Intergenerational Succession in Small Family Businesses: Borrowing Constraints and Optimal Timing of Succession

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ABSTRACT. Small family businesses differ from non-family businesses in that their functioning is not independent of the life cycle of the owner-operator, and in that other family considerations sometimes lead to sub-optimal managerial decisions from the point of view of the business. This is why a smooth intergenerational succession is essential to the profitability of the business, and to the welfare of the family as a whole. Succession within the family involves first of all the choice of a successor. The choice is affected by birth order, age differentials, and qualifications of potential successors. Choosing a successor means reaching an agreement about the timing of succession and income distribution before and after succession. This paper focuses on the decision of the business-operating family when to bring in the designated successor. A utility-maximizing time is shown to differ from the income-maximizing time only in the presence of binding borrowing constraints. Such constraints are likely to enhance an earlier succession in order to use the successor's accumulated off-business assets to ease the constraints and to increase future business income due to earlier accumulation of business-specific human capital by the successor. An additional model shows that the successor will not be willing to wait indefinitely for the formal ownership transfer of the business, because of the risk of being disinherited in some future period. The consequences of possible strategic behaviors of both the owner and potential successors on the results of these models is discussed informally.

1. Introduction

The functioning of a family business is closely linked to the life cycle of its owner-operator. Residual income of the owner includes returns to firm-specific human and organizational capital. Investment in such capital decreases with operator age because of a shorter planning horizon. To the extent that this capital is only transferrable within the family through long-term training of children, the market value of a family business is well below its value as a "going concern". If the owner cares about the future welfare of his/her children and views the family business as part of the assets he/she wishes to bequeath, succession by a child is strongly preferred from the points of view of both the owner-operator and the succeeding child.

This seems to be contrary to the evidence that the life expectancy of American family firms is only 24 years, and only about a third survive into the second generation (Beckhard and Dyer, 1983). However, using the statistics reported in Dunne *et al*. (1989), it is estimated that only about 30% of both family- and non-family-manufacturing firms reach the age of 15, and that survival rate is even lower for relatively small firms which are perceivably more comparable to family firms. Troske (1991) finds similar patterns in non-manufacturing firms. These numbers suggest that family firm survival rates are higher than those of non-family firms, and hence succession within the family is preferred. Richter (1988) reports that founders of family firms tend to attach great importance to the continuing identification of the business with the family, and that this tendency declines in the second generation. Hence, succession within the family occurs not only because of economic reasons, but sometimes even despite them.

Even if people seek to equalize the amounts they bequeath to each of their children, owners of

Final version accepted on August 23, 1995

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Small Business Economics **9**: 309–318, 1997.

family businesses will prefer to choose only one child as a successor, provided that enough non-business resources are available to compensate other children. This is because joint ownership of a family business often leads to conflicts and power struggles that eventually cause the collapse of the business and loss to all parties (Barach, 1984). However, nonbusiness resources are generally insufficient at the point in time at which succession decisions are made, and hence other heirs claim a share in the family business. This can be solved by breaking the linkage between ownership and operation of the business, so that each child gets a share of ownership but one child gets sole responsibility for the operation of the family business. This is not an ideal solution since it may still cause conflicts and incentive problems, in future if not in the current generation, but it is used frequently in practice. The following analysis will therefore focus on the case of one successor.

The first problem faced by the operator is which child to choose as a successor. This decision has to be made as early as possible in order to maximize the benefits of specific training. Several sources of uncertainty affect this decision and its timing, the major one being the future business income under the operation of each possible successor. Uncertainty about the future alternative income of each child also has an effect. Suppose the operator has two children. If their age differential is relatively small and both are willing to take over the operation of the business, the owner will decide according to expectations conditioned on the current information set. The one who seems more appropriate to run the business will be chosen in this case, unless the other has a sufficiently lower alternative income (Kimhi, 1995).

Things are more complicated if the age differential of the two potential successors is large. Expectations regarding the elder are more accurate, especially as far as future business income is concerned, and this increases the likelihood that he/she will be chosen as a successor, other things equal. Another factor is the length of the apprenticeship period. It may be shorter than optimal if the younger child is chosen, in the sense that the parent becomes too old to run the business before the successor is prepared for the task. It may be too long if the older child is chosen, in the sense that the child becomes ready and eager to succeed when the operator is still not willing to yield power (Guinnane, 1992). In this case conflicts could arise within the family which may result in the loss of all potential successors and the eventual collapse of the business.

This last point draws attention to the importance of the quality of the match between the owner-operator and his/her designated successor. In an uncertain environment, information about the quality of the match is gathered over time and gradually reduces uncertainty. Before designating a successor, the owner accumulates information about his children. At a certain point in time, the marginal value of information becomes smaller than the cost of delaying the decision, and then one child is announced as a successor. This is similar to courting in the marriage market except that searching on the "extensive margin" of additional potential successors is ruled out (Becker, 1991, p. 325), and to searching for a job while unemployed when information about compensation is acquired sequentially (Mortensen, 1986, p. 850).

During the apprenticeship period, information about the quality of the match continues to accumulate. If a poor match is revealed, the owner could change his/her mind about transferring the family business to the designated successor. This can be compared to worker-firm matching models (Devine and Kiefer, 1991, p. 229) and the theory of divorce (Becker *et al*., 1977). The main difference between those models and the current application is again that search is limited to family members. In the context of this example, if the match with the older child looks hopeless, the owner can try again with the younger, but if that one also turns out to be a failure, no other alternatives remain. This is one of the reasons why older successors are often preferred (for other reasons see Chu, 1991).

Up to now the focus has been on the owner-operator's point of view, but the children have motives of their own. They too are involved in a continuous search process during which they compare their prospects in and out of the family business. The implications of this for the owner is that he has to condition his choice of succeeding

child on the willingness of that child to succeed, and he has to consider the possibility that the succeeding child will quit at some point in time during the apprenticeship period.

Both the owner and the designated successor seem to have an interest in starting the apprenticeship period as early as possible. If pure two-sided altruism were present, the timing of ownership transfer would not matter to the profitability of the family business (Kimhi, 1994). In reality, parents care about their own welfare more than about their children's, and, perhaps to a greater extent, children care less about their parents. This leads to a conflict in which each side has an incentive to control the business. In terms of the discussion above, the child faces the risk of being replaced and hence may demand earlier transfer of ownership of the business, while the owner wishes to delay the ownership transfer in order to better assess the quality of the match. This may lead to strategic behavior on both sides.

In the first sections of this paper I will ignore conflicts and strategic behavior. Rather, I will emphasize the interaction of human and financial capital of the business-operating family as the major determinant of the timing of intergenerational succession. In particular, the family has an incentive to bring in the successor as soon as possible in order to use his business-specific human capital and to enhance his future managerial ability. On the other hand, there is an incentive to allow the designated successor to work off the business for a while and accumulate financial wealth, which can be later used in the business, especially in the presence of borrowing constraints.

In the next section I will develop a model of intertemporal consumption-investment decisions, and show that the timing of succession can be obtained as an internal solution to this optimization problem provided that human capital have the common hump-shape age profile. Section 3 will look at the same problem in the presence of effective borrowing constraints, and demonstrate the effect of the capital market on the timing of succession. Section 4 will first deal with the potential conflicts between parents and successors, by looking at the designated successor's decision whether to stay in the business or leave. In section 5, possible strategic behavior of both parties is discussed. Section 6 concludes.

2. A model of succession timing with perfect capital markets

Assume a family that draws its income from a business and from interest on assets. Business income at time t is $h(t)[k(t)]^{\alpha}$, where h is human capital of all family members associated with the business and k is physical capital. It is assumed that all family members associated with the business are employed full time in the business, so human capital has no alternative value. Alternatively it can be assumed that the return to human capital within the family business exceeds its alternative return in the range of values discussed in this paper. Physical capital, on the other hand, can earn an alternative market rate of return r. Capital markets are assumed perfect at this stage, so that the family can either use part of its wealth in the business and save the other part in the capital market, or use all its wealth in the business and even borrow in the capital market given the same interest rate r. Therefore, net family income is $h(t)[k(t)]^{\alpha} + r[z(t) - k(t)]$, where z is family wealth. Income is used for consumption and for wealth accumulation, so that wealth evolves over time according to the equation:

$$\partial z(t)/\partial t = h(t)[k(t)]^{\alpha} + r[z(t) - k(t)] - c(t) \qquad t = 1 \ldots \infty \tag{1}$$

where c is consumption.

The family seeks to maximize the discounted present value of future utility, $V(0)$, where utility is a function of consumption only,

$$V(0) = \int_0^{\infty} u[c(t)]e^{-\rho t}\, dt \tag{2}$$

subject to the constraints (1), over choices of $c(t)$ and $k(t)$, $t = 1 \ldots \infty$, given an initial value of assets. It can be shown (see appendix) that business income can be maximized separately in each period over $k(t)$ to give $k(t) = [\alpha h(t)/r]^{1/(1-\alpha)}$, and hence business income is $I(t) = [\alpha^{\alpha/(1-\alpha)} - \alpha^{1/(1-\alpha)}][h(t)/r]^{1/(1-\alpha)}$. The intertemporal optimization over consumption, assuming logarithmic utility, yields the following functions for assets and con-

sumption, respectively (the full derivation is in Appendix I):

$$z(t) = \left[\int_0^{\infty} I(\tau)e^{-r\tau}\,d\tau + z(0)\right]e^{(r-\rho)t} - e^{rt}\int_t^{\infty} I(\tau)e^{-r\tau}\,d\tau \quad t = 1 \ldots \infty. \quad (3)$$

$$c(t) = \rho\left[\int_0^{\infty} I(\tau)e^{-r\tau}\,d\tau + z(0)\right]e^{(r-\rho)t} \quad t = 1 \ldots \infty. \quad (4)$$

It can be seen that consumption in every point in time is a function of the present value of income as of time zero. This finding will be useful shortly.

Suppose now that at time t^* a successor, who previously worked outside, joins the business. He brings with him his wealth accumulation up to t^*, $w(t^*)$, and changes the stock of human capital used on the business to $h^*(t, t-t^*)$, so that net business income is $I^*(t, t-t^*)$ for all $t > t^*$. The dependence of human capital and income on $t - t^*$ stems from the assumption that the human capital involved includes a business-specific component that is accumulated by the successor only from the time he starts working in the business. From the point of view of the family, the only difference between the case with a successor to the case without a successor is that the income schedule changes at t^*. Since consumption is increasing in the present value of income, utility maximization over t^* is reduced to maximization of the present value of income, provided that it is finite. This is assured if human capital is concave in age, as is commonly assumed. It is first increasing, due to learning and accumulation of experience, and eventually decreasing due to a shorter planning horizon, lack of investment incentives, and health problems (Evans, 1987; Ghez and Becker, 1975). The present value of income when succession occurs at time t^* is:

$$PV(t^*) = z(0) + \int_0^{t^*} I(\tau)e^{-r\tau}\,d\tau + \int_{t^*}^{\infty} I^*(\tau, t-t^*)e^{-r\tau}\,d\tau + w(t^*)e^{-rt^*} \quad (5)$$

and by taking the derivative of (5) with respect to t^* and equating to zero, one essentially gets the first order condition for utility maximization over t^*:

$$I(t^*)e^{-rt^*} - I^*(t^*, 0)e^{-rt^*} - \int_{t^*}^{\infty} \partial I^*(\tau, t-t^*)/\partial(t-t^*)e^{-r\tau}\,d\tau + e^{-rt^*}\partial w(t^*)/\partial t^* - rw(t^*)e^{-rt^*} = 0 \quad (6)$$

which can be rearranged to give:

$$\partial w(t^*)/\partial t^* = rw(t^*) + [I^*(t^*, 0) - I(t^*)] + \int_{t^*}^{\infty} \partial I^*(\tau, t-t^*)/\partial(t-t^*)e^{-r(\tau-t^*)}\,d\tau. \quad (7)$$

The right hand side and left hand side, respectively, of (7), are what the family gains and loses in terms of income by delaying succession. It gains the increase in nonbusiness wealth of the successor but loses the interest on this wealth (in fact the interest is implicit in the wealth accumulation function itself so this term is somewhat artificial). It loses the contribution of the general human capital of the successor to business income (the term in the square brackets), and the discounted value of the contribution of the specific human capital of the successor in all future time periods. This last loss is because by delaying the succession, human capital of the successor will be lower in all future time periods (Kimhi, 1994). Note that equation (6) is in terms of time zero while equation (7) is in terms of time t^*.

This is illustrated in Figure 1, where two hypothetical time profiles of family assets are shown. It can be seen that moving from succession time t^1 to t^2, the growth of nonbusiness assets of the successor and perhaps his larger stock of general human capital are more than sufficient to offset the loss of business income due to the fact that he stays longer outside the business. However, the lower accumulation of business-specific human capital, which affects business income in all post-succession time periods, makes the later time of succession inferior (this is reflected in a lower value of assets at the end of the planning period).

3. Succession timing under borrowing constraints

A common obstacle to the growth of small family businesses is the lack of sufficient capital. The

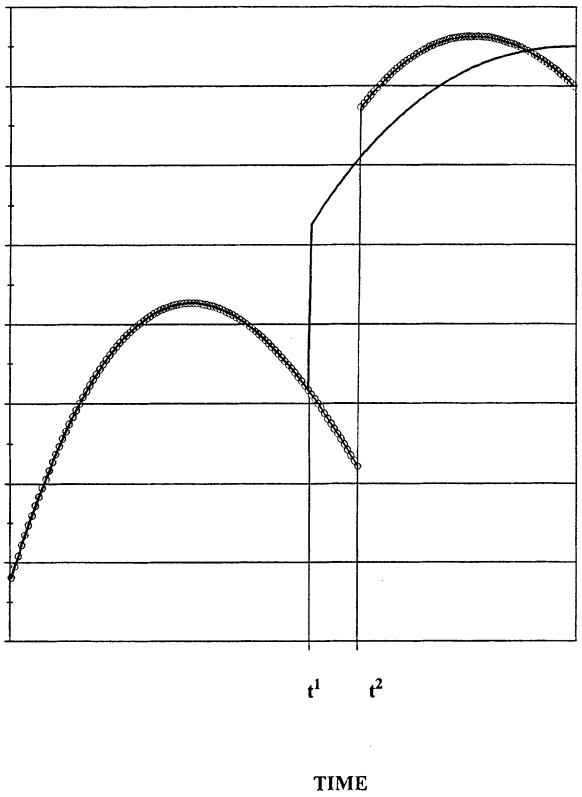

Fig. 1. Time profiles of family assets under two alternative times of succession.

family has limited resources so that self-financing of the business is limited, and this fact in turn limits the ability of the family to borrow against collateral (Evans and Jovanovic, 1989; Holtz-Eakin *et al*., 1994). However, the ability to borrow increases over time as the family accumulates assets that can serve as collateral. This of course also depends on the consumption behavior of the family. Eventually the constraints may not be binding after a certain period of business operation and asset accumulation.

The effects of borrowing constraints on the optimal timing of succession depend on whether they are still binding at the optimal time of succession without the constraints. If without the constraints the optimal succession time is t^*, and by t^* the constraints are no longer binding, then equation (7) still holds, and the optimal time of succession is unchanged. The reason is that from the point in time in which the borrowing constraints are no longer binding, utility maximization is again achieved by income maximization, and by (7) the optimal succession time depends on income determinants on and after succession. Consumption will change, of course, as the lifetime income of the family will in general be lower under borrowing constraints. It can easily be assumed that consumption will be lower at every point in time under borrowing constraints. However, the loss in consumption is likely to be higher in the time periods in which the constraints are still binding, because lower consumption helps to relax the borrowing constraints. Figure 2 shows hypothetical consumption paths with and without borrowing constraints, given that the constraints are no longer binding before the time of succession. Note that when the constraint is stricter, it takes more time to relax it (t^{++} relative to t^{+}) and consumption is lower at every point in time. The figure is drawn for a particular human capital profile, and hence it should be treated as an example.

Things are different when the borrowing con-

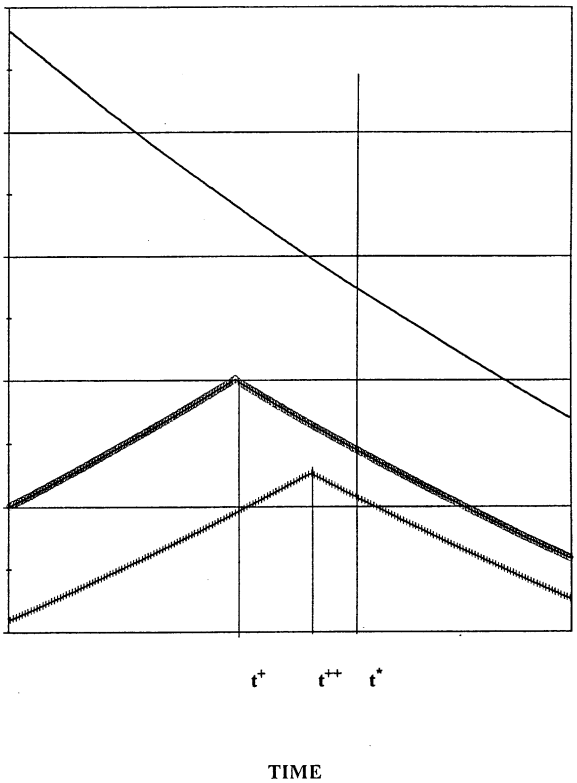

Fig. 2. Consumption paths with and without borrowing constraints when the constraints are no longer binding at t^{+} and t^{++}, alternatively, and succession is planned to t^*.

straints are still binding at t^*, the optimal time of succession in the absence of the constraints. In this case, utility maximization over succession time is not equivalent to wealth maximization, and therefore optimal succession time will in general not be t^*. It is not possible to state whether succession will be earlier or later in the presence of borrowing constraints. On one hand, there is an incentive to bring in the successor earlier because his own wealth will help to relax the constraint. On the other hand, his human capital will not be as productive in the presence of the constraints and this might be an incentive to delay succession.

Using a borrowing constraint of the form $k(t) \leq \mu z(t)$ as in Evans and Jovanovic (1989), meaning that borrowing is proportional to assets, it is not easy to get a closed-form solution for the maximization of (2) subject to (1) and the borrowing constraint. Therefore, I will use the wealth maximization problem as an approximation and then discuss how a utility maximizing solution might be different. Also, I will assume that the borrowing constraint is always binding. This assumption will not change the results since I am interested in the case in which the constraint is binding in the relevant time periods. The special case in which changing succession time might relax the borrowing constraint altogether will not be discussed here.

Putting the binding borrowing constraint $k(t) = \mu z(t)$ in (1) and ignoring consumption, one gets the law of motion of assets as:

$$\partial z(t)/\partial t = \mu^{\alpha} h(t)[z(t)]^{\alpha} + r(1-\mu)z(t) \qquad t = 1 \ldots \infty \tag{8}$$

The solution to this differential equation is:

$$z(t) = \left(\left\{ \int_0^t h(\tau) e^{-(1-\alpha)r(1-\mu)\tau}\, d\tau + [z(0)/(1-\alpha)/\mu^{\alpha}]^{(1-\alpha)} \right\} (1-\alpha)\mu^{\alpha} \right)^{1/(1-\alpha)} e^{r(1-\mu)t} \qquad t = 1 \ldots \infty \tag{9}$$

If a successor joins the business at t^*, the same law of motion is in effect from t^* on. The only differences are that the stock of human capital now includes that of the successor, and that the starting wealth is $z(t^*) + w(t^*)$. Denoting the post-succession wealth function as z^*, one gets, similarly to (9):

$$z^*(t) = \left(\left\{ \int_{t^*}^t h^*(\tau, \tau - t^*) e^{-(1-\alpha)r(1-\mu)(\tau - t^*)}\, d\tau + [z(t^*) + w(t^*))/(1-\alpha)/\mu^{\alpha}]^{(1-\alpha)} \right\} \times (1-\alpha)\mu^{\alpha} \right)^{1/(1-\alpha)} \cdot e^{r(1-\mu)(t-t^*)} \qquad t = t^* \ldots \infty. \tag{10}$$

Suppose that the family is maximizing future assets at some finite-horizon time T. It can be seen from (10) that an increase in t^* affects $z^*(T)$ in three ways (ignoring discounting): (a) an increase in the initial level of family assets ($z + w$); (b) a decrease of family assets due to the shorter time period in which the successor's human capital contributes to business income; and (c) a decrease of business income in all $t > t^*$ due to a lower accumulation of business-specific human capital by the successor. If t^* is optimal, the gain in (a) is equal in absolute value to the sum of the losses in (b) and (c). Formally, the first order condition for the maximization of (10) at $t = T$ over t^* is:

$$(1-\alpha)\{[z(t^*) + w(t^*)]/(1-\alpha)\mu^{\alpha}\}^{1-\alpha}\{[\partial z(t^*)/\partial t^* + \partial w(t^*)/\partial t^*]/[z(t^*) + w(t^*)] - r(1-\mu)\} = h(t^*, 0) + \int_{t^*}^t \partial h^*(\tau, \tau - t^*)/\partial(\tau - t^*) e^{-(1-\alpha)r(1-\mu)(\tau - t^*)}\, d\tau \tag{11}$$

The left hand side of (11) is equivalent to (a) above, and the two elements on the right hand side are equivalent to (b) and (c), respectively. This is equivalent in principle to the case of perfect capital markets.

We are now in a good position to address the main issue: what is the effect of the borrowing constraints on the optimal timing of succession? The tightness of the borrowing constraint is inversely related to the parameter μ. The effect of μ on t^* can be found by comparative static analysis applied to (11). The result is not surprisingly quite complicated and ambiguous, and will not be reported here. Rather, I will examine this issue using a simulated example. The example uses the following functional forms: $h(t) = 20 - 0.05t$; $h^*(t) = 10 + 0.02t + 0.04(t - t^*)$; and $w(t) = w(0)(e^{rt^*} - 1)/r$. The last expression basically

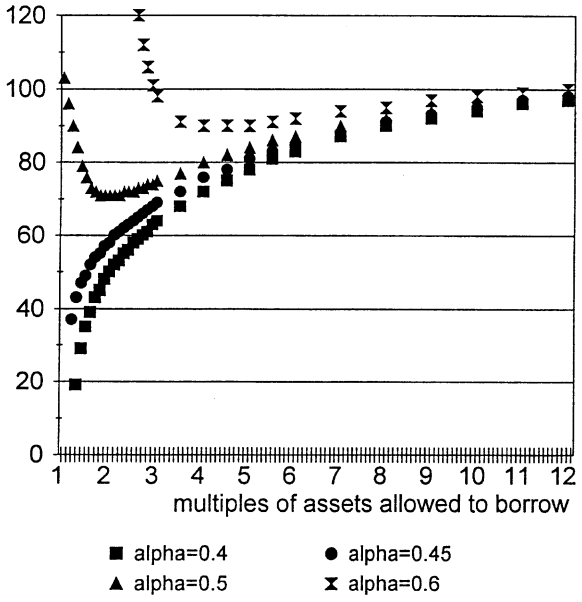

Fig. 3. The effect of borrowing constraint on the optimal succession time, for different levels of alpha (the tightness of the constraint is inversely related to the multiples of assets allowed to borrow. This example used the following parameters: $r = 0.05$; $h(t) = 20 - 0.05t$; $h^*(t) = 10 + 0.02t + 0.04(t - t^*)$; $T = 120$; $w(0) = 20$; $z(0) = 5$).

assumes a fixed off-business wage rate, for simplicity. Also, the following parameters are used: $r = 0.05$; $T = 120$; $w(0) = 20$; $z(0) = 5$.

Figure 3 shows the optimal succession time t^* as a function of μ for different values of α. For $\alpha = 0.4$ and 0.45, t^* is always rising with μ, meaning that as the borrowing constraint gets tighter, the family wishes to bring the successor in sooner. The interpretation is that as the constraint gets tighter, the contribution of the successor's human capital to present and future business income becomes more important than the contribution of his continued accumulation of off-business assets, or that his assets are more important now than in future periods even though they are still relatively small. For $\alpha = 0.5$ and 0.6, t^* is first declining with μ, up to a minimum of $\mu = 2$ and $\mu = 4.5$, respectively, and then rising. It seems that the combination of relatively high productivity of physical capital (α) and relatively tight borrowing constraints (small μ) as in the declining sections of these curves, makes it optimal for the family to delay succession and hence allow the successor to accumulate more off-business assets before joining the business. It should also be noted that succession time is increasing in α for every μ, but the effect of α on t^* vanishes as μ rises.

It should be noted that although the empirical results of Kimhi (1994) support the idea that the timing of transfer of managerial responsibility to a successor is determined optimally by a utility-maximizing family, this should be treated with caution since the model has not been confronted with more sophisticated models employing alternative assumptions about family decision-making (see for example Bourguignon and Chiappori, 1992).

4. Successor's decision to stay in the family business

Up to now I looked at the father/owner's decisions, and treated the designated successor as a passive reactor, willing to accept whatever decision is made about his future. In this section I allow the child to decide whether he stays in the family business or develops a career elsewhere. This decision has to be made again and again during the apprenticeship period, because unless a formal ownership transfer has been made, there is always the possibility of a change in the parent's decision, in which case the child has to start a career elsewhere without being compensated properly for the time he spent in the family business. The model presented below is based on unpublished work by Yoav Kislev. For simplicity, it is assumed that business ownership can only be transferred as a whole.

A discrete-time framework is used. At the beginning of each period (after the start of the apprenticeship period), the child decides whether he stays or leaves. At the end of each period, the owner announces whether he transfers ownership to the child, throws him out, or continues the apprenticeship as before. The child evaluates the probability of each of these outcomes at each of the current and future time periods as p_g, p_d, and p_n, respectively. In the final period (T) the last outcome is ruled out, and the probabilities associated with the first two outcomes are p_{gT} and p_{dT}, respectively.

The child maximizes a concave utility function of wealth at the end of period T. Wealth is accu-

mulated in the following manner: in every period the child is working in the family business, he/she accumulates $\$S$. If he leaves of his own will he takes with him a share, β, of the accumulated wealth. If he is thrown out by the parent, he takes nothing with him. In every period the child is working outside the business he accumulates $\$\alpha S$. Leaving is irreversible.

Expected utility as of the beginning of period $t < T$, conditioned on deciding to stay, can be written as $EU_t = p_g U(TS) + p_d U(0) + p_n EMU_{t+1}$, and for $t = T$ it is $EU_T = p_{gT} U(TS) + p_{dT} U(0)$. Utility conditioned on leaving at the beginning of period t is $Ulv_t = U[\beta(t-1)S + \alpha(T-t+1)S]$. The dynamic setting is finalized by writing the unconditional expected utility as $EMU_t = \max\{EU_t, Ulv_t\}$. For simplicity, there is no time discounting. Since the uncertainty is only about the decisions of the parent, the child can calculate his expected utility in any future period, conditioned on reaching that period.

This is illustrated in Figure 4. Using the values $T = 20$, $S = 100$, $\beta = 0.6$, $\alpha = 0.3$, $p_g = 0.3$, $p_d = 0.17$, $p_{gT} = 0.95$, and $p_{dT} = 0.05$, and a utility function of the form $U(W) = W^{1/2}$, the successor is found to stay until period 9. If he/she does not receive ownership at that point, he/she quits at the beginning of period 10. However, if for any reason outside this model the child stays until period 19, he/she will then decide to stay till the end. Simulations using various parameter values show that the successor will leave earlier when the probability of being disinherited (p_d) is larger and when the probability of receiving ownership (p_g) is smaller. He/she will also leave earlier when non-business income (α) is larger and when he/she gets to take a larger fraction of assets (β) if leaving voluntarily.

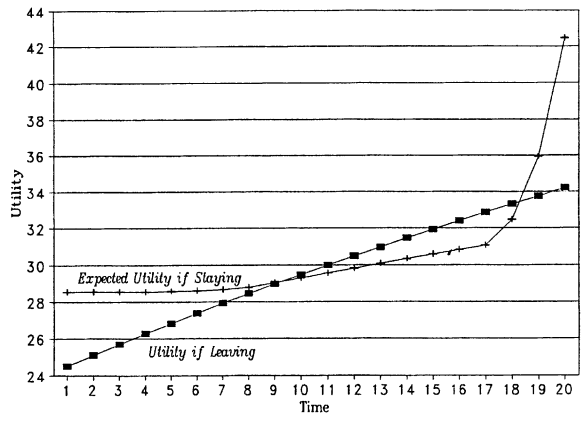

Fig. 4. Simulating the successor's decision of whether to stay or leave.

5. Strategic behavior

The model described above could be supplemented by a model describing father's decisions, and then the actual time of transferring ownership of the business could be derived by solving the models simultaneously. In that case we would also have to specify how the probabilities are determined. This will not be done here. Rather, I will discuss in general the possible behavioral patterns resulting from such an extension. Since there are only two participants in this model, strategic behavior is likely to exist. The outcome depends, among other things, on the threat points of both the father and the successor, and on the information each player has about the other's motives.

Suppose for example that the parent wishes to retain ownership of the business until period T, but is strongly averse to not having a successor. If the parent knows all the details of the successor's decision-making process, he/she will wait until the period at which he/she knows the child will leave, and then give him/her the ownership. In this case the actual time of ownership transfer is determined by the successor's interests, although the owner is the one who is making the move. On the other hand, if the child knows for sure that his parent is extremely averse to not having a successor, he/she could threaten to leave earlier, thereby forcing the parent to transfer the business earlier. In this case the parent's preferences determine the timing, but the child is making the move.

In reality, the situation is somewhere in between. Each player has some, albeit incomplete information about the other's preferences and interests, and the solution is determined by some unknown mechanism. Besides the threats described above and the like, there could be other signalling mechanisms that affect the outcome. For example, if one player assesses probabilities of future events subjectively, the other player may find it optimal to provide signals that will change the assessed probabilities in his favor. In the context of the example above, the owner may

provide signals that will cause the assessed value of the probability of transferring ownership at the end of period T to rise, hence making the successor willing to wait longer.

The outcome of the game need not be restricted to the timing of ownership transfer. The fraction of wealth the successor is allowed to take with him when leaving of his own will may also be negotiated. In practice, owners and designated successors may also negotiate an allocation of responsibilities during the apprenticeship period. It is likely that responsibilities will shift gradually from the owner to the successor. In addition, allocation of business income both before and after the ownership transfer may be negotiated. It is likely that before the transfer, owners get residual income and successors get a salary, and that this is reversed after the ownership transfer. These arrangements are often maintained as implicit contracts. Coughenour and Kowalski (1977), for example, found that only 15% of father-son family-farm partnerships had explicit contracts pertaining to the sharing of managerial responsibilities.

6. Discussion and conclusions

Intergenerational succession in family businesses involves several decisions: choosing a successor; timing the transfer of managerial responsibilities; timing the transfer of ownership; income distribution before and after the transfer; and compensation of other heirs. These decisions are made by the owners, following a bargaining process with potential successors. Motives are not restricted to doing the best for the business. Often other motives related to overall family welfare interfere or dominate, resulting in a decision that is not in the best interest of the business, such as choosing a successor who is not the best candidate for running the business. This paper has focused on two aspects of the general intergenerational succession problem separately: (1) the optimal time a successor joins the business and starts an apprenticeship period; and (2) the time a formal business ownership transfer to the successor is made. Elsewhere (Kimhi, 1995), the choice of successor among the owner's children was discussed. Regarding the first aspect, it was shown how optimal succession time is chosen as a solution to a family utility maximization problem, and how borrowing constraints affect that decision. It was found that tightening of the borrowing constraint is likely to enhance an earlier succession.

The outcomes of intrafamily bargaining over the terms of succession agreements depend on the threat points of the participants. If there are several potential successors with similar qualifications, the outcome will favor the owner. If there is only one potential successor, the outcome will favor him/her, because the owner's only alternative is to sell off. This difference will be smaller when the market value of the business is closer to its perceived value if succeeded within the family. Outcomes will be more in favor of the owner when potential business income is higher relative to non-business income, since the successor's "demand" for the business is larger. An older successor will not reach as good terms on the succession contract as his younger brother, if they are otherwise similar, since if his father is not satisfied he has the option of resorting to the younger brother. But the older successor may get better terms when the quality of the match between the owner and the successor is more important, because with him as a successor, the apprenticeship period is longer and the business takes better advantage of its benefits.

This bargaining process could be costly for the family in general and for the business in particular, because of conflicts among the potential successors, and between them and their parents. This cost can be reduced by having larger fractions of family wealth invested outside the family business. This reduces the successors' motives to compete for the business, allows the parents to compensate non-succeeding children, reduces the probability that a non-suitable successor will be chosen, and reduces the dependence of the owners on the business and on the family for old-age security.

The main implication of this analysis of succession is that proper management of family businesses should include planning ahead for the succession stage. Future income uncertainty should be reduced by a combination of savings and appropriate pension plans. Parents should make the business more attractive to their children. Businesses should be designed to keep the gap

between market value and succession value as small as possible. State interference is called for when the market for insurance and pensions is not sufficiently developed.

Acknowledgements

This research was supported by grant No. IS-1845–90 from BARD, The United States – Israel Binational Agricultural Research & Development Fund. An earlier version was presented at the 1994 Annual Meeting of the American Economic Association, Boston, MA. I thank Yoav Kislev and an anonymous referee for their useful suggestions.

Appendix

The maximization of (2) subject to (1) is similar to maximizing the following lagrange function

$$\int_0^\infty \{u[c(t)]e^{-\rho t} + \lambda(t)[h(t)[k(t)]^\alpha + rz(t) - rk(t) - c(t) - \partial z(t)/\partial t]\}\, dt \qquad (A1)$$

over $c(t)$ and $k(t)$, $t = 1 \ldots \infty$, and minimizing it over $\lambda(t)$, $t = 1 \ldots \infty$. Rewriting (A1) as

$$\int_0^\infty \{u[c(t)]e^{-\rho t} + \lambda(t)[rz(t) - c(t) - \partial z(t)/\partial t]\}\, dt + \int_0^\infty \lambda(t)[h(t)[k(t)]^\alpha - rk(t)]dt \qquad (A2)$$

one can see that given $\lambda(t)$, maximization with repect to $k(t)$ is independent of $c(t)$ and $z(t)$, $t = 1 \ldots \infty$. After the derivation of $I(t)$, (A1) becomes:

$$\int_0^\infty \{u[c(t)]e^{-\rho t} + \lambda(t)[I(t) + rz(t) - c(t) - \partial z(t)/\partial t]\}\, dt \qquad (A3)$$

Given $\lambda(t)$, one can solve for $c(t)$ in each period separately and get:

$$u'[c(t)]e^{-\rho t} = \lambda(t) \qquad (A4)$$

By the calculus of variations one can get:

$$\partial\lambda(t)/\partial t = -r\lambda(t) \qquad (A5)$$

which yields the solution $\lambda(t) = Ce^{-rt}$, and by condition (A4), assuming logarithmic utility, $c(t) = e^{(r-\rho)t}/C$. Plugging $c(t)$ and $I(t)$ into (1) and using the initial condition $z(0)$ and the transversality condition $\lim_{t\to\infty}\lambda(t)z(t) = 0$, the solution of the differential equation in (1) is (3). Also, consumption is $c(t) = \rho[\int_0^\infty I(\tau)e^{-r\tau}\, d\tau + z(0)]e^{(r-\rho)t}$, $t = 1 \ldots \infty$.

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