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Intergenerational transfers within the family and the role for old age survival

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Abstract

In this paper, we study the relationship between income and old age survival via the indirect pathway of private transfers. Our analysis focuses on intergenerational transfers in the family as an important, but so far less investigated, link between income and improved old age survival. We use an agent based model to simulate an exchange relationship between two generations in a family and incorporate realistic demographic, economic and time use data for Germany. We find that older parents transfer increasing shares of their pensions to their offspring and receive informal care or emotional support in return. This exchange motive is mutually beneficial as younger generations are in greater need for financial subsidies and older ones for contact and care. Our inductive approach adds to our understanding how income is spread in the family and how older family members can benefit from an exchange of money for care.

1 Introduction

Lack of social support or social isolation are key predictors of poor health and increased risk of death at older ages (Berkman and Syme, 1979; Seeman, 1996). Studies from Holt-Lunstad et al. (2010) or Pantell et al. (2013) show that the lack of social relationships at older ages has an equally negative effect on the risk of death like the well known factors smoking and alcohol consumption. This inverse association holds true for different health impairments, causes of death (Stringhini et al., 2012; Eng et al., 2002) and all cause mortality in general (Steptoe et al., 2013). Consequently, emotional or instrumental support from family members is found to be protective against depressive symptoms and mortality in general (Berkman and Glass, 2000; Zunzunegui et al., 2001). Nevertheless, intergenerational support is not per se beneficial for the mental and physical health of older persons (Lund et al., 2014; Seeman, 2000). It is far more important that the intergenerational relationships are motivated by the notion of exchange. Whenever reciprocity in the relations of older parents and their adult offspring is missing, one-sided relations can become stressful (Moorman and Stokes, 2014). This underlines the importance of transfers between different generations of the family as they allow to adhere to the normative expectation of mutual exchange (Antonucci, 2001). In this context, transfers between older parents and their adult children are not only financial or material transfers but also emotional or functional support (Fingerman et al., 2009). In either way, the intensity, direction and nature of transfers depends on the individual needs of each generation (Isengard and Szydlik, 2012). Parents may provide financial support, depending on their income situation, and receive emotional or functional support in return. This pathway may help us to understand why transfers play a major role in explaining the increasing life expectancy at older ages (Carey and Judge, 2001; Lee and Chu, 2012). It adds a transfer component to the relationship between higher income and better health at older ages as higher incomes may be used to motivate intergenerational exchange. From this perspective, income may affect old age health and survival through the provision of financial support in return for functional or emotional help.

In this research we aim at testing this theoretical nexus by using the inductive approach of an agent based model (ABM) that allows us to consider exchange relationships in family networks. The advantage of an ABM is that it includes norms and expectations for each agent which goes beyond a conventional micro simulation model. The agent can react to the behaviour of their closest network links and different normative constraints

for different agent circles are possible. Especially in the family context of giving and receiving we find attitudes, norms and expectations crucial to include. This modeling strategy permits us to test how changing behaviors on the individual level shape macro level outcomes. We test our model empirically in the natural experiment setting of the German reunification. Following reunification, East German pensioners witnessed an up to 10 fold increase of their pension income and a simultaneous decline of their mortality risk. Thus, we seek to emphasize that the inter familial exchange has greatly contributed to the exceptional post-reunification increases in remaining life expectancy for older East Germans. By drawing upon social theory of exchange, we develop a behavioral model from an individual's perspective and include expectations from its social environment concerning his actions (1). We test this model by using realistic demographic data for East Germany 1980-2010, information on intergenerational transfers of time and finances and individual level information on pension levels for East Germans with children and without children (2). The structural change of the German reunification is reconstructed in our sensitivity analysis (3). In four different scenarios, we will estimate how much of the change in improved old age survival could be explained by a change in income that is used for inter-familial transfers.

2 A theoretical link between income, transfers and old age survival

A behavioral model that seeks to link income changes to old age survival via an intra-familial exchange of financial, emotional and functional support needs to accommodate different strands of scientific discussion. There are three major aspects from an economic or sociological background that must be taken into account while we built our model. We derive our research hypotheses from previous empirical and theoretical findings. First, there is the ongoing discussion on the positive association between income and survival and the question if individual wealth affects our health directly or indirectly. Second, a large body of literature demonstrates the importance of intergenerational transfers as a major determinant of survival over the life course. Third, this applies not only to financial or functional transfers as a means to cope with daily living but underlines the importance of emotional support as a facilitator of wellbeing and health especially at older ages. We discuss these three aspects as the background to our model and to derive hypotheses according to which agents act in our model.

2.1 Income and mortality

The fact that wealthier individuals live longer is supported with the findings of earlier research. This association is found in studies that look on absolute wealth (Preston, 1975) as well as on wealth distribution (Kitagawa and Hauser, 1973). However, there is no consensus on why this is the case. From a health economics perspective it is argued that wealth is a proxy for health itself. Thus, healthier individuals are able to earn higher incomes over the life course (Grossman, 1972). This school of thought argues that the demand for health and medical care is positively correlated with the wage rate and that education increases the efficiency with which gross investments in health are produced. Other studies show that income is strongly associated with education. They conclude that more educated individuals live longer and generate more lifetime income (Kroh et al., 2012; Deaton and Paxson, 2001; Deaton, 2003). For Germany, these differences are enormous, wealthier men live five years longer than men with low levels of income and wealth (Kroh et al., 2012). For men in general, low education is associated with a higher fraction of men working in physically demanding and health adverse jobs that shorten their life. Even though there is a weaker association for women and older age groups (Elo and Preston, 1996), women in low income households may suffer from psychological stress caused by economic uncertainty (Belle, 1990). In both lines of thought, income is either a mediator or secondary outcome of higher education and improved health (Rogers et al., 2013). But there is also a direct pathway. Wealthier individuals can simply afford health relevant goods and services like better housing and nutrition or out-of-pocket payments for certain health services (Aguila et al., 2015). All these factors are not mutually exclusive and may certainly influence old age survival at the same time. More importantly, income may be used as transfers either within the family or a network of close relationships (Henretta et al., 2002).

2.2 Transfers and mortality

Intergenerational transfers are a fundamental feature in human lives that help to reduce the risk of death in vulnerable periods over the life course (Lee, 2003; Carey and Judge, 2001). In a bioevolutionary context, resource sharing from older generations favors the survival of their offspring. Yet, transfers also flow from younger generations to their older parents. These up- and downward flows of resources may be driven by different motives. While pure altruism is certainly a strong motive for providing kinship

support (Barro, 1974; Becker, 1974), an exchange motivation seems to prevail if we take a longer lasting transfer relationship into account (Silverstein et al., 2002). Family solidarity and mutuality affect an individuals exchange behavior and its willingness of giving and receiving (Antonucci and Jackson, 1990; Silverstein and Bengtson, 1997; Henretta et al., 1997). In economic and social exchange theory, this norm of reciprocity is central to explain the exchange relationships and non-compliance to this norm is sanctioned (Gouldner, 1960). From an economic perspective, intergenerational transfers are driven by an expectation of individual reward. Parents may invest in their offspring during the life course with the motivation to receive support in times of need at older ages. A potential silent agreement that is found in Asian welfare states (Frankenberg et al., 2002; Silverstein et al., 2006). Complementary, children may provide support for their parents in advance expecting to receive a final gratification in form of a bequest and parents themselves may strategically evaluate and guide the help they need (Cox, 1987; Bernheim et al., 1985). Even though social exchange theory is also centered around the principle of giving and receiving resources and gratifications, it emphasizes the social embeddedness of individual transfer behavior (Granovetter, 1985; Coleman, 1988). This accounts for the fact that especially families exchange more than financial or material resources over longer periods of time. A recipient of transfers may return his debt by emotional or functional support. It also avoids a quid pro quo situation in which every exchange is based on equal value. Givers of transfer in each generation may rather provide the resources that the recipient needs most in his or her current situation (Brandt et al., 2009). This can include emotional or functional support, financial subsidies or time and knowledge transfers. The negative connotation that elderly buy themselves support is not appropriately picturing the relationship between the elderly and their children. The reciprocity of mutually beneficial exchanges is of major importance for familial transfers over the life cycle and found between adult generations in many countries (Brandt et al., 2008). The younger generations are in need of monetary resources (Deindl, 2011) while older generations rather enjoy time with the family and also the feeling to be an important social contact. This pattern is found across Europe (Kohli, 1999, 2004) but compared to other European countries, transfers from parents to children in Germany are given more frequently but the amounts are smaller than for example in Southern Europe where transfers are less frequent but the amounts are higher.

2.3 Social integration, emotional support and health at older ages

The positive association between social relationships, health and wellbeing at older ages is well established (House et al., 1988; Berkman, 1995; Uchino, 2006). This leads to the claim that measures that help to avoid isolation and the feeling of loneliness should be a major target for public health policy (Cattan et al., 2005; Luanaigh and Lawlor, 2008). Herein, it is emphasized that an individual's integration into a social network is a facilitator for resource sharing, social engagement and provision of support that prevent negative health consequences (Berkman and Glass, 2000). Despite their importance in later life, quality and size of social networks changes at older and oldest ages (Field and Minkler, 1988). While weaker relationships to colleagues become less important and the number of friendship contacts diminishes, contacts to core family members become crucial (van Tilburg, 1998). In this context, older parents rely on the provision of emotional and instrumental support from their children. This, in turn, may contribute to their better health and survival chances (Seeman et al., 1987). Parents at older ages that have children tend to live longer and have better health than childless individuals (Ross and Mirowsky, 2002; Zunzunegui et al., 2009; Kendig et al., 2007).

2.4 Research Hypotheses

Based on these interdisciplinary findings, we derive the following hypothesis that we seek to address in our model. In general, we hypothesize that individuals with higher pensions live longer than individuals with lower pensions and that being a parent has an additionally beneficial effect for an individuals survival at older ages. We assume further that both observations interact as higher pension income may be used for higher intergenerational transfers. Herein, children may benefit from higher financial transfers and provide support in exchange. Finally, in this mechanisms higher income may affect health in a direct way through the amenities it buys. At the same time, it enables older people to transfer greater parts of their income to their children and receive support return.

- **H1** higher incomes enable older individuals to buy health relevant goods and services
- **H2** higher incomes facilitate higher transfers

- **H3** higher transfers yield higher returns of functional and emotional support
- **H4** income and transfers yield improved mortality

3 The theory of planned behaviour in an agent based model

We test our hypotheses by modeling an individual's behavior in a two generational family network. We draw upon Ajzen (1991)'s theory of planned behavior to explain an individuals actions in an exchange relationship with other individuals. This allows us to combine the aforementioned economic and social motivations for individual exchange behavior. On this background, an individual can act with the intention to maximizing its return of invested resources (time, emotional and material support) by taking account of his opportunity costs and the available means to act. Yet, it is still embedded in a social framework with reciprocity norms and attitudes that guide intentions. The exchange with other members of the network may comprise different forms of resources and may be guided by mutual expectations about desired behavior. That is why we use an agent-based model instead of a conventional microsimulation as within the family context, we find norms and expectations crucial to include.

According to the theory of planned behavior, three aspects predict behavioral intentions with a high degree of accuracy: attitudes, social and subjective norms toward the behavior, and perceived control over the behavior. Our analysis accommodates the three different aspects: First, an individual's intention is formed by its attitudes and expectations about the benefits of the behavior. Younger and older members of the family may engage in sharing resources with an expectation to benefit from their investments. Children may expect a return on their support efforts, in this case higher inter vivo transfers or expected bequests. If expected transfers when providing care exceed expected transfers without doing so, the agents increase their care efforts. The more the elderly transfer the higher the probability to be visited. Elderly individuals expect visits or care in exchange for their monetary transfers. Care in our analysis follows a very broad definition. It includes household help, personal visits but also telephone calls or other forms of contact. Any form of support including emotional, instrumental (receiving help), appraisal (help with decision making) or informational support is beneficial for an individual. That is the reason to use this inclusive definition of social support measured in time.

Second, an individual's intention is strongly influenced by the subjective and social norms towards the behavior. The formation of intentions is not only driven by a subjective attitude but also by prevailing expectations how the individual should behave. These control mechanisms attenuates selfish behavior in an exchange relationship. Reciprocity and solidarity guide an actor's behavior within the family. This goes beyond a pure investment idea in which parents expect an at least equivalent return in care or later life financial support. Older individuals transfer money or other resources to their descendants if they can afford it and if children or grandchildren are in need of financial support. Downward transfers from older to younger generations are also no one-way street. Children themselves may provide support and expect a certain reward in return.

The third aspect of the theory of planned behavior investigates if individuals can realize the intended behavior or not. This two-tier aspect refers on one side to an individuals perceived possession of the necessary resources to form an intention and on the other side to the actual capacity to behave as intended. From a parents perspective this would translate into the intention to transfer money to their children but this intention cannot be realized due to missing financial resources. As soon as the capacity to transfer increases, in our case through pension increases, the intention can be set into practice. Likewise, younger generations can only support their parents if they have the necessary resources to provide support. Again, this might refer to time resources that enable them to provide support. In this context, the geographical distance between parents and their children is an important predictor for care supply (Crimmins and Ingegneri, 1990). With increasing distance, the available time and financial resources become more important to provide most forms of support.

Within the model framework we take account of the three aspects of the theory of planned behavior to predict model agents' decision making process. The probability to spend time with older relatives increases with proximity, time available, and expected transfer received. In return the elderly are more likely to receive social support when they have higher incomes and their children live in an environment that expects them to provide care. In the context of the theory, our research hypotheses would address different layers in the process from intention building to actual behavior. (H1) means that an individual's control of realizing a certain behavior increases, namely the ability of purchasing health relevant goods and services. This does not necessarily mean that the actor spends it's higher income to maximize health but has the opportunity to buy better health care, quality food or housing. The income related rise of perceived and

actual control apply also to our second hypothesis (H2). Parents usually transfer money to their children if they can. When the possibility to transfer increases, older parents could decide strategically to give more to receive support in return and they may feel obliged to share their increased wealth to help their children. Children may increase the time they spend with their parents with the expectation to receive more (future) transfers or in return for the greater transfers they have directly received (H3). This return of received support is not necessarily in the form of equivalent repayment but may include other forms of emotional or practical support which enables children to comply with norms of reciprocity or solidarity. This exchange relationship is not teleologically connected with better health and survival of older parents but, indirectly, it is certainly beneficial and may mediate the association between income and better health (H4).

Our agent based exchange model will test if income changes can affect the hypothesized behaviors. The model quality will be evaluated with regard to its ability to let major macro data series emerge based on the model agents behaviors. As a baseline, we test if our model can simulate actual population dynamics and a general exchange between two generations within one family. Then we evaluate in 4 scenarios if changes in income, transfer behavior and care contribute to improvements of old age survival.

We seek to show that especially the elderly with higher pension incomes witnessed rapid survival improvements. Furthermore, we expect that with the structural break of the reunification time spend with family members increases as does the amount and percentage of inter-vivo transfers. The mutually beneficial behavior of family members assumes an exchange motive for transfers (Cox, 1987).

4 Data and Model

Demographic, economic and time use data

Our data and model implementation together with an overview of the adequacy of the model to fit realistic economic and demographic rates is in detail described in Kluge and Vogt (2016). We shortly summarize our data and methods used for the reader's convenience.

Information on survival are obtained from the Human Mortality Database (Human Mortality Database, 2013). We use age- and sex-specific death rates for the years 1952 to

2010 as a baseline for the respective age groups for men and women. To account for differences in survival between individuals in pension age, we use transition rates for individuals of different socio-economic status or by number of children from the public pension insurance dataset ("Demografiedatensatz Rentenwegfall/-bestand 1993-2007" from the Forschungsdatenzentrum der Rentenversicherung) to estimate individual adjustment factors depending on which group the individual belongs to.

The German Federal Statistical Offices provides data on age-specific fertility rates. The data from 1952 up to 1989 is available from the special issue on population statistics 1946-1989. After 1990, age-specific fertility rates are covered in the publication on population and employment (Statistisches Bundesamt, 2000). For the future, age-specific fertility rates are held constant for the remaining years until 2051. This should not be a problem, as our model focuses on the changes between 1980 and 2000 in East Germany and we do not seek to predict future developments.

Pension and transfer data for the years 1988, 1993, 2003, and 2008 separately for East and West Germany is provided by the National Transfer Accounts (NTA) database for East Germany (Kluge, 2010). The values for 1988 are based on the income survey for blue-collar and white-collar worker households 1988 for the GDR (Staatliche Zentralverwaltung fuer Statistik, 1988). After reunification, the German Income and Expenditure Survey in 1993, 2003, and 2008 (Einkommens- und Verbrauchsstichprobe, or EVS) serves as the micro foundation to estimate pensions and transfers.

We used the Time Use Surveys 1991/92 and 2001/2002 (latest available data) to estimate the frequency of contact between family members. All data sets are representative for Germany and offer detailed information to estimate age- and sex-specific values. Depending on several characteristics described below, an individual agent in the model receives a set of time- and age-varying demographic and economic parameters.

Agent-based Model

The agent-based model focuses on East Germany during the transition period 1980 to 2000. We model realistic family networks using observed demographic rates for East Germany.[1] Our main economic focus is on pensions received and private transfers given from elderly parents to their adult children.

[1]We use NetLogo (Wilensky, 1999) to model the family relationships. RNetLogo is used for data input (Thiele, 2014) and the following analysis in R.

We set the initial population size to 5,000 individuals and run 50 simulations. The initial population age distribution approximates the one of East Germany in 1952. The individuals' sex is randomly chosen, with the sex ratio being 0.5. Women have an initial number of children depending on their age. If a woman is younger than 15, the number of children is 0. Between age 15 and 25, the number of children is Poisson distributed with a mean of 1, above age 25, the initial number of children is Poisson distributed with a mean of 2. Whenever a woman of the initial population is getting married her partner takes over her family characteristics. We show our model specifications by describing a typical cycle for a typical agent. Table 1 summarizes the subroutines of the NetLogo model in detail in table form.

The first part of the model estimates the demographic parameters. At the beginning of each run, the individual checks if its about-to-die parameter is zero or one. This is estimated in the past period, the individual receives information on its age- and gender-specific death rate. In case the individual is older than 60 the death rate is adjusted depending on pension level and parental status. In case about-to-die equals 1, the agent leaves the model. Using this technique we basically assume all agents to die in December of a respective year. Individuals age by one year in each cycle until they reach their individual age at death.

Women form an own household with a unique family identifier at age 15. This is also the age when they start to look for an appropriate mate. Females are looking for a non-married male with an age difference less than 10 years. In case they are successful, the agents marry and stay married until a partner dies, in which case the remaining individual sets its status to widowed. Children can only be born within marriage. Females between age 15 and 49 receive their age-specific fertility rates for the respective year. In case a woman gives birth, her number of children increases accordingly. The mate receives the same family information such as number of children and family identifier as the female.

Younger agents can move away from their family after age 18. We assume that moving stops after age 50. The moving procedure is simple and the idea is to control for the availability of caring children in the neighborhood. We estimate the distance between a parent and its closest child. In case individuals live close together we assume that they are available to care for their elderly parents. The parameters are chosen such that around 80 percent of the parents have at least one caring child around (Bien, 1994; Malmberg and Pettersson, 2007). Due to the fact that the concept of care used here is

Routine	What happens?	Variables
Death	A random number is drawn. If individual death rate is smaller than random number, individual dies. Beginning of each run: individuals check if about-to-die variable is true (determined in last period). If so, agent leaves the model.	about-to-die, adjusted death rates for males and females
Aging	Each individual ages one year.	age
Marriage	Non-married females aged over 15 search for an appropriate mate: non-married male, no sibling, maximal age distance +/- 10 years. If they find one, agents are linked with female family ID. If partner dies, mate sets status to widowed.	married, widowed
Birth	Married females aged 15 to 45 will have a child with the probability of the age-specific fertility rate (East Germany) for the respective year.	children
Migration	Individuals can change location between ages 18 and 50. Currently, individuals move randomly and we create an availability variable such that around 80% of children live near enough to care for their parents.	availability
Pensions	Individuals enter retirement between age 60 to 65 (randomly determined). Whenever the individual reaches retirement age the pension is determined based on the years contributed (females lose 3 years for each child, males and females have random times of unemployment up to three years), the current pension value, and an occupational adjustment (ranging from 0.4 to 1.4). The life expectancy advantage is calculated comparing the pension increase for the individual compared to pre-1990.	years lost due to raising children, unemployed years, pension, pension increase
Transfers	This routine is only run for parents. We estimate the transfers given and younger individuals check if they receive above mean transfers of their age group or below. Accordingly they spend 2 hours or only 1 hour with their parents. In a second step, the young also consider the pre-1990 transfers they received and in case the transfers have increased they provide additional care that is beneficial for survival of the elderly.	transfers, transfer increase, support

Table 1: The subroutines of the model, authors own considerations

very broad and also includes telephone calls and other impersonal forms of contact this seems to be adequate.

In the second part of the model our main economic variables of interest, namely public pensions and private downward transfers, are determined. Individuals have a randomized pension age between age 60 and 65. Before 1990, retirees receive a random pension of around 200 euros. This value corresponds to the per capita pension values for the GDR estimated within the National Transfer Accounts project for 1988. After 1990, the pension values increase significantly which is in line with real data. The year, agents decide to retire, their pension is estimated according to a simple form of the German pension formula. The actual pension value is multiplied with the years each individual contributed which corresponds to the simplest calculation of German pension benefits. To increase the variance in pension benefits we added an occupation adjustment that varies between 0.4 and 1.4 to account for different income levels. The years contributed depend on the individuals' unemployment history (each individual can have up to 3 years of unemployment that are deducted). As in GDR times unemployment played a minor role we have chosen the relatively low deduction of up to 3 years. In addition, women lose 3 years of contributions for each child. Depending on the pension increase relative to the pre-1990 values, individuals receive an individual adjustment factor. If its lower than three times the pre-1990 value, the adjustment factor is 1.8, corresponding to the disadvantage a poor pensioner without children has according to the German pension data. If the pension amounts to more than 5 times the pre-1990 value, the individual gets the factor 1 assuming that he or she receives the full advantage of decreasing death rates after 1990 that is observed in real data.

The elderly use a fraction of their pension to transfer it to their descendants. The fraction is estimated as a yearly percentage of mean transfers to the next generation from the National Transfer Accounts project. Before 1990, elderly were giving around 1 percent of their pension income to their children or grandchildren according to the micro survey from 1988. Shortly after reunification we find that the fraction increased to around 3 percent and peaks in 2003 with a value of almost 6 percent. The elderly shared their newly accomplished wealth within the family. For the years in between, when no micro survey and no NTAs were available, the data is interpolated. We estimate the household income of the elderly couple and determine the amount of transfers to their children. The children determine their support for the elderly dependent upon the amount of transfers received. This is a two-staged procedure: first the young will evaluate their transfers

received towards the mean of their age group. In case it is lower than average, the hours per week are set to one, the mean of hours for everybody. In case an individual receives above average transfers, care intensifies to two hours per week. Second the young compare the transfers after 1990 with the transfers they received before. In case the transfers increased substantially they add another hour to their care efforts. The amount of support in return determines the adjustment for the corresponding death rates of the elderly individual. In case you do not have a caring child around the adjustment factor is one. In case you do have a normal caring child around the beneficial factor is set to 0.8 and in case you have a very close relationship with your child the factor is set to 0.7, that is the advantage of having children in the German pension data in terms of survival.

The main characteristics are stored for each cycle and each simulation in a dataset that provides detailed information for each individual over a full life course.

5 Results

We develop a baseline scenario using varying death rates, a scenario with changing pension levels and a last variant where the impact of social interaction variation is estimated. The model captures main demographic patterns and social security pensions for East Germany together with time use data on frequency of family contacts and social interaction. The results are based on several runs with an initial population size of 5,000 individuals. The adequacy and fit of the model is in detail shown in Kluge and Vogt (2016). The model mimics age profiles, age specific fertility rates, pension and transfer data for East Germany in the time of societal transition between 1980 and 2010 quite well.

The results for the different scenarios are shown in Table 5. The first row shows the results for the simulation that uses the real observed death rates and no other adjustments as model input. Here, we assume that all covariates important to determine the mean age at death are covered by the real observed rates. In 2010, mean age at death for men is 73.5 years and 81.0 years for women. The second scenario estimates the disadvantage for poor individuals without children. We adjust the death rates to fit the German pension fund data for this subgroup. This shall reflect the combined effect of pension disadvantage together with the disadvantage of being childless. It disregards

Death rates	**Other adjustments/ implications**	**Survival benefit**
real observed rates		mean age at death 73.5 (men) and 81.0 (women), close to reality 2010
death rates * 2	disadvantage of poor individuals without children (German pension fund data)	1990-2010: on average 3 years lower mean age at death
death rates * (1.3, 0.8, 0.4)	**comparison to pre-1990 income**: if individual has less than 3 times pre-1990 income death rates are adjusted with 1.3; 3-5 times pre-1990 income results in the adjustment factor 0.8 which reflects the advantage of wealthier individuals over poorer individuals; more than 5 times pre-1990 income results in adjustment of 0.4	mean age at death around reality for entire population
death rates * (2, 1, 0.6)	Full pensions and same pre-1990 comparison as described above	On average 1 year lower mean age at death
death rates * (2, 1, 0.6)	0.5 pensions and same pre-1990 comparison as described above	On average 3 years lower mean age at death
death rates * 1.5	individuals receive less than 1 hour care/social interaction per week, reflects disadvantage of wealthier individuals without children (German pension fund data)	on average 2 years lower mean age at death
death rates * (1.5, 0.7, 0.4)	**comparison to pre-1990 care**: less than 1 hour per week results in an adjustment factor of 1.5; 1-3 hours care per week received reflects advantage of parents over childless individuals results in 0.7 adjustment factor; more than 3 hours of care per week reflects in highly advantageous adjustment factor of 0.4 which reflects rates for wealthy parents	including social interaction results in real observed rates and a faster convergence after 1990 than in the pension scenario

Source: adjustment factors based on German pension fund data, own calculations

other differing factors such as health care quality, environmental or individual lifestyle factors that are certainly important and will be referred to in the concluding section. Within only 20 years an advantage in the mean age at death occurs of 3 years on average in the scenario using the real observed rates as compared to the ones for poor individuals without children. In this model, this is the combined effect of higher pensions and thus higher transfers. For this analysis we focus on elderly individuals above age 60. In reality in addition, male middle age mortality in the transition period played an important role in Eastern Germany. This could be addressed in the future with a realistically modeled labor market.

In a second scenario we vary the pension height and mortality adjustment factors. Individuals compare their pension wealth with their pension wealth before 1990 and according to the increase they receive a favorable/unfavorable adjustment factor. This shows the impact of individual wealth on survival. We find that the model is responsive to both, changes in the adjustment factors and in the pension level. The adjustment factors (1.3, 0.8, 0.4) result in death rates estimated from the German pension fund data for the respective subgroup. Assigning the members of the subgroups their relative adjustment factors results in comparable results for the real observed mean age at death. The unfavorable adjustment factors (2, 1, 0.6) result in a one year lower mean age at death on average. Halving the pension level results in another two year disadvantage in the mean age at death on average. We find the importance of income and income differentials for survival confirmed as was shown in earlier research for East Germany (Gaudecker and Scholz, 2007; Kibele et al., 2013).

The last scenario factors in the social interactions of elderly East Germans. A couple determines the household income and the actual amount the couple would like to transfer to the children. The children compare their received transfers with the transfers pre-1990. The basic care level that all children provide to their parents is set to one hour, according to the time use data for East Germany 1991/92. As described before, care reflects all kinds of emotional or functional support, including simple phone calls. The more transfers children receive after 1990, the more they intensify their social interaction up to more than 3 hours per week. Without transfers, all individuals receive an adjustment factor of 1.5, which reflects the disadvantage of childless individuals to parents. In the period 1990-2010, this results in a disadvantage of around 2 years in mean age at death as compared to the scenario allowing transfers. The level of transfers only results in short run differences in the mean age at death. The higher transfers result in a faster

convergence but results in comparable death rates in the long run. This could mean that any kind of social interaction is beneficial for survival.

6 Conclusion

The results of our model show the importance of money for longevity, a fact that is well-known from the existing literature. In our setting, we go a step further and our agent-based model in addition includes the important variable of social interaction/connectedness/embeddedness for longevity. We use the theory of planned behaviour to model these social interactions (Ajzen, 1991). The advantage of the agent-based model includes the importance of norms and expectations to model family relationships. The link between income and income sharing within family networks is an important parameter for survival in the literature. Especially for elderly individuals giving and receiving transfers is an important driver for health and well-being. The case study of East Germany is highly suited to investigate the presented research question as for the time of transition between 1980 and 2010, good quality data is available for public and private transfers and time use.

We estimate our model for three different settings. First, we explore the impact of changing adjustment factors itself. Here, we find a 3 year disadvantage in mean age at death on average for the least favorable adjustment factors. The second scenario investigates the impact of the pension level. Halving the pension level results in a 2 year disadvantage in mean age at death for the period 1990-2010 on average. Adding transfers to the analysis results in a 2 year advantage as compared to the scenario without inter-vivo transfers.

We find our hypotheses 1 to 4 confirmed by the model. Higher income itself is beneficial for survival in our model. In addition, East German elderly share their higher income with their descendants and increase the fraction of income transferred. This in return increases the care efforts of the children and is beneficial for survival via the indirect transfer pathway. The additional positive effect of transfer giving and receiving as compared to the pure income effect of increased pensions is important to understand family relationships and the impact of connectedness on health and survival for individuals.

Income and transfers are both beneficial for survival and cannot be separately assessed

in our model. Both income and transfers are in addition connected to social integration and health at older ages. The interlinkages cannot be precisely disentangled here. Still, we are confident that with the solid base of the German pension fund data and the estimation of the adjustment factors for different individuals, we can provide interesting results for subgroups such as poor or wealthy elderly individuals or parents and childless people.

The agent-based model is a first step to include family networks into an analysis of survival in the case study of Eastern Germany after reunification. Not all factors are explicitly covered in our model. For example, health care quality and environmental factors as well as individual lifestyle factors are only implicitly included using the real observed death rates for the period 1980-2010. The model cannot account for these separately. In the future, it would be beneficial to add realistic labor market and other economic parameters for younger individuals. In addition, the data input comes from a wide range of sources. Thus, a direct causal pathway cannot be estimated and quantified.

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