ALTRUISM AND BEYOND

An economic analysis of transfers and exchanges within families and groups

ODED STARK

CAMBRIDGE

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This book employs economic methodology to study the motives for and the repercussions of transfers and exchanges within families, between generations, and within groups. The book shows how the allocative behavior and wellbeing of one family member depend on his altruistic link with another family member, how the timing of the intergenerational transfer of the family productive asset affects the recipient's incentive to engage in human capital formation, and how transfers from an adult to his parents impinge on future transfers to him from his own children. In addition, the book shows that under asymmetric information high-skill migrant workers make transfers to low-skill would-be migrants in order to lure them to stay put, and that under incomplete information a group-specific informational edge – lower recognition costs – results in a superior exchange outcome. Finally, altruism, which in the beginning of the book is assumed, is explained: the transmission to or probable acquisition by children of parental traits and the exchange between siblings are shown to result in a stable equilibrium wherein no agent behaves nonaltruistically.

The book studies both altruistic and nonaltruistic motives for transfer behavior. In addition, it traces some of the market repercussions of intrafamilial, intergenerational, and intragroup transfers and exchanges.

Critical acclaim for *Altruism and Beyond*

"The prevalence and importance of altruistic transfers in human affairs is a constant reproach to the economists' standard postulate of strict self-interest. In this short book Oded Stark shows how self-interested and altruistic behaviors are often subtly intertwined. As just one example, why do parents press their children for grandchildren? Because, he suggests, grandchildren motivate the middle generation to care for their elders – since doing so is likely to elicit parallel behavior in turn from their own children! Stark's volume deepens our understanding of the sources and consequences of altruistic behavior both within families and within ethnic groups."

Jack Hirshleifer, University of California, Los Angeles

"Oded Stark has been at the forefront of research designed to comprehend issues at the interface of economics and sociology. In this book Stark brings his remarkable insights into the behavior of migrants to understand the motives that underlie the behavior of economic agents when such agents are viewed as members of a family or of a larger group. … [T]his book is a nice mix of theory and empirics. The book is full of all kinds of interesting research ideas. … [I]t is one of those books which actually sets you thinking about your own life, particularly your interactions with your parents and your children."

Kyklos

"Oded Stark's book is a very stimulating one; it will undoubtedly inspire numerous future contributions in various fields."

European Journal of Political Economy

"Sparkling … insightful … a pleasure to read."

Population Studies

"[A] stimulating book. … Stark is to be commended for pushing the theoretical … frontiers of economic methodology into new and innovative directions."

Population and Development Review

"I would strongly recommend to read this book."

De Economist

"No doubt most economists will cheerfully (and sometimes correctly) continue to ignore altruism. For those who cannot, altruism will remain a tricky subject. This book, however, should make them a little less puzzled by the selfless behaviour of so many non-economists."

The Economist

ALTRUISM AND BEYOND

AN ECONOMIC ANALYSIS OF TRANSFERS AND EXCHANGES WITHIN FAMILIES AND GROUPS

Oscar Morgenstern Memorial Lectures

Oscar Morgenstern (1902–1977), a Professor of Economics at Princeton University and prior to that at the University of Vienna, is well known for having had an enquiring mind that was seldom satisfied with prevailing answers to the main intellectual questions of the day. In spite of his considerable enthusiasm for mathematics, it was his view that the social sciences, and economics in particular, require a mathematical structure which is different from that developed for physics and the natural sciences. His own contributions, notably and notwithstanding the *Theory of Games and Economic Behaviour* co-authored with John von Neumann, should not be interpreted to imply that his view was that game theory alone is rich enough in its understanding and description of human behavior to provide adequate models of individual agents.

Oscar Morgenstern played an instrumental role in the establishment of the Institute for Advanced Studies in Vienna. The mission of the Institute was to revive advanced research and teaching in Austria, especially through the development of new formal methods and models appropriate for social science enquiry. The Oscar Morgenstern Memorial Lectures, which are sponsored by the Institute and delivered there annually, represent a fitting scholarly tribute to his memory.

Oscar Morgenstern Memorial Lectures

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CAMBRIDGE
UNIVERSITY PRESS

PUBLISHED BY THE PRESS SYNDICATE OF THE UNIVERSITY OF CAMBRIDGE
The Pitt Building, Trumpington Street, Cambridge, United Kingdom

CAMBRIDGE UNIVERSITY PRESS
The Edinburgh Building, Cambridge CB2 2RU, UK
40 West 20th Street, New York, NY 10011-4211, USA
477 Williamstown Road, Port Melbourne, VIC 3207, Australia
Ruiz de Alarcón 13, 28014 Madrid, Spain
Dock House, The Waterfront, Cape Town 8001, South Africa

http://www.cambridge.org

First published in printed format 1995

ISBN 0-511-03784-8 eBook (Adobe Reader)
ISBN 0-521-47419-1 hardback
ISBN 0-521-66373-3 paperback

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Preface

Reading Oscar Morgenstern's fascinating work on what constitutes proper economic research persuades me that he would have approved of the theme and approach of this book: economic methodology (seasoned with a little mathematics) applied to a study of the motives that underlie the behavior of agents as family members and as members of distinct groups.

Lectures published in this book not only address transfers but also, to a great extent, emanate from transfers. To begin with, all six lectures-turned-into-chapters benefited considerably from searching questions raised by colleagues and students who attended the lectures in Vienna. Chapter 1 owes much to the comments and suggestions of Kenneth J. Arrow, Gary S. Becker, Theodore C. Bergstrom, and Paul A. Samuelson. Chapter 2 is fully due to collaboration with Oded Galor. Chapter 3 is fully due to collaboration with Donald Cox, enriched by Richard Arnott, Gary S. Becker, Theodore C. Bergstrom, and Zvi Griliches. Chapter 4 owes a debt of gratitude to Donald Cox for his invaluable input. Chapter 5 is freer from ambiguity as a result of advice offered by Robert J. Aumann and Ian Molcho. Collaboration with Theodore C. Bergstrom gave rise to chapter 6, the refinement of which is due to comments by Carl Bergstrom, Gary S. Becker, Jack Hirshleifer, and Andreu Mas-Collel.

The conversion of lecture notes into a published volume can be – but was not – a joyless undertaking, because of the encouragement and support I received from Bernhard Felderer, the advice and help I received from Christian Helmenstein, and the dedicated and skillful assistance of Isabella Andrej, and Elinor Berg. I am indebted to the World Bank's Policy Research Department and Research Committee, Bank Austria, and Tel-Aviv University for financial support. But the greatest debt of all is to my wife Shua Amorai Stark and my children Eran and Alit, who in their very special way prompted and inspired me to ponder and reflect on intrafamilial and intergenerational transfers and exchanges.

Quite obviously, I will be very pleased if all those whom I have mentioned will accept this book in exchange for their stimulation, collaboration, and support, and as a token of my gratitude.

Introduction

Introduction

The first three lectures-turned-into-chapters in this book implement the idea that economic methodology is helpful in understanding the motives for and the repercussions of transfers and exchanges even if they take place *outside* markets. Although it may seem odd to think of a family environment as a "marketplace," or of family members in their relationships with each other as market agents, it is quite natural to use an economist's lens to view the ways in which the preferences and actions of one family member impinge upon and modify the choice-set, the behavior, and the wellbeing of another.

Chapter 1 investigates the relation between the allocative behavior and wellbeing of one family member and his altruistic link with another. Chapter 2 explores how the timing of the intergenerational transfer of the family's productive asset affects the recipient's incentive to engage in human capital formation. Chapter 3 sheds light on the way in which transfers from an adult to his parents impinge on future transfers to him from his own children. Each chapter also traces at least some of the ensuing *market* repercussions. Chapter 1 refers to a disincentive to transact in anonymous markets arising from altruistically-motivated automatic transfers between altruistically-linked family members; chapter 2 considers the effect of individuals' human capital investment decisions on economy-wide per capita income; and chapter 3 suggests that the benefits that accrue to particular family members from engaging in intrafamilial transfers could account for the fact that they have a lower rate of participation in the labor market. Economics (narrowly defined) thus provides the tools but also reaps some gains from their use.

Although chapter 4 also examines the market-wide repercussions of individual conduct, it essentially takes a reverse track: it studies the repercussions of informational asymmetry, differentiated by skill, on migration and transfer behavior, and only in passing asks how specific market features, such as the self-employment and wage-employment composition of the labor force, are affected by a specific motive for remittances.

To a considerable extent some features of families such as good mutual information on character and attributes – "type" – transcend into larger groupings, of migrants say, who share a common origin. In chapter 5, this group-specific informational edge – lower recognition costs – is shown to result in a specific *market* outcome – a higher per capita income per migrant relative to nonmigrants. Here again I trace the market repercussions of an intragroup feature.

Although the chapters that relate to migrants follow the chapters that do not, the study of nonmarket transfers and exchanges, as exemplified by the first three chapters, is informed and motivated by a strong interest in labor migration (both within and from developing countries). In studying motives for migrants' remittances, I began to see that the spectrum of feasible transfer motives ranged from pure altruism to pure self-interest. Empirical analysis to determine where in the spectrum the actual motive lies revealed that it is not at the end points (Lucas and Stark [1985], Stark and Lucas [1988]).

A fascination with altruism led to a number of studies (for example, Bernheim and Stark [1988], Stark [1989]) as well as to chapter 1 in this book. But in line with the initial suspicion that there might be more than altruism at work in transfers between family members (as anthropologists have known all along), chapters 3 and 4 suggest new, nonaltruistic motives for transfers. Still, the very prevalence of altruism is of considerable interest. Whereas chapter 1 *assumes* altruism within the family – and considers some of its repercussions – chapter 6 tries to *explain* altruism. It is shown that the transmission or probable acquisition of parental traits (patterns of behavior) by children and the exchange between family members (siblings) may result in a stable equilibrium wherein no agent behaves nonaltruistically. The qualifier "may" is used because the results are model-specific (the basic prisoner's dilemma model of chapter 5 is reused), altruism is defined in a particular manner, and the "altruism only" equilibrium is one of several possible equilibria. Yet chapter 6 demonstrates and redemonstrates an outcome in which altruism as a trait is acquired, transmitted, and sustained, not in spite of evolutionary pressures and the forces of selection but *because of*, or *through*, these pressures and forces.

As a collection these lectures, as life itself, feature both a concern for others and a selfish calculus. In doing so they restore a balance I sensed a decade ago but ignored somewhat in the intervening period.

The opportunity to introduce lectures already delivered is also a temptation to speculate on themes to be taken up in future forums. One line of thought that merits additional study relates to the tendency in the literature to differentiate between altruistic motives for transfers and exchange motives for transfers (Lucas and Stark [1985], Cox and Rank [1992]). When recipients' income declines, donors will transfer more if the transfers are motivated by altruism, but less if the transfers are motivated by exchange. The reasoning is that the recipient's *capacity* to provide a future service – for example, insurance – should the donor fall on hard times, is weakened. A lower (expected) value is matched by a lower price (transfer). What this argument seems to ignore, however, is the possible effect of transfers on the *willingness* to provide a service. An increased (or an unchanged) transfer coinciding with a decline in the recipient's income can be interpreted as a manifestation of real concern, and is likely to enhance the recipient's gratification: the recipient's *will* to offer support in the future is positively affected. Now, if the donor is aware of this link between his *behavior* and the recipient's *preferences* and if a stronger propensity more than offsets a weakened ability, it could well be in the donor's interest, in his sequential exchange with the recipient, to continue to transfer the same amount. Thus an optimizing exchange-motivated donor will behave in a manner akin to that of an altruist, and the inference of a transfer motive from the sign of the ratio between the change in the amount transferred and the change in the recipient's income breaks down. Under altruism $dT/dY < 0$, where dY is the change in the recipient's income and dT is the change in the donor's transfer; under exchange $dT/dY > 0$. However, under exchange with preference-shaping transfers – which may be termed "strategic exchange" – it is possible to have $dT/dY < 0$.

Altruism, exchange, or various "shades" of the two may not encompass all possible motives for transfers. It seems to me that an aversion to unfairness could also account for transfer behavior. Persons who are economically very successful and amass considerable wealth typically donate substantial sums to charities, establish philanthropic foundations, and so on. Being very fortunate (relatively to others) could be associated with the notion that inequities in income are somehow unfair. Can we assume that there is a subjective threshold of acceptable unfairness beyond which transfers are elicited? If so, the associated questions – what determines the thresholds and why they differ across individuals – could warrant theoretical, experimental, and empirical study.

Two somewhat extreme and apparently irrational types of behavior may be consistent with an "aversion to unfairness" argument in agents' utility functions: the destruction of one's own property by well-off individuals in some tribal or primitive societies, and the rejection of the share offer in a once-played ultimatum game.[1] Even though such abandonment differs from transfers, these examples help to capture a pure "aversion to unfairness" effect; clearly, altruism is not involved.

A second line of thought that could warrant further study pertains to the behavioral implications of altruism. A good way to think about the issue is to conceptualize altruism as insurance. This gives rise to the two well-known problems of moral hazard and adverse selection. The incentive of a son toward whom a father is altruistic to exert effort to secure consumption, can be weakened by the knowledge that failure on his part will trigger altruistic transfers. When the son does not face the full cost of his actions he will exert insufficient effort. Therefore, as is the case with insurance contracts, weak altruism is better than strong ("complete") altruism since it compels the son to face part of the consumption risk. *If*, however, the father *can* observe and verify the level of effort undertaken by his son, no loss will arise from strong altruism ("full insurance"). Support will be forthcoming when the shortfall is due to adverse exogenous events, but will not occur if it is caused by laziness. "Altruism cum reason" thus evades the unwarranted repercussion of what might be termed "altruism cum softness." *If*, however, the father *cannot* completely verify the reason for consumption shortfalls, an adverse selection problem can arise. Assume that there are several sons, some of whom reside and work away from home, as migrants for example. Extending a given equal degree of altruism toward all the sons will induce the

[1] In the ultimatum bargaining game, two agents have one opportunity to share a given amount of money. Agent 1 states his demand and then agent 2 accepts or rejects this demand. If agent 2 accepts, sharing ensues. If agent 2 rejects, both agents get nothing.

least industrious to depend on altruistic transfers, and a lower degree of altruism will hurt the more industrious sons should they face consumption shortfalls arising from events outside their control.

In this context note that a positive outcome *could* arise if an altruistic father structures transfers so that they supplement and amplify the rewards arising from expending effort. If the substitution effect dominates the income effect, effort expended under altruism will be larger than effort expended in the absence of altruism. But more effort should result in higher income, on average. A testable prediction is that the variance in market outcomes across children is attributable to the variance in altruistic inclinations across parents.

What could mitigate the disincentive problem arising from altruism cum imperfect observation and monitoring is the possibility that altruism demonstrated entails altruism acquired and practiced, that is, reciprocated. If repeated acts of altruism by the father are witnessed during the son's youth, the son could become an altruist too, in which case an inclination to exploit the father's altruism will be countered by the son's altruism. Being an altruistic father is then not detrimental to his son expending proper effort but, rather, conducive to such an exertion. Exposure to altruism could result in internal self-monitoring that fully offsets nonobservability. The connection with market repercussions can be illustrated with a migration example. When not all children end up being equally altruistic toward their parents, a more altruistic child will be chosen as the family's migrant, even if the labor market earnings of that child are lower than those of the less altruistic child, given that the parents' objective is to partake in the migrant child's earnings. In the Philippines, the labor market earnings of young women are lower than the earnings of young men, but since young women tend to remit more to their families, the typical migrant is a daughter, not a son (Lauby and Stark [1988]). This reflection suggests that it would be interesting to do research on how altruism is instilled and cultivated. Chapter 3, which considers imitation and internalization, offers one direction; chapter 6, which models evolutionary transmission and imitation, offers another, but there are surely more.

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1

Altruism, transfers, and wellbeing

Introduction

In all economies, but particularly in less developed countries, a considerable proportion of resource transfers takes place outside the realm of the marketplace: inside families, within households, and among members of kin group or caste. Often it is not all that clear what exactly these transfers "buy": we do not see commodities moving in the reverse direction nor do we observe a flow of easily definable services. For example, households in rural India "purchase" insurance against variability in consumption not from insurance companies but from other households whose sons marry their daughters, and whose incomes exhibit low covariability with their own (Rosenzweig and Stark [1989]). Such actions are different from typical marketplace exchanges where the transfer of a commodity from A to B is accompanied by the transfer of another commodity from B to A and where one of the exchangeables is money, so that it is quite clear what is being bought – and at what price. It is generally argued that nonmarket intragroup transfers are mandated by the insufficient development of markets and that as development proceeds, a larger share of transfers and exchanges is relegated to the marketplace. This reassignment is believed to hasten the pace of economic development as the scope for exchange and trading opportunities increases. This, in turn, should feed back into the production opportunities set by facilitating increased specialization and recourse to comparative advantage.

The precise mechanisms that generate nonmarket transfers have not so far been well explored. This chapter reviews the role of intragroup altruism as one force leading to nonmarket transfers. If individuals receive altruistically-motivated transfers which, in a sense to be made precise, are more valuable to them than transfers received through alternative routes, that is markets, then the preference for interaction between altruistically-connected individuals will not be eradicated as the economy becomes more market oriented. It is, however, probably inappropriate to view altruism as a static force, ignoring the possibility of those events or actions that lead to its rise or fall (Stark [1989]). Thus if the overall effect of enhanced altruism on a social group is positive, the group is more likely to foster it and the practices based upon it will be more persistent than if the effect is negative. This variation may help to explain the different transition rates to transfer regimes that are governed by full market forces.

Suppose that altruism is not invariant to conduct and actions, and that an activity which nurtures altruism precludes engagement in a beneficial market activity. Markets will not develop if the net transfer value arising from the altruism-enhancing (or altruism-preserving) activity is larger than the net value due to the market activity. Moreover, the introduction of markets could crowd out altruistically-motivated actions to such an extent that the group concerned may actually be worse off. Commercialization of blood-giving in the United States may explain why the amount of blood given voluntarily in that country is small and the total (per capita) supply of blood significantly less than in the United Kingdom where giving blood is completely voluntary and unpaid. (It is as if individuals cease to give blood when they see that other people are being paid for it; see Titmuss [1970] and Arrow [1974].)

The present chapter does not attempt to fully explain how an economy governed by altruistically-motivated transfers transforms into a market-transfers economy. But it does contribute to understanding why such a transition may or may not take place. The chapter draws on the notion that when as an opportunity to trade anonymously a market entails transaction costs that are absent from an altruistically-based transfer regime, the market will be "missing" or inactive. The argument that "market failures eventually give rise to institutional arrangements that act as complete or partial surrogates for what markets do not provide" (De Janvry, Fafchamps and Sadoulet [1991]) thus misses the point that causality may run in exactly the reverse direction: the edge that existing (nonmarket) institutional arrangements have over market structures inhibits the evolution of markets and, if markets are created, works against the inclination to transact in them. We return to these points in the Conclusions section of the chapter.

Transfers and altruism

We formulate a fairly general model of preferences for family members. We focus on situations involving two individuals, F and S (father and son), although the principles discussed here can be generalized to larger groupings and other settings (such as, for example, the case of a sequence of generations caring about their own felicity as well as the utility of the parent generation and the succeeding generation).

Let C denote the sole consumption good, corn, the total amount of which we fix arbitrarily. Suppose all this corn is initially under the father's control. The level of corn consumed by an individual affects his pleasure. We refer to this direct pleasure as "felicity" and describe it by functions $V_F(C_F) > 0$, $V_S(C_S) > 0$, $C > 0$, $V'_F(C_F) > 0$, $V'_S(C_S) > 0$, where C_F is the consumption of corn by the father and C_S the consumption of corn by the son. Each individual cares about his own felicity and the utility of the other. Reflecting the fact that each individual likes to consume corn (own felicity) and wants the other to be happy, utility is given by the following two simultaneous functions:

$$U_F(C_F, C_S) = (1 - \beta_F)V_F(C_F) + \beta_F U_S(C_S, C_F), \tag{1.1}$$

$$U_S(C_S, C_F) = (1 - \beta_S)V_S(C_S) + \beta_S U_F(C_F, C_S). \tag{1.2}$$

We have parameterized altruism by a simple scalar β_i – the weight that one places on the utility of the other relative to one's own felicity. We assume that $0 < \beta_i < 1$, that is, i attaches a nonnegative weight both to his own felicity and to the other's utility; he is neither masochistic nor envious. To flesh out the implication of utility interdependence for preferences over consumption allocations we can solve (1.1) and (1.2) in terms of $V_F(C_F)$ and $V_S(C_S)$. This yields:

$$U_F(C_F, C_S) = (1 - \alpha_F)V_F(C_F) + \alpha_F V_S(C_S), \tag{1.3}$$

$$U_S(C_S, C_F) = (1 - \alpha_S)V_S(C_S) + \alpha_S V_F(C_F), \tag{1.4}$$

where

$$\alpha_F = \frac{\beta_F(1 - \beta_S)}{1 - \beta_F\beta_S} \tag{1.5}$$

and

$$\alpha_S = \frac{\beta_S(1 - \beta_F)}{1 - \beta_F\beta_S}. \tag{1.6}$$

Note that from the restrictions on β_i in the fundamental specification it follows that $\alpha_i > 0$ *and* also, as can easily be verified, that $\alpha_F + \alpha_S < 1$.[1]

For analytic simplicity we suppose for now – but see below on generalization to other functional forms – that

$$V_F(C_F) = ln(C_F) \tag{1.7}$$

and that

$$V_S(C_S) = ln(\mu C_S), \tag{1.8}$$

where $\mu > 0$. Since

$$C_F + C_S = C, \tag{1.9}$$

we can solve for the optimal level of the father's consumption of corn by differentiating (1.3) with respect to the single variable C_F. This yields

$$\begin{aligned} \frac{dU_F(C_F, C_S)}{dC_F} &= \frac{d}{dC_F}\,[(1-\alpha_F)\,ln\,C_F + \alpha_F\,ln(\mu(C-C_F))] \\ &= \frac{1-\alpha_F}{C_F} - \frac{\mu\alpha_F}{\mu(C-C_F)}. \end{aligned}$$

[1] If one *begins* with (1.3) and (1.4) rather than with (1.1) and (1.2) then there is no apparent reason to impose the restriction that $\alpha_F + \alpha_S < 1$. When $\alpha_F + \alpha_S > 1$, *F* and *S* will have disagreements in which each wants the other to accept a larger share of the communal corn. We ignore such a case for two reasons. First, it strikes us as more natural to take (1.1) and (1.2) as the fundamental specification of preferences rather than (1.3) and (1.4). While individuals may be able to observe each other's levels of happiness, they certainly cannot apprehend each other's felicity directly. That $\alpha_F + \alpha_S < 1$ then follows from the absence of envy and masochism in the fundamental specification. Second, if one wishes to consider cases in which $\alpha_F + \alpha_S > 1$ then one can simply think of individual *F* (*S*) as *S* (*F*). When an individual cares more about another person than about himself, then the individual is essentially the other so the two can simply be renamed. Our results then refer to questions such as what happens (for instance, to economic performance) as altruism falls from excessive levels.

From the first order condition we thus obtain

$$\left(\frac{C_F}{C_S}\right)_F = \frac{1 - \alpha_F}{\alpha_F}, \tag{1.10}$$

where the subscript F indicates that this is the optimal consumption ratio arising from the father's optimization.

In a similar way we can derive the consumption ratio which is optimal from the son's point of view:

$$\left(\frac{C_F}{C_S}\right)_S = \frac{\alpha_S}{1 - \alpha_S}. \tag{1.11}$$

From inspection of (1.10) and (1.11) it follows that

$$\left(\frac{C_F}{C_S}\right)_F > \left(\frac{C_F}{C_S}\right)_S \Leftrightarrow \frac{1 - \alpha_F}{\alpha_F} > \frac{\alpha_S}{1 - \alpha_S} \Leftrightarrow \alpha_F + \alpha_S < 1; \tag{1.12}$$

since the right-hand side inequality indeed holds, we conclude that the father's optimal allocation is such that he wishes to consume a larger proportion of corn than his son wishes him to consume. However, this does not necessarily imply a conflict. In figure 1.1, point B represents the father's preferred ratio whereas point A represents the son's preferred ratio. To be sure, if the prevailing allocation is anywhere between 0 and A, that is, the son receives more than his preferred ratio while the father receives less than his preferred ratio, both father and son will favor transfer of corn from son to father. If the existing allocation is anywhere to the right of B, both parties will favor transfer of corn from father to son. However, should the initial allocation lie anywhere between A and B, there will not be blissful unanimity: a conflict will arise as the father would like to move right toward B, whereas the son would like to move left toward A.

Several implications can now be drawn. First, mutual altruism intersected with certain initial allocations of the consumption good results in mutually agreeable transfers; individuals who are altruistically linked can expect automatic

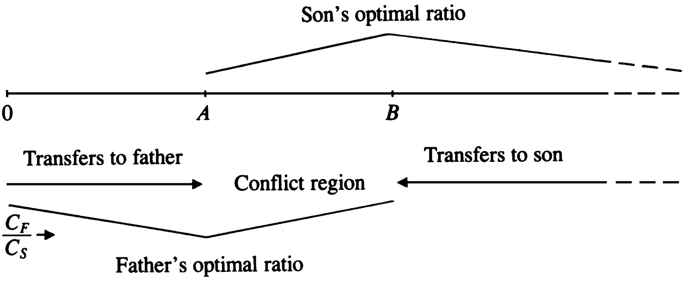

Figure 1.1 Optimal consumption ratios

(negotiation-free or conflict-free) transfers should the initial allocation be unfavorable to them (in the sense of falling outside AB). It is this feature of "guaranteed" transfers that accounts for the strong attraction of being associated with a kinship network even if anonymous markets exist. Note in particular that if father and son happen to experience an initial ratio to the left of A (a consensus for reallocation in favor of the father), it is immaterial who decides how to divide consumption: whether the son controls the stock of corn – in which case he will transfer corn to the father – or the father does – in which case he will retain the corn.

Second, although the presence of altruism narrows the domain of conflict (in the absence of altruism $\beta_F = \beta_S = 0$, that is, each party would like to consume the entire supply of corn leaving zero quantity to the other party) it does not eradicate it. The result that altruism does not necessarily eliminate conflicts about consumption allocations is clearly true in a model of one-sided altruism – for example, in a model where a parent's utility depends on own consumption, the number of children, and the utility attained by each child, and where the parent spends his earnings and inheritance on own consumption, on bequests to children, and on costs of raising children. It is not too difficult to show that in this setup, optimization by the parent could result in a conflict with the children who want larger bequests than the parent is willing to give (Barro and Becker [1989]). But what is more revealing is that two-sided (mutual) altruism does not necessarily eliminate conflicts over allocations either.

Third, suppose the father's altruism toward his son rises. How will the distribution of corn be affected by such an increase? Put differently, what happens to consumption choices when the father becomes "more loving"? Given the interdependence of the utility functions, the answer to this question is not obvious. We know that β_F, the relative weight the father attaches to the utility of his son, reflects the intensity of his altruism. We thus need to examine the sign of a change in the optimal ratio with respect to a change in β_F. We obtain

$$\frac{\partial \left(\frac{C_F}{C_S}\right)_F}{\partial \beta_F} = \frac{-\frac{d\alpha_F}{d\beta_F}}{\alpha_F^2} < 0 \qquad (1.13)$$

with the inequality sign arising from $\frac{d\alpha_F}{d\beta_F} > 0$ as can be verified by inspection of (1.5). Thus if the son succeeds in raising his father's altruism toward him, B in figure 1.1 shifts to the left so that, for example, more initial allocations result in conflict-free transfers from father to son. Note, however, that although the conflict range is declining in the intensity of the father's altruism toward his son, it is not eradicated (that is, as long as $\alpha_F + \alpha_S < 1$).[2]

Fourth, suppose that a bumper crop (or, in another context, a public transfer) raises the quantity of corn

[2] The result that the conflict range declines in β_F can be obtained formally as follows. Let the conflict range be defined by $D = \left(\frac{C_F}{C_S}\right)_F - \left(\frac{C_F}{C_S}\right)_S$. Since

$$D = \frac{1-\alpha_F}{\alpha_F} - \frac{\alpha_S}{1-\alpha_S} = \frac{1}{\alpha_F} - \frac{1}{1-\alpha_S} = \frac{1}{1-\beta_S}\left(\frac{1-\beta_F\beta_S}{\beta_F} - 1 + \beta_F\beta_S\right),$$

we have that $\frac{\partial D}{\partial \beta_F} = \frac{1}{1-\beta_S}(-\frac{1}{\beta_F^2} + \beta_S) < 0.$

available for distribution and consumption. How would transfers be affected? Since constraint (1.9) would now merely change to $C_F + C_S = kC$, $k > 1$, optimization will result in (1.10) and (1.11) as before. Hence, (1.12) continues to hold and A and B in figure 1.1 do not shift. (Indeed, for the chosen logarithmic specification of the utility functions, the preferred point B has both father's and son's consumptions rise in exactly the same proportion as the family's total corn, and likewise with regard to preferred point A.) Potential conflicts over consumption allocations are not a declining function of the total quantity of the consumption good. It appears then, not surprisingly, that the son's route to higher utility is a larger quantity of C available for total consumption – regardless of how this greater quantity is distributed (inspect (1.4)). However, only a stronger father's altruism can secure a distribution which is at once conflict-free *and* more favorable.

Suppose (1.7) and (1.8) are replaced by

$$V_F(C_F) = \gamma C_F^{\gamma} \tag{1.7$'$}$$

and

$$V_S(C_S) = \gamma C_S^{\gamma} \tag{1.8$'$}$$

for any $0 < \gamma < 1$. The analysis as per (1.9) through (1.12) follows through as before, except that the optimal consumption ratios now appear as

$$\left(\frac{\tilde{C}_F}{\tilde{C}_S}\right)_F = \frac{1-\alpha_F}{\alpha_F} \tag{1.10$'$}$$

and

$$\left(\frac{\tilde{C}_F}{\tilde{C}_S}\right)_S = \frac{\alpha_S}{1-\alpha_S}, \tag{1.11$'$}$$

where $\tilde{C}_F = C_F^{1-\gamma}$ and $\tilde{C}_S = C_S^{1-\gamma}$. From inspection of (1.10′) and (1.11′) it follows that $\left(\frac{\tilde{C}_F}{\tilde{C}_S}\right)_F > \left(\frac{\tilde{C}_F}{\tilde{C}_S}\right)_S \Leftrightarrow \alpha_F + \alpha_S < 1$ which brings us back to figure 1.1, except that $\frac{\tilde{C}_F}{\tilde{C}_S}$ substitutes for $\frac{C_F}{C_S}$.

Two remarks are in order. First, the preceding four results are not specific to logarithmic utility functions. They hold under an alternative (exponential) specification of the utility function. Indeed, the results arising from using logarithmic or exponential utility functions are due to these specifications representing homothetic utility functions over allocations.

Second, it is of interest to see whether the result pertaining to the increase in the family's corn is general. It turns out that as long as $V_F(C_F)$ and $V_S(C_S)$ are strictly concave functions, an increase in the family's corn results in the father's preferred allocation having greater consumption both for himself and for his son. A symmetric statement applies to the son. When preferences are additively separable and the consumption functions are strictly concave, *all* goods are normal goods and therefore a larger quantity of C, regardless of its distribution, is sure to raise the son's utility (see Becker [1974]).

Finally, even though a rise in the intensity of the father's altruism entails larger transfers of corn to the son, how would the *utilities* of the father and his son be affected by such a rise? To obtain an answer we first note that from (1.10) – the father's optimal choice – we get $C_S = \alpha_F C$ and $C_F = (1 - \alpha_F)C$. Substituting these, (1.7) and (1.8) into (1.3) yields

$$U_F(C_F, C_S) = (1 - \alpha_F)\, ln[(1 - \alpha_F)C] + \alpha_F\, ln(\mu\alpha_F C). \quad (1.14)$$

From the same substitution into (1.4) we further obtain

$$U_S(C_S, C_F) = (1 - \alpha_S)\, ln(\mu\alpha_F)C + \alpha_S\, ln[(1 - \alpha_F)C], \quad (1.15)$$

where, to reiterate, it is understood that we have substituted for the father's optimal choice. Differentiating (1.14) and (1.15) with respect to β_F yields[3]

$$\frac{dU_F(C_F, C_S)}{d\beta_F} = \frac{d\alpha_F}{d\beta_F} \ln \frac{\mu\alpha_F}{1-\alpha_F}, \tag{1.16}$$

$$\frac{dU_S(C_S, C_F)}{d\beta_F} = -\frac{d\alpha_S}{d\beta_F} \ln \frac{\mu\alpha_F}{1-\alpha_F} + \frac{d\alpha_F}{d\beta_F}\,\frac{1-\alpha_F-\alpha_S}{\alpha_F(1-\alpha_F)}. \tag{1.17}$$

Consider first (1.16) – the change in the father's utility resulting from a change in his altruism toward his son. Since $\frac{d\alpha_F}{d\beta_F} > 0$ we conclude that for sufficiently small μ, increased altruism always makes the father worse off.[4] Next, we turn our attention to (1.17). Note that the second term is nonnegative. However, $\frac{d\alpha_S}{d\beta_F} < 0$ (from (1.6)) so that for sufficiently small μ the first term is negative. Indeed, by choosing μ small enough, we can always make the first (negative) term dominate the second (nonnegative) term. Thus if we raise the father's altruism toward his son, both father and son may be worse off despite the transfers (recall (1.13)) from father to son! Although consumption transfers

[3] It may strike the reader as peculiar to differentiate with respect to β_F since β_F is a preference parameter. We interpret this procedure as follows. The father's altruism for the son may depend upon various external events. The derivatives would then describe the effects of altruism-enhancing events on wellbeing. In a context somewhat different from the one studied here, for instance, a marriage market, we can envision i (F) as selecting a marriage partner j (S) from a continuum of alternatives (that is, there is a potential partner for each $(\beta_i \beta_j)$ combination). The derivatives would then describe the effects on wellbeing of varying one's marriage partner.

[4] Note that by substituting genetic fitness for utility (see Becker [1976]), Wilson's (1975) argument that altruism reduces personal fitness may not only be vindicated but broadened: altruism may actually reduce group fitness.

play a positive role in enhancing utility, this role can be dominated.[5]

It is useful to check how general is the result that with utility interdependence, a rise in altruism that leads to consumption transfers could make the transferring party worse off. In particular, does the result depend on the underlying specification of the utility functions? Does it hinge on the parameterization of a rise in the father's altruism being expressed through an increase in β_F? Or on the asymmetry imposed on the problem in (1.7) and (1.8)? The answers to all these questions are negative.

We refer to (1.3) and (1.4) and consider once again the case where the father has a total fixed amount of corn available for consumption $\overline{C}$. Suppose the felicity functions are such that for any $C \geq 0$, $V_F(C_F) = V_S(C_S) = V(C)$. As before, we solve for the optimal level of the father's consumption of corn. If the father is not altruistic toward his son at all, that is, if $\alpha_F = 0$, the father chooses C to maximize $V_F(C_F) = V(C)$ subject to $C \leq \overline{C}$. The father's utility will be $V(\overline{C})$. Now for another extreme, suppose $\alpha_F = \frac{1}{2}$. Then the father would want to maximize (see (1.3)) $\frac{1}{2} V_F(C_F) + \frac{1}{2} V_S(C_S)$ subject to $C_F + C_S \leq \overline{C}$. If the father's preferences are strictly convex, he will choose $C_F = C_S = \overline{C}/2$ and his utility will be $\frac{1}{2} V(\overline{C}/2) + \frac{1}{2} V(\overline{C}/2) = V(\overline{C}/2)$. The father is worse off than when he is perfectly selfish – it is as if he has two stomachs to fill; no extra pleasure arises from altruism toward his son. Note, in particular, that the same argument follows through for *small* increases in α_F. One way of intuitively interpreting this result is that in the model utilized here, a perfectly nonaltruistic father who consumes $\overline{C}$ and has no interest in his son will be

[5] Note that for this result to hold, μ being "sufficiently small" constitutes a sufficient condition, not a necessary condition. We know from (1.5) that $\mu \dfrac{\alpha_F}{1-\alpha_F} = \mu \dfrac{\beta_F - \beta_F \beta_S}{1-\beta_F}$. Thus $\mu \dfrac{\alpha_F}{1-\alpha_F} < 1$ will hold for some pairs (β_F, β_S) even if $\mu = 1$.

exactly as well off as he would be if he had enough corn so that both he and his son could consume the same amount $\overline{C}$.

Further examination of the inverse altruism – wellbeing relationship is offered in the appendix.

Conclusions

We have examined altruistically-motivated consumption transfers as part of an effort to account for nonmarket transfers. We have seen that altruistic linkages lead to autonomous, negotiation-free transfers, and that such transfers respond positively to stronger altruism. The demonstration that altruism reduces transaction costs may be seen as a rationale for the persistence of nonmarket transfers. But we have also seen that given our quite natural assumptions concerning the altruism parameters, mutual altruism does not necessarily result in group (social) harmony, even though its rise narrows the conflict range. In spite of enhanced transfers prompted by such a rise, both parties may end up worse off. (O. Henry provides a moving illustration of such an outcome in his story "Gift of the Magi.") These results help explain why in some social environments a shift toward market-oriented transfers and exchanges may be quicker than in others, as the disadvantages (decline in utility) associated with intragroup altruistic linkages outweigh the advantages.

An earlier paper (Stark [1989]) raises the point that while an economy with substantial altruism will be Pareto superior to an economy with no altruism, an economy with a little altruism may be inferior to an economy with no altruism at all. This unhappy, second-best type result arises from the fact that altruism can increase possibilities for exploitation and limit the availability of credible strategies, narrowing the range of possible beneficial social arrangements. This may explain the prevalence of economies of self-interested rather than altruistic people. (Bernheim and Stark [1988] provides a more complete explanation of this result.) Perhaps the results in the present chapter, that altruism does not eliminate conflict and that altruism can actually make everyone worse off, support the view that exploitation and strategic behavior nudge agents toward self-interested behavior in markets. A fuller investigation of how the rise and fall of altruism impinge on the evolution of markets awaits research by economists and other social scientists.

Appendix

Suppose we represent the father's and the son's preferences, and utility interdependence by

$$U_F(C_F, U_S) = V_F(C_F) + \delta_F U_S(C_S, U_F), \tag{1.A1}$$

$$U_S(C_S, U_F) = V_S(C_S) + \delta_S U_F(C_F, U_S), \tag{1.A2}$$

where $0 \leq \delta_i \leq 1$, $i = F, S$; increase in altruism is defined as increase in δ_i. Solving in terms of consumption, we obtain

$$U_F(C_F, C_S) = \frac{1}{1-\delta_F\delta_S} V_F(C_F) + \frac{\delta_F}{1-\delta_F\delta_S} V_S(C_S), \tag{1.A3}$$

$$U_S(C_S, C_F) = \frac{1}{1-\delta_F\delta_S} V_S(C_S) + \frac{\delta_S}{1-\delta_F\delta_S} V_F(C_F). \tag{1.A4}$$

We look at the following example. Suppose the felicity functions are $V_F(C_F) = V_S(C_S) = V(C)$ for all $C > 0$. If the father is not altruistic toward his son at all, that is, if $\delta_F = 0$ and $\overline{C}$ is total corn available for consumption, the father chooses C to maximize $V_F(C_F) = V(C)$ subject to $C \leq \overline{C}$. His utility will be $V(\overline{C})$. Now, if the father has $\delta_F = 1$ and $\delta_S = 0$, and if the father's preferences are strictly convex, he will choose $C_F = C_S = \overline{C}/2$ and his utility will be $V(\overline{C}/2) + V(\overline{C}/2)$. If preferences are strictly convex and $V(0) \geq 0$, we have $V(\overline{C}/2) + V(\overline{C}/2) > V(\overline{C})$, a case where increase in altruism has a positive effect on utility. *However*, if preferences are strictly convex and $V(0) < 0$, then depending on the shape of the $V(C)$ function and on $\overline{C}$, $V(\overline{C}/2) < \frac{1}{2} V(\overline{C})$, so that again, as we raise the father's altruism toward his son, the father may be worse off. This last case is portrayed in figure 1.A1.

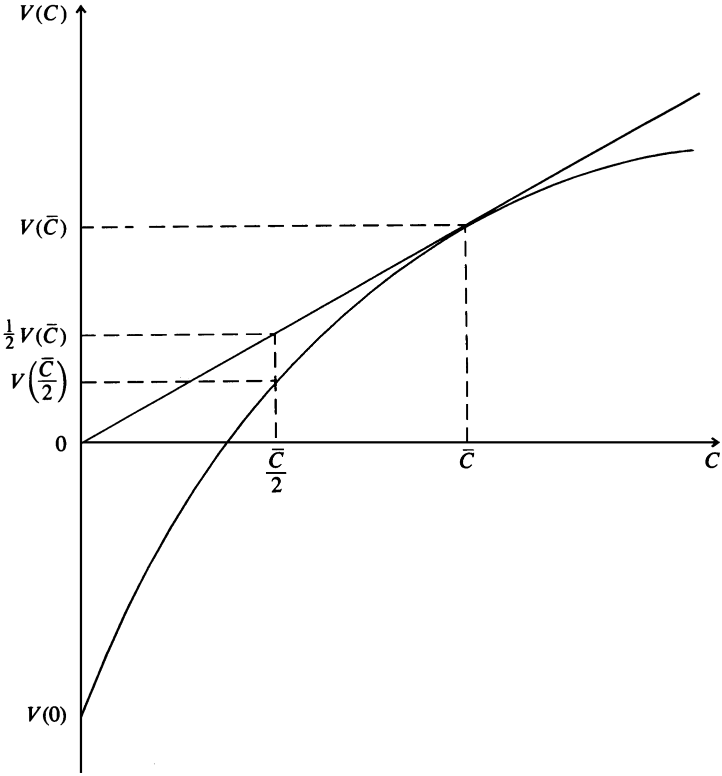

Figure 1.A1 Convex preferences and $V(0)<0$: an example

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2

The timing of intergenerational transfers: an implication

Introduction

A fairly strong positive association exists between per capita income and life expectancy across developing countries.[1] Even though associations do not reveal causality, in this case one explanation of the association is as transparent as the association itself: countries that master means and resources to provide more and higher-quality health and health related services end up having longer-lived residents. The possibility that causality runs in exactly the opposite direction, that is, that longer life expectancy translates into higher per capita income, is less well recognized. This possibility is taken up in the current chapter. Specifically we study the chain that longer life expectancy encourages larger investments in human capital which in turn facilitates the attainment of higher per capita income. Although in itself this chain is not novel, the proposed microeconomic rationale which underlies the observed macroeconomic relationship is.

When education and skills are more abundant, countries produce more. Although the close link between investment in

[1] For a group of 75 developing countries in 1989 (World Bank [1991]) the Pearson correlation coefficient between life expectancy and per capita income is 0.7421. The coefficient for the same countries in 1977 (World Bank [1979]) was 0.7567. The change is not significantly different from zero (using conventional levels of significance).

human capital, per capita income, and growth is well documented (e.g., Lucas [1988], Romer [1990], Azariadis and Drazen [1990], Ehrlich and Lui [1991], Mankiw, Romer and Weil [1992], Galor and Zeira [1993]) the underlying mechanism is not yet fully understood. Becker, Murphy and Tamura (1990) have suggested an explanation that draws on the role of fertility behavior: higher fertility is assumed to raise the rate of discount in the intertemporal utility function, thereby discouraging investment in human capital. Just as changes in fertility behavior modify the incentive structure that impinges on investment behavior, holding life expectancy constant, according to our approach changes in life expectancy account for changes in human capital investment, holding fertility behavior constant.

To illustrate how different life expectancies bring about different levels of investment in human capital, consider a world where assets are fully transferred through bequests. If life expectancy is 40, and if a child is capable of making productive use of familial assets at the age of 20, then bequests occur exactly when the child is ready to receive and make a productive use of the assets, assuming that the parent was 20 when the child was born. However, if life expectancy is 70 then, retaining other assumptions as above, the child must wait on average 30 years to receive familial assets. The incentive for the child to invest in the acquisition of human capital would then be greater, provided that both forms of capital enhance earnings.

The links between life expectancy and per capita income, on the one hand, and per capita income and human capital, on the other, however modeled, do not convert easily into a causal relationship between life expectancy, human capital formation, and per capita income.[2] In this chapter we offer a microeconomics-based model that provides such a relation-

[2] It is of interest to note that the "Basic Indicators" table in the *World Development Reports* of the World Bank provides data on only three measures of development: per capita income, life expectancy, and adult literacy – a measure of human capital.

ship – to our knowledge, for the first time. Specifically, we demonstrate that in an economy where life expectancy is long and the transfer to offspring of the familial productive resource – land – takes place late in life, individuals invest more in human capital formation than if life expectancy is short and the parental transfer takes place early in life. Since the timing of the transfer is not known with certainty, a decision to invest in human capital formation must factor in the possibility that acquired human capital will not be used or that it will be used only slightly. That is, if the earnings arising from combining labor with a productive physical asset – land – are higher than the earnings arising from assetless application of labor amplified by human capital, the individual will switch from the latter to the former, and this possible shift has to be considered in deciding to acquire human capital. We develop the model to show that the productivity implications arising from human capital formation are such that (economy-wide) per capita income is higher when parental life expectancy is longer.

The model

Consider an overlapping-generations economy in which economic activity is conducted over infinite discrete time. In every period t, $t = 0, 1, 2, \ldots$, the economy produces a single good in two sectors: a nonfarm sector in which the production technology requires efficiency units of labor, and a farm sector that uses land and physical units of labor in the production process.

Production

The nonfarm sector

Production in the nonfarm sector occurs within a period according to a constant returns to scale production technology which is stationary across time. The output of the nonfarm sector produced at time t, Y_t^{nf}, is

$$Y_t^{nf} = f(L_t) = L_t f(1), \tag{2.1}$$

where L_t is the quantity of labor, measured in efficiency units, employed at time t. The production function $f : R_+ \to R_+$ is twice continuously differentiable, $f'(L_t) > 0$ and $f''(L_t) = 0$ $\forall L_t \geq 0$, and $f(0) = 0$. The market for efficiency units of labor is perfectly competitive. Given constant returns to scale in production the wage rate per efficiency unit of labor is therefore stationary at a level $\overline{w}$, where

$$\overline{w} = f'(L_t) = f(1). \tag{2.2}$$

The farm sector

Production in the farm sector occurs within a period and allows individuals who own a unit of land to combine it with their own physical unit of labor to produce $\tilde{y}$ units of output (regardless of the number of efficiency units embodied in this unit of physical labor).[3] The marginal productivity of an additional unit of labor is lower than that in the nonfarm sector. Furthermore, land changes hands only through intrafamilial, intergenerational transfers.

Consumption and investment in human capital

In every period t a generation is born. A generation consists of a continuum of individuals of measure N.[4] Each member

[3] This simplification is not essential for our results; we can allow for $\tilde{y}$ to be somewhat sensitive to coupling with human capital. For four developing countries for which comparable evidence is available, the effect of an additional year of schooling on both wages and farm output is positive, although the percentage increase in wages is 3 to $5\frac{2}{3}$ times the percentage increase in farm output, with the former being as high as 17 percent (World Bank [1991], table 3.2).

[4] For simplicity, there is no population growth. The qualitative nature of the analysis will not be affected by allowing nonzero population growth.

of generation t has a single parent in generation $t-1$ and each parent of generation $t-1$ has a single offspring in generation t. The economy consists, therefore, of a continuum of dynasties of measure N. Each dynasty is endowed with a unit of land that is transferred across generations. By the existing social code land is transferred from parent to child upon the death of the parent.

The duration of life is uncertain. Individuals may live either two or three periods. They face a probability $\alpha \in [0,1)$ of dying at the end of the second period. If they survive, with probability of $(1-\alpha)$, they die at the end of the third period. Population size is thus $N + N + N(1-\alpha) = N(3-\alpha)$.

Individuals of generation t are characterized by their intertemporal utility function defined over consumption in the three periods of their life.

$$U^t = \sum_{i=1}^{3} \beta^{i-1} u(c_i^t), \tag{2.3}$$

where $\beta < 1$ is the individual's discount factor and

$$u'(c) > 0 \quad \textit{and} \quad u''(c) \leq 0 \quad \forall c \geq 0; \quad u(0) > -\infty. \tag{2.4}$$

Thus $u : R_+ \rightarrow R$ is strictly monotonic increasing, concave, and bounded from below. Furthermore, it satisfies the expected utility axioms.

In the first period of their lifetime (youth), individuals of generation t are endowed with a unit of labor but with no land. Individuals allocate their unit endowment of labor between work in the nonfarm sector at the competitive market wage $\overline{w}$ and investment in human capital. Given the absence of capital markets or the availability of storage technology, individuals consume their entire wage income in the first period. Thus the first period consumption of a member of generation t is $c_1^t = \overline{w}\ell$, where $\ell \in [0,1]$ is the proportion of the unit endowment of labor that an individual chooses to allocate to work, and $(1-\ell)$ is therefore the proportion allocated to investment in human capital. The amount of human capital, h (measured in efficiency units of labor that are available for usage in the second period of the individual's lifetime), generated by this investment in human capital is

$$h = \phi(1 - \ell), \tag{2.5}$$

where

$$\phi(0) = 1; \quad \phi(1 - \ell) > 1, \quad \phi'(1 - \ell) > 0 \quad \text{and}$$

$$\phi''(1 - \ell) < 0 \quad \forall \ell \in (0, 1). \tag{2.6}$$

Thus if investment in human capital does not take place (i.e., $(1 - \ell) = 0$) the number of efficiency units available for the individual in the second period is equal to the initial endowment of 1. Otherwise, the number of efficiency units available in the second period is increasing in the level of investment in human capital, but at a decreasing rate.[5] Furthermore,

$$\lim_{\ell \to 1} \phi'(1 - \ell) = \infty \qquad \textit{and} \qquad \lim_{\ell \to 0} \phi'(1 - \ell) = 0. \tag{2.7}$$

In the second period of their lifetime (middle age) individuals of generation t are endowed with $\phi(1 - \ell)$ efficiency units of labor, and with probability $\alpha \in [0, 1)$ (i.e., in case of a parent's death at the end of the second period of the parent's lifetime) with a unit of land. If the parent does not die and consequently no land inheritance is obtained, individuals supply inelastically their efficiency units of labor, generating a wage income of $\overline{w}\phi(1 - \ell)$. This wage income is subsequently consumed. However, if the parent does die, the individual inherits a unit of land. Individuals, therefore, may utilize the technology which combines a unit of land and a physical unit of labor to produce $\tilde{y}$ units of output. Since transfer of the

[5] Direct outlays in connection with human capital investment are disregarded. The investment costs consist only of forgone earnings.

property rights to land is not allowed, this technology will be employed as long as $\tilde{y} > \overline{w}\phi(1-\ell)$.[6] Suppose that this inequality indeed holds and that the distribution of earnings is fairly compact, that is,

$$\tilde{y} = \overline{w}\phi(1-\ell) + \epsilon, \tag{2.8}$$

where $\epsilon > 0$ is sufficiently small. It follows that regardless of the level of investment in human capital, individuals who inherit land find it beneficial to utilize the traditional technology and to produce $\tilde{y}$ units of output which is subsequently consumed. Thus second period consumption of an individual of generation t, c_2^t, is

$$c_2^t = \begin{cases} \overline{w}\phi(1-\ell) & \text{with probability} \quad 21\text{-}\alpha \\ \tilde{y} & \text{with probability} \quad 2\alpha. \end{cases} \tag{2.9}$$

Individuals reach the third period of their lifetime with probability $(1-\alpha)$. At that time they are endowed with a unit of land (inherited from the deceased parent) and with $\phi(1-\ell)$ efficiency units of labor. Given (2.8), individuals in this case employ the traditional technology which generates $\tilde{y}$ units of output that is subsequently consumed. Thus $c_3^t = \tilde{y}$.

Individuals allocate their first-period endowment of labor between work and investment in human capital so as to maximize their expected utility from consumption. Thus

$$\ell(\alpha) = argmax\{u(\overline{w}\ell) + \beta\{(1-\alpha)u[\overline{w}\phi(1-\ell)] + \alpha u(\tilde{y})\} + \beta^2(1-\alpha)u(\tilde{y})\}. \tag{2.10}$$

Given the properties of the ϕ function as stated in (2.6) and (2.7), and since $\alpha \in [0,1)$, the solution to (2.10) is interior

[6] The qualitative nature of the analysis will not be affected if the land can be rented as long as $\tilde{y} > \overline{w}\phi(1-\ell)$ + land rent, namely, as long as the owner of the land is significantly more productive than potential renters in cultivating the land. Rosenzweig and Wolpin (1985) provide strong evidence that such productivity differentials do exist.

(that is, the level of investment in human capital $(1-\ell) \in (0,1)$) and is given by the first order condition

$$(1-\alpha)\phi'(1-\ell) = \frac{u'(\overline{w}\ell)}{\beta u'[\overline{w}\phi(1-\ell)]}. \tag{2.11}$$

Proposition 1: *Under (2.4), (2.6), and (2.7), an increase in the parent's life expectancy increases the investment in human capital by the child (that is,* $\partial(1-\ell)/\partial(1-\alpha) > 0$ $\forall \ell \in (0,1)$*).*

Proof: See appendix.

Stationary output

In every period t, each young individual supplies ℓ efficiency units of labor to the nonfarm sector. In addition, with probability $(1-\alpha)$, each middle-aged individual supplies $\phi(1-\ell)$ efficiency units of labor to this sector. Thus the aggregate supply of labor to the nonfarm sector in efficiency units, L_t, is

$$L_t = [\ell + (1-\alpha)\phi(1-\ell)]N. \tag{2.12}$$

Given (2.1), the output produced in the nonfarm sector is $Y_t^{nf} = L_t f(1)$. The output produced in the farm sector at time t is $Y_t^f = \tilde{y}N$. The aggregate output produced in the economy at time t, Y_t, is therefore stationary at a level $\hat{Y}$, where

$$\hat{Y} = \hat{Y}^{nf} + \hat{Y}^f = \{[\ell + (1-\alpha)\phi(1-\ell)]f(1) + \tilde{y}\}N. \tag{2.13}$$

Given that the population size is $(3-\alpha)N$, the per capita aggregate output, $\hat{y}$, is

$$\hat{y} = \frac{[\ell + (1-\alpha)\phi(1-\ell)]f(1) + \tilde{y}}{3-\alpha}. \tag{2.14}$$

The following results can thus be derived:

Proposition 2: *Under (2.4), (2.6) – (2.8), an increase in life expectancy increases the stationary per capita output in the economy (that is,* $\partial\hat{y}/\partial(1-\alpha) > 0$*).*

Proof: See appendix.

Corollary: *Consider a world that consists of countries which are identical in all respects except for the life expectancy of their populations. Under (2.4), (2.6) – (2.8), the per capita income is higher in countries in which life expectancy is longer.*

As follows from (2.13), (2.14), and (2.A2), aggregate as well as per capita output in the nonfarm sector increase with life expectancy. The aggregate output in the farm sector is constant, however, given the constant supply of land. Furthermore, since an increase in life expectancy increases the number of individuals in the economy at any point in time, in per capita terms the output in the farm sector decreases with life expectancy. Thus the proposition holds as long as the increase in the per capita output in the nonfarm sector outweighs the decrease in the per capita output in the farm sector. As follows from (2.A2), if (2.8) is not satisfied, Proposition 2 and the Corollary are less likely to hold the larger the share of farm output in total output.

Summary, implications, and predictions

Human capital theory predicts that, holding all else constant, a longer life expectancy encourages individuals to invest more in human capital formation because of the prolongation of the payoff period. Our model expands the human capital framework to incorporate the case where the prolongation of life expectancy of cohort t induces more human capital formation by cohort $t+1$ because of the resulting postponement of the transfer of familial productive assets. We prove that, as a consequence, per capita income in the economy with the longer-lived generation t is higher.

The model expands the human capital framework in yet another way: the acquisition of human capital serves not only as a means of enhancing productivity but also as a form of insurance. In the event that land will not be transferred in the second period, earnings are guaranteed to be higher than those that would have accrued to bare labor.

The analysis helps explain a number of stylized facts. Several empirical studies point to absence of a trend toward equality across countries except among the subset of the very wealthy countries (Romer [1986, 1990], Lucas [1988]). One reason for this nonconvergence could be that poor economies are locked in an incentive structure that operates to discourage human capital formation. And low levels of human capital formation translate into low levels of per capita income. If human capital not only enhances the productivity of those who accumulate it but also confers *external* benefits on the productivity of others, economies that form large quantities of human capital will increasingly distance themselves from economies that form small quantities. Income equality may not come about simply in the natural course of events. Our model thus predicts that as long as disparities in life expectancy across countries exist, disparities in the levels of per capita income between countries will exist as well. Evidence suggesting that some convergence does occur (e.g., Barro [1991], Barro and Sala-i-Martin [1992], Mankiw, Romer and Weil [1992]) is not, however, inconsistent with our model. If life expectancy is endogenized, then convergence in life expectancy *may* take place and lead, in conjunction with other factors, to convergence in per capita income.

The model may hint at an interesting association between the behavior of parents, the wellbeing of their children, and social welfare. Especially if children cannot borrow against expected terminal assets, the timing of the transfer of parental wealth impinges not only on their behavior toward their parents but apparently also on allocative decisions. This, in turn, affects the children's own wellbeing, and hence the wellbeing of society. A social rationale for the postponement of the transfer of familial resources to the time of death – or very close to that time – may thus be that this pattern results in a higher per capita output. Our model may then be read "inside out": if a society were to adopt a rule of conduct as assumed, would it be better off in the long run as compared to a society that pursues an alternative norm? The apparent advantage of postponing the timing of intergenerational transfers may explain the evolution and sustainability of a social code that so mandates.

In the 1960s and 1970s, the Moshav movement in Israel prohibited breaking up family plots. Consequently one child, usually the eldest son, inherited the family farm. Whereas typically the heir-designate did not acquire a college or university degree, the other children did. For them, the low probability of receipt of the family land (an event which could have taken place had the eldest son died prematurely) served as an inducement to acquire other earning-enhancing capital. This pattern mimics the experience of European societies in the middle ages in which military activity was a means to secure wealth. In England, for example, under the institution of primogeniture – the exclusive right of the eldest son to inherit his father's estate – *younger* sons who declined to become clergymen had to resort to military prowess as the only socially acceptable means to make their fortunes. Baumol (1990) reports that in a good many cases this resulted in spectacular success and quotes the case of "William Marshal, fourth son of a minor noble, who rose through his military accomplishments to be one of the most powerful and trusted officials under Henry II and Richard I, and became one of the wealthiest men in England."

Prior to listing a number of testable implications, we consider two issues that could work against our approach.

First, we have assumed a constant fertility behavior. Yet parents may offset the effect of their anticipated prolonged life by delaying childbearing so that the familial pool of work-years is unchanged. A child born in this adaptive state will then face exactly the same planning horizon and thereby the same incentive structure as a child born in the early years of a short parental life expectancy. Consequently, our model will not bite. We know though of no fertility model nor any empirical study that predicts or produces such possible full adjustment. And if anything less than full adjustment takes place, our sign hypothesis clearly remains unchanged. Moreover, in the present chapter we model the behavior of the offspring, not the parent. Endogenization of fertility decisions mandates a different modeling approach (possibly a bargaining game framework) where *both* child and parent optimize. Future work may nonetheless expand beyond our framework by tracing the implications arising from cases with more than one child per parent, and cases in which parents' life expectancy affects the number of children in the family and possibly the timing of the children's birth.

Second, if the extra years arising from prolonged life expectancy accrue at older ages and if, therefore, these years do not fully translate into extra work-years on the farm, enhanced longevity will result in only a partial postponement of the transfer of the family land to the offspring. Only in the unlikely case that prolonged life leads to no additional work-years will our effect possibly wash out. We say "possibly" because longer-lived parents control their land longer. Relinquishing title to their offspring at some transfer price prior to their death is thus, incentive-wise, equivalent to a delayed transfer.

Our model gives rise to several testable predictions. One such prediction is that the parental life expectancy effect has a positive impact on the level of the investment in human capital undertaken by the children, an effect which is separate from the one arising from the prolongation of life of the children themselves (the children's life expectancy effect). The empirical difficulty here is that children who observe a longer life expectancy of their parents may infer that their own life expectancy will also be longer, so that their human capital investment decisions may be fully explained by the traditional human capital framework. To overcome this difficulty, though, we can think of a situation where the life expectancy of the parents rises while that of the children falls, yet human capital formation by the children is larger. Such an outcome can only arise from the operation of the parental life expectancy effect since the negative children's life expectancy effect implies reduced investment in human capital by the children. We can likewise think of a situation where the life expectancy of the parents falls, that of the children rises, yet investment in human capital by the children declines. Any one of these scenarios could then provide a discriminating test between our model and the traditional human capital model.

More concretely, though, our model predicts that in a country such as India, where typically daughters do not inherit the family's land but sons do, a rising life expectancy of the parents – even if interpreted by the children as a signal that their own life expectancy will be longer – has a stronger effect on human capital formation by boys (two effects are operative) than by girls. Furthermore, consider the case of societies characterized by "perfect primogeniture" – the eldest son receiving all the bequest. Since all other children are then immune to the timing of transfer, their human capital investment behavior will not be sensitive to a change in the life expectancy of the parent. Thus if the life expectancy of the parent rises, then, again, even if all children were to infer that their own life expectancy will be longer, human capital investment by the eldest child will increase by more than will human capital investment by the other children.

The number of individuals who either engage in human capital formation or work in the nonfarm sector is an increasing function of life expectancy.[7] Suppose these activities are carried out in the urban economy. A prediction of the model is then that longer life expectancy is positively correlated with the proportion of the population residing off the farm.

Finally, the procedure employed in the construction of our model gives rise to the following testable prediction: the higher the share of the farm sector in total output, the smaller the impact of life expectancy on per capita output.

Appendix

Proof of Proposition 1: Using the implicit function theorem, it follows from (2.11) that

$$\frac{\partial \ell}{\partial \alpha} = \frac{-\beta u'[\overline{w}\phi(1-\ell)]\phi'(1-\ell)}{\overline{w}u''(\overline{w}\ell) + \beta(1-\alpha)\{u''[\overline{w}\phi(1-\ell)]\overline{w}[\phi'(1-\ell)]^2 + u'[\overline{w}\phi(1-\ell)]\phi''(1-\ell)\}}. \tag{2.A1}$$

Noting (2.4), (2.6), and (2.7), the Proposition follows.

Proof of Proposition 2: Using (2.14),

$$\frac{\partial \hat{y}}{\partial \alpha} = \frac{\{[1-(1-\alpha)\phi'(1-\ell)]\frac{\partial \ell}{\partial \alpha} - \phi(1-\ell)\}(3-\alpha)f(1) + \{[\ell + (1-\alpha)\phi(1-\ell)]f(1) + \tilde{y}\}}{(3-\alpha)^2}$$

$$= \frac{[1-(1-\alpha)\phi'(1-\ell)]\frac{\partial \ell}{\partial \alpha}(3-\alpha)f(1) - [\phi(1-\ell)f(1) - \tilde{y}] - [\phi(1-\ell) - \ell]f(1)}{(3-\alpha)^2}. \tag{2.A2}$$

[7] Since N out of the $(3-\alpha)N$ members of the population are tilling the N farms, for the remainder $(2-\alpha)N$, $\partial[(2-\alpha)N]/\partial\alpha < 0$.

As follows from (2.6), $\phi(1-\ell) > 1 > \ell \quad \forall \ell \in (0,1)$. Furthermore, $(1-\alpha)\phi'(1-\ell) > 1$ as follows from (2.11), (2.4), and (2.6), and $\phi(1-\ell)f(1) = \phi(1-\ell)\overline{w} = \tilde{y} - \epsilon$, where $\epsilon > 0$ is sufficiently small, as follows from (2.2) and (2.8). Thus noting (2.A2) and Proposition 1, the Proposition follows.

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3

An exchange implication of transfers: the demonstration effect

Introduction

Recent evidence indicates that private intergenerational transfers of income, wealth, and in-kind services are motivated, at least in part, by exchange considerations. For example, parents attach strings to money given to their children and transfers are made with the expectation of future repayment. Evidence supporting the idea that intergenerational transfers in the family are motivated partly by self-interest is contained in papers by Lucas and Stark (1985), Bernheim, Shleifer and Summers (1985), and Cox (1987).

Despite evidence supporting the existence of an exchange element in private transfers, we do not know much about the *mechanisms* that sustain and enforce these two-way transactions. Enforcement of intergenerational exchanges has hardly been explored in economics. One possibility is that enforcement comes from explicit incentives: economic punishments or rewards. Bernheim, Shleifer and Summers offer evidence that the threat of disinheritance induces children to provide attention to their parents. But monetary mechanisms may not always work. Suppose a parent lends to his child, expecting repayment in old age. If anticipated future bequests motivate behavior only mildly, or not at all, the parent may have little economic leverage for enforcing an implicit long-term contractual arrangement. The bequest motive might be particularly weak in nonwealthy families, and may not work at all when testamentary freedom is precluded by law.

Another possible enforcement mechanism is recourse to the legal power of the courts and the state. But in many countries, including the United States, the courts rarely become involved in enforcing such intergenerational arrangements as repayment of private intrafamilial loans (Shanas and Streib [1965]). Courts are reluctant to interpret familial understandings as legal commitments.

A third possible mechanism for enforcing intrafamilial arrangements is altruism. In Kotlikoff and Spivak (1981) mutual altruism enforces annuity-type contracts among family members. But Bernheim and Stark (1988) show that in a good many instances altruism inhibits rather than facilitates the enforcement of intergenerational exchanges. Altruistic parents may be quite unwilling, and effectively unable, to punish children who have reneged on promises. Altruism may, for example, undermine the credibility of a threat to disinherit. If children do not consider the threat of harsh reprisal credible, their inclination to fulfill obligations to parents will be eroded, and intrafamilial agreements will be harder to enforce.

The present chapter pursues an idea that we call "preference shaping," which we suggest is an important means to facilitate and secure exchange in general, and support in particular. Loosely defined, the term applies when one person influences another with regard to honoring the terms of an agreement. Specifically, parents may attempt to inculcate a sense of guilt for misbehavior (or gratification for good behavior) in their children. Guilt is an internal enforcement mechanism; once planted, the individual monitors himself.[1]

[1] For further discussion of the distinction between internal and external sanctions, see Elster (1989). He argues that internalized norms are followed even if violation is unseen and not explicitly punished, because the presence or expectation of emotions like guilt and shame work as informal sanctions. See also Frank (1988) for an analysis of the role of guilt and other emotions in strategic interactions, and Becker (1993) for an analysis of parental inculcation of guilt in children.

But inculcating a sense of guilt consumes resources, so preference shaping is also an economic problem.[2]

Consider the following setup. Suppose capital markets are "perfectly imperfect." Neither parent nor child can borrow from or lend to third parties. The child earns little today but considerably more tomorrow. The converse is true for the parent. An agreement wherein the parent lends to the child today and is repaid tomorrow would facilitate consumption-smoothing and improve the wellbeing of both parties. The problem is that in a sequence of moves, the parent may not have the last (effective) word. If no bequest motive exists to enforce loan repayment, and each family member is self-interested, how might the parent manipulate the child's preferences to improve the prospect of repayment?

One option is to rely on the child's participation in institutions such as schools and the church to manipulate preferences. These institutions are set up in part to create guilt for reneging on such agreements.

Another mode, and the focus of our analysis, is direct influence – the "demonstration effect." Parents teach children the desired behavior by setting an example. The children must be close by, and examples might have to be visible, and repeated. Such acts might well be costly to parents, who must behave differently than they would if they were not shaping their children's preferences. On the other hand, demonstration can increase the likelihood that children will honor their commitment.

How will the demonstration effect facilitate intergenerational exchanges? Suppose a family consists of a child (K), a parent (P), and a grandparent (G). P wants K to transfer resources to him in the next period when P becomes a G and

[2] The use of guilt, attitudes, and group norms as explanations of behavior has a long and rich tradition in sociology. Not so in economics, however. Becker (1988, p.9) remarks that "Economists neglect concepts like norms and guilt because no one really knows how they evolve. Moreover, sociologists ... are too prone to use norms as a deus ex machina to explain behavior that is difficult to explain in other ways."

K becomes a P. To demonstrate to K how he should behave in the next period, P makes visible transfers to G when K is around to watch.

The demonstration-effect hypothesis generates falsifiable predictions that differ from predictions that arise from other theories of transfer behavior. The key idea is that the presence and characteristics of K impinge on the transfers from P to G. Thus transfers from P to G depend positively on the presence of K.[3] Standard theories of the allocation of time and money might predict the opposite effect from the one implied by our approach. The presence of young children places demands on the parent's time and budget. Conventional wisdom then suggests that, all else being equal, the competing presence of young children would *reduce* transfers from P to G.

For the sake of illustration, suppose that care can be provided in a lump form or in installments that amount to the same total. If, as child psychologists point out, the preference formation effect of repeated and regular small-scale acts of care is stronger than the effect arising from a single large-scale act, the presence and age of children would affect the *distribution* of care-giving.[4]

Further, the demonstration-effect hypothesis predicts that the *composition* of transfers from P to G is important. The transfers must be *visible*. In-kind transfers are better than cash and, if transfers take the form of attention, visits are better than telephone calls.

[3] A formal representation of this and related ideas is provided in the following section.

[4] Experimental evidence from cognitive psychology indicates that distributed repetition is better than massed input for stimulating recall in situations involving memory and learning (Glass, Holyoak and Santa [1979]). Further, Bandura (1986) cites numerous studies in which repetition strengthens the influence of one person's behavior on another's. In particular, Bandura cites evidence that such repetition is effective when using role models to mold the moral development of children.

The longer is P's life expectancy, the greater is P's incentive to manipulate K's preferences, since P expects to depend on K for a longer period of time. If P employs the demonstration effect, G will receive more transfers from P. If transfers affect G's life expectancy, the demonstration effect generates a positive intergenerational correlation in life expectancies over and above the effects of heritability.

The demonstration-effect hypothesis contrasts with the exchange theory of bequests advanced by Bernheim, Shleifer and Summers. They argue that parents must have bequeathable wealth to elicit attention from their children. In our framework, contact and attention can occur without the promise of a bequest, even in a setting with purely self-interested parties. According to our approach, parents would provide attention to grandparents without anticipated payments from them since the provision of such attention allows the demonstration effect to operate and thus the receipt of future payments or support from their own children.

This approach produces a wider array of falsifiable predictions than other approaches because we expand the domain of analysis from two to three generations. Our analysis shows that the interaction of members of two generations cannot be considered in isolation. In our model (see the following section), grandparents, parents, and grandchildren are behaviorally linked. Note that in the simplest model of the parent-child relationship, the children's utility is a function of leisure and transfers from the parent, and the parent's utility is a function of own consumption and care received. (The family thus faces two resource constraints – one pertaining to the sum of attention and leisure, the other to the total amount of consumption.) Linkages arise from the two flows: the consumption good from parents to children, and the attention (forgone leisure) by children to parents. In a typical non-cooperative game, the children choose their level of attention *following* the parent's choice of the transfer rule and actual transfers are made subsequent to the provision of attention.

This modeling approach rests on the notion that absent the said sequence, agreements between parents and children will not be binding and enforceable. At the heart of the model, then, lies a conflict, and the model itself traces a procedure to resolve it. (Bernheim, Shleifer and Summers, and Cremer and Pestieau [1991] are examples.) We offer an alternative perspective: parents exert effort to eliminate or reduce the very evolution of a conflict; care and attention will then flow as and when required, independently of strategic considerations. Provision of the desired future care arises not from preceding transfers to the would-be care-givers but from demonstrations of transfers to a third party.

A basic model of transfers and imitation

There is an apparent tension between the postulated imitative behavior and standard utility maximization that can be resolved by incorporating an imitation component in the expected utility maximand. This renders the idea of a demonstration effect fully consistent with a choice-theoretic approach to behavior.

Consider for simplicity single-parent, single-child families. The parent seeks to maximize the expected value of $U(x, y)$ where x is what the maximizer, P, does for her mother, G, and y is what the maximizer's daughter, K, does for maximizer P. Suppose that with probability $0 \leq \pi \leq 1$ a daughter will simply imitate her mother's action, and with probability $1 - \pi$ the daughter will choose an action to maximize her expected payoff, *aware that her own daughter may be an imitator*. Therefore, a mother, P, chooses to maximize

$$EU(x, y, \pi) = \pi U(x, x) + (1 - \pi)U(x, y), \qquad (3.1)$$

where U is a continuous, twice differentiable, quasi-concave utility function with $U_1 < 0$ and $U_2 > 0$, where x is the transfer from P to G, and where y is the transfer from K to P.

To derive P's choice of x, x^*, differentiate (3.1) with respect to x to obtain

$$EU_1 = \pi(U_1^I + U_2^I) + (1 - \pi)U_1^S, \qquad (3.2)$$

where superscript I denotes utility if K is an imitator, that is, $U^I \equiv U(x, x)$, and superscript S denotes utility if K is a selfish maximizer, that is, $U^S \equiv U(x, y)$. Subscripts denote partial derivatives. Hence, from the first order condition for maximization,

$$-[\pi U_1^I + (1 - \pi)U_1^S] = \pi U_2^I. \qquad (3.3)$$

The left-hand side of (3.3) is the marginal cost of transferring to one's parent while the right-hand side is the marginal benefit from receiving which, in turn, is equal to π times the marginal utility of receiving from one's child. Thus the likelihood of *not* being imitated ($\pi < 1$) taxes one's transfer to one's parent.

The second order conditions are satisfied. Thus the solution x^* is unique and we can write it as $x^* = x^*(y, \pi)$.[5]

Remark 1: The equilibrium choice of x is increasing in π. To see this note from (3.2) that

$$\frac{\partial x^*}{\partial \pi} = -\frac{EU_{13}}{EU_{11}} = -[U_1^I - U_1^S + U_2^I]/EU_{11} = U_1^S/\pi EU_{11} > 0, \qquad (3.4)$$

recalling that $U_1^S < 0$, and noting that the sufficiency condition implies $EU_{11} < 0$. The higher the probability of imitation, the more "productive" the transfers to one's parent, and hence the more of them there will be.

[5] An interior solution (the marginal benefit curve intersects the marginal cost curve in the positive quadrant) is obtained as long as $\pi U_2^I(0,0) > -[\pi U_1^I(0,0) + (1 - \pi)U_1^S(0,0)]$. A sufficient condition for an interior solution is that $\lim_{x \to 0} \pi U_2^I \to \infty$.

Remark 2: In a stationary environment, the planning problem faced by each generation is the same as the one faced by its predecessor so that the maximizing action of K will be the same as that of P. Hence,

$$y = x^* = x^*(y, \pi). \tag{3.5}$$

The resulting dynamic equilibrium, $\bar{x}$, in which *everyone* chooses the same action,[6] is unique and stable if $|\partial x^*/\partial y| = |-EU_{12}/EU_{11}| = |(1-\pi)U_{12}^S/EU_{11}| < 1$. Intuitively, the effect of receipts from a child on the marginal disutility of providing for one's parent cannot be too large in order for the steady state to be stable.[7] Given the existence of a stable steady-state solution, it is easy to show that the equilibrium transfer $\bar{x}$ is increasing in the probability of imitation, that is, $d\bar{x}/d\pi > 0$.[8]

Remark 3: Steady-state expected utility is maximized when $\pi = 1$. To obtain this result, define

$$\begin{aligned} V(\pi) &= \underset{\bar{x}}{arg\,max}\{\pi U(\bar{x}(\pi), \bar{x}(\pi)) + (1-\pi)U(\bar{x}(\pi), \bar{x}(\pi))\} \\ &= \underset{\bar{x}}{arg\,max}\, U(\bar{x}(\pi), \bar{x}(\pi)). \end{aligned} \tag{3.6}$$

Thus

$$V'(\pi) = U_1 \frac{d\bar{x}}{d\pi} + U_2 \frac{d\bar{x}}{d\pi} = (1-\pi)U_2 \frac{d\bar{x}}{d\pi} > 0, \tag{3.7}$$

6 $\bar{x}$ is the value of x which maximizes $\pi U(x, x) + (1-\pi)U(x, \bar{x})$. The first order condition for maximization is $-U_1^S = \pi U_2^I$ (since now $U_1^S = U_1^I$). Again, the marginal cost of kindness to one's parent, $-U_1^S$, equals π times the marginal utility of kindness from one's child, U_2^I.

7 The issue of stability is somewhat subtle because *current* actions depend on *future* ones, that is, the nonlinear difference equation given in the second equality in (3.5) is backward looking. It can be expressed recursively as a function of any future generation's choice of y. With $|\partial x^*/\partial y| < 1$ in the neighborhood of $\bar{x}$ the backward-looking solution of the difference equation converges to a stable steady state, $\bar{x}$, for any given terminal value of y.

8 $d\bar{x}/d\pi = [-EU_{13}/EU_{11}]/[1 + (1-\pi)U_{12}^S/EU_{11}] > 0$, from (3.4) and the stability condition in Remark 2.

since maximizing behavior (the first order condition for $\bar{x}$) implies $-U_1 = \pi U_2$, and recalling the last sentence in Remark 2. Hence maximal utility is achieved at $\pi = 1$. Since P chooses x solely to influence K and does not take into account the corresponding benefit to G, there is an externality that causes an underprovision of x. The closer π is to 1, the smaller the externality. Families in which imitation is more likely have higher utility, and a social planner would set $\pi = 1$.

Remark 4: We have assumed single-child families. What if a family has no children? Alternatively, what if it has several children? If there is no child around who would imitate, $\pi = 0$. In this case (3.1) becomes

$$EU(x, y) = U(x, 0), \tag{3.1'}$$

which is maximized with $x = 0$ since $U_1 < 0$. Since the demonstration effect is inoperative, no transfers from P take place. It follows then that G will prefer P to have a child than to be childless.

If there are several children, $n > 1$, a given act of transfer will be imitated by each of the n observing children. If each child behaves in the same manner, we have

$$EU(x, y, \pi, n) = \pi U(x, nx) + (1 - \pi)U(x, ny), \tag{3.1''}$$

$$EU_1 = \pi U_1^I + \pi U_2^I n + (1 - \pi)U_1^S. \tag{3.2'}$$

Then, P's choice of x, x^{**}, is x that solves

$$-[\pi U_1^I + (1 - \pi)U_1^S] = \pi U_2^I n. \tag{3.3'}$$

Compared with the case of only one child (3.3), since the marginal benefit is now higher (the marginal benefit curve shifts up by n to intersect the marginal cost curve at a higher x), $x^{**} > x^*$.[9] In the presence of several children then, the

[9] Using (3.2′), the effect of an increase in n on the equilibrium choice of x is given by $\partial x^*/\partial n = -EU_{14}/EU_{11} = -\pi U_2^I/EU_{11} > 0$.

demonstration effect is more "productive" than in the presence of only one child and hence more is being transferred. Thus G will prefer P to have several children.[10]

In the following section we test some of the implications of the demonstration-effect approach using a household survey microdata set that contains detailed demographic and socio-economic information. We also present and discuss evidence from existing studies relevant to our approach. The concluding section lists additional implications and suggests directions for further research.

Evidence

We explore two related questions: is there evidence that a child's observation of parental giving to the older generation has any effect on his/her own behavior in later life? And are the parent's transfers to the grandparents affected by the presence of the grandchildren?

To address these and related questions, we use the National Survey of Families and Households (NSFH) data set, conducted between March 1987 and May 1988, which includes 13,017 US households. It contains a main sample of 9,643 households and an oversample: a double-sampling of blacks, Puerto Ricans, Chicanos, single parents, persons with step-children, cohabiting persons, and newlyweds. The NSFH randomly determines the primary respondent (usually the householder or the spouse of the householder; see Sweet, Bumpass and Call [1988]).

We delete from the sample respondents with missing values for earnings, age, or education, missing values for spouse's earnings, extreme values for income or financial transfers ($10 million and $900,000, respectively), dormitory or

[10] Alternatively, with n imitating children, a transfer of only x/n would result in receipt of x. The first order condition is identical to (3.3′).

barrack residents, and those with missing values for geographic distance from parents and/or in-laws.

The NSFH is suited for our purposes because it contains information about in-kind transfers provided by children to their parents as well as some retrospective information on early life-cycle experiences.

Intergenerational correlations

A necessary condition for the demonstration effect to work is for early life-cycle events to affect choices later on. If early experiences are quickly forgotten, or parental examples are ignored, there is little chance that a demonstration would matter much for child behavior. So the first question is whether early childhood experience affects adult behavior. In particular, if a child observes his or her parents making transfers to grandparents, will this observation affect the child's transfer behavior later in life?

We find some evidence that early transfer experience does indeed affect subsequent transfer behavior. Survey respondents were asked if a grandparent had ever moved in with the family when the respondent was a child (under 19 years old). They were also asked if their own parents had ever moved in with them when the respondents headed their own households. The percentage of respondents who shared housing with their parents was higher for respondents whose grandparent(s) had moved in when the respondents were children. The results are as follows: of the 1,642 respondents whose grandparents lived with the family, 12.4 percent shared housing with their own parents. In contrast, of the 8,133 respondents whose grandparents lived apart from the respondent's family, only 9.8 percent shared housing with their own parents. The incidence of sharing housing with parents is 27 percent higher for those respondents whose grandparents had moved in when the respondents were children.

Of course, these unconditional means are likely to capture more than the intergenerational transmission of attitudes. They could also reflect intergenerational correlation of budget constraints. For example, shared living arrangements might be more common among the poor, so much of the pattern could be driven by intergenerational correlation in income and wealth. But the positive effect of grandparent co-residence holds up even when we control for the earnings and net worth of the respondents, and for the parents' permanent income (table 3.A1 in the appendix). Early grandparent co-residence increases by 2.6 percentage points the probability that parent(s) had moved in with the respondent. (The effect is significant at the 0.01 level.) It appears then that the partial effect of grandparent co-residence is the same as the unconditional effect reported in the preceding paragraph.

Still, table 3.A1's findings are open to criticism because of the omission of a potentially important variable – the income of the grandparents. Suppose the grandparent moved in with the parent because the former was quite poor. With positive intergenerational correlation in incomes, the dummy for grandparent co-residence could be picking up the effects of unobservables in parental income. The fact that the grandparent was so poor that he/she had to move in with his/her children could indicate that the next generation is poor as well, so the elderly have to move in with their children.

Yet the NSFH contains information that further helps mitigate the problem of intergenerational correlation of income. Our approach is concerned with the formation of preferences, so it would be useful to look at a variable that measures the willingness of respondents to make transfers to their parents. Respondents were asked if they agreed or disagreed with the following statement: "Children should let aging parents move in with them when the parents are too old to live on their own." More than half the respondents agreed with the statement, although in fact only about 2 percent of elderly parents live with their children. This discrepancy, however, is not inconsistent with truthful attitudinal responses. A willingness to let parents move in is only a necessary condition for their move, which involves both preferences and budget constraints. And public income transfers to the elderly have sharply reduced the number of elderly parents who move in with their children (Becker and Murphy [1988a], Kotlikoff [1992]). We recognize that there can be considerable differences in what people say and what they do, but the respondents are not likely to have overstated their generosity for the sake of impressing the interviewer because the respondents filled out a questionnaire in private. Of the two subsamples, 56.5 percent of the 1,253 who experienced grandparent co-residence agreed with the statement, compared to 52.8 percent of the 5,785 who did not experience grandparent co-residence. (Note that the sample is limited to those with at least one living parent.)

The possible responses to the attitudinal statement (total sample averages are given in parentheses) were "agree strongly" (17 percent), "agree" (37 percent), "neither agree nor disagree" (35 percent), "disagree" (9 percent), and "strongly disagree" (2 percent). Ordered probit estimates that control for respondent and parental characteristics are given in table 3.A2 in the appendix. They indicate the same result: having a grandparent move in when the respondent was young positively affects reported attitudes concerning providing parents with housing.

While these results must be interpreted cautiously, note that there are forces that could affect attitudinal responses in the opposite direction. Having a grandparent move in may divert family resources from the child, exerting a negative influence on the willingness to have parents move in. Yet despite these possible influences, we find a positive effect.

We note here the strong evidence from demand analysis studies that the habitual component of consumption is proportional to past consumption, and that habit plays a very important role in consumer behavior (see Becker [1991], Heien and Durham [1991]). This suggests that exposure to repeated, especially regular attention and care by parents to grandparents would result in a "habit" of care-giving in adulthood.

Findings from psychology, demography, and sociology are consistent with the evidence reported above. For example, in a review of evidence from psychology concerning parents as role models for child behavior, Radke-Yarrow, Zahn-Waxler and Chapman (1983) report that, in addition to laboratory-type studies that documented the influence of parental role models on child behavior,

> Data from a very different context also make the link between parental model and child behavior. London (1970) found that in their retrospective accounts of childhood, Christians who rescued Jews from the Nazis revealed a strong identification with moralistic, principled parents. Rosenhan (1969) provides data in a study of youth who were involved in the Civil Rights movement. He classified the youth either as fully committed altruists (i.e., with sustained personal involvement in work with the underprivileged) or as partially committed (i.e., with participation in one or several freedom rides). From detailed life-history interviews, Rosenhan characterized parental behavior. Parents of the fully committed youth had themselves been involved in altruistic, social causes of considerable magnitude. They had given their children many opportunities for observing and participating in these causes.
>
> (Radke-Yarrow, Zahn-Waxler and Chapman, p.503)

There is considerable demographic evidence that events experienced during childhood impinge strongly on conduct in adult life, and of the importance of the family context in which children grow up. Teenage fertility and divorce constitute two examples. Daughters of teenaged mothers face significantly higher risks of teenaged childbearing than daughters of older mothers. In general, patterns of teenage family formation, that is, marriage and childbearing behavior, tend to be repeated intergenerationally (Kahn and Anderson [1992]). Children of divorced parents appear more prone to divorce than children whose parents stayed married. For example, white women who were younger than 16 when their parents divorced or separated were 59 percent more likely to be divorced or separated themselves (Glenn and Kramer [1987]).

Further examples include: intergenerational transmission of parenting techniques – parents who use harsh discipline, for example, are more likely to have been severely disciplined themselves (Sears, Maccoby and Levin [1957]); child abuse – children with abusing parents are more likely to abuse their own children (Bandura [1986, p.265]); affectional closeness – self-reported measures of closeness to parents during adolescence are highly correlated with such measures once adolescents reach adulthood (Rossi and Rossi [1990]); early family relationships and assistance – quality measures pertaining to early parent-child relationships are positively associated with contemporary assistance from adult children to parents (Whitbeck, Simons and Conger [1991]). These findings are consistent with Becker's (1991) prediction that through habit formation early life events can have a significant impact on behavior later in life.

There is a large sociological literature concerning the intergenerational transmission of attitudes. The typical study is conducted as follows. Parents and their children are asked about their views on politics, religion, or women's rights. The researchers measure parent-child correlations in the responses, which are usually positive and large, though often the underlying reasons are not provided. (Republican parents might have Republican children because both generations are wealthy, for example.) Some studies (for example, Glass, Bengston and Dunham [1986]) attempt to separate the effects of incomes and tastes but access to the necessary list of controls is often incomplete. (The data set used by Glass, Bengston and Dunham contains income and education measures for the children but not for the parents.)

Even if researchers using household microdata could control perfectly for budget-constraint variables, there are reasons why intergenerational congruence in attitudes might not necessarily imply parental influence as a causal mechanism. Parent-child attitude similarity could be generated, for example, by the media, genetics, or even child influences on parents (Smith [1983]).

While household microdata studies are not informative about the causal nature of attitude transmission, controlled laboratory experiments of social psychologists do point to a causal mechanism between parental role models and child imitators. Bandura (1986) cites several laboratory studies showing that children mimic punishment techniques inflicted on them when given an opportunity to punish others. Numerous controlled experiments cited by Eisenberg and Mussen (1989) indicate that children's pro-social behavior – giving gifts to others, for example – is enhanced when role models increase their own pro-social behavior.[11]

Despite all limitations, the evidence from sociology and psychology appears consistent with the idea that traits can be passed from one generation to another by way of example.

The demonstration effect

Assuming that by setting an example parents can influence the preferences of their children, is there evidence that parents use this leverage to enhance their own wellbeing? We address this issue by investigating the effects that children of respondents have on the "services" that respondents provide to their parents. The hypothesis is that, in line with Remark 4, the *presence* of children will increase the quantity of services that respondents provide to their parents.

[11] For example, in a typical study, fourth- and fifth-graders face a situation in which they must decide whether to donate some of their winnings from a game to charity. The treatment group is shown the example of a "model," that is, an adult who demonstrates, solely by example, the norm of giving. These children were more likely to contribute than those in the control group which had no model. The study also found that repeated examples reinforced the impact of the model on imitative behavior.

We measure services by respondent–parent contact (visits and telephone calls) as, for example, in Bernheim, Shleifer and Summers.[12] Respondents reported frequency of contact, which we translate into number of contacts: not at all – 0, about once a year – 1, several times a year – 6, one to three times a month – 24, about once a week – 52, and several times a week, 100. We add visits and telephone calls and aggregate across parents and parents-in-law.

We employ a long list of controls in the estimating equation for services. We enter a vector of respondent characteristics: income and wealth, education, age, marital status, number of siblings, and dummies for whether the respondent or the spouse work full-time, for whether the household has two earners, and for race. We also enter parental characteristics: imputed permanent income, number of living parents and parents-in-law, distance of parents and of parents-in-law from the respondent's home, and dummies indicating whether at least one parent or parent-in-law is alive, whether parents or parents-in-law are married and together, and whether parents or parents-in-law are divorced.

Parental income is imputed from earnings functions estimated within the sample for men and women separately. The NSFH contains information on parental schooling, occupation, and age. We use the estimates to impute permanent income for parents by substituting their characteristics into the respondent earnings functions to predict parental earnings at age 45. We also impute a cohort effect

[12] Contact with children could in some instances be critical for the wellbeing of parents. Indeed, evidence from the medical literature attests to the life prolongation effect of companionship. A study of 1,200 heart attack survivors finds that patients who lived by themselves were nearly twice as likely as those with companions to have another attack or die from one within six months. None of the known risk factors for second heart attacks – advanced age, low socioeconomic status, or severe heart damage – accounted for the ill health of subjects who lived alone. The explanation suggested by the authors of the study is that "human contact may subtly affect heart function" (Case, Moss, Case, McDermott and Eberly [1992]).

(three-quarters of one percent) to reflect productivity increases. The cohort effect is one-half the average increase in output per person-hour from 1957 to 1985. The earnings functions are estimated using generalized Tobit. For parents-in-law, only schooling and age are available, so to impute their permanent income we repeat the process described above, omitting occupation from the earnings functions. We include observations with missing information necessary to impute parental income, and flag them with a dummy variable indicating that parental income is missing. In addition to these regressors we add a dummy indicating whether the respondent's household is childless. We find that having a child increases parent-child contact by 10 contacts per year (table 3.1). (Total contact – visits plus telephone calls – average 140 per year in the sample.) Next we enter, in addition to the dummy for being childless, the number of children aged 0 to 4, the number aged 5 to 18, the number older than 18, and the number of children living outside the respondent's home.

We find that households with a child older than 18 living at home contact their parents 19 more times a year than childless households. Those with one child aged 5 to 18 contact their parents 10 more times than childless households (table 3.2). Though having at least one child raises contact with parents, which is consistent with Remark 4, having several children can reduce contact relative to childless households. For example, estimated contact is lower for households having three children between the ages of 5 and 18 than for childless households. One reason why contact could decline with the number of children is that visits – especially long-distance ones – might become considerably more costly. But another possible reason is that having several children lessens the need for parents to use the demonstration effect. Suppose parents want a child to provide attention and care when the parents reach old age. If the likelihood that a child will give care is independent, or largely independent, of the presence of

Table 3.1 *OLS estimates – contact with parents*

Variable	Coefficient	*t*-value	Variable mean
Constant	98.0062	10.861	1.0000
Earnings	−0.141189E-03	−2.613	31102
Earnings^2	0.192173E-09	2.064	0.25455E+10
Net worth	0.661938E-05	1.848	77665
Years of education	−2.33891	−5.434	12.919
Age	−1.23849	−11.082	36.570
Married	9.15356	2.901	0.61620
Female respondent	1.07519	0.422	0.57931
Husband and wife both work	3.23134	1.201	0.46659
Wife works full time	1.68723	0.689	0.42233
Husband works full time	−0.449929E-01	−0.017	0.51892
Black	15.4628	5.042	0.15412
Number of siblings	−1.08309	−3.807	5.3745
Number of living parents	32.5569	3.750	2.3459
Total parental income	−0.417313E-03	−4.876	46962
Parental income missing	−26.3241	−7.013	0.16519
Distance from parents	−0.280744E-01	−27.570	429.74
Distance from in-laws	−0.123179E-01	−10.162	1327.1
Have any living parents	62.5779	6.380	0.93524
Have any living in-laws	45.4408	4.845	0.51428
Parents live together	−5.97531	−0.692	0.41413
In-laws live together	51.9773	6.208	0.25755
Parents divorced	−6.97486	−2.478	0.16491
In-laws divorced	−1.74250	−0.436	0.76923E-01
Parent(s) in bad health	14.5534	1.609	0.16177
In-law(s) in bad health	9.28535	0.992	0.80202E-01
Have no children	−10.1760	−3.887	0.26561

Sample	7,319
Dependent variable mean	140.072
R^2	0.325164
F-statistic	135.1378

Table 3.2 *OLS estimates – contact with parents, number of children included*

Variable	Coefficient	*t*-value	Variable mean
Constant	103.637	10.929	1.0000
Earnings	−0.130579E-03	−2.419	31102
Earnings^2	0.186293E-09	2.005	0.25455E+10
Net worth	0.610603E-05	1.709	77665
Years of education	−2.53214	−5.827	12.919
Age	−1.16248	−8.669	36.570
Married	8.42021	2.655	0.61620
Female respondent	1.46286	0.575	0.57931
Husband and wife both work	3.32379	1.227	0.46659
Wife works full time	−1.84012	0.750	0.42233
Husband works full time	0.978985E-01	−0.037	0.51892
Black	15.7099	5.128	0.15412
Number of siblings	−0.939674	−3.284	5.3745
Number of living parents	32.8070	3.788	2.3459
Total parental income	−0.456864E-03	−5.321	46962
Parental income missing	−27.4215	−7.304	0.16519
Distance from parents	−0.278808E-01	−27.407	429.74
Distance from in-laws	−0.122988E-01	−10.174	1327.1
Have any living parents	63.7738	6.518	0.93524
Have any living in-laws	46.4772	4.969	0.51428
Parents live together	−5.47028	−0.635	0.41413
In-laws live together	51.8018	6.201	0.25755
Parents divorced	−6.37436	−2.269	0.16491
In-laws divorced	−1.62743	−0.408	0.76923E-01
Parent(s) in bad health	14.7616	1.636	0.16177
In-law(s) in bad health	8.59604	0.921	0.80202E-01
Number of children aged 0–4	1.68370	0.839	0.36959
Number of children aged 5–17	−6.68682	−5.823	0.81596

Table 3.2 (*cont.*)

Number of children aged 18 and over	3.02809	0.851	0.69682E-01
Number of children outside of household	−1.87351	−1.878	0.56387
Have no children	−16.6876	−4.903	0.26561
Sample	7,319		
Dependent variable mean	140.072		
R^2	0.329296		
F-statistic	119.2731		

other children, and if there is some random, independent probability of a child being of a caring type, then, a larger number of children translates into a higher such likelihood.

Presumably, visits are more effective as a means of setting example than telephone calls. If this is so, and the demonstration effect is important, the *composition* of contact should be affected by the presence of children. We find some evidence in support of this prediction. For the overall sample, the number of visits is 40 percent of total contact. The fraction of contact that is comprised of visits is a percentage point lower for childless households than for those with one child aged 5 to 17 (table 3.3). The difference in composition is significant at about the 0.15 level.

Additional results

Respondent contact with parents is responsive to income and prices (tables 3.1–3.2). As would be expected with time-intensive activity, higher earnings reduce contact. The earnings effect on contact is negative until earnings reach nearly $500,000. But the earnings effect on contact is small and only marginally significant – at sample means, a $10,000 increase in earnings reduces the number of contacts by a little more than one. The contact effects of full-time employment for men and women and dual-earner status are not statistically significant. Having higher net worth increases contact,

Table 3.3 *Tobit estimates – visits as a proportion of total contact*

Variable	Coefficient	*t*-value	Variable mean
Constant	0.575215	23.113	1.0000
Earnings	−0.825491E-06	−5.890	31527
Earnings^2	0.111836E-11	4.678	0.26033E+10
Net worth	0.165656E-07	1.636	76522
Years of education	−0.123425E-01	−10.798	12.953
Age	−0.657669E-03	−1.842	36.293
Married	−0.709700E-02	−0.855	0.62306
Female respondent	−0.661877E-02	−1.001	0.57772
Husband and wife both work	−0.831611E-02	−1.185	0.47522
Wife works full time	−0.817652E-02	−1.280	0.42622
Husband works full time	0.129939E-01	1.899	0.52633
Black	0.495641E-02	0.616	0.15137
Number of siblings	0.464027E-02	6.195	5.4023
Number of living parents	0.953045E-01	4.259	2.3785
Total parental income	−0.706863E-06	−3.179	47880
Parental income missing	−0.798556E-02	−0.808	0.16094
Distance from parents	−0.862539E-04	−31.239	428.74
Distance from in-laws	−0.260496E-04	−8.274	1363.2
Have any living parents	−0.246543E-01	−0.969	0.93847
Have any living in-laws	−0.695734E-01	−2.880	0.52394
Parents live together	−0.882218E-01	−3.965	0.42242
In-laws live together	0.400520E-01	1.874	0.26429
Parents divorced	−0.660497E-01	−2.834	0.16460
In-laws divorced	−0.807503E-01	−3.355	0.82371E-01
Parent(s) in bad health	0.158130E-01	2.157	0.16390
In-law(s) in bad health	0.194000E-01	1.885	0.77584E-01
Number of children aged 0–4	0.295580E-02	0.568	0.37609
Number of children aged 5–17	−0.679285E-02	−2.269	0.82118

Table 3.3 (*cont.*)

Number of children aged 18 and over	−0.116601E-01	−1.237	0.68431E-01
Number of children outside of household	0.774987E-03	0.291	0.54309
Have no children	−0.192451E-01	−2.163	0.26556

Sample	7,102
Dependent variable mean	0.3971
Log-likelihood	−101.03

though again the impact is small – a $150,000 increase in net worth is associated with a one-unit increase in contact.

Distance is a reasonable proxy for the price of contact. As we would expect, distance exerts a negative, precisely measured effect on respondent–parent contact. But the elasticity of contact with respect to distance is quite low in absolute value, which accords with findings from other data sources (for example, Klatzky [1971]). This evidence suggests that there are few substitutes for parent–respondent contact. Supplementary evidence on this issue is provided by Hill (1970), who interviewed three generations of 85 families about financial and in-kind transfers exchanged between generation members. He found that survey respondents gave quite low preference ranking to nonfamilial sources of in-kind aid and contact, such as clergy or social workers, compared to familial sources.

This evidence is consistent with the idea that parents cannot buy attention (or attention of the right type) in the marketplace. With regard to a service as special as filial attention, the market can provide only poor substitutes. Moreover, attention is personal and intimate, and as such is difficult to define. The transaction costs associated with an arrangement to have attention supplied from outside the family are therefore bound to be quite high.

Contact falls with the age and education of the respondent. Each finding is consistent with an inverse relationship between the permanent income of respondents and the amount of contact. For example, holding earnings and earnings determinants fixed, being older implies lower permanent income. Though contact falls with respondent education, however, it is by no means clear that contact measured in "quality units" falls as well. Presumably, better-educated respondents are able to provide attention and high-quality assistance to parents, perhaps means more sophisticated than calls and visits.

The proxy for permanent income of the respondent's parents is inversely related to contact, contrary to the findings reported by Bernheim, Shleifer and Summers. This finding is intriguing because it suggests that the promise of a bequest conditional on desirable behavior as measured by contact may not be an important determinant of parent-child contact. Indeed, the parental income effect suggests that contact may in part be motivated by altruism. The effect of the number of siblings on contact is consistent with the altruistic motive as well. If among siblings contact with parents is a "public good," having more siblings could reduce contact. Yet part of the pattern can also be consistent with the demonstration effect. Contact that is, or appears to be, motivated by altruism may have a stronger effect on children than contact that appears to be self-interested. And, while contact with parents who are in poor health is less frequent (tables 3.1 and 3.2), the fraction of contact comprised of visits is higher when parents or parents-in-law are in poor health.

Additional issues

Our approach leads us to expect gender differences in the incentives to employ the demonstration effect, or any other means to modify child preferences, because men and women have substantially different life expectancies – in many countries the difference exceeds 10 years. In addition, since wives are usually younger than husbands, the latter are more likely to have their spouse take care of them when they become infirm. Since wives are more likely to be widows when they become infirm, women would probably rely on spouses for care much less than men and instead would expect to rely on their children more than men. Women, therefore, have a much longer horizon over which to reap benefits from child loyalty and child-provided services.[13] Of course, there are other reasons why such gender differences could be expected, the most prominent of which are male–female wage differences and specialization within the household.

Since our empirical results measure outflows of contact, it is difficult to determine in the case of a married couple whether it is the husband, wife, or the couple who is providing the contact. But findings from other data sets – particularly those that measure inflows of services – indicate strong gender differences in the provision of services to elderly parents. For example, Stoller (1983) collected information from a sample of 753 people aged 65 or over, on assistance they had received from informal support networks (up to 5 people). Nearly half these informal helpers were adult children. Stoller found that, in terms of hours of assistance provided, daughters gave twice as much help to parents as sons (30 hours per month versus 15). Unfortunately, Stoller did not have wage information for sons and daughters, but she did have information on employment status. Being employed reduced significantly the sons' time spent providing help, yet mattered little for daughters' time. Tomes (1981) estimated a "child services" equation (measured by number of visits to parents) and had information about earnings in addition to employment status. He found, as Stoller did, that women provided more services than men. Leigh (1982) also finds a positive female effect for interaction

[13] This reasoning is consistent with a study by Schultz (1990) who examines fertility behavior in Thailand and finds that wives prefer more children than husbands. See also Raut (1992) for an example of a theoretical analysis of fertility decisions in a framework in which parents receive old-age support from children.

with parents and cites several other studies that provide the same result.

Recent findings from a survey of children of elderly Massachusetts residents provide further evidence to this effect, and report that financial assistance from children to their elderly parents, even in cases in which the elderly are quite poor, is rare (Kotlikoff and Morris [1989]). Since financial transfers are not visible – or are much less visible to grandchildren than, say, visits – this last result is well-predicted by the demonstration-effect argument. But the more suggestive finding is that which pertains to women. As with other studies of gender differences in the provision of care to elderly parents, the tempting explanation is that the shadow price of women's time is lower. But the pattern of daughters providing more care than sons holds even when the study controls for the marketplace earning effect. The demonstration-effect approach then provides an explanation for gender effects in the provision of care that are not accounted for by wage differences.

We have not specifically addressed the issue of the differential support that parents receive from daughters versus sons in developing countries. A recent study of transfers to the elderly in Karateng, Kenya (Hoddinott [1992]) finds that mature resident daughters (nonstudents over 15 years of age) provide twice as many hours of assistance with household tasks than mature resident sons, and that absent daughters provide five and a half times as many hours of assistance as do absent sons. These findings are considered somewhat perplexing since land in Karateng is passed on from fathers only to their sons; as land is not bequeathed to daughters, the threat of land disinheritance does not apply to them. (Land is by far the main familial asset and its value rises as it becomes more scarce.) The author is unable to account for daughters' substantial support, intimating that "[i]nvestigation into the reasons why daughters provide assistance, particularly those who are no longer members of their parent's household represents an area where future research would be valuable." Our approach might help in this regard.

In a survey of old-age security motives for fertility in developing countries Nugent (1985) stresses that such security systems are reliable only if the children's loyalty can be reasonably guaranteed. He notes further (pp.78–9) that

> Notably, the most important locus for loyalty training is the household itself, and the most important dispensers of such training are usually women. In part, this is because they shoulder most of the responsibility for managing household activities and in part because ... it is they who have the most to gain from such loyalty training.

An alternative to the demonstration-effect mechanism for inculcating child loyalty is for parents to engage in moral training of their children through the use of institutions such as schools or churches. Because of the above-mentioned reasons, we would expect women to be disproportionately engaged in religious activities, in addition to and independent of the effects of the female–male wage differential. Women stand to gain more from having children who have been duly trained. Empirical studies of religious participation (Azzi and Ehrenberg [1975], Ehrenberg [1977]) indicate that, controlling for wages of men and women, religious participation by women exceeds that of men. Further, participation increases with the number of school-age children. Empirical patterns for religious participation thus parallel those of the demonstration effect, suggesting that these are alternative mechanisms for achieving the same objective.

Conclusions

Family and group norms such as guilt and obligation are potentially powerful forces for determining behavior. But a choice-theoretic approach to norms does not exist in either the economic or sociological literature. This chapter takes a preliminary step toward the development of such an approach. Parents expend resources to inculcate preferred behavior patterns in their children. We argue that familial norms do not emerge on their own; they are deliberately cultivated by rational agents.

Our approach complements related work dealing with familial transfers. For example, Ehrlich and Lui (1991) consider an overlapping-generations model in which parents invest in children in order to receive financial and in-kind old-age support from them later on in life. Support from children is secured through self-enforcing contracts. The assumptions invoked to achieve self-enforcement include, first, that parents and children have identical preferences and, second, that not supporting parents leads to similar behavior on the part of the violator's own children. Our approach goes a step further with respect to the enforcement issue by analyzing the mechanisms through which preferences of children can actually be affected by parental behavior. Rather than *assume* that reneging on a contract will lead children to do the same, we argue that children are taught how to deal with implicit contracts by observing their parents' behavior, and that parents are aware of this learning facility and conduct their affairs accordingly.

Our approach also has implications for the labor market behavior of women. In light of the connection between gender and the demonstration effect discussed above, we would expect women's labor market participation to be less than men's even if, for example, there were no wage discrimination or differential by gender. Women will be less active in the labor market than men because the returns arising from alternative, nonlabor market activity – administering and demonstrating care – are higher. The key elements in women's allocation of time to market and nonmarket activities are life expectancy and the age difference at marriage. As we have noted, the likelihood that wives will provide at least some care for their spouses in old age is greater than the likelihood that women will be cared for by their husbands: both because they are younger than their husbands and because their life expectancy is longer, women are less active participants than men in labor market activities.

With the availability of additional data, several implications of our approach could be subjected to simple tests, and could explain several phenomena. For example, *Newsweek* magazine (December 23, 1991) reports on evidence presented to the US Senate Committee on Aging, and informal evidence provided by the American College of Emergency Physicians, that elderly people are being abandoned in hospital emergency rooms under the pretext of illness, "usually by relatives who are too poor, too tired, or too stressed-out to continue providing care." All else being held constant, we would expect abandonment to be inversely associated with the presence of grandchildren. Our approach also addresses a number of demographic issues. For example, in a population experiencing increased life expectancy, the number of would-be grandparents is rising. Because of the benefit arising from the care and attention of one's children if grandchildren are present, there is a larger constituency to support, encourage, and even subsidize the production of grandchildren. An aging population thus may have a built-in mechanism that operates against excessive growth of the average age of the population.

Our approach can help explain the evolution of norms in social groups larger than families. This is useful since the adoption of social norms by individuals is better understood than the process that translates the behavior and conduct of individuals or families into group norms. For example, our approach predicts that when a family's bequeathable wealth is low, family norms are more likely to evolve through the demonstration effect. The demonstration effect is more useful for parents who have little in the way of other means (such as the promise of a bequest) to enforce implicit contracts with their children. Further, the provision of care for the elderly by the state weakens incentives to inculcate values in children through the demonstration effect. Indeed, if inculcating the said values has the effect of producing better citizens in general, then the benefits arising from the state's care-giving functions may have to be weighed against an additional cost.

Future research might explore the potentially addictive qualities of guilt or a sense of obligation. Loyalty to parents might be addictive in the sense that the marginal utility of a current act of loyalty depends positively on the individual's history of loyal behavior. Becker and Murphy (1988b) show that it is this "adjacent complementarity" that can lead to addictive behavior. Further, they show that early events can have a profound impact on steady-state behavior. Parents have considerable leverage over implicit prices faced by their children and thus have the capability to inculcate addictive loyalty in their children. The demonstration effect is likely to be part of this process.

One final thought is worth noting. We have remarked on the possibility that parents would like their children to become parents themselves because it is likely that the children would then demonstrate attention and care. Yet it is possible that an alternative mechanism is at work: parenting and raising children bring about a degree of concern and care for others. This extends beyond one's children (to include one's parents), a positive externality of sorts. Caring practiced becomes a propensity. How caring and concern for others are forged, as opposed to the market and nonmarket consequences of their presence, is a topic that lies at the very frontier of research on the family.

Appendix

Table 3.A1 *Probit estimates – parents ever lived in respondent's home*[a]

Variable	Coefficient	Asymptotic *t*-value	Variable mean
Constant	−1.45177	−9.407	1.0000
Earnings	−0.110800E-05	−1.188	26,122
Earnings^2	0.182301E-11	1.344	0.22010E+10
Net worth	0.921088E-07	1.841	82,277
Years of education	−0.128665E-01	−1.899	12.356
Age	0.102080E-01	5.867	43.462
Married	0.905547E-01	1.588	0.55980
Female respondent	0.600528E-01	1.516	0.59857
Black	−0.115943	−2.211	0.16655
Number of siblings	−0.190484E-01	−3.845	5.4229
Number of living parents	0.429727E-01	0.188	1.7575
Total parental income	−0.710884E-05	−3.147	35,177
Parental income missing	−0.665766E-01	−0.774	0.12399
Total income of deceased parents	0.351028E-05	2.066	13,132
Deceased-parent income missing	0.787344E-02	0.159	0.20440
Distance from parents	−0.513261E-04	−1.997	321.76
Distance from in-laws	0.102053E-04	0.336	993.89
Have any living parents	0.367602E-01	0.159	0.70087
Have any living in-laws	0.711440E-01	0.305	0.38527
Parents live together	−0.296877	−1.311	0.31008
In-laws live together	−0.252981	−1.101	0.19304
Parents divorced	0.188944	0.808	0.12123
In-laws divorced	0.286618	1.185	0.60153E-01
Number of children aged 0–4	−0.596433E-01	−1.358	0.28368
Number of children aged 5–17	0.209958E-01	0.955	0.66046
Number of children aged 18 and over	0.111419	2.350	0.81739E-01

Table 3.A1 (*cont.*)

Variable	Coefficient	Asymptotic *t*-value	Variable mean
Number of children outside of household	0.551650E-02	0.463	0.96992
Have no children	−0.154793	−2.577	0.25340
Grandparents lived with respondent	0.190904	4.035	0.16798
Any parents who have died	−0.389584E-01	−0.565	0.40399

Sample	9,775
Respondent's parent moved in	1,000
Respondent's parent never moved in	8,775
Dependent variable mean	0.102
Log-likelihood	−2906.5
Likelihood at binomial	−3226.8

[a] Dependent variable = 1 if respondent's parents ever moved in with respondent, 0 otherwise.

Table 3.A2 *Ordered probit estimates – respondent's attitude toward letting parent move in. Sample: respondents having at least one living parent or in-law*

Variable	Coefficient	Asymptotic *t*-value	Variable mean
Constant	2.17829	17.702	1.0000
Earnings/30,000	−0.723120E-01	−3.621	31,281
$Earnings^2$/30,000	0.288032E-02	2.336	0.25731E+10
Net worth/80,000	−0.124324E-02	−0.341	78,110
Years of education/12	−0.153966	−2.370	12.959
Age/36	−0.942983E-01	−1.650	36.511
Married	0.215184E-01	0.577	0.61537
Female respondent	−0.135740E-01	−0.500	0.58113
Black	0.285708	7.631	0.15303
Number of siblings/5	0.583294E-01	3.418	5.3435
Number of living parents/2	−0.139930	−0.631	2.3596
Total parental income/50,000	−0.576519E-01	−1.056	47,400
Parental income missing	−0.273915E-01	−0.595	0.16212
Distance from parents/400	0.126860E-01	2.488	429.76
Distance from in-laws/1,300	0.523446E-01	2.564	1,319.89
Have any living parents	0.941122E-01	0.753	0.93961
Have any living in-laws	0.221429E-01	0.186	0.51265
Parents live together	0.126715	1.151	0.42398
In-laws live together	−0.309215E-01	−0.297	0.25575
Parents divorced	0.397989E-01	0.345	0.16382
In-laws divorced	0.103339	0.876	0.81273E-01
Number of children aged 0–4	0.472078E-01	1.957	0.36928
Number of children aged 5–17	0.199946E-01	1.435	0.81216
Number of children aged 18 and over	0.550710E-01	1.253	0.69480E-01
Number of children outside of household	−0.308733E-02	−0.263	0.55229
Have no children	0.520236E-01	1.230	0.26741

Table 3.A2 (*cont.*)

Variable	Coefficient	Asymptotic *t*-value	Variable mean
Grandparents lived with respondent	0.112201	3.282	0.17803
μ_1	0.787466	25.395	
μ_2	1.94106	56.002	
μ_3	3.00771	81.418	

Sample	7,038	1.0000
Disagree strongly	157	0.0223
Disagree	618	0.0878
Neutral	2,498	0.3549
Agree	2,579	0.3664
Agree strongly	1,186	0.1685
Log-likelihood	−9292.5	
Likelihood at binomial	−9389.0	

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4

Transfers by migrants: a strategic motive for remittances

Introduction

The modeling of migrants' remittance behavior is of interest for four distinct reasons.

First, remittances are of a gigantic magnitude. Two examples serve to illustrate this. In 1980 workers' remittances provided as much foreign exchange as exports did for Pakistan and Upper Volta, more than 60 percent of exports for Egypt, Turkey, and Portugal, and about 40 percent of exports for Bangladesh and Yugoslavia (World Bank [1984]). The International Monetary Fund estimates that in 1990, remittances into 38 labor-exporting countries amounted to US$33.8 billion (Elbadawi and Rocha [1992]). This must, however, be a lower bound because remittances through "unofficial" channels are not included in this estimate. There are many more rural-to-urban migrants in developing countries than there are international migrants from developing countries in more developed countries, and as a general rule, internal migrants frequently tend to remit to their families back in the rural areas about 30 percent of their urban-earned income (Stark [1991]). Even though the absolute sums remitted by internal migrants are considerably smaller than the sums transferred by international migrants, the considerably larger number of internal migrants implies total internal remittances running into billions of dollars.

Second, predicting remittance response to perturbations either in the incomes of recipients of remittances or in the incomes of remitters is sensitive to the motive for remitting. Policy choice is likewise sensitive. To illustrate, consider altruism versus exchange. The altruistic hypothesis of remittances predicts that remittances received and recipients' pre-transfer income would be inversely related. In other words, altruistic migrants react to recipients' income shortfalls by remitting more. But if, instead, transfers are motivated by self-interest and exchange considerations, a positive relationship between recipients' income and remittances can occur. For example, if transfers are used to purchase services from the recipients (say, care of own cattle left behind), a rise in the recipients' market wages will drive up the price of the services they provide. (These diametric predictions help unravel remittance motives in concrete situations.) If, for example, remittances are viewed as a welfare-increasing, informal income-equalizing mechanism, the government(s) in question may wish to refrain from instituting steps hindering them or will likely support policies favoring them. But the policy choice will then have to be contingent on the underlying motive.

Third, remittances are a unique form of transfers. While typically it is difficult to assess empirically transfers between family members who co-reside, remittances between migrants away from home and their families who stay behind can be measured more easily. Observed transfers between family members can unravel hidden underlying intrafamilial relationships.

Fourth, there is an active and growing general interest in nonmarket exchanges, intrafamilial transfers, and intergenerational linkages. The study of remittances constitutes part of this inquiry, and could advance it considerably.

In this chapter we study a motive for remittances that has not been explored in the remittances literature. We first provide a simple formal model that points to what we call the strategic motive for remittances. We then draw a number of implications and predictions. The basic idea is as follows: when information pertaining to individual skill levels of migrant workers is unknown to employers at destination, all migrant workers receive a wage based on the average product of the group of migrants. Since the high-skill workers would benefit from dissuading the low-skill workers from migrating, they should be willing to make a transfer to the low-skill workers to induce them to stay put. The conditions under which such transfers will be made are spelled out and their precise magnitude is determined. Migrants thus remit to nonmigrants motivated not by altruistic considerations but rather by pure self-interest: remittances protect the wage of the high-skill workers from being "contaminated" by the presence of the low-skill workers in the same pool.

Labor migration under asymmetric information: the basic model

Assume a world consisting of two countries: a rich country, R, and a poor country, P. We can likewise assume a country consisting of a rich urban area and a poor rural area. In a given occupation let the net wages for a worker with skill level θ be $W_R(\theta)$ and $W_P(\theta)$ in the rich country and the poor country respectively[1] such that $\partial W_P(\theta)/\partial\theta > 0$ and $\partial W_R(\theta)/\partial\theta > 0$. (Thus workers' productivities in the sending and receiving countries are ranked identically.) To reflect the fact that R is rich and P is poor, it is assumed that

[1] To make the analyses tractable we assume throughout that the wages in both R and P are dependent only upon a worker's skill level and not upon the excess supply of or demand for labor. In this we follow the similar assumption made in the optimal tax literature. Thus, for example, $W_R(\theta)$ and $W_P(\theta)$ may be linear in θ such that $W_R(\theta) = r_0 + r\theta, r_0 > 0$, $r > 0$ and $W_P(\theta) = p_0 + p\theta$, $p_0 > 0, p > 0$. It can be shown (see Stark [1991], ch. 12) that these equations are reduced equilibrium forms where in each equation the left-hand side is the equilibrium wage and the right-hand side is the productivity of a worker with skill level θ.

$W_R(\theta) > W_P(\theta)$ for all θ.[2] Also, without loss of generality, let θ be defined upon the closed interval $[0, 1]$ and let the density function of P workers on θ be $F(\theta)$.

In addition, given that P workers are likely to have a preference for a P life style because of cultural factors, social relationships, and so on, it is assumed that P workers apply a discount factor to R wages when comparing them to P wages. Thus when making the migration decision, they compare $kW_R(\theta)$ with $W_P(\theta)$ where $0 < k < 1$. A P worker will therefore migrate from P to R if

$$kW_R(\theta) > W_P(\theta). \tag{4.1}$$

Clearly, without further restrictions on $W_R(\theta)$ and $W_P(\theta)$ there may be several values of θ for which $kW_R(\theta) - W_P(\theta) = 0$. Hence as illustrated in figure 4.1, there may be several distinct skill groups along the skill axis. Thus in figure 4.1, the workers in skill intervals $0\theta_1, \theta_2\theta_3, \theta_4 1$ migrate, whereas those in the complementary intervals do not. We shall refer to a case in which there are at least three distinct groups (for example, along the θ axis, migrating, nonmigrating, migrating) – a situation which can occur only if at least one of the $W_P(\theta)$ and $W_R(\theta)$ functions is nonlinear in θ – as the nonconvex case. Similarly, we shall refer to the type of case in which there are only two or fewer distinct groups as the convex case.

Let us now assume that the skill of each potential migrant is known in P, where he or she has been observed for a while, but is unknown in R. When markets are isolated in the sense that information does not ordinarily flow across them (or does not flow costlessly and freely) an employer (or employers) in one market may possess information on individual worker productivity – for example, such information may be revealed to the employer

[2] This may, for example, result from a higher capital-to-labor ratio in R, from a superior technology in R, or from externalities arising from a higher average R country level of human capital per worker.

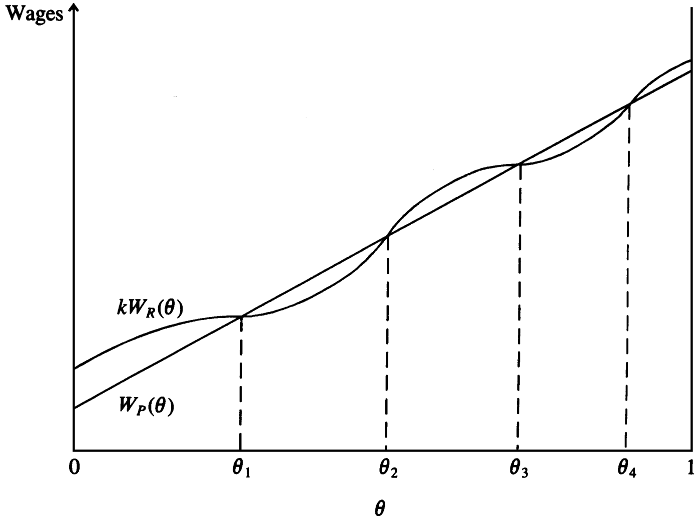

Figure 4.1 Disjoint skill intervals of migration under symmetric information

over time as a by-product of his or her normal monitoring and coordinating activities – but the information is employer- or market-specific. Also, for the moment, let us exclude the possibility that true skill is revealed in *R* over time.

Faced with a group of workers whose individual productivity is unknown to the employer (only the distribution of earnings abilities is known), the wage offered will be the same for all such workers and will be related to the average product of all members of the group. Let us assume that the actual individual wage offered is equal to the average product of the group[3] and that wage offers are known to all workers.

[3] If employers are risk neutral and production functions are linear in skills, the employer does not suffer from his or her ignorance of the true skill level of each worker, so paying the average product per worker will be the competitive outcome. These assumptions of risk neutrality and linearity in production are the commonly accepted assumptions in the screening literature (see, for example, Stiglitz [1975]).

Hence denoting by $\overline{W}_R$ the wage payable in the rich country to a migrant of unknown skill level and assuming n distinct migrating groups, $\overline{W}_R$ is given by

$$\overline{W}_R = \sum_{i=1}^{n} \int_{\underline{\theta}^i}^{\overline{\theta}^i} W_R(\theta)F(\theta)d\theta / \sum_{i=1}^{n} \int_{\underline{\theta}^i}^{\overline{\theta}^i} F(\theta)d\theta, \tag{4.2}$$

where $\underline{\theta}^i$ and $\overline{\theta}^i$ are respectively the lowest and highest skill level migrating in group i, where i is one of the continuous groups migrating, and where the skill level increases with i. (Note that $0 < \underline{\theta}^1 < \overline{\theta}^n < 1$ for nonempty migrating sets.) It follows immediately that $\overline{W}_R < W_R(\overline{\theta}^n)$.

The following result (lemma) can now be established. Under asymmetric information if the top skill level migrating is $\overline{\theta}^n$ then any skill level $\tilde{\theta}$ where $\tilde{\theta} < \overline{\theta}^n$ will also migrate.

To prove this result consider any $\tilde{\theta}$, such that $\tilde{\theta} < \overline{\theta}^n$. Now, since by assumption $\overline{\theta}^n$ migrate, it must be that $k\overline{W}_R > W_P(\overline{\theta}^n)$. Also, since $\tilde{\theta} < \overline{\theta}^n$ then $W_P(\tilde{\theta}) < W_P(\overline{\theta}^n)$ and hence $k\overline{W}_R > W_P(\tilde{\theta})$ so that $\tilde{\theta}$ skill levels also migrate.

The implication of this result is that under asymmetric information, everyone with a skill level less than or equal to $\overline{\theta}^n$ migrates, so that all workers in the interval $[0, \overline{\theta}^n]$ migrate. Note the contrast with the case of full information, as depicted in figure 4.1, where the migration pattern could be nonconvex.

Thus under asymmetric information the wage payable to all migrating workers in R is

$$\overline{W}_R = \int_0^{\theta^*} W_R(\theta)F(\theta)d\theta / \int_0^{\theta^*} F(\theta)d\theta, \tag{4.3}$$

where θ^* is the top skill level migrating. Thus $\overline{W}_R$ can be written as $\overline{W}_R(\theta^*)$.

Under asymmetric information, then, workers of skill level θ for which

$$k\overline{W}_R(\theta^*) > W_P(\theta) \tag{4.4}$$

will migrate from P to R.[4]

Given this characterization of the migration pattern under asymmetric information we now proceed to an example of a two-groups case.

A two-groups case: an example

Assume there are just two types of workers: low-skill workers whose skill level is θ_1, and high-skill workers whose skill level is θ_2, with skill-related wage rates $W_i(\theta_1)$ and $W_i(\theta_2)$ in the poor country $i = P$ and rich country $i = R$. Assume that the two skill types constitute α percent and $1 - \alpha$ percent of workers in the profession, respectively. Suppose that no costs are associated with migration, except those embodied in k, and that k is such that $kW_R(\theta_1) < W_P(\theta_1)$ yet $kW_R(\theta_2) > W_P(\theta_2)$. This assumption is introduced in order to capture the differential migration incentives of the symmetric information state and the asymmetric information state. It implies that under symmetric information only the relatively high-skill workers will migrate. However, if we assume that

$$\alpha kW_R(\theta_1) + (1 - \alpha)kW_R(\theta_2) > W_P(\theta_2) \tag{4.5}$$

then, under asymmetric information, the θ_2 workers will again migrate but this time the θ_1 workers will migrate as well (a result that follows immediately from the above lemma). If at the end of the first employment period employers in R identify

4 (4.4) provides a cut-off condition which is due to individual rationality. It can be proven that the arising equilibrium is compatible with, indeed ensues from, the other side of the market, namely, the behavior of firms in the destination R. See Stark (1991, ch. 12).

costlessly and correctly the skill levels of individual workers and adjust pay accordingly, the low-skill workers will return to P while the high-skill workers will stay in R. Since θ_1 are not pooled with θ_2, θ_2's R country wage can only be higher, that is

$$kW_R(\theta_2) = \alpha kW_R(\theta_2) + (1-\alpha)kW_R(\theta_2) > \alpha kW_R(\theta_1) + (1-\alpha)kW_R(\theta_2). \tag{4.6}$$

By assumption, the expression on the right-hand side of the inequality is larger than the alternative poor country wage $W_P(\theta_2)$.

Considering the entire migration experience we see that migration is positively selective. Even though no selectivity is observed initially – both low-skill workers and high-skill workers leave – with the passage of time and the removal of informational asymmetry, the return of the low-skill migrants to their home country produces a feature of positive selectivity. Initially migration is not selective in skills, but *ex post* it is.

Strategic remittances

Suppose now that workers can act jointly (form cohesive groups). Since the high-skill workers would benefit from dissuading the low-skill workers from migrating, they should be willing to make a transfer to the low-skill workers to induce them to stay put. This will free the high-skill workers from being pooled with the low-skill workers *right from the start*. Of course, the transfer (a cost) must be smaller than the associated benefit conferred by the difference between the R country wage of the high-skill workers if they were to migrate alone, and the R country wage of the high-skill workers if the low-skill workers were to migrate with them. Put differently, the transfer must be smaller than the high-skill workers' symmetric information–asymmetric information wage differential. Formally, the transfer $\tilde{T}$ has to fulfill the condition

$$\tilde{T} < W_R(\theta_2) - [\alpha W_R(\theta_1) + (1-\alpha) W_R(\theta_2)], \tag{4.7}$$

where

$$\frac{1-\alpha}{\alpha}\tilde{T} = k\alpha W_R(\theta_1) + k(1-\alpha) W_R(\theta_2) - W_P(\theta_1) + \varepsilon, \tag{4.8}$$

where $\varepsilon > 0$ is a sufficiently small constant. From (4.7) and (4.8) we obtain

$$\frac{\alpha}{1-\alpha}[k\alpha W_R(\theta_1) + k(1-\alpha) W_R(\theta_2) - W_P(\theta_1)] < \tilde{T} < W_R(\theta_2)$$

$$-[\alpha W_R(\theta_1) + (1-\alpha) W_R(\theta_2)] = \alpha[W_R(\theta_2) - W_R(\theta_1)]. \tag{4.9}$$

Considering the last expression in (4.9) we see the importance for existence of a steep wage profile by skill in the rich country. For $\tilde{T}$ that fulfills (4.9) we thus obtain the following: by offering the low-skill workers $\frac{1-\alpha}{\alpha}\tilde{T}$ each, the high-skill workers succeed in having the former stay put. Notice that the low-skill workers cannot extract a transfer larger than $\tilde{T}$ by threatening to migrate as this threat would not be credible: if they were to migrate, these workers would receive a payment valued at

$$k\overline{W}_R = k\alpha W_R(\theta_1) + k(1-\alpha) W_R(\theta_2).$$

But if they stay put they receive each $W_P(\theta_1) + \frac{1-\alpha}{\alpha}\tilde{T}$, which is larger than $k\overline{W}_R$ by ε. And of course, the high-skill workers are still better off in the wake of such a transfer because they are left with $W_R(\theta_2) - \tilde{T}$, which is worth $k[W_R(\theta_2) - \tilde{T}]$ to them, and this, by construction, is better than a payment worth $k\overline{W}_R$.

Subject to the existence condition for $\tilde{T}$ holding, several predictions and implications arise.

First, if workers can act jointly, they will form action groups by type, and migration will be selective right from the start; only the high-skill workers will migrate. Testable implications then are that selectivity and remittances are positively related and that return migration and remittances are negatively related.

Second, migrants will remit to nonmigrants, motivated not by altruistic considerations but rather by pure self-interest: migrants remit to nonmigrants to buy them off, to prevent them from migrating. Remittances serve to protect the wage of the high-skill workers from being contaminated by the presence of low-skill workers in the same pool. Remittances will thus be targeted to those at home who *have* earning power since there would be no need to "bribe" those who would not credibly threaten to engage in labor migration. Migrants who remit to nonmigrant members of their households[5] or even to their community (village) of origin at large (as, for example, Turkish migrant workers in Germany and Mexican migrant workers in the United States are reported to do) may do so in part to enhance the welfare of the stayers, but also in part to directly improve their own wellbeing. Quite often, migrants from a given sending area in P work together in a given facility or work site in R such that remitting to a well-defined "target" set of potential migrants at home is effective in preserving the migrants' wage. This small-scale effect also helps mitigate possible free riding by an individual migrant who might be tempted to avoid remitting while enjoying the repercussions arising from other migrants' contributions.

Third, the role of remittances is cast in a new light. Remittances enhance allocative efficiency by countering the effect of informational asymmetry, thus enabling *all* agents to locate on the utility frontier as implied by the first-best allocation rule of (4.1).

Fourth, in addition to explaining why remittances are

[5] The chapter's two-skill-level implementation of the asymmetric information theory predicts that the nonmigrant household members will be low-skill workers.

initiated and predicting their precise magnitude, the strategic motive for remittances also explains why remittances come to a halt. Once the high-quality workers are identified, their wage is immune to erosion arising from migration of low-quality workers. Hence the need to buy off the latter evaporates, and remittances to them cease.

Fifth, it is possible that group formation involves some organizational cost. The asymmetric information approach to labor migration predicts that the formation of groups is more likely when the differential between the rich country wage of the high-skill workers and the rich country wage of the low-skill workers is large; and when the pace at which individual skill levels are discerned in the country of destination is slow.

Sixth, suppose an entry tax $\overline{T}$ is in place that is large enough to make it not worthwhile for the low-skill workers to migrate under asymmetric information but not so large as to swamp the high-skill workers' own discounted wage differential. (A formal derivation of the entry tax is provided in the appendix.) Then, even if workers could form groups by type, the low-skill workers would be unable to extract a transfer from the high-skill workers since such a demand cannot be backed by a credible threat of migration should the transfer not be made. Thus taxing migrants and the transfer of remittances to nonmigrants (to prevent the latter from migrating) are mutually exclusive. Consistent with our third point, the entry tax *enhances* efficiency.

A numerical example serves to illustrate. Suppose $W_P(\theta_1) = 7$, $W_P(\theta_2) = 9$, $W_R(\theta_1) = 10$, $W_R(\theta_2) = 20$; $F(\theta)$ is such that $\alpha = 1 - \alpha = \frac{1}{2}$; and $k = \frac{2}{3}$. Thus under symmetric information only θ_2 migrate as $kW_R(\theta_2) = \frac{2}{3} \cdot 20 > 9$ but $kW_R(\theta_1) = \frac{2}{3} \cdot 10 < 7$, while under asymmetric information both skill levels migrate as

$$k\alpha W_R(\theta_1) + k(1-\alpha)W_R(\theta_2) = \frac{2}{3} \cdot \frac{1}{2} \cdot 10 + \frac{2}{3} \cdot \frac{1}{2} \cdot 20 = 10 > (W_P(\theta_1) = 7;\ W_P(\theta_2) = 9).$$

As to the remittances scenario, if the high-skill workers offer to transfer $\tilde{T} = 3 + \varepsilon$, given by (4.8), the low-skill workers will stay put. The low-skill workers cannot extract a larger transfer by threatening to migrate as this threat would not be credible: if they were to migrate these workers would receive 15 (which is worth only 10 to them). But if they stay put they receive an assured $7 + 3 + \varepsilon > 10$. And of course, the high-skill workers are still better off in the wake of such a transfer because they are left with $17 - \varepsilon$ units, which are worth $11\frac{1}{3} - \varepsilon$ units to them, and this is better than a payment worth 10 units.

This example helps elucidate an additional point. Suppose θ_1, θ_2 is a pair of brothers, and suppose that there are two such pairs. We focus on incentives and coordination. If all four migrate, each will receive 15, the value of which is 10. Now suppose that a high-skill worker alone attempts to induce his low-skill brother, z, to stay put. This, however, will not work. In the absence of migration by z, the remaining migrants will receive $\frac{1}{3}(10 + 20 + 20)$, the value of which is $11\frac{1}{9}$. This is better than 10 and therefore desirable, but there is only $(1\frac{1}{9} - \varepsilon) \cdot \frac{3}{2} = 1\frac{2}{3} - \varepsilon$ to be transferred by z's brother to z, and since $7 + 1\frac{2}{3} - \varepsilon < 10$, the unwarranted migration cannot be blocked. If, however, z's brother persuades the other migrant workers to join him in remitting to z, the scheme will work. For example, each needs to remit $1 + \varepsilon$, which means that z will receive $10 + \varepsilon$, while each migrant will be left with $\frac{50}{3} - 1 - \varepsilon$ and this is worth $\frac{2}{3}(\frac{47}{3} - \varepsilon) = 10\frac{4}{9} - \varepsilon$, which is better than 10. Of course, a still better outcome would be secured if the two high-skill workers banded together to "screen out" the two low-skill workers; numerically, though, this is identical to the equal shares of each type of worker case alluded to in the preceding paragraph. What is especially interesting about this example is not only that coordination can secure a Pareto improvement that individual action cannot, but also that some migrants may be observed to remit to nonmigrant workers toward whom no altruism prevails at all. Moreover, by illustrating the dependence of strategic remittances on coordination and monitoring, the example implicitly suggests that upon larger waves of migration, strategic remittances will be smaller; remittances per migrant will then be declining in the size of the group of migrants. The free riding problem associated with buying off low-skill workers who, from the point of view of the high-skill workers, are public "bads" is more likely to arise the larger and less cohesive is the group of high-skill workers.

Conclusions

In preceding work considerable effort was spent on modeling and subsequently testing the idea that migration by individuals is a familial strategy aimed at securing migrant-to-family remittances (Stark [1991]). These remittances are taken to be motivated by concern for the wellbeing of those staying behind, or by the need to pay them for past, on-going, or future services. This chapter steps outside this framework. It argues that migrants may remit to nonfamily members not because of altruism or a need to establish an exchange relationship, but rather because of an interest in protecting their wages from being contaminated by the presence of fellow migrant workers in a migrant pool whose members receive a wage based on the average product of the group of workers, rather than on individual product. If the strategic motive for remittances is operative, screening migrants at the point of entry will adversely affect remittance flows. This consideration connects with, and should thus impinge on, the political economy of migration legislation, especially procedures aimed at sorting workers.

Empirical inquiries concerning the relationship between transfers and recipient characteristics have produced conflicting results. Some studies conclude that remittances are motivated by altruism; others point to exchange or insurance motives. And still others see remittance behavior as governed by a combination of motives.[6] One reason for the conflicting results may have to do with possible misspecification of the empirical remittance functions that stems from ignoring the strategic motive for migrant transfers. Suppose that the donor is the dominant player in the remittance arrangement, so that transfers from migrant to nonmigrant are given by (4.8). This equation contains three variables: the migrant's actual earnings, the recipient's actual earnings, and the recipient's potential earnings in country R. (4.8) predicts that the coefficient for actual recipient earnings is -1. Suppose an empirical remittance equation is estimated, which contains actual earnings of migrant and recipient but not the recipient's potential earnings. The recipient earnings coefficient in such an equation would be affected by omitted-variable bias. The direction of the bias is upward because (a) the recipient's potential earnings have the effect of raising remittances, and (b) the recipient's actual earnings and potential earnings in R are likely to be positively correlated. As a consequence of the omission, the positive effect of potential earnings in R is attributed to actual earnings, resulting in an algebraically higher coefficient. The possible omitted-variable bias might explain why empirical remittance functions produce conflicting sign patterns for the impact of recipient income on transfers, as the values of the omitted-

[6] For example, some studies find an *inverse* relationship between recipient income and remittance amounts (Kaufmann and Lindauer [1986; El Salvador], Kaufmann [1982; the Philippines], and Ravallion and Dearden [1988; rural households in Java]). This finding is consistent with altruism; the poorer receive more transfers. But other studies find a *positive* relationship between recipient income and remittance amounts (Lucas and Stark [1985; Botswana], Ravallion and Dearden [1988; urban households in Java], and Cox, Eser and Jimenez [1998; urban households in Peru]). This finding is inconsistent with purely altruistic motives for remittances.

variable-bias terms are likely to vary from one instance to another.[7]

Our analysis also forges a link between remittances and the ease with which employers can make judgments about individual skill levels. Consider the effect of occupational licensing on remittances. If migrants possess some certification that is recognized fairly quickly by employers in *R*, the informational asymmetry problem becomes less severe and might well disappear. If so, we would expect that migrants working in occupations which are commonly licensed would have a diminished incentive to remit. Similarly, if a migrant is self-employed, his or her earnings will not be much affected by informational asymmetries and again, incentives to remit will diminish. Thus the strategic model predicts that remittance flows will be sensitive to the occupational structure of the migrant group. In particular, we would expect that occupational status would be significant in empirical remittance equations even after controlling for the pre-remittance incomes of donors and recipients. Further, if we were to broaden our analysis to include occupational choice we might expect that informational asymmetry would give migrants an added incentive to become self-employed as opposed to working for wages and salaries. Indeed, a testable implication is that the higher the dispersion of skill levels at origin (and, therefore, the greater the potential wage erosion), the more likely high-skill migrants (who seek to avoid either pooling or remitting) will self-select into self-employment.

Appendix

Suppose that the rich country wishes to attract and retain only high-skill workers, and that screening (testing) indivi-

[7] For example, the correlation between potential and actual wages is likely to be lower if low-skill workers in country *P* are subject to binding minimum wages.

dual migrants (would-be or actual) is very costly or highly unreliable. The asymmetric information approach identifies an instrument that facilitates such a differentiation.

The rich country can announce an entry tax (visa fee) of $\overline{T}$ units. This tax must be large enough to make it not worthwhile for the low-skill workers to migrate under asymmetric information but not so large as to swamp the high-skill workers' own discounted wage differential. To secure these dual requirements, it is necessary to find the minimal tax that solves

$$k[\alpha W_R(\theta_1) + (1-\alpha)W_R(\theta_2) - \overline{T}] < W_P(\theta_1). \qquad (4.A1)$$

That is, the tax $\overline{T}$ should solve

$$k[\alpha W_R(\theta_1) + (1-\alpha)W_R(\theta_2) - (\overline{T} - \varepsilon)] = W_P(\theta_1), \quad (4.A1')$$

where $\varepsilon > 0$ is a sufficiently small constant, while maintaining

$$k[W_R(\theta_2) - \overline{T}] > \mathrm{W_P}(\theta_2). \qquad (4.A2)$$

From (4.A1) and (4.A2) we obtain

$$k\alpha W_R(\theta_1) + k(1-\alpha)W_R(\theta_2) - W_P(\theta_1) < k\overline{T} < kW_R(\theta_2) - W_P(\theta_2). \qquad (4.A3)$$

Existence then requires that

$$W_P(\theta_2) - W_P(\theta_1) < \alpha k[W_R(\theta_2) - W_R(\theta_1)]. \qquad (4.A4)$$

Existence is thus more likely the steeper the wage profile is by skill in the rich country relative to the wage profile by skill in the poor country, a condition quite likely to hold. If the proportion of the low-skill workers in the occupation under review, α, is relatively large, and if the rate of location discount is not high, the entry tax that solves (4.A1′) will also fulfill (4.A2).

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5

Exchange with recognition costs: an explanation of migrants' performance

Introduction

This chapter is motivated by an attempt to account for the empirical finding that migrants often outperform the native born. The underlying idea is that how migrants fare, absolutely and relative to the indigenous population, depends on group attributes rather than on individual abilities and skills. It is postulated that characteristics of the market environment and trade technology rather than returns to traditional characteristics of human capital play a role in explaining this outcome.

Typically, research work on migration specifies an equation of the following type:

$$p_i^a = p(W^a, U^a, C^a, A^a, \epsilon^a), \tag{5.1}$$

where p_i^a is the probability of person a (observed at random) choosing location i, W^a is a vector of discounted wage streams available to person a in various locations, U^a is a vector of unemployment rates applicable to person a, C^a is a vector of discounted costs incurred in relocating, A^a is a vector of a's characteristics, and ϵ^a is a stochastic term reflecting a's idiosyncratic tastes. When microdata are used, the dependent variable in an equation similar to (5.1) is usually a dummy variable for the mover–stayer distinction (or polytomous if more than one destination is distinguished). When macrodata are used, the typical approach is to estimate

$$m_{ji} = m(W_i, W_j, U_i, U_j, d_{ji}, A_j, \xi), \qquad (5.2)$$

where m_{ji} is the fraction of population j migrating to i, W_i and W_j are the mean wages in i and j respectively, U_i and U_j are the mean unemployment rates in i and j respectively, d_{ji} is the distance from j to i, A_j is a vector of average personal attributes among the j population, and ξ is a stochastic disturbance. Using (5.2) as an approximation to (5.1) involves proxies such as current earnings for discounted future earnings, distance for migration costs, and so on. Note that (5.2) includes only mean values for earnings and personal characteristics; if (5.1) and (5.2) are strictly linear, (5.2) is simply the mean value of (5.1). Typically, estimates of (5.2) find a positive effect for destination wage, negative effects for origin wage and distance, and so on. The estimates of (5.1) usually find positive effects for level of schooling and family size, negative effects for age and costs of move, and so on.

(5.2) includes the explanatory variable A_j – a vector of average personal attributes among the j population, which in turn originates from the A^a vector of personal attributes in (5.1). In accounting for migrants' market performance, the close attention paid to the characteristics of the persons who migrate has stifled consideration of the characteristics of persons present at the destination site; A_i is rarely found on the right-hand side of an equation such as (5.2). To illustrate how powerful such an inclusion could be, let us sketch an example. Suppose that in urban destination i the political system is based on proportional representation with elected representatives. Those members of the population originating in some rural area have $1/3 - \epsilon$ share of the legislative council while the indigenous population has the larger $2/3 + \epsilon$ share, where $\epsilon > 0$ is a sufficiently small fraction. Major political decisions deemed unfavorable to any population group can be enacted if carried through by a 2/3 majority. Clearly, the migrants' share is just short of blocking such pieces of legislation. But if the resident migrant community could induce additional migration from the home areas the situation would change dramatically. We should then expect the old-timers to support and subsidize additional migration until the balance of power shifts to $1/3 + \epsilon, 2/3 - \epsilon$.[1] The idea is that circumstances that affect earlier migrants (relative to the indigenous population) account for the current flow of migrants beyond any reference to the attributes of the migrants. Although the literature observes that the success or failure of migrants is contingent on assistance from friends and relatives, there is little discussion of what determines such assistance, under what conditions it will be offered, what motivates the assistance, and so on.

Indeed, the performance of migrants and how they fare relative to the indigenous population may depend on attributes of the migrants *as a group* versus attributes of the indigenous population *as a group*. In the terminology of (5.2), (average) attributes of both the migrant population in i and the nonmigrant population in i, that is, A_i^M, A_i^{NM} play an explanatory role.

Trade as a game with recognition costs

Assume a population that consists of two groups: migrants and indigenous people. Each group consists of agents who trade cooperatively, C, and agents who trade noncooperatively, NC. In the model, members of each group trade only with other members of their own group (but see the appendix for a relaxation of this assumption). Agents do not know the type of the agents with whom they trade, but they

[1] Possible attempts by the indigenous population to curtail such migration will presumably be less effective than efforts by past migrants to foster it.

can obtain such information at a cost. The idea is that the cost at which migrants can obtain the requisite information about fellow migrants is lower than the cost incurred by nonmigrants in assessing whether a fellow nonmigrant is of C-type or of NC-type. The results derived are that in this situation, the equilibrium proportion of C-type agents in the migrant population is higher than the equilibrium proportion of C-type agents in the nonmigrant population. And since, by construction, the payoff matrices of each subpopulation are the same,[2] the per capita payoff of migrants is higher than that of nonmigrants – the migrants outperform the nonmigrants. If the cost-of-information advantage is not present, however, migrants will fare no better than nonmigrants.

We proceed as follows. Let a prisoner's dilemma type of table represent the payoffs from cooperation and noncooperation for two agents, E and F, matched at random:

		Agent F	
		C	NC
Agent E	C	(T, T)	(R, U)
	NC	(U, R)	(S, S)

In this payoff matrix $U > T > S > R > 0$ (and $2T > U + R$; total payoffs are maximized when both agents cooperate). Let the share of C-type agents in a given group be P_C and let the cost of finding out the type of another agent be $K \geq 0$. In the environment we have in mind there is no memory – every trade is conducted as if it were the first – and the C-type

2 Migration enables agents to utilize a production technology specific to the country of destination which is superior to that for the country of origin (see Galor and Stark [1991]). Hence the benefits to agents from migration are not conditional on migrants trading with nonmigrants.

agents "move" first. Given the payoff matrix, the trade strategy chosen by a C-type agent is based on the fraction of the group who are C-type, and on the type-determining cost. If a C-type agent engages in trade without determining the type of the trading partner, and the other C-type agents behave similarly, the payoff to a C-type agent is $\Pi_C = P_C T + (1 - P_C)R$. If a type-determining cost K is incurred, the payoff will be $\tilde{\Pi}_C = T - K$.[3] The cost will be incurred if $\tilde{\Pi}_C > \Pi_C$, that is, if $K < (T - R)(1 - P_C) = K^*$. Thus for values of $K < K^*$, a C-type agent will have a payoff of $T - K$ while an NC-type agent will have a payoff of S. Assuming for the rest of this chapter that

$$T - K > S \tag{5.3}$$

(that is, the cost is never so large as to swamp the difference between the payoff from joint cooperation and the payoff from joint noncooperation), the C-type agents will have an edge and their share of the population will rise.[4] If, however, $\tilde{\Pi}_C < \Pi_C$, that is, if $K > K^*$, the C-type agents will trade randomly. In this case, though, the payoff to an NC-type agent will be $\Pi_{NC} = P_C U + (1 - P_C)S$. The NC-type agent will have an edge if $\Pi_{NC} > \Pi_C$, that is, if $P_C U + (1 - P_C)S > P_C T + (1 - P_C)R$, which indeed holds

[3] By incurring cost K, the C-type agent attains a trade with a C-type agent with probability 1. To see why, suppose the C-type agent announces his intention to undertake the type-determining action. Since this action determines a type perfectly, no NC-type agent will approach a C-type agent, knowing that such a meeting will not result in a trade. The C-type knows that the NC-type knows this, which could tempt the C-type not to incur the cost after all. However, what works against such a temptation is the realization that any failure to pursue type-determining could result in the NC-type approaching the C-type, which in turn will result in a trade that was considered undesirable when the decision to incur K, rather than trade randomly, was taken.

[4] For an explicit evolutionary exposition see chapter 6 in this book.

since $U > T$ and $S > R$.[5] Then, the share of the NC-type agents in the population will rise. We see that equilibrium obtains when $K = K^*$, that is when

$$P_C = 1 - \frac{K}{T - R}. \tag{5.4}$$

The equilibrium distribution of agents by type in the population is thus explained as a result of a dynamic process converging to the distribution.

Two comments are in order. First, the equilibrium is stable since if the proportion of agents of a given type happens to be larger than the equilibrium proportion, their payoff will be lower than the payoff of agents of the other type (and their population share will decline), and vice versa. For example, if P_C happens to be lower than its equilibrium level, K^* must maintain $K^* > K$ since $\frac{\partial K^*}{\partial P_C} < 0$. Hence, the inequality $\tilde{\Pi}_C > \Pi_C$ will hold, that is, the payoff of the C-type agents will be larger than the payoff of the NC-type agents and the population share of the C-type agents will increase.

Second, since $K \geq 0$, $T > R$, and $K < T - S < T - R$ (the first inequality is due to (5.3), the second to the payoff matrix), $\frac{K}{T-R}$ is a fraction between 0 and 1. Therefore, P_C must maintain $0 \leq P_C \leq 1$. This means that except for the two boundary cases, in equilibrium the population is a mixture of C-type agents and NC-type agents (such an equilibrium is called polymorphic). The two polar cases are as follows: if K happens to be as large as $T - R$ (that is, as large as the difference for a cooperating agent between the payoff from trading with a cooperator and the payoff from trading with a noncooperator) there will be no cooperators;

[5] Suppose that by incurring some cost $\tilde{K}$ the NC-type agents can identify the C-type agents in an attempt to trade with them rather than to trade randomly. But then the C-type agents will be reluctant to trade randomly as this confers a payoff of R which is worse than Π_C; the C-type agents will fare better by incurring K (and will receive a payoff $\tilde{\Pi}_C$). Thus invoking the assumption that the C-type "move" first, the possibility of NC-type agents incurring $\tilde{K}$ is negated.

P_C will be zero. (If they incur the recognition cost, the C-type agents will have a payoff R; because R is less than Π_{NC} for all values of P_C, however, the C-type agents will be driven out.) On the other hand, if K is as low as zero, $P_C = 1$; the noncooperators, who will always have a payoff of only $S(< T)$, will be driven out.

(5.4) entails the following first result: the equilibrium share of the C-type agents in a population is inversely related to the cost of establishing the type of a party to trade. The proof is $\frac{\partial P_C}{\partial K} = -\frac{1}{T-R} < 0$.

What are the payoffs to C-type and NC-type agents at the equilibrium point? For a C-type the payoff is $T - K$, and for an NC-type it is S. Therefore, the per capita payoff is $y = P_C(T - K) + (1 - P_C)S$. This entails the following second result: the larger the share of the C-type agents in the population, the higher the per capita income. The proof is $\frac{\partial y}{\partial P_C} = T - K - S > 0$, where the inequality sign is due to (5.3).[6]

Conclusions

The cost of establishing the type of a partner to trade helps account for the performance of migrants compared with that of the indigenous population. Typically, migrants constitute a more homogeneous and cohesive group than nonmigrants do, live in closer proximity to each other, originate in a closely linked group, and constitute a minority share of the population they join. These attributes render it cheaper for a migrant to trace the type of a fellow migrant. This cost advantage results in a larger equilibrium share of cooperating

[6] The assumption that the payoff matrices of each of the subpopulations are the same can be relaxed without affecting this result. Even if the payoffs to migrants from trade with fellow migrants are systematically lower than the payoffs to nonmigrants from trade with fellow non-migrants, the recognition cost edge could result in the per capita income of migrants dominating the per capita income of nonmigrants.

agents, which in turn leads to higher per capita payoff.[7] The empirical findings of Chiswick (1986a, 1986b) and Bloom and Gunderson (1991), to mention just two examples, who note that migrants who have been in the receiving country for some time[8] often have a higher mean income than that of the indigenous population, can thus be explained not only by an appeal to superior skills and human capital or to unobserved abilities and innately higher productivity but also to a trade and exchange environment that induces more cooperation, which in turn leads to a higher average payoff.

An interesting policy implication is that the spreading of migrants thinly throughout the indigenous population and various "anti-clustering" steps or processes aimed at inducing the assimilation of migrants may, by raising the cost of establishing the type of a partner to trade, reduce rather than enhance the wellbeing of migrants. Conversely, processes that reinforce the cohesion of groups of migrants tend to be conducive to, rather than to hinder, their economic performance.

Appendix

Suppose that trade between migrants and nonmigrants can take place, that an agent can identify costlessly the type of group a trading partner belongs to, but not the partner's *C*- or *NC*-type, and that a *C*-type agent can find out a partner's trait, but at a cost. This cost, however, is larger than the cost pertaining to within-group detection. It is easy to show that a *C*-type migrant will not trade with a nonmigrant. If he were

[7] Perhaps ethnic minorities that concentrate in ethnic enclaves and fare well succeed not in spite of their concentration, but because of it.

[8] Interestingly, the studies reporting that migrants outperform the indigenous population point out that they do so only some time after arrival. Perhaps a time-consuming process of convergence to an equilibrium P_C accounts for this result.

to do so, incurring a cost $K' > K$ where K' and K are the across-groups and within-group detection costs, respectively, his payoff would have been $T - K'$, which is lower than $T - K$. If, however, he were to trade randomly, his payoff would have been

$$\Pi'_C = [\alpha P_C^M + (1-\alpha)P_C^{NM}]T + [\alpha(1 - P_C^M) + (1-\alpha)(1 - P_C^{NM})]R,$$

where α $(1-\alpha)$ is the share of the migrant (nonmigrant) group in the combined population and P_C^M (P_C^{NM}) is the proportion of C-type agents in the migrant (nonmigrant) group. This payoff is lower than the payoff arising from a random within-group trade. The proof is

$$\begin{aligned}\Pi_C = P_C^M T + (1 - P_C^M)R = [\alpha P_C^M + (1-\alpha)P_C^M]T \\ +[\alpha(1 - P_C^M) + (1-\alpha)(1 - P_C^M)]R > \\ [\alpha P_C^M + (1-\alpha)P_C^{NM}]T \\ +[\alpha(1 - P_C^M) + (1-\alpha)(1 - P_C^{NM})]R = \Pi'_C\end{aligned}$$

since (due to the detection cost advantage) $P_C^M > P_C^{NM}$. A random trade with nonmigrants will thus not take place. Since migrants reject trade with nonmigrants, nonmigrants who may have attempted to engage a migrant in trade will be quickly turned away: language, accent, color of skin, and other similar traits are recognized virtually costlessly, flawlessly, and immediately. We conclude then that the possibility of intergroup trade need not result in such a trade and hence that the migrants' edge is immune to this possibility.

This last case assumes that agents are "hard-wired" as C or NC. But what if agents who are C ("nice") within their own group turn out to be NC ("ruthless") when trading with outsiders? The answer is that the foregoing conclusion that trade will not take place holds *a fortiori*. The reason is that now the possible appeal that migrants may have to pursue trade with nonmigrants is even weaker since the actual P_C^{NM} migrants would have encountered upon trade would be lower.

What if a reverse switch is allowed? In particular, consider the possibility that in order to facilitate trade with migrants, the *NC*-type nonmigrants will, upon trading with migrants, behave as if they were *C*-type. This switch cannot erode the migrants' edge either. To see why note that the migrants will now face a group of nonmigrants all of whom are of *C*-type. By assuming an *NC*-type, the *C*-type migrants will derive *U* from a trade with a nonmigrant whose payoff will therefore be *R*. This is clearly worse than what the nonmigrants can obtain by trading with members of their own group. Such a scheme will thus not work.

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6

Intrafamilial transfers and exchanges: forming and sustaining altruism

Introduction

A plausible evolutionary argument for selfishness would assert that if natural selection favors those who receive high payoffs, and if altruists get lower payoffs than selfish individuals, then evolution will tend to eliminate altruists. In this chapter, we will show that, paradoxically, evolution can sustain cooperative behavior between relatives even in single-shot prisoner's dilemma models, where cooperation benefits one's opponent at a cost to oneself.[1]

We consider two-player, two-strategy games in which a player who cooperates gets a payoff of R if his or her opponent cooperates, and S if the opponent defects. A player who defects gets T if his or her opponent cooperates, and P if the opponent defects. In a prisoner's dilemma game, $S < P < R < T$, so that defection is a dominant strategy for each player, and $S + T < 2R$, so that total payoffs are

[1] In this chapter, we identify *altruism* with playing *cooperate* in a prisoner's dilemma game. For explorations of more subtle connections between cooperative actions and preferences and the wellbeing of others, see Bernheim and Stark (1988), Stark (1989) and chapter 1 in this book, and Bergstrom (1989, 1995). Most human interaction occurs in environments that are more conducive to cooperation than prisoner's dilemma games. We have chosen the case of prisoner's dilemma in order to show that evolution can select for altruism even in a most hostile environment.

maximized when both cooperate. An individual's strategy is determined either by genetic inheritance or by imitating the behavior of parents or nonparents.

The evolution of genetically-transmitted behavior toward siblings

Not much is known about the environments that shaped our genes, and most economists do not believe that evolutionary hypotheses can explain human preferences. But since the fundamentals of mating, childrearing, and sibling relations have changed little over the millennia, we believe that evolutionary theory can enrich the study of the economics of the family.[2]

Population biologists (Hamilton [1964], Dawkins [1976]) predict altruistic behavior not only between parents and children but also among siblings and other close relatives. Dawkins' expression of this view in *The Selfish Gene* is that the replicating agent in evolution is the gene rather than the animal. Since a gene carried by one animal is likely to appear in its relatives, genes for helping one's relatives when the assistance is cheap enough will prosper relative to genes for total selfishness.

Altruistic sororities without sex

We introduce the logic of inheritance with a model of asexual reproduction. Individuals who survive to reproductive age will have two daughters. Each daughter inherits a genetically-programmed strategy (either cooperate or defect) from her mother and plays that strategy in a game of prisoner's

[2] We have good company in this heresy. Becker (1976) and Hirshleifer (1978) explore evolutionary theories of altruism in the family. Frank (1988) and Robson (1996) propose evolutionary explanations for emotions and attitudes toward risk.

dilemma with her sister.[3] The larger her payoff in this game, the greater the probability that she survives and reproduces.

We claim that the only stable equilibrium[4] is one in which every individual cooperates with her sister. In a population of cooperators, each individual gets payoff R. A mutant who defects against her cooperating sister will get $T > R$. However, her good fortune will not be sustained by her descendants. Her daughters and their descendants will all defect, and hence will each get a payoff of $P < R$. In the long run, the mutant's descendants will reproduce less rapidly than the cooperators and will gradually disappear from the population.

A population of defectors, on the other hand, would be invaded by mutant cooperators. A mutant cooperator would face a defecting sister and get a payoff of S, while normal defectors get $P > S$. However, her daughters and their descendants will cooperate with their siblings and get payoffs of R while the daughters of the defectors and their descendants will all get payoffs of $P < R$. The mutant's descendants therefore reproduce more rapidly than the defectors and will eventually predominate.

Note that the outcome "cooperators only" in a model of asexual reproduction has been derived without controlling for population size. Yet, by way of an example, it can be demonstrated that the outcome holds with a constant population. Suppose we begin (in generation zero) with two daughters – one cooperator and one defector. Their payoffs from playing against each other are $(S, P, R, T) = (1, 2, 3, 4)$, that is,

3 A strategy here thus stands for a programmed pattern of behavior, not an object of choice.

4 By "stable equilibrium," we mean an equilibrium that is dynamically stable. This should not be confused with the notion of Nash equilibrium in "evolutionary stable strategies" discussed in evolutionary game theory.

		Daughter B	
		C	D
Daughter A	C	$(3, 3)$	$(1, 4)$
	D	$(4, 1)$	$(2, 2)$

where we take the payoffs to represent the number of offspring. After the play, the population grows to 5. To hold the population at the constant level of 2, we multiply the offspring numbers by 2/5. Thus the adjusted (first generation) numbers are $1 \cdot 2/5 = 0.4$ cooperators and $4 \cdot 2/5 = 1.6$ defectors. (There is no difficulty with fractions here since we have in mind expectations in a large population.) Now, each of the 0.4 cooperator descendants receives a payoff of 3 from playing with her cooperator sister, while each of the 1.6 defector descendants receives a payoff of 2 from playing with her defector sister. The numbers of their offspring are, respectively, $0.4 \cdot 3 = 1.2$ and $1.6 \cdot 2 = 3.2$, summing up to 4.4. The adjusted (second generation) numbers are therefore $1.2 \cdot 2/4.4 = 0.545$ cooperators and $3.2 \cdot 2/4.4 = 1.455$ defectors.

We see then that after the first generation, the cooperators begin to recover (from 0.4 to 0.545) and will eventually swamp the defectors. (Clearly, the only exception would be a prisoner's dilemma game where $S = 0$; that is, if cooperators in the zero generation leave no offspring, cooperators will never be able to recover.)

The occasional altruism of siblings in sexually-reproducing species

Human parents will not be surprised to find that siblings in sexually-reproducing species are not always so cooperative. Depending on the payoff parameters in a prisoner's dilemma game, there can be a unique stable equilibrium with cooperators only. For some parameter values, there are two stable equilibria – one with cooperators only and one with defectors only – and for some parameter values the only stable equilibrium is "polymorphic" with positive proportions of each type. However, the payoff parameters in the prisoner's dilemma game can give rise to a unique stable equilibrium with defectors only.

Consider a large sexually-reproducing population in which mating is monogamous and random. For simplicity, assume that each individual either dies without mating or survives to mate and has exactly three offspring. Each offspring plays a game of prisoner's dilemma with each of its two siblings. The probability that an individual survives to reproduce is higher the greater its total payoff in these two games.

An individual's strategy depends on the contents of a single *genetic locus* that contains two genes, one selected at random from each of its parents' two genes. There are two kinds of genes: the *c* (cooperate) gene and the *d* (defect) gene, and three possible types of individuals, *cc* homozygotes who carry two *c* genes, *cd* heterozygotes who carry one *c* gene and one *d* gene, and *dd* homozygotes who carry two *d* genes. *cc*-type homozygotes always play *cooperate* and *dd*-type homozygotes always play *defect*. If heterozygotes always defect, then the *d* gene is said to be dominant and the *c* gene to be recessive. If heterozygotes always cooperate, then the *c* gene is said to be dominant and the *d* gene is recessive. In determining the stability of equilibrium we do not assume that either *c* genes or *d* genes are intrinsically dominant, but allow the possibility that mutation could produce a dominant gene of either *c*-type or *d*-type.

Consider a population that consists entirely of cooperating *cc* homozygotes. Suppose that a *c* gene in one individual mutates to a *d* gene that is dominant. The mutant individual is a *cd* heterozygote who plays *defect*. The mutant individual gets a higher payoff than a normal member of the population, since it defects while its siblings cooperate. But whether the mutant genes will proliferate or disappear depends on whether the mutant individual's heterozygote offspring have higher or lower payoffs than normal individuals.

When the mutant *cd*-types are rare, they almost certainly mate with *cc*-types. Each offspring of such a union will be a cooperating *cc* with probability 1/2 and a defecting *cd* with probability 1/2. A heterozygote offspring will defect. With probabilities 1/4 each, its siblings will be *cd* and *cd*; *cd* and *cc*; *cc* and *cd*; and *cc* and *cc*. The payoffs from the plays with these siblings will be, respectively, $2P$, $P + T$, $T + P$, $2T$. The expected payoff to the heterozygote defector in the games it plays with its two siblings is therefore $[2P + 2(P + T) + 2T]/4 = T + P$. Normal individuals with normal siblings cooperate with cooperating siblings and get payoffs of R from each game. Heterozygote offspring of a mutant defector therefore get higher payoffs and reproduce more rapidly than normal individuals if and only if $T + P > 2R$.

Now consider a population that consists entirely of *dd*-types in which a *d* gene mutates to a *c* gene that is dominant, so that heterozygotes cooperate. A mutant *cd*-type individual will almost certainly mate with a normal *dd*-type. Each offspring of such a union will be a cooperating *cd* with probability 1/2 and a defecting *dd* with probability 1/2. A heterozygote offspring will cooperate. With probabilities 1/4 each, its siblings will be *cd* and *cd*; *cd* and *dd*; *dd* and *cd*; and *dd* and *dd*. The payoffs from the plays with these siblings will be, respectively, $2R$, $R + S$, $S + R$, $2S$. The expected payoff to the heterozygote cooperator in the games it plays with its two siblings is therefore $[2R + 2(R + S) + 2S]/4 = S + R$. Normal individuals with normal siblings defect against defecting siblings and get P from each game. Heterozygote offspring of a mutant cooperator therefore get higher payoffs and reproduce more rapidly than normal individuals if $S + R > 2P$.

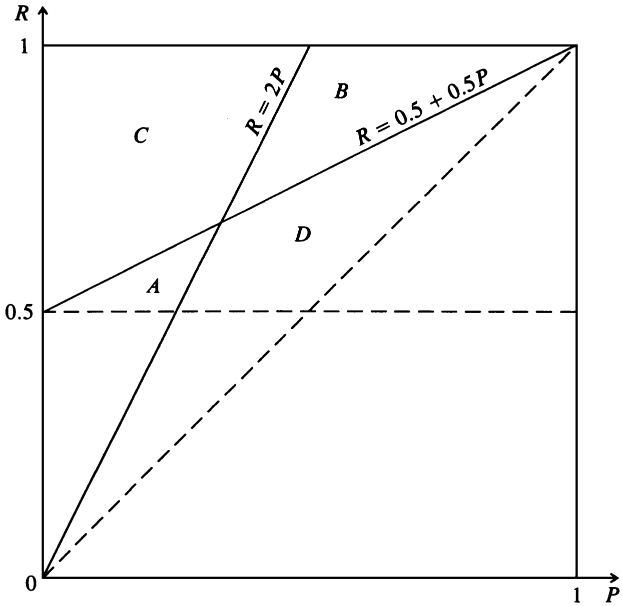

Figure 6.1 Equilibrium regimes for diploid siblings

It follows that there is a stable equilibrium consisting entirely of *cc*-type cooperators if $2R > T + P$ and a stable equilibrium consisting entirely of *dd*-type defectors if $2P > S + R$. Prisoner's dilemma games can be found where one, both, or neither of these inequalities are satisfied. The possibilities are illustrated in figure 6.1, where the game is normalized by setting $S = 0$ and $T = 1$. (With this normalization, the game is a prisoner's dilemma game if $R > P$ and $R > 0.5$. The region above the two dotted lines satisfies these conditions.) For parameter values in Region C, there is a *unique* stable equilibrium with a population consisting entirely of *cc*-type cooperators. In Region D, there is a *unique* stable equilibrium with a population consisting entirely of *dd*-type defectors. It can be shown that in Region B there are two stable equilibria, one with a population of cooperators only and one with a population of defectors only, and that for parameter values in Region A the only stable equilibrium is a polymorphic equilibrium. (See Bergstrom and Bergstrom [1992].)

In an asexual population, cooperative siblings prevail because an individual's sibling is almost certainly "programmed" to treat her in the same way that she is programmed to treat her sibling. In a diploid sexual population, a mutant individual (with a dominant mutant gene) whose genes tell him to treat his siblings in a way different from normal will, with probability 1/2, have siblings who treat him just as he treats them. This probable similarity is sufficient to sustain cooperation in some but not all prisoner's dilemma games.

The evolution of behavior that is acquired by imitation

Similar results obtain when behavior toward one's siblings is acquired by imitation rather than through genetic hardwiring. We assume that with probability v a child randomly selects one parent as a role model and adopts that parent's strategy. With probability $1 - v$ the child chooses a random nonparent as a role model.[5] Each individual has two siblings and plays a game of prisoner's dilemma with each of them. The probability that an individual survives to reproduce is proportional to its average payoff in these two games.

Let mating be monogamous. Parent couples can be one of three possible types: two-cooperator couples, "mixed couples" with one cooperator and one defector, and two-defector couples. Let x be the fraction of the adult population who are cooperators. If marriage is purely random, the fraction of marriages with two cooperators is $x \cdot x = x^2$, the fraction with two defectors is $(1 - x)(1 - x) = (1 - x)^2$, and the fraction with mixed couples is $2x(1 - x)$. If marriage is purely assortative, the fractions of cooperators and defectors are, respectively, x and $1 - x$. To allow mating patterns that

[5] This is a variant of cultural transmission models developed by Cavalli-Sforza and Feldman (1981) and Boyd and Richerson (1985).

are intermediate between the polar cases of purely random mating and purely assortative mating, we define a parameter m where $0 \leq m \leq 1$, such that when mating is purely random $m = 0$, and when mating is purely assortative $m = 1$. In the population at large, the proportion of two-cooperator couples is thus $x^2 + mx(1 - x)$, the proportion of two-defector couples is $(1 - x)^2 + mx(1 - x)$, and the remaining proportion of mixed couples is $2(1 - m)x(1 - x)$.

Given the rules of imitation and our assumptions about mating, the proportions of cooperators and defectors who survive to reproduce will determine the expected proportions of each type of family, where family types are distinguished by the number of cooperating parents and the number of cooperating children. This in turn determines the expected proportions of cooperators and defectors who survive to reproduce in the next generation.[6]

Conveniently, the rate of change of the ratio of cooperators to defectors turns out to be linear in the proportion x of cooperators in the population. Specifically, this rate of change is proportional to $\alpha x + \beta(1 - x)$, where $\alpha = v^2(1 + m)(T - P) - 2(T - R)$ and $\beta = v^2(1 + m)(R - S) - 2(P - S)$. Depending on parameter values, the dynamics of this system falls into one of the following qualitatively distinct cases:

- $\alpha > 0$ and $\beta > 0$: the only stable equilibrium is a population consisting entirely of cooperators.
- $\alpha < 0$ and $\beta < 0$: the only stable equilibrium is a population consisting entirely of defectors.
- $\alpha < 0$ and $\beta > 0$: the only stable equilibrium is a polymorphic equilibrium in which the proportion of cooperators is $\beta/(\beta - \alpha)$.
- $\alpha > 0$ and $\beta < 0$: there are two stable equilibria, one with a population of cooperators only and another with a population of defectors only.

6 Details are provided in the appendix.

There is a simple heuristic explanation of these results. The proportion of cooperators will increase or decrease depending on whether the average payoff to cooperators is higher or lower than that to defectors. If defectors were as likely as cooperators to have cooperative siblings, then defectors would get higher expected payoffs than cooperators. However, siblings are more likely to be similar than random pairs of individuals. As the proportion of one type in the population approaches zero, the probability that an individual of the rare type has a sibling of the rare type approaches $v^2(1+m)/2$ and the probability that an individual of the common type has a sibling of the rare type approaches zero. To derive this expression consider, for example, the case of rare cooperators. The probability then that a cooperator will mate with a cooperator is m, the probability that a cooperator will mate with a defector is $1-m$. When cooperators are rare, say, only two in a large population, and m is, say, 2/3, then the matching process is such that with probability 2/3 the other cooperator will be "brought" to mate with the cooperator, while with probability 1/3 the mate will be chosen at random and thus most surely will be a defector. The probability of a cooperator–cooperator match is thus 2/3, that is, m.[7] When cooperators are rare, a child can be cooperator only if the child imitates a parent, provided the parent is a cooperator. (Clearly, if the

[7] Alternatively, we can ask: if an individual is a married cooperator, what is the probability that he will be married to a cooperator when cooperators are rare in a population consisting of, say, N couples? This conditional probability is the total number of cooperators married to cooperators, divided by the total number of cooperators who are married at all, that is:

$$\frac{2[x^2+mx(1-x)]N}{2[x^2+mx(1-x)]N+2(1-m)x(1-x)N}=x+m-mx,$$

which, for $x \to 0$, is equal to m.

child imitates a nonparent, the child most surely will be a defector.) In order for both a child and its sibling to be cooperators, both children need to imitate either parent when both parents are cooperators, and the cooperating parent when one parent is a cooperator and one is a defector. The probability of the first of these events is mv^2; the probability of the second event is $(1-m)\frac{v^2}{2}$. The probability then that a cooperating child will have a cooperating sibling is $mv^2 + (1-m)\frac{v^2}{2} = (1+m)\frac{v^2}{2}$.

When cooperators are rare, the expected payoffs of cooperators and defectors approach $Rv^2(1+m)/2 + S(1 - v^2(1+m)/2)$ and P, respectively, in each game they play. Since each individual plays with two siblings, the difference between the expected total payoff of rare cooperators and that of normal defectors is $v^2(1+m)(R-S) - 2(P-S) = \beta$. A similar calculation shows that when defectors are rare the difference between the expected payoff of cooperators and the expected payoff of defectors is α. Therefore, when α and β are both positive (negative), a population of cooperators (defectors) could not be invaded by defectors (cooperators), but a population of defectors (cooperators) would be invaded by cooperators (defectors). When $\beta < 0$ and $\alpha > 0$, normal defectors do better than rare cooperators and normal cooperators do better than rare defectors, so that there are two stable equilibria, one with cooperators only and one with defectors only. When $\beta > 0$ and $\alpha < 0$, there are no stable equilibria that have only one type of individual.

When there is perfectly assortative mating ($m = 1$) and children always imitate a parent ($v = 1$) then $v^2(1+m)/2 = 1$ and $\alpha = \beta = 2(R-P) > 0$, so the only equilibrium has a population consisting entirely of cooperators. Since in this case each child imitates its two identical parents, the outcome is the same as with asexual reproduction.

If mating is perfectly random ($m = 0$) and children always imitate a parent ($v = 1$), then $\alpha = 2R - T - P$ and $\beta = R + S - 2P$. The parameter values yielding the four possible types of equilibria are the same as for diploid inheritance and correspond to Regions C, D, B, and A in figure 6.1. Finally, if children never imitate a parent ($v = 0$, that is, they imitate a random nonparent who, when cooperators are rare, is sure to be a defector), then $\alpha = 2(R - T) < 0$ and $\beta = 2(S - P) < 0$, and the only equilibrium is a population consisting entirely of defectors.

When cooperators are rare, how can cooperative behavior prevail? If children are likely to imitate their parents rather than a random role model, v is high; and parents are likely to be cooperators when m is high. The higher is $v^2(1 + m)$, the greater the set of payoff parameters for which both β and α are positive, in which case the population will consist of cooperators only. That is, the higher is $v^2(1 + m)$, the more likely it is that cooperative behavior will prevail. While random mating ($m = 0$) does not exclude the "cooperators only" outcome as both β and α can still be positive, imitation of parents ($v > 0$) is necessary to get the "cooperators only" outcome.

Conclusion

We have studied environments in which an individual gets a higher payoff from defecting than from cooperating and where "copies" of an individual are more likely to appear the higher is her payoff. Even in such unpromising soil, cooperation can persist and flourish. The reason is that both genetic and cultural inheritance are blunt instruments that typically do not operate on individuals in isolation. Those who inherit a genetic tendency to cooperate are more likely than others to enjoy the benefits of cooperative siblings. Similarly with cultural inheritance; altruism can prevail when individuals are likely to interact with others who share the same role model.

Appendix

Here we prove the results claimed in the third section of the chapter.

Pairs of individuals can be of three types. A type-1 pair consists of two cooperators, a type-2 pair consists of one cooperator and one defector, and a type-3 pair consists of two defectors. If the fraction of cooperators in the population is x, and the assortative mating parameter is m, then the fractions of parent pairs of the ith type is given by the ith entry in the column vector

$$\vec{p}(x) = (x^2 + mx(1-x), 2(1-m)x(1-x), (1-x)^2 + mx(1-x))'.$$

Assume that a child imitates a randomly chosen parent with probability v and a randomly chosen member of the population at large with probability $1 - v$. The probability that a randomly chosen pair of offspring from a type-i parent pair is a type-j sibling pair is given by the ijth entry of the following matrix, $M(x) =$

$$\begin{pmatrix} (v+(1-v)x)^2 & (\frac{v}{2}+(1-v)x)^2 & (1-v)^2x^2 \\ 2(v+(1-v)x)(1-v)(1-x) & 2(\frac{v}{2}+(1-v)x)(1-\frac{v}{2}-(1-v)x) & 2(1-v)x(v+(1-v)(1-x)) \\ (1-v)^2(1-x)^2 & (1-\frac{v}{2}-(1-v)x)^2 & (v+(1-v)(1-x))^2 \end{pmatrix}$$

Given that the fraction x of the nth generation are cooperators, the probability that a randomly chosen pair of siblings from the $n+1$st generation are of type i is given by the ith entry of the column vector $\vec{s}(x) = M(x)\vec{p}(x)$. Calculation shows that $\vec{s}(x) = (s_1(x), s_2(x), s_3(x))$, where

$$s_1(x) = x\left(\frac{v^2(1+m)}{2}(1-x) + x\right),$$

$$s_2(x) = -2x(1-x)\left(\frac{v^2(1+m)}{2} - 1\right),$$

$$s_3(x) = (1-x)\left(\frac{v^2(1+m)}{2}x + (1-x)\right).$$

Cooperators in type-1 sibling pairs will get payoffs of R and cooperators in type-2 sibling pairs will get payoffs of S. Defectors in type-2 sibling pairs will get payoffs of T and defectors in type-3 sibling pairs will get payoffs of P.

The probability that any individual survives to reproduce is assumed to be proportional to the average payoff that it receives in the games it plays with its siblings. This means that the total number of surviving cooperators in the second generation will be proportional to $2s_1(x)R + s_2(x)S$ and the total number of offspring of defectors in the second generation will be proportional to $s_2(x)T + 2s_3(x)P$. The rates of increase of the numbers of cooperators and defectors will thus be proportional to, respectively, $\rho_c(x) = (2s_1(x)R + s_2(x)S)/x$ and $\rho_d(x) = (s_2(x)T + 2s_3(x)P)/(1-x)$. Substituting in the expressions for $s_1(x)$, $s_2(x)$, and $s_3(x)$, we see that $\rho_c(x)$ and $\rho_d(x)$ are both linear expressions in x and that $\rho_c(x) - \rho_d(x) = \alpha x + \beta(1-x)$ where $\alpha = v^2(1+m)(T-P) - 2(T-R)$ and $\beta = v^2(1+m)(R-S) - 2(P-S)$.

Since x is increasing or decreasing depending on whether $\rho_c(x) - \rho_d(x) = \alpha x + \beta(1-x)$ is positive or negative, the dynamics of this model is as claimed in the third section of the chapter and as shown in figure 6.A1.

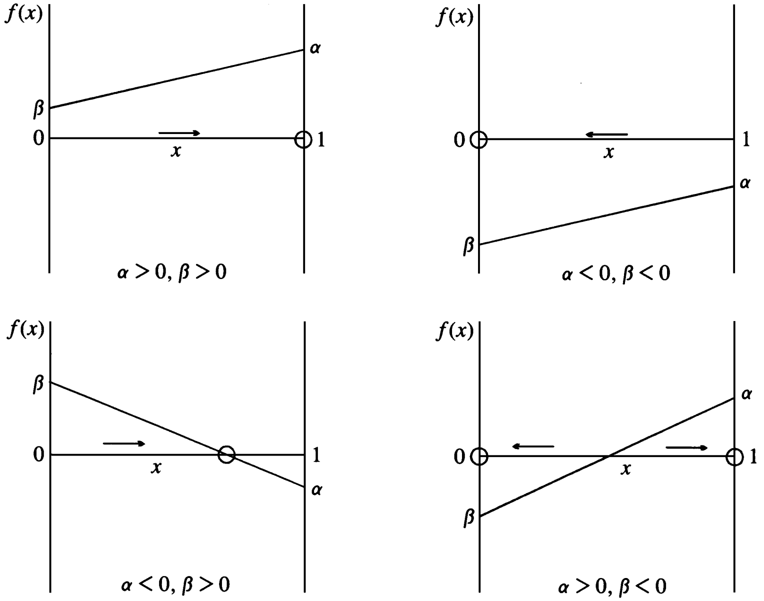

Figure 6.A1 The dynamics of cultural evolution.
Stable equilibria are circled. Arrows indicate direction of movement. $f(x)=\alpha x+\beta(1-x)$.

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