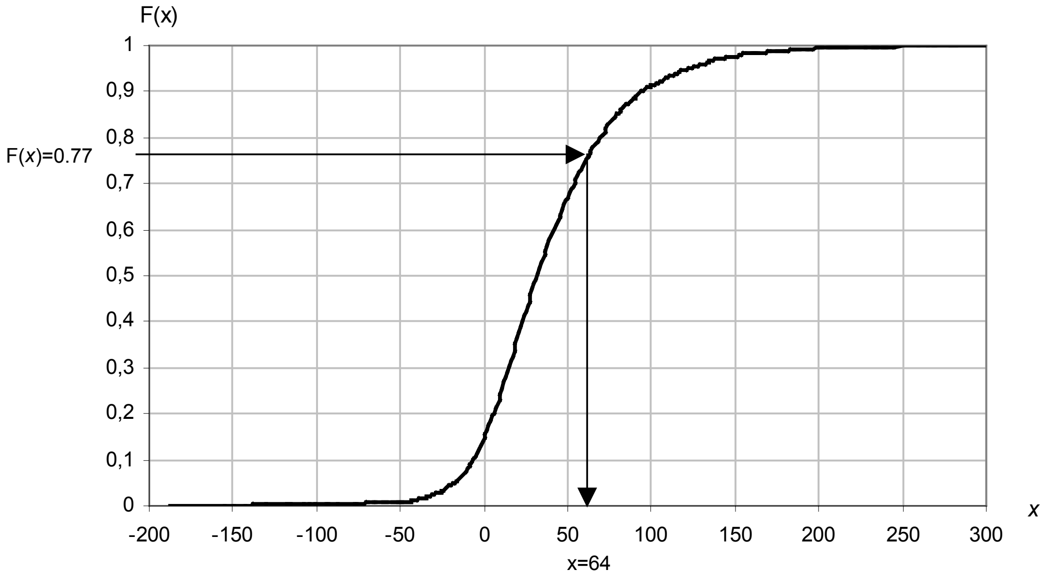
[7] Since the distribution is not symmetric and additionally afflicted with outliers, the mean is not an appropriate measure, and serves just for comparison with the median. Because of the skewness of the distribution on the right hand side, the mean has been biased upwards.

**Figure 4.4: Age difference of married couples in years subject to marriage age of females (relative frequency in %)**




In the FAMSIM+ project, we will consider this circumstance and calculate the respective cumulative distribution function for the various marriage ages. Figure 4.5 shows such distribution function for females who married at the age of 20-24. The following example shows how age difference is assigned to a couple in the simulation process. Since a distribution function varies between zero and one, we can generate a uniformly distributed random number within the interval [0; 1]. Assuming this generated random number is 0.77, then x equals 64, since $F^{-1}(0.77) = 64$. This simulation procedure can be performed for all kinds of distributions, parametric or non-parametric.

**Figure 4.5: Cumulative distribution function of age difference in months for females married at the age of 20–24**



# 5 Partner Matching in the FAMSIM+ Model

In FAMSIM+, the simulation of partnership careers is organized in two separate sub models: one determining the time of the start and end of partnerships, and one finding (or generating) an appropriate partner in the simulation. In contrast to the FAMSIM prototype model, FAMSIM+ is a closed population model. The terms open and closed population in microsimulation usually correspond to whether the matching of spouses is restricted to persons within the population, or spouses that are imputed. In open population models, partners are usually attached as attributes to the 'dominant' individuals of the population with characteristics synthetically generated or sampled from a host population. On the contrary, closed models allow to track kinship networks, and furthermore, enforce more consistency, given a population large enough to find appropriate matches.

Regarding the timing of partnership transitions, we will mainly follow the approach of the FAMSIM prototype model using logistic regression models in order to determine monthly transition probabilities. In the prototype model, five partnership transitions were modeled, namely transitions from single to marriage, from single to unmarried cohabitation, from marriage to single, from unmarried cohabitation to marriage, as well from cohabitation to single. The model as well as a complete set of statistical output for five European countries is published in Spielauer (2000). Given the complex interactions between the explanatory variables used, it is easier to examine the model through visual comparisons of risks based on selected life course scenarios. In the following, some scenarios are presented for demonstration:

**Figure 5.1: Risk for transition from being a single to unmarried cohabitation for an example life course**

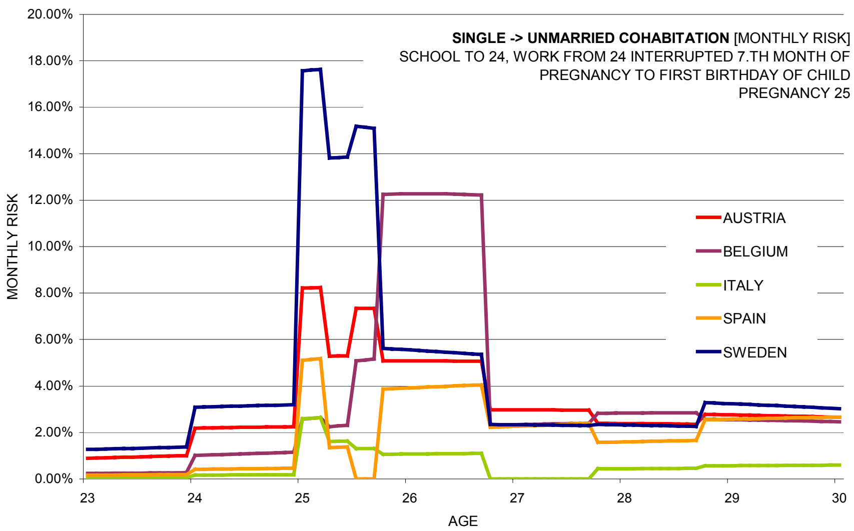



Figure 5.1 shows the monthly transition rates from being a single to unmarried cohabitation for a woman finishing school and starting to work at the age 24, and who becomes pregnant at the age 25. The working career is assumed to be interrupted from the $7^{th}$ month of pregnancy until the first birthday of the child. Note that this risk pattern cannot be interpreted

independently of marriage risks, as pregnancy plays a very different role as 'a reason for getting married' in the different countries.

As unmarried cohabitation generally plays a much more dominant role in Sweden as compared to the other countries, monthly probabilities to move into unmarried cohabitation are highest there for almost the entire age interval under observation. Not surprisingly, pregnancy also increases the probability to start an unmarried cohabitation to its highest level in Sweden. Partners move together already in the first months of pregnancy in all countries except in Belgium, where the birth of the child seems to be the event that matters most.

Figure 5.2 of the monthly risks of marriage shows the complementary picture. The probabilities of marriage are lowest in Sweden, and only rise very slightly during and after pregnancy as compared to other countries. Italy, Spain and Belgium are at the same level if one accounts for the different timing of marriage at different stages during and after pregnancy.

**Figure 5.2: Risk for transition from being single to marriage for an example life course**

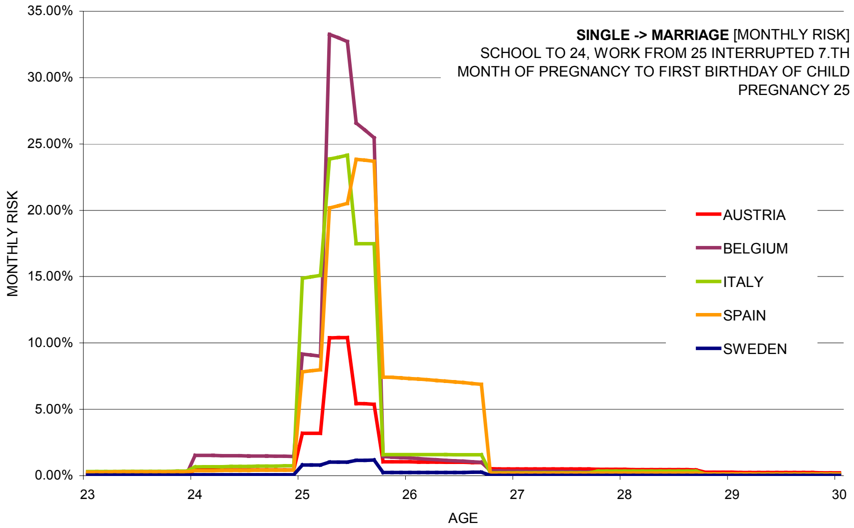
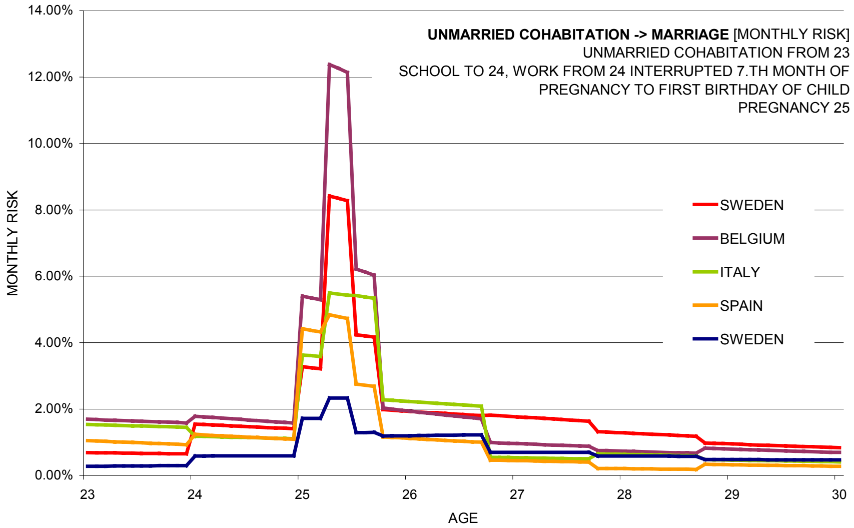



Figure 5.3 depicts the monthly risk of marriage for a woman living in unmarried cohabitation. Once again, pregnancy increases the probability of marriage to varying degrees in the different countries; the highest probabilities are found in Belgium and Austria, and the lowest in Sweden.

**Figure 5.3: Risk for transition from cohabitation to marriage for an example life course**




Regarding 'finding of the right match', the descriptive analysis done in this study will serve as the basis of a first version of a matching model in FAMSIM+. As in the prototype model, also FAMSIM+ is female driven in the sense that it is the woman who decides when to start and end partnerships, and who tries to find an appropriate partner. In a first step, we will follow a rather simple model, in which age difference and education level are determined stochastically from probability tables derived from the micro census data. The analysis done in this paper clearly shows that these patterns are subject to an ongoing change due to the changing marriage market, especially regarding the educational composition of the population. As it is a closed model, consistency is enforced, as women have to find an existing suitable person in the simulated population. Therefore, the model has to define what happens if such a match cannot be found. As this is still an area of future research in the context of the FAMSIM+ project, it is interesting to note that in the context of model development, microsimulation - besides its use for projections - can also serve as a tool for theory development and testing. In this sense, microsimulation models can be used to study the implications of certain assumptions - e.g. regarding searching behaviors - matching models meanwhile being typical applications of 'abstract' microsimulation and ABCD (Agent Based Computational Demography).

# 6 Summary

As expected, education plays an essential role in couple formation. Females tend to prefer males with the same education or one educational level higher, if the marriage market allows it. However, since the educational progress has developed a lot better for females, the marriage market has changed over the time. The impact on the marriage market has especially compelled females with higher education to scale down their preferences in the educational level of the male.

Additionally, marriage age is an important factor in the structure of the age difference of couples. In view of the fact that females who marry young do not have much choice in the selection of younger males, their partners are usually older. A completely different picture occurs for females who marry at an older age; males are both older and younger, and age differences vary considerably.

These outcomes will be considered in the development of the partner matching procedure to be implemented in the FAMSIM+ microsimulation project that is currently being developed at the Austrian Institute for Family Studies.

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