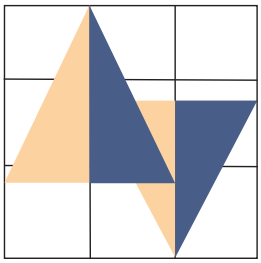

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Accepted by the 'editorial board'*

Estimating the Migrant Survival Advantage From Orphanhood of Second Generation Migrants

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Abstract

It is well known that migrants are healthier and thus show lower mortality than the native population. Generally, this phenomenon is explained by a special selection effect which may influence mortality and morbidity rates and there is no doubt that the healthy migrant effect is apparent on the micro level. It is however unclear to which extent this phenomenon contributes to mortality differences on the macro level. In order to analyze the existence and the possible extent of the migrant survival advantage the orphanhood method is used as it is done in many developing countries by analyzing German survey data for 2,465 individuals of Turkish and Italian origin as well as a German control group with 1,220 respondents. By using information on parents' place of birth the foreigner group is divided further into the sub-groups "immigrants" (foreign-born parents of respondents born in Germany) and "foreign-born" (foreign-born parents of foreign-born respondents). The estimates for life expectancy at young adult ages provide for both sexes substantive advantages for the foreigners and among men especially for the subgroup of immigrants, thus indicating a significant healthy migrant effect.

Description of the topic to be studied

It is known from several studies that migrants are healthier and thus show lower mortality than the native population what has been described for various countries and ethnic groups for internal as well as for international migrants (among many others e.g., (1986); (Razum et al. 1998); (Razum, Zeeb, and Rormann 2000); (Palloni and Arias 2004); (Anson 2004), (Deboosere and Gadeyne 2005)). Generally, this phenomenon is explained by a special selection effect which may influence mortality and morbidity rates. This selective migration is expected to operate in two directions entailing the movement of a "select group" of healthy or unhealthy migrants ((Abraído-Lanza et al. 1999); (2003b); (Palloni and Arias 2004); (Luy and Caselli 2007)). The movement of healthier individuals is known as the so-called "healthy migrant effect". On the other hand, it seems that sick migrants are involved in return migration, for example, to be nearer to family or care-giving institutions. The latter phenomenon is also known as "salmon bias" ((2003b); (Razum 2006)).[1]

Most studies on mortality differences between migrants and the non-migrants are based on individual data measuring the relative mortality risk of the two population groups and there is no doubt that the healthy migrant effect is apparent on the micro level. It is however unclear to which extent this phenomenon contributes to mortality differences on the macro level. Based on the indirect concept of connecting age structures and mortality levels of populations on district level, (Luy and Caselli 2007) found indicators that migration-caused selection effects significantly affect regional mortality differences in Italy and Germany. The study, however, concentrated on correlations and did not provide any insight into the absolute or relative impact of migration-caused selection effects on demographic macro parameters.

In most cases official population statistics are not useful in order to examine mortality differences between migrants and non-migrants since they are biased by a significant data artefact. Life tables for the foreign and native population calculated from official German population statistics elucidate this bias. Table 1 contains the life expectancy at age 20 for the German and the foreign population as well as the difference between them for selected years between 1980 and 2004 according to life table calculations based on official German population data. For both sexes, life expectancy of the foreign population exceeds those of the German population by more than 10 years. Only in 1987, the

[1] It should be stressed that the lower mortality of migrants is not only affected by physical condition but also by socioeconomic status (e.g., (van Steenbergen et al. 1999). However, this doesn't hold for all ethnic migrant groups, what provides even more support to the "healthy migrant hypothesis" ((King and Locke 1987); (Turra and Goldman 2006).

year of (West) Germany's last census with correction of population data, the difference is between six and six and a half years in favour of the foreign population. The more years pass since 1987 the higher becomes the difference, being 16.3 years among females and even 21.1 years among males according to the most recent data for 2004. The unrealistic foreign survival advantage according to official population statistics increases significantly with age. For life expectancy at age 80, for instance, the foreign survival advantage is 17.6 years among females and 25.3 years among men (data not shown in Table 1).

These numbers show that the data bias caused by unregistered emigration of former immigrants prevents the use of official population data for estimating the healthy migrant effect in terms of demographic macro measures like life expectancy. It is even unclear to which extent the numbers for 1987 reflect factual mortality differences between the foreign and the native German population. In order to analyze the existence and the possible extent of mortality differences between migrants and non-migrants this study follows the approach of indirect mortality estimation by using survey data as it is done in developing countries where (trustworthy) population data does not exist. Test simulations, analysis of their inner consistency and comparisons to independent data have shown that indirect techniques provide promising and surprisingly robust results in most cases (Arthur and Stoto 1983); (Timæus 1991c). This paper shows that these methods can help even in developed countries when direct techniques cannot be used or when their application is limited by severe data biases.

Data and research methods

In order to examine the healthy migrant phenomenon the "Integrationsurvey" is used that was carried in 2000 by the Federal Institute of Population Research in Germany (BiB). For the research project "determinants and indicators of integration and segregation of the foreign population in Germany" 2,465 interviews have been done with 18 to 30 years old women and men of Turkish (1,241 interviewed persons) and Italian origin (1,224 interviewed persons). Most of these immigrants belong to the so-called group of "second generation migrants", thus being children of former immigrants to Germany. Additionally, the survey includes a control group of 1,220 German persons with no migration background of the same age range. The questionnaire contains several items on life conditions, behavior, preferences, and family background including questions on the survival of parents and their year of birth (the questionnaire and a description of the data can be found in (2002)).

The estimation of adult mortality from information on the survival of the parents with the "orphanhood method" belongs to the standard tools for obtaining demographic

information for developing countries. Overviews can be found in the United Nation's "Manual X" (Hill, Zlotnik and Trussell 1983) or in some more recent publications (Timæus 1991c); (Hill, Choi, and Timæus 2005); (Hill 2006). The demographic relationship between the share of orphans and the mortality experiences of their parents has been described first by (1939) who proposed to estimate the number of orphans from life table functions for adult survivorship. Later, (Henry 1960) suggested to reverse this approach in order to estimate adult mortality from the number of orphaned children in cases where the underlying mortality and fertility schedules are known or assumptions can be drawn for applying specific mortality and fertility models. (Brass and Hill 1973) further developed this idea and proposed methods for estimating life table survivorship ratios from proportions of respondents of successive five-year age groups with mother or father alive based on a set of weighting factors. In the subsequent years, several scholars suggested successively improved and extended regression-based methods for estimating adult mortality from orphanhood data (Hill and Trussell 1977); (1983); (Timæus 1991b)a; (Timæus 1991a)b; (Timæus 1992); (Timæus and Nunn 1997).

The basic idea of the orphanhood method is that the age group of respondents represents the survival time of the mother (or father). Consequently, the proportion of respondents of a given age group with mother (or father) alive approximates a survivorship ratio from an average age of childbirth to that age plus the age of the respondents. The available methods model this relation using different patterns of fertility, mortality and age distribution to allow the conversion of a proportion with parent surviving into a life table survivorship ratio, controlling for the actual pattern of childbearing. Moreover, Brass and Bamgboye (1981) developed a general method for estimating the reference date of estimates derived from data on survival of parents (see (1983).

The Integration-Survey provides all information necessary to apply the orphanhood method with almost maximum possibilities, since in addition to the age of respondents and the information of the survival of their fathers and mothers the birth year of the parents is known as well. However, the restriction to ages 18 to 30 only allows orphanhood-based estimates for the relative survival from age 25 to 50 for females ($l(50)/l(55)$) and from age 32.5 respective age 35 to 60 for males ($l(60)/l(32.5)$ respective $l(60)/l(35)$). Comparisons of the orphanhood-based estimates using the Integrationsurvey data projected for the total German population the with the corresponding official life tables reveal that the method proposed by (Timæus 1992) provides the best and very precise estimates of adult mortality in Germany (see Table 2). For estimating the mortality level of male and female immigrants the group of "foreigners" has been further sub-divided into "immigrants" (foreign-born parents of respondents born in Germany)

and “foreign-born” (foreign-born Germans of respondents born outside Germany).[2] In some cases both parents belong to one of these foreigner groups, in others only the father or the mother, respectively. Thus, the case numbers differ between mothers and fathers included in the analysis. In order to get results comparable to the official data presented in Table 1, the estimated mortality levels are transferred into life tables for adults using the Brass logit life table system. Since the estimated calendar year for the orphanhood-based estimates is around 1991 (see Table 2), the German life table of 1986/88 is used as standard life table for this procedure.[3]

The big advantage of this study is that the results enable a quantitative estimation of the healthy migrant effect without the exorbitant bias caused by the data problems as shown in Table 1. Finally, bootstrap confidence intervals are used to test the statistical significance of the found mortality differences between the analyzed population groups and the German life table of 1986/88 used as standard life table for the Brass logit model.

Findings and Discussion

Although the data used in this study and thus the resulting estimates are not affected by the bias of unregistered emigration the lower mortality of migrants becomes apparent for both, males and females. The estimates for males refer to the relative survival $l(60)/l(35)$. As shown in Table 3, the proportions of respondents with father alive provide estimates for their fathers' relative survival probabilities from age 35 to age 60 of 0.8527 for Germans, 0.9214 for all foreigners, 0.9452 for the immigrants, and 0.8919 for the foreign-born. The corresponding $l(60)/l(35)$-value of the reference life table 1986/88 is 0.8666. Thus, the estimates for the native German population lie below this level as indicated by the negative α-value presented in the sixth column of Table 3. All groups of foreigners exhibit lower mortality than the reference life table, the differences

[2] Note that the group of “foreign-born“ parents does contain both, immigrants to Germany and parents that never emigrated from their home country. Unfortunately, the Integrationsurvey does not allow a further specification of parents belonging to the “foreign-born” persons. Thus, if migrants do have a survival advantage the mortality level of the group of “foreign-born” persons should be expected to lie between the mortality level of native Germans and the “immigrant” group.

[3] The life table 1986/88 is used rather than the life table 1989/91 since it is based on the census data of 1987 and thus not as biased by the foreign population as the subsequent life tables (see Table 1). In any event, the mortality levels of the life tables 1986/88 and 1989/91 differ only minor and all the results are not affected by choosing any of these life tables.

to all foreigners and the immigrants being statistically significant. The latter group shows the lowest mortality indicating the existence of a significant healthy migrant effect. The transformation of these estimated mortality levels into complete life tables provide an immigrants' advantage in life expectancy at age 35 of almost seven years compared to the native German population (see also survivorship functions shown in Figure 1). The corresponding advantages of all foreigners are 4.7 years and of the foreign born 2.4 years. It is remarkable that the orphanhood-based estimates are very close to the differences between the foreigners and Germans according to official population statistics in the census year 1987. Thus, the extent of life expectancy differences between immigrants and Germans reflected by official population statistics for the year 1987 seems to be realistic.

For females, too, the orphanhood-based estimates provide statistically significant lower mortality levels of all foreigners and the sub-group of immigrants compared to the reference life table, while Germans exhibit a higher mortality level (see Table 4 and Figure 2). In contrary to men, the mortality levels of the sub-groups of foreigners do not differ from each other providing an advantage in life expectancy at age 25 of around six and a half years. Also among females the orphanhood-based estimates fit the differences according to the life tables based on official population statistics of 1987 almost exactly.

Although the orphanhood method applied to the Integrationsurvey data for Germany does work extremely well (see Table 2) and the obtained results remarkably fit the estimates based on census data, orphanhood estimates generally suffer from distinct limitations. Inherently, they measure only the overall level and trend of mortality and cannot detect unusual age patterns or short-term fluctuations in mortality. Thus, the estimated survivorship functions cannot cross over and reflect a kind of proportional hazards assumption. (1986) has shown that the ratios of age-specific mortality rates of several birthplace groups of immigrants to Australia to the values for all Australia differ significantly from constant values, thus, they exhibit a high level of heterogeneity. That means that the mortality level estimated on basis of part of the life table function as it is done with the orphanhood method might not necessarily represent the mortality of other age segments as well as the overall mortality level. However, according to Young's results, this heterogeneity occurs mainly in the younger and older age groups and less the middle adult groups of which the mortality level is estimated with the orphanhood method (1986): pp 35-36).

Furthermore, due to the restriction regarding respondents' age groups of the Intergrationsurvey only one specific relative survival can be estimated for both, females and males. For females, in principle, the Timæus and Manual X methods additionally

allow the estimation of $l(55)/l(25)$ based on the orphanhood of the respondents aged 25-29 (for males this is not possible since the estimation methods require both age groups 20-24 and 25-29). The final results regarding the differences between Germans and foreigners and between the sub-groups of the foreigners are identical to the estimates for $l(50)/l(25)$. However, the mortality levels resulting from these $l(55)/l(25)$ estimates are too low compared to the reference life table for West Germany. For Germans themselves, the orphanhood-based estimate for the mortality level is even statistically significant below the mortality level of the reference life table, and for all foreigner groups there are no statistically significant deviations. The question why the estimates for $l(55)/l(25)$ do not fit as good as do those for $l(50)/l(25)$ cannot be answered at the current stage of this research, however. Further analysis taking into account the single age-specific proportion of orphaned respondents is needed. First examinations suggest that too few respondents belonging to the group with foreign born parents (especially those of Turkish origin) report that their parents are dead. It appears that a proportion of them instead answer the questions in terms of their foster-parents or step-parents. Additionally, some might not know if their parents are still alive for instance as a consequence of lost contacts to the family that is still living in the home country.

In any event, the quality of the data used in this study is considerably better than in developing countries. This holds especially for the given ages of the respondents and their parents, thus the most important source of bias in traditional applications of the orphanhood method. Thus, indirect methods can provide new possibilities for gaining knowledge of specific demographic aspects of developed populations that otherwise could not be examined. Mortality differences between the foreign and the native born population in Germany and the definition of immigrants in order to isolate the healthy migrant effect are only two of such examples. The results of this study suggest that indirect methods are providing reliable results especially in combination with results from other data sources. The question of mortality differences by place of birth is important for projections of allochtonous and autochtonous populations and for providing more accurate knowledge about the future ethnic composition of a population. Additionally they could explain (at least partly) regional mortality differences inside countries if there are dominant immigration and emigration areas.

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Tables and figures

Table 1: Life expectancy at age 20 of the German and the foreign population living in West Germany, official population data, selected calendar years

	Males					Females				
Calendar Year	1980	1987	1995	2000	2004	1980	1987	1995	2000	2004
Foreign Population	67.4	59.3	68.0	74.0	77.9	75.2	66.1	73.1	75.8	78.6
German Population	51.5	53.2	54.6	55.5	56.8	58.0	59.6	60.7	61.5	62.3
Difference	15.9	6.1	13.4	18.5	21.1	17.2	6.5	12.4	14.3	16.3

Data: Statistical Office of Germany; own calculations
Note: from 2000-2004 data for total Germany

Table 2: Survivorship estimates for the total German population derived from maternal and paternal orphanhood of respondents aged 20-29, Integrationsurvey 2000

(a) Females

Method	Relative survival	Reference date	Estimate	Life table 1989/91	Estimate/life table-ratio
Timæus	$l(50)/l(25)$	1990.88	0.9707	0.9718	0.9989
Brass/Hill	$l(50)/l(25)$	1990.88	0.9619	0.9718	0.9898
Manual X	$l(50)/l(25)$	1990.88	0.9688	0.9718	0.9969

(b) Males

Method	Relative survival	Reference date	Estimate	Life table 1989/91	Estimate/life table-ratio
Timæus	$l(60)/l(35)$	1990.89	0.8672	0.8721	0.9944
Brass/Hill	$l(60)/l(32.5)$	1990.89	0.8654	0.8691	0.9957

Notes:
Cases with German mothers = 389, foreign mothers = 779, German fathers = 837, foreign fathers = 1,771; weights for total population based on the share of German and foreign females and males at the ages 20-29 in 1991: German females = 0.9286, foreign females = 0.0714, German males = 0.8711, foreign males = 0.1289; reference date estimated by using the procedure proposed by Brass and Bamgboye (1981)

Table 3: Estimation of male adult mortality from paternal orphanhood of respondents with German and foreign fathers, using the Timæus method, Integrationsurvey 2000

	$l(60)/l(35)$	Survey date	Reference period	Reference date	Mortality level a	$e(35)$
Germans	0.8527	2001.00	10.13	1990.87	-0.088	38.38
Foreigners	0.9214*	2000.94	9.85	1991.09	0.265	43.05
Immigrants	0.9452*	2000.94	9.75	1991.19	0.458	45.37
Foreign Born	0.8919	2000.93	10.06	1990.87	0.090	40.79

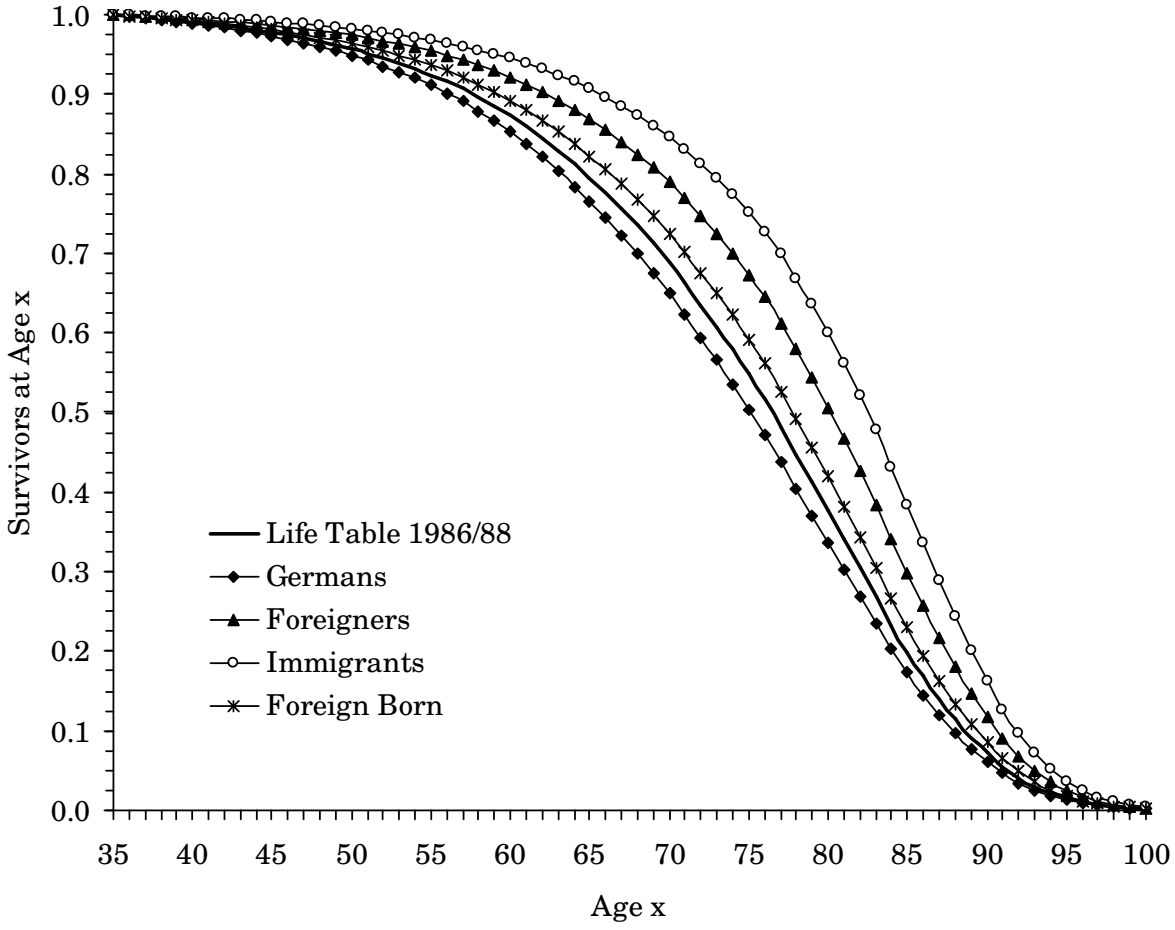
Notes:
* Statistically significant deviation from reference life table 1986/88 for West Germany at the 95 per cent confidence level (based on Bootstrap confidence intervals, n = 500); reference period estimated by using the procedure proposed by Brass and Bamgboye (1981); mortality level and $e(35)$ estimated with Brass logit model, standard: life table 1986/88 for West Germany; survey date refers to the mid-point of the group-specific survey period

Table 4: Estimation of female adult mortality from maternal orphanhood of respondents with German and foreign mothers, using the Timæus method, Integrationsurvey 2000

	$l(50)/l(25)$	Survey date	Reference period	Reference date	Mortality level a	$e(25)$
Germans	0.9657	2001.00	10.09	1990.91	-0.097	53.65
Foreigners	0.9888*	2000.93	9.94	1990.99	0.474	60.39
Immigrants	0.9885*	2000.93	9.93	1991.00	0.461	60.25
Foreign Born	0.9885	2000.93	9.97	1990.96	0.461	60.24

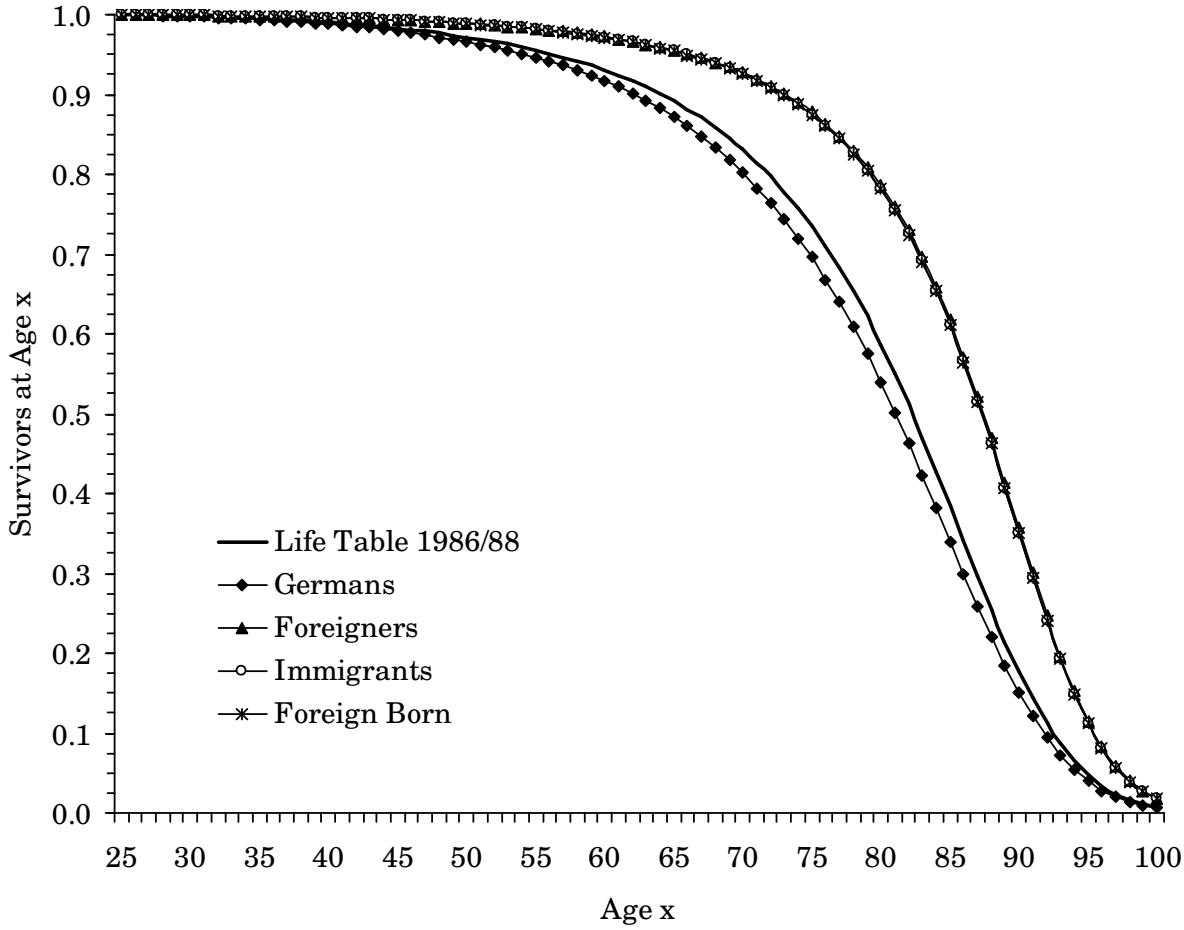
Notes:
* Statistically significant deviation from reference life table 1986/88 for West Germany at the 95 per cent confidence level (based on Bootstrap confidence intervals, n = 500); reference period estimated by using the procedure proposed by Brass and Bamgboye (1981); mortality level and $e(25)$ estimated with Brass logit model, standard: life table 1986/88 for West Germany; survey date refers to the mid-point of the group-specific survey period

Figure 1: Estimated male adult survivorship curves from paternal orphanhood of respondents with German and foreign fathers, Integrationsurvey 2000



Notes: mortality levels based on estimates for $l(60)/l(35)$ using the Timæus method; life tables estimated with Brass logit model, standard: life table 1986/88 for West Germany

Figure 2: Estimated female adult survivorship curves from maternal orphanhood of respondents with German and foreign mothers, Integrationsurvey 2000



Notes: mortality levels based on estimates for $l(50)/l(25)$ using the Timæus method; life tables estimated with Brass logit model, standard: life table 1986/88 for West Germany