Blood and Money: Kin altruism, governance, and inheritance in the family firm

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First Draft: 20 April, 2012, This Draft: 15 September, 2014

Abstract

Using the kin altruism framework (Hamilton, 1964), this paper models descendant family firms. Kin altruism makes relatives soft monitors, leading to a "policing problem" within family firms. This policing problem results in both increased managerial diversion and increased monitoring expense at fixed compensation levels. When incentive constraints determine compensation, increasing kinship always increases the efficiency of the family firm under family management but may not increase firm value and promotes nepotistic hiring. When labor market reservation constraints determine compensation, kinship always lowers efficiency, sometimes increases firm value, and does not induce nepotism. Regardless of the binding constraint, kinship increases the cost of external capital and generates a divergence between the policy and bequest preferences of founders and their direct descendants.

Keywords: Corporate governance, entrepreneurship, kin altruism, contract theory

I would like to thank seminar participants at the Balliol Interdisciplinary Institute, the Saïd Business School, the University of Manchester, the University of Rotterdam, Humboldt State University, Duke University, the University of North Carolina, the University of Reading, Tel Aviv University, Gothenberg University, the Bank of Finland, NBER Entrepreneurship Workshop 2013, European Summer Symposium on Financial Markets 2013, 2014 Western Finance Association Meeting, and the 2014 European Finance Association Meeting. Special thanks are extended to Andy Gardner, Andrew Ellul, Simon Gervais, Radha Gopalan, and Mike Burkart for very helpful comments on earlier drafts of this paper. The usual disclaimer applies.

1 Introduction

Family firms are ubiquitous.[1] Their ubiquity raises the question of whether the defining characteristic of family firms—kinship—affects their value and behavior. To address this question, some framework for analyzing kinship's effect is required. By far, the most well developed and empirically validated approach to modeling kinship in the social and natural sciences is founded on Hamilton (1964), which develops an inclusive-fitness based rationale for kin altruism.[2]

The inclusive fitness of a given agent is that agent's own fitness summed with the weighted fitness sum of all other agents, the weights being determined by the other agents' coefficient of relatedness, i.e., their kinship, to the given agent. The logic behind kin altruism is that gene expression affects the number of copies of a gene in the gene pool both through its direct effect on the fitness of the agent expressing the gene and through its effect on the fitness of other agents sharing the gene. Because of relatedness, kin have a far higher than average probability of sharing any gene, including genes for altruistic behavior. Thus, a gene for kin altruism can increase in a population even if it is harmful to the fitness of the agent having the gene, provided that the costs to the agent are low relative to the benefits to kin. Selection of a kin altruistic gene requires that $rB > C$, where r represents the coefficient of relatedness, typically less than 0.50, B the benefit to the relative, and C the cost to the kin altruist.

This paper's agendum is to apply the kin altruism framework to the family firm. The focus of our analysis is descendant family firms—firms which are wholly owned and managed by genetically related agents. In the extension sections, we briefly consider the implications of inclusive fitness for the incentives of firm founders and the effects of passive extra-family ownership stakes.

We introduce kin altruism into a principal/agent model of effort, monitoring, and diversion. The effort model is quite standard: the owner fixes compensation based on incentive and participation constraints and the manager exerts unobservable effort. A monitoring problem arises because cash flows are only observed by the manager unless the owner incurs monitoring costs.

[1] As documented by Porta et al. (1999), 45% of publicly listed international firms are family controlled. Even in the U.S., the majority of firms with revenues less than $500 million are family controlled, and many very large firms are tied to families, e.g., Ford, and Walmart. Moreover, a number of very large firms are controlled, managed, and wholly or almost wholly owned, by members of a single family, e.g., Koch Industries and Cargill in the U.S., Esselunga S.p.A and Parmalat Finanziaria S.p.A. in Italy. In fact, even using their most narrow definition of "family firm," Astrachan and Shanker (2003) estimate that more than 30% of US GNP is produced by family firms.

[2] For example, Madsen et al. (2007) provides experimental evidence that agents' willingness to bear costs to benefit other agents is monotonically increasing in kinship. Daly and Wilson (1994) find that step fathers are more than 60 times more likely to kill their preschool children than biological fathers. Field evidence from other researchers shows that kinship relations increase political alliance ability (Dunbar et al., 1995), facilitate the assumption of group leadership (Hughes, 1988), and increase the probability of survival in catastrophic circumstances (Grayson, 1993).

Thus, the monitoring model closely tracks the standard costly-state-verification framework, for example Townsend (1979). However, in contrast to most state verification models, the owner cannot commit to monitoring.

Our analysis shows that kinship's affects on firm behavior are subtle. The first result in the paper is that, consistent with the observations of Bertrand and Schoar (2006), but not with the perspective of Fukuyama (1995), kinship *per se* does not increase trust or reduce owner–manager conflict. In fact, at fixed compensation and output levels, kinship always exacerbates monitoring problems. When owners are related to managers, they are soft monitors. Managers know this and take advantage. The resulting managerial attempts at diversion increase dissipative monitoring expense. Moreover, monitoring inefficiency is a log-convex function of kinship: marginal increases in kinship induce larger increases in monitoring expense when the managers and owners are more closely related.

Thus, if kinship is to be a source of value in the kin altruism framework, it must create value through some other mechanism. The inclusive fitness framework predicts that, given the opportunity, kin agents accept reductions in personal payoffs if and only if such reductions generate much larger increases in family payoffs. Thus, for kinship to generate value, family agents must operate in an environment in which the intrafamily payoff distribution significantly affects total family payoffs. The classical principal/agent setting is one such environment. When the agency frontier is open, i.e., when, absent kinship, equilibrium managerial compensation is less than the level required to induce first-best effort, increasing compensation increases managerial effort and thus total firm value. In this setting, small increases in effort by managers above their selfish optimal level generate large family gains while only imposing small costs on managers. At the same time, small increases in compensation above the owner's selfish optimal level impose only small losses on owners and generate large gains in output and thus total family value. Hence, kin altruism increases both managers' willingness to exert effort at any fixed level of compensation and owners' willingness to pay for any fixed level of effort.

When the agency frontier is open, even in cases where kinship increases monitoring expense, increasing kinship between owners and managers always increases net firm efficiency. However, increased efficiency need not translate into increased firm value because kinship also affects the distribution of value between family owners and managers. In contrast to the efficiency of family firms, which depends on the agency frontier being open, whether efficiency translates into increased firm value depends inversely on the costs of monitoring inflated by the degree of kinship between the agents. Thus, when the degree of kinship is high, the costs of monitoring must be lower for the efficiency gains from family ownership to translate into firm value gains. If we view the costs of monitoring as being inversely related to the quality of institutions, this result implies a certain complementarity between the quality of institutions and kinship for generating firm value. Thus, the traditional notion that kinship is a substitute for institutional quality is not consistent with the kin altruism perspective.

When the agency frontier is open, and institutions are sufficiently strong to permit the sharing of efficiency gains, increasing the degree of kinship between firm owners and managers increases firm value. If the human capital required to run the firm is family specific, this result implies that increasing kinship always increases firm value. However, when external candidate managers exist, increasing kinship also increases the likelihood of nepotism, i.e., family owners appointing less competent family members over more competent external candidates. Nepotism results because, when the agency frontier is open, managerial employment generates rents for managers. Family owners, who realize that they must concede rents to someone—either family or external candidate managers, prefer to concede rents to family members.

What happens when the frontier is closed? A number of recent papers have argued that, at least for large firms in some developed economies, competition in managerial labor markets rather than incentive optimization is the binging constraint fixing managerial compensation.[3] In this context, incentive constraint are already satisfied by the labor-market determined managerial compensation levels. When the frontier is closed, our basic results reverse: manager/owner kinship always reduces efficiency. When a family manager has both general human capital and family-specific human capital, owners use the family specificity of human capital and the manager's family loyalty to reduce compensation. Reduced compensation increases managerial diversion and thus lowers efficiency. In some cases, despite efficiency costs, this family loyalty "hold up" can increase firm value. In general, firm value is quasiconcave in the degree of kinship between owners and managers. Thus, firm value is maximized at intermediate levels of kinship at which the loyalty holdup extracts significant compensation concessions from managers yet kinship is not so high as to significantly erode the monitoring incentives of owners.

When the agency frontier is closed, the concessions that family owners extract from family managers are proportional to the total efficiency loss from the owner hiring an external manager on the competitive labor market. Regardless of whether family owners hire inside or outside the family, owners set compensation to match reservation compensation demands and thus managers do not earn agency rents. Because managers to not earn agency rents, owner hiring decisions are not nepotistic. Because, manager selection is efficient and family-specific human capital is used by owners simply for rent extraction, family-specific human capital only effect is to increase the efficiency losses induced by kinship. Absent any family-specific human capital, e.g., in a pure positive assortative matching world where agency constraints are never binding, the lower monitoring efficiency of family firms implies that matching owners and managers

[3]See for example, Murphy (2002) and Gabaix and Landier (2008)

based on kinship is inefficient. At the same time, absent firm-specific human capital, owners' loyalty hold up strategy is completely ineffective. Thus, firm value as well as owner welfare is highest when the firm is managed by external managers. Hence, in a positive assortative matching world, family owners strictly prefer to hire external managers.

Thus far, we have only discussed the behavior of wholly descendant-owned family firms. Developing an analysis of partially family-owned firms and founder-controlled firms is certainly possible but is outside the scope of this paper. However, to motivate both the existence and persistence of wholly-descendant owned family firms we consider how founder preferences might affect the structure of descendant firms and why such firms might eschew external capital. First, we show that, under very weak restrictions on family pedigrees, the kin altruism model implies that founders always exhibit greater "family benevolence" than any of their descendants, i.e., their preferences place more weight on total family value relative to the distribution of family value across descendants than the preferences of any descendant. Benevolence has two effects. When the founder forecasts that the firm will be managed by a descendant who is not the controlling owner, the founder has an incentive to fix the descendant manager's compensation at a level that is higher than the descendant non-managing owners prefer when higher compensation results in higher firm output. At the same time, founder benevolence implies that founders have more nepotistic hiring preferences than descendants. Thus, retiring founders have an incentive to appoint an entrench related managers even when such entrenchment is counter to the interests of the other more closely related non-managing descendants.

With regard to external capital, we consider the marginal effect of introducing passive outside capital on a wholly family-owned firm. We show that, regardless of whether the agency frontier is open or closed, the marginal cost of outside capital is higher for family owners than non-family owners. The higher cost arises because external finance reduces kin manager effort incentives, makes the owner an even "softer" monitor of the kin manager, and reduces the efficacy of the loyalty hold up. Thus, outside capital is fairly costly to family firm owners and will only be acquired to fund highly profitable investments. This result suggest that when family firms lack exceptional growth opportunities, family ownership will persist.

The inclusive fitness/kin altruism model of the family firm has a number of direct implications for the performance and behavior. Its most basic insight is that the translation of kin altruism into increased firm efficiency and value is mediated by institutional/environmental factors discussed above. The complex and conditional nature of the kinship/ value relationship perhaps explains the conflicting empirical results on the relation between value effects of kinship.[4]

[4]Anderson and Reeb (2003) report a positive effect of family ownership on firm performance for U.S. firms and Sraer and Thesmar (2007) report similar results for French firms. However, Miller et al. (2007) and Villalonga and Amit (2006) find, for U.S. firms, that, after controlling for the effect of a founder owner, family firms do not outperform non-family firms. See Miller and Le Breton-Miller (2006) for a comprehensive summary of these

Although the model does not make unconditional predictions about the effect of family ownership on performance, it does make predictions concerning the variables that drive performance differences between family and non-family firms. For example, the model predicts that family firms operating in environments that feature low human-capital specificity and highly competitive markets for managerial talent should perform worse than family firms operating in environments in which human capital is firm specific and managerial labor markets are underdeveloped. The analysis also makes a number of fairly unconditional predictions about the behavior of family firms. First, because of higher external capital costs, family firm owners will impose higher hurdle rates for new investments requiring external finance than non-family firms. For this reason family firm investment should be more sensitive to financial slack (which can be measured using the financing deficit variable developed by Frank and Goyal (2003)). Second, even when hiring is nepotistic, and thus family firms underperform relative to non-family firms, family managers should still overperform relative to the performance predicted by their human capital and level of compensation. Third, founder benevolence predicts that successor CEO appointments by founders of relatives will both be more nepotistic than descendant appointments and that total compensation, including bequeathed minority ownership stakes, will be larger. These predictions have not been directly tested. However, Bennedsen et al. (2007) show that the valuation effect of founder selection of a kin successor is negative.

As detailed above, this paper directly address the issues raised by economics and finance research on family firms. In addition the paper is also related, albeit more loosely, to a number of other strands of research in economics, evolutionary psychology, and evolutionary biology. We highlight a few of these connections below.

Models of altruism's effects on corporate financing and governance have been developed which posit altruism between non-related agents. For example, see Lee and Persson (2010) and Lee and Persson (2012). If one accepts that altruism is a good way to model relationships between unrelated agents, and if our model simply compared firm behavior in the presence of altruism with firm behavior in its absence, then it would be hard to argue that our model predictions distinguish family and non-family firms. However, almost all of our analysis relates to how increasing the *level* of altruism affects firm behavior. Thus, our contrasts between family and non-family firms depend only on the assumption that kin-based relationships exhibit significantly higher overall levels of altruism than non-kin relationships. The consensus in the psychology and evolutionary psychology literature strongly supports this assumption.[5]

The importance of the agency frontier in our model is also analogous to results on kin selection in evolutionary biology. If related animals compete only with relatives for a fixed pool of

results and of the various definitions of "family firm" used in this literature.

[5] See Section 7 for a more detailed discussion of this question.

resources, then aiding one relative only harms other relatives. in this case, the force of selection will not favor an altruistic allele. The introduction of an agency problem into our analysis permits the pool of resources (the total value generated by the firm) to vary with altruism and thus “opens up a frontier” over which kin altruism can operate. Models in evolutionary biology which rationalize the prevalence of kin altruism also requires some mechanism for opening the frontier (Taylor and Irwin, 2000).

This model’s results on the monitoring problem induced by kinship tie it to a large, dispersed, and sometimes informal, literature on conflicts and lack of trust between related agents. For example, Bertrand and Schoar (2006) argue that cooperation between family members is difficult to achieve. Barr et al. (2008) shows that, in the presence of external enforcement mechanisms, agents prefer to club with family members to share risk, but in the absence of external enforcement, kinship does not predict clubbing. Similar conclusions have been reached by evolutionary biologist considering the question of whether “policing strategies” are favored by natural selection. Ratnieks (1988) finds evidence to support a model predicting a negative association between relatedness and policing through a comparative study of Bumble bee and Honey bee policing behavior. Gardner and West (2004) and El Mouden et al. (2010) develop more general theoretical models which show that high levels of relatedness generally disfavor the selection of policing strategies.

2 Model

The world lasts for one period, bracketed by dates 0 and 1. All agents are risk neutral and patient. There are two agents in the baseline model: a “family owner” and a “family manager.” Sometimes, when there is no risk of ambiguity, will refer to the family owner/manager pair simply as the “owner” and the “ manager.” The family owner and family manager are kin. The owner has monopoly access to a project which we will call a firm. The owner can only operate the project if he secures the efforts of the manager. Collectively, the family owner and family manager are called “family agents” and the total value received by the family owner and family manager is called “family value.” We assume that consanguinity between agents leads them to partially internalize the effects of their actions on the payoffs to other family members. The specific mechanism governing this internalization, borrowed from the theory of kin selection, is presented later.

In the baseline model, the family owner hires the family manager by making a first-and-final compensation offer that the family manager can either accept or reject. If the offer is accepted, the manager makes an unobservable effort decision that produces a cash flow also only observed by the manager. In order to induce the manager to exert effort and accept employment, the owner offers the manager an contract that satisfies limited liability. Because effort and realized cash flow are observed only by the manager, neither effort nor the realized cash flow are verifiable or contractible. After observing the cash flow, the manager makes a verifiable report of cash flows to the owner. The manager and owner then divide reported cash flow based on the employment contract. After receiving the manager's report, the owner has the option of monitoring. Monitoring imposes a non-pecuniary cost on the owner. Monitoring is perfectly effective in that it always detects and returns to the owner all firm cash flow in excess of reported cash flow.

2.1 Preferences

The kin altruism preferences of family agents are reflected in their utility function, u:

$$u^{\text{Self}} = v^{\text{Self}} + h\,v^{\text{Relative}}, \quad 0 \leq h \leq 1/2. \tag{1}$$

$$0 \leq h \leq 1/2. \tag{2}$$

where v^{Self} represents the agent's own value and v^{Relative} represents the relative's value. Value includes both the monetary payoffs and the non-pecuniary costs of effort, in the case of the manager, and monitoring, in the case of the owner.[6] The scalar h represents kinship, the strength of the relation, or family tie, between the family agents. Condition 2 is motivated by the fact that the ½ is the highest degree of relatedness produced by typical mating patterns.[7] Note

[6]Alternative approaches to modeling altruism are perfectly reasonable but are either much more cumbersome than our approach or less consistent with the kin altruism perspective. One could, for instance, model altruism in a framework where agents maximized the weighted sum of selfish and related agent utility rather than payoffs. Since, under altruism, the map from payoffs to utility is invertible and monotone, this formulation is equivalent to our approach but is more cumbersome. On could also model altruism by assuming that agents evaluate the weighted sum of total payoffs using different (and perhaps non linear) utility-of-payoff functions, e.g., see (Lee and Persson, 2012). This formulation introduces interesting paternalism effects where agents take actions that lower related agents' subjective utility "for their own good." However, this approach is not consistent with the kin-altruism perspective where payoffs rather than subjective utility determine fitness. A very reasonable alternative to our approach would be to incorporate a non-linear fitness function in the analysis. Such a function would map payoffs into fitness. Related agents would internalize the effects of their actions on the weighed sum of these fitness functions. Unfortunately, it is not clear which fitness function should be used. Moreover, such a formulation would greatly increase the complexity of the analysis and raise questions concerning the dependence of the analysis on the specific fitness function chosen. For these reasons, we have chosen to simply identify fitness with payoffs.

[7]The condition that the degree of kinship between the owner and manager, h, does not exceed ½ is motivated by inclusive fitness, which limits for non-inbreed, non-monozygotic (i.e., non-identical twins) haploids (e.g., humans) kinship to at most ½. This specific boundary for h is not required to establish our results; however, some boundary is frequently required. As kin altruism becomes unlimited, i.e., $h \to 1$, the monitoring problem generated by relatedness vanishes because either (a) the owner concedes all firm value to the manager or (b) managerial effort converges to the first-best level even in the absence of any compensation. Whether (a) or (b) occurs first depends on complex polynomial expressions. Because these cases are not very interesting when altruism is motivated by inclusive fitness, we eschew working out these boundary conditions.

that agents are not altruistic in the sense of preferring relatives' gains to their own. If asked how they would split a fixed amount of money with a relative, each relative's preferred choice is to take everything for herself. However, relatives might abstain from such transfers when the transfers are highly dissipative, i.e., the transfer from one to another significantly reduces family value. This observation is most apparent if we rewrite the utility function using some equivalent formulations. Let $v^{\text{Family}} = v^{\text{Self}} + v^{\text{Relative}}$ represent family value. Using v^{Family}, we can express the utility function of a family agent in the following three forms:

$$u^{\text{Self}} = v^{\text{Family}} - (1-h)\, v^{\text{Relative}}, \tag{3}$$

$$u^{\text{Self}} = (1+h)\, v^{\text{Family}} - u^{\text{Relative}}, \tag{4}$$

$$u^{\text{Self}} = h\, v^{\text{Family}} + (1-h)\, v^{\text{Self}}. \tag{5}$$

These reformulations are trivial from a technical perspective but provide crucial insights for the subsequent analysis. Equation 3 shows that when choosing between two outcomes that produce the same family value, the family agent always prefers the outcome that produces a smaller value for the relative. Equation 4 expresses the principle that when choosing between actions that leave the utility of the relative fixed, family agents always prefer the choice that is family-value efficient. This principle is analogous to the principle in contract theory that, when all possible actions of the principal hold the agent to his reservation payoff, the principal selects the efficient value-maximizing action. We will see that the principle embodied by equation 4 imposes profound limitations on the ability of kinship to affect firm behavior. Equation 5, shows that the utility of family members is a weighted average of selfish and family value, with the weight on family value given by h and the weight on self value given by $1-h$.

2.2 Effort

The random cash flow from the project, $\tilde{x}$, has the following distribution

$$\tilde{x} = \text{dist.} \begin{cases} \bar{x}, & \text{w.p. } p \\ 0 & \text{w.p. } 1-p \end{cases}. \tag{6}$$

The manager selects $p \in [0, \bar{p}]$, $\bar{p} \in (0,1]$. p represents the probability that the cash flow from the project equals $\bar{x} > 0$. We call p the *uptick probability*. The manager's choice of p imposes a non-pecuniary effort cost of $\mathscr{E}(p)$ on the manager, where $\mathscr{E}(\cdot)$ is a weakly increasing function of p. Effort is not observable by any agent except the manager. If the firm fails to operate, the project produces a payoff of 0, and the manager receives a payoff of v_R, the manager's reservation payoff.

2.3 *Kinship and monitoring*

After the cash flow is generated, the manager observes the cash flow. The cash flow is the manager's private information. After observing the cash flow, the manager sends a message to the owner. This message is observable and verifiable by third parties. We call this message "reported cash flow." We assume that reported cash flow cannot exceed the cash flow. Thus, we can view the report of cash flow as being equivalent to the deposit of the cash flows in an escrow account as in, for example, Harris and Raviv (1995). As in Harris and Raviv, by the revelation principle, we can also assume that report equals either 0 or $\bar{x}$. Cash flows in excess of reported cash flows are termed "unreported cash flows." The owner has access to a monitoring technology. If the owner uses the technology and monitors, the owner incurs a non-pecuniary cost of $c > 0$. We call this cost the "cost of monitoring." The monitoring technology is perfectly effective, it completely returns all unreported cash flows to the owner. If the owner does not monitor, the manager receives all unreported cash flows. In this case, we say that the manager "diverts" cash flows. The owner decides whether to monitor after observing the manager's report. Monitoring cannot be verified by third parties but is observed by both the manager and the owner. Because only reported cash flows are verifiable, contracts must be contingent only on reported cash flows. Contracts are assumed to satisfy limited liability. Thus, when the reported cash flow equals 0, the only feasible limited liability contract stipulates a payment of 0 to both the owner and manager. When the reported cash flow equals $\bar{x}$, feasible contracts stipulate that the manager receives w and the owner receives $\bar{x} - w$, where $0 \leq w \leq \bar{x}$. We term w "management compensation" or simply "compensation." If the manager reports $\bar{x}$, reported cash flow equals the highest possible cash flow and the owner knows that the report is truthful. In this case, the owner has no incentive to monitor. If the reported cash flow is 0, then it is either the case that (a) the cash flow is, in fact, 0 and the manager reported truthfully or (b) the manager "underreported," i.e., the cash flow equaled $\bar{x}$ and the manager reported 0. If the manager reported 0 when the true cash flow is 0, the unreported cash flow equals 0 and thus monitoring does not benefit the owner. If the manager underreported cash flows, monitoring permits the owner to capture the unreported cash flow of $\bar{x}$. Our model of reporting and monitoring is quite standard and closely tracks the Townsend (1979) model of costly state verification. The major difference is that, in contrast to Townsend, the owner cannot precommit to monitoring. Thus, the question of the renegotiation proofness of the monitoring decision, which is important in Townsend, is not relevant to our analysis.

2.4 *Parameter restrictions*

Throughout the analysis, we impose the following parameter restrictions:

$$\max_{p \in [0,\bar{p}]} p\bar{x} - (v_R + \mathscr{E}(p) + c) > 0, \tag{7}$$

$$(1-h)\bar{x} - c > 0. \tag{8}$$

(7) implies that the expected cash flow to the project exceeds the cost of effort, monitoring, and the manager's reservation payoff. Thus, absent any kinship between the agents, undertaking the project is optimal even if undertaking the project requires that the owner incur the monitoring expenditure, c. The second restriction, (8), implies that the owner's utility benefit from monitoring when the owner knows that the manager has underreported cash flow, which equals the gain from transferring a concealed cash flow of $\bar{x}$ from the manager to the owner, $(1-h)\bar{x}$, exceeds the cost of monitoring, c. If this assumption were violated, the owner would never monitor and the manager would divert the entire cash flow.

3 Kinship and monitoring when compensation and output are fixed

In this section we treat compensation, w, and effort, and thus the uptick probability, p, as fixed parameters. Thus, there are only two interesting choices we must analyze: the manager's reporting decision when $x = \bar{x}$, and the owner's monitoring decision when the manager reports 0. In later sections, we will endogenize w using the manager's participation or incentive compatibility conditions. We analyze the monitoring/reporting problem in the case where the game is not trivial, i.e., when the cost of monitoring, c, is positive. In this case, monitoring is costly and will only be undertaken when the gains from monitoring exceed its cost. The gain from monitoring depends on the likelihood that managers attempt diversion by underreporting. Managerial underreporting will depend, in turn, on the likelihood of monitoring. In equilibrium, monitoring and underreporting will be simultaneously determined.

3.1 *Incentives to underreport*

When the cash flow equals $\bar{x}$ and the manager reports $\bar{x}$, he receives w and the owner receives $\bar{x} - w$. If the manager reports 0, and the owner does not monitor, the manager receives $\bar{x}$ and the owner receives 0; if the owner monitors, the manager receives 0 and the owner receives $\bar{x} - c$.

Thus, conditioned on underreporting, the manager's utility is

$$u_M^{\text{Underreport}} = (1-m)\,\bar{x} + h\,m\,(\bar{x} - c), \tag{9}$$

and conditioned on truthfully reporting $\bar{x}$, the manager's utility is

$$u_M^{\text{NotUnderreport}} = w + h(\bar{x} - w). \tag{10}$$

Thus, the manager's best reply is to divert if $m < m^*$, not divert if $m > m^*$, and, both diversion and non-diversion are best responses if $m = m^*$, where m^* is determined by equating (9) and (10), which produces

$$m^* = \frac{(1-h)(\bar{x} - w)}{c\,h + (1-h)\bar{x}}. \tag{11}$$

3.2 Incentives to monitor

Let ρ represent the owner's posterior assessment of the probability that the cash flow is $\bar{x}$ conditioned on the manager reporting 0. Later, we will determine this posterior using Bayes rule. If the owner monitors, the owner will receive $-c$ if the cash flow is 0 and $\bar{x} - c$ if the cash flow is $\bar{x}$. Thus, the owner's payoff from monitoring is

$$\rho\,\bar{x} - c.$$

If the owner decides not to monitor, his payoff is 0. Now consider the manager's expected payoff conditioned on a report of 0. If the cash flow is actually 0, the manager's payoff is 0 regardless of the owner's monitoring decision; if the cash flow is $\bar{x}$, the manager receives $\bar{x}$ if the owner does not monitor, and 0 if the owner monitors. Thus, the utility to the owner from monitoring, reflecting both his payoff and the portion of manager's payoff that is internalized as specified in (1), is given by

$$u_O^{\text{Mon.}} = \rho\bar{x} - c.$$

If the owner does not monitor, the owner's utility is given by

$$u_O^{\text{NotMon.}} = h\,\rho\,\bar{x}.$$

Thus, the owner's best reply is to monitor if $\rho > \rho^*$ not monitor if $\rho < \rho^*$; both monitoring and not monitoring are best replies if $\rho = \rho^*$, where

$$\rho^* = \frac{c}{(1-h)\,\bar{x}}.$$

Let σ represent the probability of the manager reporting 0 conditioned on the cash flow being $\bar{x}$. The cash flow distribution (which is given by (6)) and Bayes rule imply that ρ, the probability that the cash flow equals $\bar{x}$ conditioned on a report of 0, is given by

$$\rho = \frac{\sigma p}{\sigma p + (1-p)}.$$

3.3 Monitoring/reporting equilibrium

In this section, the uptick probability, p is exogenous. For some choices of p, the solution to the monitoring reporting problem is "trivial," i.e., the solution will call for the owner not to monitor and for the manager to divert the entire cash flow. In subsequent sections we show that the owner will never select compensation policies that produce these trivial solutions. Thus, to focus on solutions to the monitoring reporting game which can be supported by optimal compensation policies, we impose the following parametric restriction:

$$(1-h)\bar{x}p > c. \tag{12}$$

Assumption (12) ensures that the uptick probability, p, is sufficiently high to ensure that monitoring is a best reply to a managerial strategy of always underreporting cash flows. To determine the equilibrium level of monitoring and reporting, first note that no equilibrium exists in which monitoring occurs with probability 1: if monitoring were to occur with probability 1, then the manager would never underreport. In that case, monitoring would not be a best response for the owner. Next, note that the highest possible value of ρ, produced by the conjecture that the manager always underreports, is p. Thus, assumption (12) ensures that for a sufficiently high probability of underreporting, the owner would monitor. If assumption (12) were not satisfied, then the owner will never monitor and the equilibrium solution would be for the manager to underreport with probability 1. Thus, there is a unique mixed strategy equilibrium in which (3.2), (11) and (3.2) are satisfied. The equilibrium probabilities of underreporting, σ^*, and monitoring reports of 0, m^*, in this mixed strategy equilibrium are given by

$$\begin{aligned} \sigma^* &= \frac{c(1-p)}{p(\bar{x}(1-h)-c)}, \\ m^* &= \frac{(1-h)(\bar{x}-w)}{ch+(1-h)\bar{x}}. \end{aligned} \tag{13}$$

We see from equation (13) that monitoring intensity is decreasing in kinship, h, while managerial underreporting is increasing in h. This implies that diversion is larger when kinship is higher.

The only source of value dissipation in the monitoring/reporting game is *monitoring expense*, the expected cost of monitoring the reporting/monitoring equilibrium. Monitoring expense is simply the probability of monitoring multiplied by the cost of monitoring, c. Thus, the effect of kinship on family value depends on the probability of monitoring. The effect of kinship on the probability of monitoring is more subtle that the other comparative statics: the owner's monitoring decision is made ex post, after a 0 report is observed.[8] Zero reports occur when the actual cash flow is 0 or the manager underreports. Thus, holding monitoring intensity constant, the probability of monitoring is increasing in the probability of underreporting. Because underreporting triggers monitoring, it increases monitoring costs to the owner. Part of this cost increase is internalized by the related manager. Because kinship increases internalization, the level of monitoring required to deter diversion falls with kinship. At the same time, because the related owner internalizes the manager's gain from diversion in proportion to kinship, the probability of diversion required to trigger monitoring increases with kinship. Thus, kinship both (a) increases underreporting and (b) reduces the probability that zero reports will be monitored. The combined effect of (a) and (b) determines kinship's effect on the probability of monitoring. Monitoring occurs if and only if a report of 0 occurs and that report is monitored. Thus, the probability of monitoring is given by $\mathrm{PM}^* = m^*(1-p(1-\sigma^*))$. The fall in m^* induced by an increase in kinship decreases the probability of monitoring. At the same time, the increase in σ^*, also induced by an increase in kinship, increases the probability of monitoring. The effect of kinship on the probability of monitoring is thus not obvious at first glance. However, explicit calculation of the equilibrium probability of monitoring, PM^*, shows that

$$\mathrm{PM}^* = m^*(1-p(1-\sigma^*)) = \frac{(1-h)^2(1-p)\bar{x}(\bar{x}-w)}{((1-h)\bar{x}-c)(ch+(1-h)\bar{x})}. \tag{14}$$

is an increasing function of h. These observations motivate the following proposition.

Proposition 1. *For fixed compensation, w, and uptick probabilities, p, that satisfy* (12)*, there is a unique equilibrium. In this equilibrium, the probability of monitoring zero reports, m^*, and underreporting, σ^* are given by equation* (13)*. In the equilibrium,*

a. The probability of underreporting, σ^*, is increasing and convex in kinship, h,

b. The probability of monitoring of zero reports, m^*, is decreasing and concave in kinship, h.

c. The probability of monitoring and hence monitoring expense are both increasing and log convex (a fortiori convex) in kinship, h.

d. The probability of diversion is increasing in kinship, h.

[8] Were the owner to choose the monitoring probability ex ante, before observing the manager's report, the owner's monitoring costs would be sunk and thus would not affect the related manager's diversion incentives. The author is indebted to Simon Gervais for clarifying this point.

Proof. These results follow from differentiating the expression for underreporting, zero-report monitoring, diversion, and the total probability of monitoring. □

Thus, at any fixed compensation level, kinship increases both diversion and monitoring expense, which are proportional to the probability of monitoring. This result follows because increasing kinship reduces the welfare loss to the owner from diversion of firm resources by his kin—the manager. This weakens monitoring incentives. Weaker monitoring incentives lead to more underreporting and thus more reports of low cash flows. Since monitoring only occurs after zero reports, this leads to a higher total probability of monitoring even though, conditional on a low report being made, the probability of monitoring is lower. Hence, increasing kinship lowers family value.

Intuition for the somewhat surprising result that kinship increases the probability of monitoring and lowers family value can be gleaned from inspecting the elasticity of the total probability of monitoring with respect to kinship:

$$\frac{\mathrm{PM}'(h)}{\mathrm{PM}} = \underbrace{\frac{c}{(1-h)\left((1-h)\bar{x}-c\right)}}_{\frac{\mathrm{PZeroReport}^{*\prime}(h)}{\mathrm{PZeroReport}^{*}(h)}} + \underbrace{\left(-\frac{c}{(1-h)\left((1-h)\bar{x}+ch\right)}\right)}_{\frac{m^{*\prime}(h)}{m^{*}(h)}}. \tag{15}$$

The elasticity of zero reports with respect to kinship, $\mathrm{PZeroReport}^{*\prime}/\mathrm{PZeroReport}^{*}$ is inversely proportional to the term $(1-h)\bar{x}-c$, which represents the owner's diversion-monitoring gain, i.e., the gain to the owner from monitoring when the owner knows diversion is being attempted by the manager. The absolute value of the elasticity of zero-report monitoring with respect to kinship, $-m^{*\prime}/m^{*}$ is inversely proportional to $(1-h)\bar{x}+ch$, the manager's cost of apprehension, i.e., the loss to the manager of diversion when diversion is monitored. An increase in the total probability of monitoring requires that the absolute elasticity of zero reports exceeds the absolute elasticity of zero-report monitoring. Both elasticities contain a $(1-h)\bar{x}$ term, which reflects the transfer of monitored cash flow back to the owner. They differ with regard to how they factor in the monitoring cost term, c. The owner's diversion-monitoring gain is reduced by the entire cost of monitoring, c, because the owner directly incurs this cost. This effect increases the absolute value of the elasticity of the zero-report probability. In contrast, the manager's cost of diversion is increased by only part of the monitoring cost, hc, reflecting altruistic internalization of monitoring costs. This effect reduces the absolute elasticity of monitoring. Thus, the probability of zero reports exhibits more absolute elasticity than the probability of monitoring of zero reports, i.e., kinship reduces the rate of monitoring zero reports more slowly than it reduces the rate of zero reports and thus increases the total probability of monitoring. This same elasticity effect implies that $\mathrm{PM}'(h)/\mathrm{PM}$, i.e., the probability of monitoring and thus monitoring expense is log-convex in kinship. Log convexity implies that kinship's marginal effect on the monitoring problem is much greater when the owner and manager are close relatives, e.g., siblings of founder than it is when they are distant relations.

4 Kinship when the agency frontier is open: The agency model

The agency model is meant to reflect the case where the agency frontier is open; that is, the incentive constraint determines managerial compensation and total family value is always increased by marginal increases in the manager's share of total output. Initially, we assume that neither the firm nor the manager have outside options. We implement this assumption by setting the manager's reservation compensation to zero, i.e., we assume that $v_R = 0$ and assume that the family manager is the only candidate for managing the firm. The agency problem is introduced by assuming that the uptick probability, p, equals the level of (unobservable) managerial effort. Effort imposes a non-pecuniary additive cost on the manager of $\mathscr{E}$, where

$$\mathscr{E}(p) = 1/2\, k\, p^2, \quad p \in [0, \bar{p}].$$

We assume that the upper bound on p, $\bar{p}$, and the first-best uptick probability both equal 1. Because the first-best uptick probability solves the problem:

$$\max_{p \in [0,1]} \bar{x}\, p - \mathscr{E}(p),$$

the condition that the first-best uptick probability equals 1 is equivalent to the condition that $k \geq \bar{x}$. To simplify the exposition of the results and reduce the number of free parameters, we further assume that the marginal cost of effort at the first-best uptick probability equals 0, which implies that $k = \bar{x}$. In summary, we impose the following functional form on effort cost:

$$\mathscr{E}(p) = 1/2\, \bar{x}\, p^2, \quad p \in [0, 1]. \tag{16}$$

Extending the analysis to $k > \bar{x}$ would simply complicate the algebra. The effective upper bound on p in this case would be $x/k < 1$. Since the first-best uptick probability would be less than 1, the monitoring problem would persist even at first-best effort, reducing to some extent the effect of increased p on the value of the firm. Because, as we will see, kinship increases p, this would reduce the positive effect of kinship on value. Permitting $k < \bar{x}$ would change the results in a rather trivial fashion. In this case, the owner could eliminate the agency problem without granting the manager complete ownership of the firm. Thus, for some parameterizations of the model, kinship would eliminate both the agency and monitoring problem. Algebraically defining this region is quite tedious and provides no new insights.[9]

For a fixed compensation level, w, and uptick probability, p, monitoring and reporting probabilities will be the same as those derived in Section 3.3 where we analyzed the monitoring and reporting subgame. These probabilities are provided by (13). In order to induce the manager to expend sufficient effort to produce uptick probability p, it must be the case that, given compensation w, p is an optimal choice for the manager. Because truthful reporting (like underreporting) is always a best response in the mixed strategy solution of the monitoring/reporting subgame, the manager's utility given truthful reporting, provided by (10), represents the manager's utility when the cash flow equals $\bar{x}$. The cash flow equals $\bar{x}$ with probability p. When the cash flow equals 0, which occurs with probability $1-p$, the manager's utility is simply the internalized cost of owner monitoring, $h\,c\,m^*(w)$. Thus, we see that the manager's utility in the agency model conditioned on uptick probability p and compensation w can be expressed as

$$u_M^A(p,w) = p\,(w + h\,(\bar{x} - w)) - (1-p)\,h\,c\,m^*(w) - \frac{\bar{x}\,p^2}{2}.$$

The manager's choice of the uptick probability is defined by

$$p \in \operatorname{Argmax}\{p \in [0,1] : u_M^A(p,w)\}. \tag{17}$$

Solving problem (17) for p yields the equilibrium compensation associated with uptick probability p. Define this level of compensation as $w_M^A(p)$. $w_M^A(p)$ is given by

$$w_M^A(p) = \frac{\bar{x}p - h\,(c + (1-h)\bar{x} + p\,(\bar{x} - c))}{(1-h)^2}. \tag{18}$$

$w_M^A(p)$ represents the compensation level that is required to induce the manager to produce uptick probability p given that the manager accepts the owner's employment offer.

The equilibrium monitoring and reporting strategies derived in Section 2.3 require assumption (12). This assumption is equivalent to $p \geq c/((1-h)\,\bar{x})$. Thus, assumption (12) restricts the domain of $w_M^A(\cdot)$ to $p \geq c/((1-h)\,\bar{x})$. The range of $w_M^A(\cdot)$ is also restricted by the limited liability constraints. The owner limited liability constraint requires that $w \leq \bar{x}$ and the manager limited liability constraint requires that $w \geq 0$. However because w_M^A is strictly increasing in p we can express these constraints on the range of w_M^A as constraints on the domain of w_M^A.

[9] More generally, our analysis considers only extreme cases, where the incentive constraint is binding for all solutions or where it is not binding for any solutions to the contracting problem. Intermediate cases are easy to analyze numerically and were included in earlier versions of this paper. However, extending the analysis to such cases does not generate qualitatively different outcomes or analytically tractable comparative statics. Because our framework is designed simply to present the underlying logic of kin altruism's effects on family firms, we have not included these results in the current draft.

Because w_M^A is strictly increasing and $w_M^A(1) = \bar{x}$, for all $p \in [0,1]$, the owner limited liability constraint $w \leq \bar{x}$ is satisfied. In contrast, the manager limited liability constraint $w \geq 0$ does restrict the feasible choices of p. Solving equation (18) for $w_M^A(p) = 0$ yields,

$$p^{w=0} = h\left(1 + \frac{(1-h)\,c}{c\,h + (1-h)\,\bar{x}}\right). \tag{19}$$

Thus, the constraint that $w \geq 0$ can be implemented by constraining the owner to choosing $p \geq p^{w=0}$. In summary, condition (12), and the manager limited liability conditions will be satisfied provided that $p_{\min} \leq p \leq 1$, where $p_{\min}$ is defined as

$$p_{\min} = \max\left[p^{w=0}, \frac{c}{(1-h)\bar{x}}\right]. \tag{20}$$

The owner's utility, given uptick probability p, and compensation $w_M^A(p)$ is given by

$$u_O^A(p) = p\Big((1-\sigma^*(p))\big(\bar{x} - (1-h)\,w_M^A(p)\big) + \sigma^*(p)\,h\,\bar{x}\Big) - h\,{}^1\!/\!{}_2\,\bar{x}\,p^2. \tag{21}$$

The only constraint that remains to be considered is the manager's participation constraint. If the manager rejects the owner's offer of employment, the value to both manager and owner will equal 0. This implies that the manager's utility from rejecting the owner's offer is 0. Thus, the manager's participation constraint is

$$u_M^A(p, w_M^A(p)) \geq 0. \tag{22}$$

The owner's problem is to maximize u_O^A over feasible choices of p, subject to the participation constraint, (22), i.e., the owner's problem is given by

$$\begin{gathered}\max_{p\in[p_{\min},1]} u_O^A(p),\\ s.t.\; u_M^A(p, w_M^A(p)) \geq 0.\end{gathered} \tag{23}$$

We will first solve a relaxed problem which ignores the participation constraint and then show, in Proposition 2, that, in fact, the ignored participation constraint is always satisfied. The relaxed problem is defined as follows:

$$\max_{p\in[p_{\min},1]} u_O^A(p). \tag{24}$$

The solution to this problem is characterized by Lemma 1,

Lemma 1. *The solution to the relaxed problem* (24) *has the following characteristics:*

i. u_O^A *is strictly concave.*

ii. The value of p that solves (24) *is always interior.*

iii. The optimal choice of p^A *is uniquely defined by the first-order condition:* $u_O^{A\prime}(p^A) = 0$.

Proof: See the Appendix.

The important implication of Lemma 1 is neither the owner nor manager limited liability constraints ever bind, i.e., the family owner will always offer positive compensation to the family manager but never offer compensation equal to the entire cash flow $\bar{x}$. The owner limited liability constraint not being binding follows from our earlier assumption that $(1-h)\bar{x} > c$. The manager limited liability constraint not being binding relies to some extent on assumption (2), that $h \leq 1/2$.[10]

4.1 Effect of kinship on output, compensation, and monitoring

Lemma 1 shows that the optimal compensation decision made by the owner is quite well behaved as an optimization problem. However, we will see that the comparative statics of this problem with respect to kinship, h, are quite subtle. Their subtlety results from the symmetric effect of kinship on owner and the manager. When kinship increases, the amount that the owner needs to pay to ensure a given level of effort changes and the owner's willingness to increase compensation also changes. The interaction of these effects make the relation between kinship and variables such as compensation rather complex. To simplify some of the expression used to sign these relations, we introduce a new variable $\chi = c/\bar{x}$. χ represents the cost of monitoring normalized by the uptick cash flow. Introducing χ simplifies the analysis because the value functions, for the owner and manager, and thus the corresponding utility functions are all homogeneous of degree 1 in $\bar{x}$ for a fixed level of affiliation, i.e., $v_j(\bar{x}, c, h) = \bar{x}\, v(1, \chi, h)$, $j = O, M$. Thus, if we let $\hat{v}_j(\chi, h) = v_j(1, \chi, h)$, we can express these value and utility functions as, $v_j(\bar{x}, c, h) = \bar{x}\, \hat{v}_j(\chi, h)$ and $u_j(\bar{x}, c, h) = \bar{x}\, \hat{u}_j(\chi, h)$. Because, when the problem is parametrized using the normalized cost of monitoring variable χ, $\bar{x}$ enters the objective function only as a positive multiplier, it does not affect the optimized value of p. Thus, we can express the optimized value of p, p^A, purely in terms of h and χ. This simplifies our expressions greatly. An additional advantage of the normalization is that $\hat{v}_j$ represents the value received by j when $\bar{x} = 1$. Thus, in the subsequent section, where we consider the hiring decision when a candidate

[10] There exists a region of the parameter space where h is less than 1 but greater than $1/2$ over which the owner's optimal policy is to set $p = p^{w=0}$, i.e., to pay zero compensation. In essence, in this region, it is optimal for the owner to compensate the family manager purely through internalized firm value. When this occurs, the limited liability constraint prevents further increases in kinship from changing the terms of compensation. However, as argued earlier, because kinship coefficients in excess of $1/2$ are unlikely and because characterizing the region in which the limited liability constraint is binding is tedious.

external manager exists, we fix $\bar{x} = 1$ for the family manager and model the external candidate manager as a manager identical to the family manager with respect to effort preferences and normalized cost of monitoring who differs from the family manager only in two respects— his competence, proxied by $\bar{x} = e$ is greater than 1 and his kinship with the firm owner, h, equals 0. Using this approach, we do not need to derive a new value function for the external candidate manager.

Our first characterization of the effect of kinship in the agency context, Proposition 2, shows increasing kinship always increases effort and thus the uptick probability, p.

Proposition 2. *The uptick probability, p which solves the relaxed agency problem represented by expression* (24), *p^A, is*

$$p^A(h,\chi) = \frac{1+\chi}{2} + \frac{h}{2}\left(\frac{(1-h)^2 + (1-h)h\chi + (1+h)\chi^2}{(1-h)((1-h)(2+h)+h\chi)}\right)$$
$$\approx \frac{1+\chi}{2} + \frac{h}{4}\left(1 + \left(\frac{\chi}{1-h}\right)^2\right), \quad \chi = c/\bar{x}. \quad (25)$$

i. *The uptick probability, p^A, is increasing in kinship h, i.e., $\partial p^A/\partial h > 0$.*
ii. *The marginal effect of increased kinship on the uptick probability is increasing in the normalized cost of monitoring, χ, i.e., $\partial^2 p^A/\partial h \partial \chi > 0$.*
iii. *The utility of the manager given that $p = p^A(h,\chi)$ is always strictly positive. Thus, p^A, the solution to the relaxed agency problem* (24) *solves the agency problem defined by expression* (23).

Proof: See the Appendix.

The expression for the equilibrium uptick probability provided in Proposition 2 does exhibit a complex dependence on kinship. The complex dependence is expected given the symmetric nature of kinship altruism. However, the relation between kinship and the uptick probability is not as turbid as one might expect simply from inspecting the expression for p^A. First, the character of the equilibrium uptick probability is transparent in some special cases. When the cost of monitoring equals 0 (and thus, $\chi = 0$), $p^A = (1+h)/(2+h)$ and is clearly increasing in kinship, h. When the manager and owner are unrelated, i.e., $h = 0$, the expression for p^A in Proposition 2 reduces to $p^A = (1+\chi)/2$. Thus, increasing the cost of monitoring, increases the equilibrium level of effort when the manager and owner are unrelated. The reason is straightforward. As the cost of monitoring increases, the owner's ability to capture the cash flows of the firm through monitoring falls. Increased capture of firm rents by the manager improves the manager's effort incentives. It is also clear from inspecting the expression for p^A in the Proposition that the uptick probability at positive levels of kinship is always higher than the uptick probability when the manager and owner are unrelated (i.e., $h = 0$). Second, the approximate expression for p^A, which, over the admissible set of model parameters, approximates p^A with a maximal absolute error of less than 5%, transparently reveals the essential nature of the kinship/uptick probability relation.[11] The approximation is clearly increasing in h and its rate of increase is increasing in the normalized monitoring costs, χ. The intuition for these results is that kinship increases the owners willingness to concede rents to increase output. Moreover, the owner prefers firm value reductions resulting from rent concessions to the manager to firm value reductions resulting from dissipative monitoring expenses. The owner's relative preference for rent concessions increases with kinship. Increased compensation lowers monitoring expense at the cost of increased rent concession. Thus, when χ is larger, the concessions to the manager induced by an increase in kinship are larger. These larger concessions lead to greater managerial effort and thus a larger increases in the uptick probability. Proposition 2 shows that the uptick probability itself has the same properties as its approximation. However, some tedious algebra is required for this derivation and it is therefore deferred to the Appendix.

Proposition 2 also shows that the manager's participation constraint is always satisfied by the solution to the relaxed problem. In a model incorporating agent altruism, demonstrating that the manager's participation constraint is satisfied even under the assumption that the manager has no outside options is not entirely trivial. The difficulty is that the manager will internalize part of the owner's value. Because the probability of monitoring and thus the owner incurring monitoring expenses, is higher when output is low, the manager, if he accepts the owner's compensation offer, has an incentive to exert effort simply to lower the owner's monitoring expense. Thus, it is conceivable that the manager might be willing to exert effort at a low compensation level that leaves his utility negative but not as negative as it would have been had the manager accepted employment but exerted no effort. In which case, positive output would be produced were the manager to accept employment but accepting employment would violate the manager's reservation constraint. Proposition 2 shows that owners, even if they ignore the reservation constraint of the manager, will never select such low compensation levels. Compensation violating the participation constraint yet yielding significant output, p, requires a high degree of owner/manager kinship. However, the owner's optimal choice of p, ignoring the participation constraint, increases with kinship. The increase in p is always sufficient to keep the manager's utility positive and thus above the reservation constraint.

The question remains as to whether this positive effect of kinship on the uptick probability, p, is countered by increased monitoring expense induced by increased kinship. The next proposition shows that the probability of underreporting is always increasing in the degree of kinship.

[11] The approximation was obtained by replacing the denominator of the expression for p^A by the first three terms of its geometric series expansion. The accuracy of the approximation was determined by numerical means and the code is available upon request.

Thus, our earlier result—that kinship increases the likelihood of underreporting at a fixed compensation level—also holds when compensation is endogenously determined by the incentive compatibility constraint of the agency model.

Proposition 3. *In the agency setting, the probability that the manager will underreport a high cash flow, σ^{A*}, is given by*

$$\sigma^{A*} = \frac{(1-p^A(h,\chi))\chi}{p^A(h,\chi)(1-h-\chi)}.$$

σ^{A*} is increasing the degree of kinship, h, between the manager and owner.
Proof: See the Appendix.

Proposition 3 shows that increased kinship never induces the owner to adjust compensation upward sufficiently to nullify the underreporting incentives generated by increased kinship. However, underreporting per se does not generate monitoring expenses. It only generates costs if zero reports are monitored. The likelihood that zero reports are monitored depends not only on the normalized cost of monitoring, χ, but also the level of compensation, w. Increasing w reduces the probability of monitoring required to deter diversion. Thus, the effect of kinship on monitoring depends on kinship's effect on compensation. The next result characterizes the compensation–kinship relation.

Proposition 4. *Compensation, w, in the agency setting is given by*

$$w^{A*} = w_M^A(p^A(h,\chi)).$$

Increasing kinship, h, can either increase or reduce w^{A*}. The conditions for each of these cases are provided below: Let $\alpha = \chi/(1-h)$. If

i. If $\alpha < \underline{\alpha}_W \equiv 1/\sqrt{3} \approx 0.58$, increasing kinship reduces compensation, w^{A*}
ii. If $\alpha > \bar{\alpha}_W \equiv \sqrt{13}-3 \approx 0.61$, increasing kinship increase compensation, w^{A*}
iii. If $\alpha \in [\underline{\alpha}_W, \bar{\alpha}_W]$ increasing kinship reduces (increases) w^{A*} whenever $h < (>) h_W$, where

$$h_W = \frac{(1-\alpha)\sqrt{(1+\alpha)\,(4-11\,\alpha^2+\alpha^3)} - \left(2+\alpha-6\,\alpha^2-\alpha^3\right)}{4\,\alpha\,(1-\alpha-\alpha^2)}.$$

Proof: See the Appendix.

Note that the our surd parameterization of the boundary between positive and negative kinship effects is expressed in terms of h and $\alpha = \chi/(1-h)$ rather than h and χ. The map $((h,\chi) \to (h,\chi/(1-h))$ is however one-to-one and thus the parametrization provides a complete, albeit not very intuitive, characterization of the (h,χ) regions where increased kinship reduces and increases compensation. Expressed in terms of h and χ these regions are defined

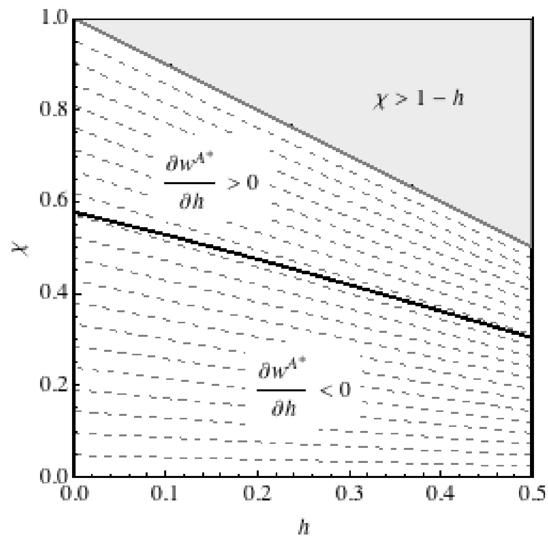


Figure 1: The effect of kinship, h, on compensation, w^{A*}. In the figure, the horizontal axis represents the level of kinship, h. The vertical axis represents the normalized cost of monitoring, $\chi = c/\bar{x}$. The thin dashed lines represent points (h,χ) on the graph which generate the same altruism inflated cost of monitoring, $\alpha = \chi/(1-h)$.

by quintic polynomials and thus do not yield tractable parameterizations. In contrast, in the transformed variables h and α, the regions are defined by a jointly quadratic polynomial and thus permit a surd parameterization. In fact, the proposition shows that the effect of kinship on compensation is almost, but not quite, determined simply by $\alpha = \chi/(1-h)$. Note that α can be expressed as $\alpha = \chi/(1-h) = \chi\,(1+h+h^2\ldots)$. Thus, α can be thought of as the altruism inflated cost of monitoring per unit of firm scale. When altruism inflated costs of monitoring are high, i.e., $\alpha > \bar{\alpha}_W \approx 0.61$, monitoring costs are salient to owners. The owner sacrifices personal gains to reduce expected monitoring expense and adopts a high compensation policy. Increased compensation lowers monitoring intensity because, at higher levels of compensation, the intensity of monitoring required to deter diversion is lower. In this region, increasing kinship leads to even larger owner concessions to the manager. When $\alpha < \underline{\alpha}_W \approx 0.58$, the cost of monitoring is not salient to the owner. The owner thus exploits the increased non-pecuniary effort incentives provided by increased kinship to lower managerial compensation. In this case, the uptick probability increases with kinship but not as much as it would have had the owner not reduced compensation. The dependence of kinship's effect on compensation on the altruism inflated cost of monitoring is illustrated in Figure 1. In the figure, we present the regions of (h,χ)-space were increasing kinship increases and decreases compensation. Dashed curves in the figure represent"iso-α" curves, i.e., points in (h,χ)-space which produce the same altruism inflated cost of monitoring. The fact that these curves are nearly parallel to the boundary between the regions where increasing kinship increases and reduces compensation indicates the close but not quite perfect dependence of the compensation–kinship relation on α.

At a fixed compensation level, as shown in Section 3.3, kinship reduces the owner's incentive to monitor zero reports, albeit not sufficiently to counter the increased level of underreporting. When compensation is endogenously determined by the incentive problem, Proposition 4 shows that increases in kinship reduces compensation when α, the altruism inflated cost of monitoring, is sufficiently small. Reduced compensation increases the level of monitoring required to deter diversion and in some cases this increase is sufficient to counter the reduction in monitoring incentives induced by increased kinship. This observation is formalized in the following proposition.

Proposition 5. *The probability that the owner will monitor reports of a low cash flow in the agency setting, m^{A*}, is given by*

$$m^{A*} = \frac{1 - p^A(h, \chi)}{1 - h}.$$

Increasing kinship, h, can either increase or reduce m^{A*}. The conditions for each of these cases are provided below: Let $\alpha = \chi/(1-h)$; define $\underline{\alpha}_m = \sqrt{2} - 1 \approx 0.41$; define $\bar{\alpha}_m \in (0,1)$ as be the unique positive root of the cubic equation, $\alpha^3 + 9\,\alpha^2 + 3\,\alpha - 4$, $\alpha_m \approx 0.51$.[12] Then

i. if $\alpha < \underline{\alpha}_m \approx 0.41$, increasing h increases monitoring, m.
ii. if $\alpha > \bar{\alpha}_m = 0.51$, increasing h reduces monitoring
iii. If $\alpha \in (\underline{\alpha}_m, \bar{\alpha}_m)$, then increasing h increases (decreases) monitoring whenever

$$h > (<) \frac{\sqrt{1 - 2\,\alpha + 3\,\alpha^4 - 2\,\alpha^5} - \left(1 - 3\,\alpha^2\right)}{2\,\alpha\,(1 - \alpha - \alpha^2)}.$$

Proof: See the Appendix.

Proposition 5 shows that, once again, the effect of kinship is fixed to a large extent simply by the altruism inflated cost of monitoring, α. When this cost is low, $\alpha < \underline{\alpha}_m \approx 0.41$, the cost of monitoring is of second-order importance to the owner and the owner uses increases in the manager's kin altruism to reduce the manager's compensation so much that, even after accounting for the reduced underreporting incentive engendered by kinship, the owner must increase monitoring to deter diversion. Thus, m increases with kinship. When $\alpha > \underline{\alpha}_m \approx 0.51$, the adverse effect on family value of monitoring expenses becomes sufficiently salient to deter the owner from making such substantial reductions in compensation.

In contrast to the owner's compensation and monitoring strategy, w and m, expected monitoring expense is not tightly related to the altruism inflated cost of monitoring. Monitoring expense is

[12] In fact, it is possible, using Cardan's formula for cubic, to solve for this cubic equation for $\bar{\alpha}_m$. The exact solution is $\bar{\alpha}_m = -3 + 2\sqrt{6}\sin\left(\frac{1}{3}\tan^{-1}\left(\frac{\sqrt{367}}{41}\right)\right) + 2\sqrt{2}\cos\left(\frac{1}{3}\tan^{-1}\left(\frac{\sqrt{367}}{41}\right)\right)$.

directly dependent on another factor—the uptick probability, p. Because a low cash flow must be reported when in cash flow is truly low, and, when the cash flow is high, the probability that it will be reported as low is less than one, increasing p reduces monitoring expense. When this effect is sufficiently strong, monitoring expense can fall as kinship increases even when the altruism inflated cost of monitoring is low. When this occurs, compensation falls with kinship, and thus underreporting increases, and the probability of monitoring zero reports also increases. However, the positive effect on the uptick probability induced by increasing kinship is sufficient to outweigh both of these effects. This result is formalized in Proposition 6.

Proposition 6. *Expected monitoring expense in the agency setting, ME^{A*}, is given by*

$$ME^{A*} = \bar{x}\chi \frac{(1-p^A(h,\chi))^2}{1-h-\chi}.$$

Increasing kinship, h, can either increase or reduce ME^{A*}. The conditions for each of these cases are provided below. Let $\alpha = \chi/(1-h)$. If

i. If $\alpha < \alpha_{ME} \equiv 1/2\left(\sqrt{145}-11\right) \approx 0.52$ then kinship always increases ME^{A*}.

ii. If $\alpha \geq \alpha_{ME}$, then increasing kinship reduces (increases) ME^{A*} whenever $h < (>) h_{ME}$, where

$$h_{ME} = \frac{-6\alpha^2 - \alpha - \sqrt{(1-\alpha)^2(2\alpha+1)(2\alpha+3)(3-4\alpha)} + 3}{2\alpha(\alpha(2\alpha+3)-3)}.$$

Proof: See the Appendix.

4.2 Kinship's and value

Thus, for a significant range of the parameter space, increasing kinship increases output by increasing p and also reduces monitoring expense. In fact, as the next proposition demonstrates, even over the region where kinship increases monitoring expense, the net effect of increasing kinship on family value under equilibrium compensation policies is always positive.

Proposition 7. *Family value in the agency setting, $v^{A*} = v_M^{A*} + v_O^{A*}$, is given by*

$$v^{A*} = \bar{x}\left(\frac{p^A(h,\chi) + (1-p^A(h,\chi))p^A(h,\chi)}{2} - \frac{\chi(1-p^A(h,\chi))^2}{1-h-\chi}\right).$$

v^{A*} is increasing in kinship, h.

Proof: See the Appendix.

The intuition behind Proposition 7 is that the only region of the parameter space where increased monitoring expense might overwhelm the positive effects of increased kinship on output is a region where the altruism inflated cost of monitoring is low. However, over this region, although monitoring expense is increasing in kinship, it is small in absolute terms and thus the increased monitoring expense is always more than compensated by the increased output induced by increasing kinship.

The value to the owner and manager are given by substituting in the in the equilibrium reporting and monitoring probabilities, given by equation (13), the equilibrium compensation schedule, given by equation (18), and the equilibrium uptick probability, given by (25), into the manager's value function and then noting that the owner's value is the difference between family value, given in Proposition 7, and the manager's value. This yields, after some algebraic simplification, the following result:

$$v_M^{A*} = \bar{x}\,\frac{1}{2}\left(1+(1-p^A(h,\chi))\left((1-p^A(h,\chi))\left(\frac{2(1-\chi)}{1-h-\chi}-1\right)-\frac{2(1-h(1-\chi))}{(1-h)^2}\right)\right) \quad (26)$$

$$v_O^{A*} = v^{A*} - v_M^{A*}, \quad (27)$$

where v^{A*} is given in Proposition 7 and p^A is defined by equation (25).

Proposition 7 shows that when incentive constraints bind, kinship increases family value. This increase in family value is divided between the manager and the owner. This raises the question of who captures the value gain? Although it is not possible to obtain a surd parameterization of the regions where increasing kinship increases firm and manager value, once again the division of the gains from kinship depends largely on the altruism inflated cost of monitoring, $\alpha = \chi/(1-h)$. This result is recored below.

Proposition 8. *Let $\alpha = \chi/(1-h)$ represent the altruism inflated cost of monitoring and let v_O^{A*} represent the owner value in the agency model. Similarly let v_O^{A*} represent the manager value.*

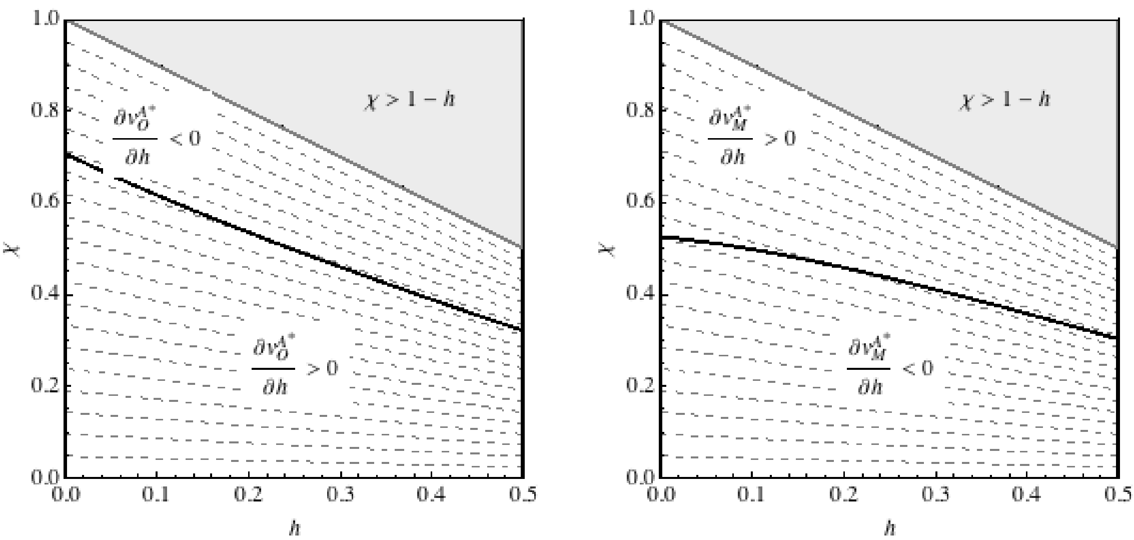
i. When the altruism inflated cost of monitoring, α, is less than the unique root (between 0 and 1) of the polynomial, $-6-10\,\alpha+19\,\alpha^2+18\,\alpha^3+3\,\alpha^4$, which is approximately equal to 0.624, owner value increases as kinship increases. When α is greater than $1/\sqrt{2}\approx 0.707$ owner value decreases as kinship increases.

ii. When α is less than the unique root of $-1-\alpha+5\,\alpha^2+\alpha^3$ between 0 and 1, which is approximately equal to 0.525 manager value decreases as kinship increases. When α is greater than the unique root of $-26-31\,\alpha+88\,\alpha^2+54\,\alpha^3+5\,\alpha^4$ (between 0 and 1), which is approximately equal to 0.604, manager value increases as kinship increases.

Proof: See the Appendix.

Proposition 8 shows that division of kinship gains depends primarily on the altruism inflated cost of monitoring. When this cost is low, the direct effect of kinship in reducing compensation and the indirect effect from reduced compensation increasing monitoring, both reduce manager value and increase owner value. When the altruism inflated cost of monitoring is high, the owner, anticipating the large increased monitoring expense that kinship generates at a fixed compensation policy is willing to increase compensation significantly. This leads to higher value for the manager and lower value for the owner. In intermediate cases, the owner and manager split the gain from the increase in family value and both owner value and manager value increase. This result is illustrated in Figure 2 which plots the effect of increased kinship on owner and manager value for different levels of kinship and the normalized monitoring costs. The dashed lines in the figure, which represent, iso-α curves are nearly parallel to the boundary between the regions where increasing kinship increases and decreases value. This illustrates the close but imperfect relation between the altruism inflated cost of monitoring, α, and the effect of increasing kinship on owner and manager value.

Thus, Propositions 8 and 4 show that both w^{A*}, and v_M^{A*} are nearly determined by the altruism inflated cost of monitoring. However it is worthwhile noting that neither w^{A*} or v_M^{A*} correspond to directly with observed official realized compensation typically measured in empirical research. w^{A*} represents promised compensation contingent on an uptick and thus it does not reflect the effects of kinship on the uptick probability itself. v_M^{A*} includes both gains from convert diversion and the non-pecuniary costs of effort, both of which vary with kinship. Thus, it is difficult to formulate simple hypotheses linking observed managerial compensation with kin altruism in the agency setting.



Panel A. Effect of kinship, h, on the owner's value, v_O^{A*}.

Panel B. Effect of kinship, h, on the manager's value, v_M^{A*}.

Figure 2: In the figures, the horizontal axis represents the level of kinship, h. The vertical axis represents the cost of monitoring normalized for firm size, $\chi = c/\bar{x}$. The thin dashed lines represent points (h, χ) on the graph which generate the same altruism inflated cost of monitoring, $\alpha = \chi/(1-h)$.

4.3 Nepotistic hiring

Thus far, we have assumed that the family manager is the only potential manager of the firm. We now consider how kinship affects the hiring decision when there are two candidate managers of the firm. One candidate manager, the family manager, is related to the owner through kinship given by $h > 0$ the other candidate manager, the "external manager," is not related to the owner, i.e., for the external manager, $h = 0$. The normalized cost of monitoring χ is the same for both candidate managers. Except for relatedness the only difference between the two managers is the payoff they generate conditioned on an uptick, $\bar{x}$. We assume that for the family manager, $\bar{x} = 1$ and for the unrelated manager, $\bar{x} = e > 1$. Keeping with the agency setting, we assume that the reservation payoffs of both the external and family candidate managers are 0. This assumption is not required to establish our result but we require that the participation constraint not be binding and the assumption of a zero reservation value is a convenient way to ensure that this is the case.

Thus, for any fixed level of effort, the external manager produces higher expected output. However, this does not imply that the external manager is "better" than the family manager. Kinship can increase managerial effort and sometimes, at endogenous compensation levels, also reduce monitoring expenses. How we define "better" is also not entirely clear as it depends on which value function is used to make the comparison of the external and family management. We consider two possibilities–shareholder value and social value. Shareholder value compares the value of the firm under the external and family managers while social value considers the sum of the payoffs to the three agents, the family owner, the family manager, and the external manager. To formalize these ideas, first note that, because the reservation value of the manager who is not hired equals 0. if the family manager is hired, the total payoff will equal the sum of the family (kin) manager's value and the family owner's value, which we represent by v^K. Similarly if the external manager is hired, the total payoff will equal the sum of the family owner's value and the external manager's value, which we represent by v^E. We represent the family owner's value if the owner hires the family (kin) manager by v^K_O and, if the owner hires the external manager, by v^E_O. We represent the value of the family and external manager if they are hired by the owner by v^K_M and v^E_M respectively. The payoff of any shareholder is proportional to the owner's value. Thus, hiring the external manager is shareholder preferred if $v^E_O > v^K_O$. Because shareholder value equals total value less the value received by the hired manager, the share value gain from hiring the external manager is proportional to

$$\Delta^E_{\text{Sh}} = (v^E - v^K) - (v^E_M - v^K_M) > 0. \tag{28}$$

Hiring the external manager is socially preferred if total value is higher under the external manager. Thus, the gain from hiring the external manager under the social objective function is

$$\Delta_{\text{SW}}^{E} = v^{E} - v^{K} > 0. \tag{29}$$

The owner's hiring decision is governed neither by the social welfare function nor share value maximization but rather by the kin altruism as specified in (1) . Using the form of the altruism function given in equation (3) we can express the owner's gain from hiring the external manager as

$$\Delta_{O}^{E} = (v^{E} - v^{K}) - (v_{M}^{E} - (1-h)\, v_{M}^{K}). \tag{30}$$

Proposition 9. *In the agency setting,*

i the gain to the family owner from hiring the family manager is always greater than the social gain and the shareholder gain.

ii If $e < 2$ (i.e., the external manager's competence is less than twice the family manager's) and the altruism inflated cost of monitor, α, is sufficiently close to one, hiring is always shareholder value nepotistic.

iii Parameters of the model exist under which the shareholder gain from hiring the external candidate is positive while both the family owner's gain and the social gain from hiring the external candidate are negative, i.e., nepotistic hiring can increase social welfare.

Proof: See the Appendix.

Proposition 9 shows, first, that the family manager's hiring decision is never "anti-nepotistic" in the agency setting. Shareholder preferences are based on the difference between the change in total value and the change in managerial rents induced by the hiring choice. Family owner preferences are also based on the difference between the change in total value and the change in managerial rents. However, for the family owner, the rents extracted by the family manager are discounted at a rate proportional to kinship. Thus, the gain to the family owner from the change in managerial rents induced by selecting the external candidate is smaller than the share value gain. In fact, the kinship-based cost of external management, $v_{M}^{E} - (1-h)\, v_{M}^{K}$, is always positive. Thus, although the payoffs to family managers may well be higher than the payoffs to external managers, the growth in family manager rents caused by increased kinship is never sufficient to offset the increased discounting of these rents also induced by increased kinship.

These observations are illustrated in Figure 3. As the altruism inflated cost of monitoring, α, converges to 1, anticipated monitoring expense, relative to the family owner's willingness to monitor the family manager, becomes so large that the owner's optimal policy under family management converges to conceding firm value to the family manager. Because this concession eliminates the agency problem by making the manager the effective owner of the firm, the family manager's effort converges to first-best. Thus, social welfare is higher under the family manager but, of course, share value is lower. When the altruism inflated cost of monitoring α approaches zero and thus the costs of monitoring are small, neither shareholder nor manager interests are aligned with social welfare. In this case, compensation to the family manager is low. Share value might maximized by hiring the family manager because the lower managerial rents under the family manager more than offset the total value gain from hiring a more competent external candidate. *A fortiori*, the family owner also prefers the family manager because the family owner discounts the small rents extracted by the family candidate. Thus, in this case, hiring is nepotistic relative to the social welfare criterion but not necessarily relative to shareholder-value maximization.

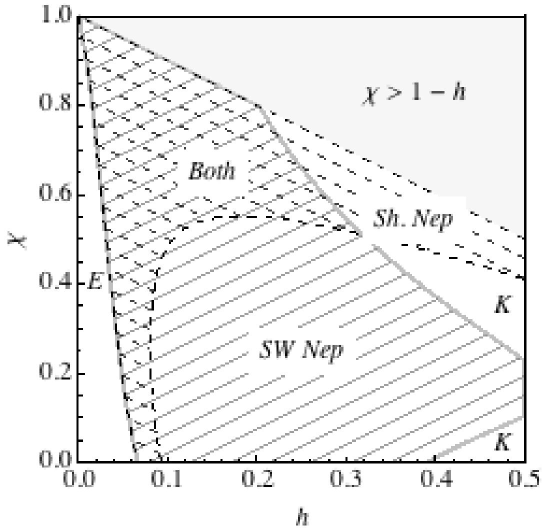


Figure 3: *Nepotism in the agency setting.* In the figure, the degree of kinship, h, is plotted on the horizontal axis and the normalized level of kinship, $\chi = c/\bar{x}$ on the vertical axis. Output conditioned on an uptick, $\bar{x}$ equals 1 under the family manager, K and 1.1 under the external manager, E. In the regions labeled K (E) social welfare, the family owner's utility, and shareholder value are all maximized by selecting the family (external) manager. In the region labeled "SW Nep." share value and owner utility are maximized if the family manager is selected but social welfare would be higher if the external manager were selected. In the region labeled "Sh. Nep." social welfare and owner utility are maximized if the family manager is selected but share value would be higher if the external manager were selected. In the region labeled "Both", family owner utility is maximized by selecting the family manager but both share value and social welfare would be higher if the external manager were selected.

5 When the frontier is closed: The labor market model

The labor market model is meant to reflect the case where the agency frontier is closed. That is, the participation constraint determines managerial compensation and the uptick probability selected by the firm does not vary with kinship. In order to maximize the transparency of the logic underlying the results, we choose the simplest possible parameterization of the model that satisfies these conditions: the upper bound on the uptick probability, $\bar{p}$, is less than 1, effort is costless, and the manager's reservation value is positive. As in the agency setting, we initially assume that the family manager is the only candidate for managing the firm. Later, we consider the effect of external candidate managers. The specific parametric assumptions we impose are as follows:

$$\mathscr{E}(p) = 0, \tag{31}$$

$$v_R > 0, \tag{32}$$

$$\bar{p} < 1 \tag{33}$$

$$(1-h)\bar{x}\bar{p} > c, \tag{34}$$

$$\bar{x}\bar{p} - v_R > c. \tag{35}$$

This rather stark specification of the labor market setting is not the only scenario that will produce our results. For example, it is easy to augment the specification with a fixed cost for effort for all positive levels of the uptick probability. In this scenario, again, the uptick probability selected by the firm will equal $\bar{p}$ regardless of kinship. It is also possible to add a quadratic cost of effort, of the sort used in Section 4, provided that the effort cost parameter k is sufficiently small to ensure that the upper bound, $\bar{p}$, is the optimal uptick probability for the firm regardless of kinship. In both of these cases, effort costs to the manager for producing $p = \bar{p}$ would factor into the manager's participation constraint in the same way as increasing the manager's reservation value by a like amount. However, these elaborations do not add new insight and force us to tract two variables—reservation value and fixed effort cost—which end up being perfect substitutes. Thus, our parameterization is simpler and more economical than these alternatives. The key to the results in this section is that the model parameterization satisfies the condition that, in response to an increase in kinship, the owner will not alter the terms of compensation in a way that increases family value.

In the labor market setting, the uptick probability is fixed. Thus, kinship affects value only through its effect on compensation. This makes the analysis considerably more tractable. In the agency setting, we were only able to analytically characterize the directional effect of marginal increases in kinship on the endogenous variables, (e.g., family value, owner value). In the labor market analysis, we will be able to also characterize the overall "shape" of the functional relation between kinship and these variables.

5.1 Compensation

No output can be produced without managerial effort. Thus, the owner will always offer sufficient compensation to ensure effort and retain the manager. Since effort is costless in this specification, the manager, if he accepts employment, will always exert sufficient effort to produce $p = \bar{p}$. If the manager accepts employment, the cash flow to the manager equals either $\bar{x}$ or 0. If the cash flow equals $\bar{x}$, the manager's utility is as given in monitoring/reporting subgame defined in Section 3.3. Since both underreporting and not underreporting are best replies in the subgame, we can use the manager's utility when the manager does not underreport to compute manager utility in this case. If the realized cash flow is 0, the manager's payoff is 0 and the owner's payoff equals the losses from monitoring the manager's 0 cash flow report, given by $-m^* c$. Thus, the manager's utility is

$$u_M^L(w) = \bar{p}\,(w + h\,(\bar{x} - w)) - (1 - \bar{p})h\,m^*(w)\,c. \tag{36}$$

The owner's utility is determined in like fashion. If the manager reports $\bar{x}$, which occurs with probability $(1 - \sigma^*)\,\bar{p}$, the owner's utility is $\bar{x} - (1 - h)\,w$. If the manager report's 0, the owner's utility is given by the mixed strategy equilibrium in the monitoring/reporting subgame. Since both monitoring and not monitoring are best replies in the subgame, we can use the owner's utility when the owner does not monitor to compute owner utility in this case. The utility of the owner after a report of 0 given that the owner does not monitor is given by $h\rho^*\bar{x}$. The probability of a zero report is $1 - (1 - \sigma^*)\,\bar{p}$. Thus, the owner's utility is given by

$$(1 - (1 - \sigma^*)\,\bar{p})(h\rho^*\bar{x}) + ((1 - \sigma^*)\,\bar{p})(\bar{x} - (1 - h)\,w).$$

Using equation (3.2) we can simplify this expression to

$$u_O^L(w) = \bar{p}\,((1 - \sigma^*)(\bar{x} - (1 - h)\,w) + \sigma^*\,h\bar{x})\,. \tag{37}$$

From (13), (37), and (34) it is clear that, despite kinship, the owner's utility is decreasing in the level of managerial compensation. For this reason the owner will never set compensation higher than the level required to satisfy the problem's constraints. One constraint is the participation constraint: if the manager does not work for the firm, he earns v_R and the owner's payoff is 0. Thus, the minimum managerial compensation that satisfies the participation constraint is determined by the equation

$$u_M^L(w) = v_R.$$

Solving this equation for compensation, w, yields the minimal compensation to the manager required to ensure that the participation constraint is satisfied:

$$\frac{v_R}{\bar{p}} - \frac{h((\bar{p}\bar{x} - v_R)((1-h)(\bar{p}\bar{x} - c) + c\bar{p}))}{(1-h)\bar{p}(ch + (1-h)\bar{p}\bar{x})}. \tag{38}$$

There is one other constraint on compensation, limited liability, which requires a non-negative payment to the manager. Thus, in order to obtain the equilibrium level of compensation we need only impose the limited liability condition. Hence, when the participation constraint can be satisfied at a positive level of compensation, the participation constraint binds; otherwise the manager's compensation is 0. Hence, compensation in the labor market setting is given by

$$w_M^{L*} = \max\left[\frac{v_R}{\bar{p}} - \frac{h((\bar{p}\bar{x} - v_R)((1-h)(\bar{p}\bar{x} - c) + c\bar{p}))}{(1-h)\bar{p}(ch + (1-h)\bar{p}\bar{x})}, 0\right]. \tag{39}$$

Our first result is that, as long as the participation constraint binds, i.e., compensation is positive, increasing kinship reduces the equilibrium compensation level, w_M^{L*}. This result is recorded below.

Proposition 10. *In the labor market setting, compensation, w_M^{L*}, is weakly decreasing in kinship, h and, whenever $w_M^{L*} > 0$, w_M^{L*} is a smooth strictly decreasing convex function of h.*
Proof: See the Appendix.

The negative effect of kinship on compensation results from a "loyalty hold-up." Because the management skills required by the project are family specific, if the manager refuses to work for the family firm, project cash flows are lost, which harms the family as a whole. The manager internalizes the family's losses and thus will be reticent to reject low salary offers from the owner. In the presence of kin altruism, the indispensability of the manager weakens rather than strengthens the managers ability to extract value from the firm.

5.2 Efficiency

In Section 3.3 we showed that the probability of monitoring increases with kinship at fixed compensation. In Section 5.1 we showed that increased kinship leads to lower compensation. Reductions in compensation, absent diversion by the manager, increase the size of the owner's residual claim, $\bar{x} - w$. The gain from diversion relative to non-diversion is exactly this residual share. Thus, lowered compensation makes underreporting more attractive at any fixed monitoring policy. Hence, reductions in compensation require increases in monitoring to deter underreporting. Combining these two observations makes the logic behind the following proposition apparent.

Proposition 11. *In the labor market setting,*

(a) $w_M^{L*} > 0$*, the probability that the owner will monitor the manager's report of a zero cash flow,* m^**,is strictly increasing in kinship.*

(b) The probability of monitoring and monitoring expense are increasing in kinship.

(c) Family value is decreasing in kinship.

Proof: See the Appendix.

Note that both when the payment to the manager is fixed, the case considered in section 3.3, and in this section, where the payment is negotiated, kinship increases the unconditional probability of monitoring. However, in the fixed payment case, the probability of monitoring conditioned on a report of zero falls as kinship increases. However, when compensation is fixed by the participation constraint, the loyalty hold up ensures that even the conditional probability of monitoring increases with kinship. Thus, although kinship increases the probability of monitoring even when compensation is fixed, the probability of monitoring will be much more responsive to increases in kinship when compensation is negotiated and the participation constraint binds. This implies that, in the labor market setting, the adverse effect of kinship on family value is much more pronounced than in the fixed compensation case.

5.3 Value of the owner and manager

The effect of kinship on owner and manager value depends not only on kinship's effect on efficiency but also on its effect on the distribution of value between the manager and the owner. Because of these distributional effects, increasing kinship may increase owner value even when it lowers family value.

5.3.1 Owner value

Equations (39), (13), and (37), determine the owner's value, v_O^{L*}, which is given by

$$v_O^{L*} = \bar{p}\,(m^*\,\bar{x}\,\sigma^* + (1-\sigma)\,(\bar{x} - w_M^{L*})) - c\,m^*(1 - \bar{p}\,(1-\sigma^*)). \tag{40}$$

where σ^* is defined by (13) and w_M^{L*} by (39).

From Propositions 10 and 11, we see that increasing kinship will (i) lower compensation, (ii) increase underreporting, and (iii) increase monitoring expense. Effect (i) increases firm value while effects (ii) and (iii) lower firm value. For this reason, the relation between firm value and kinship is, in general, neither monotone nor concave. However, the relation between kinship and value is strictly quasiconcave. Hence, the relation is always unimodal. Whether the value-maximizing level of kinship is interior depends on the degree of uncertainty regarding firm cash flows and the costs of monitoring relative to the total expected operating cash flows. These observations are formalized in Proposition 12.

Proposition 12. *In the labor market setting,*

i. firm value is a strictly quasiconcave function of kinship, h, and thus is minimized at extreme values of kinship.

ii. If

$$\bar{p}\bar{x} > (1+\frac{1}{\sqrt{2}})\,c \approx 1.71\,c,$$

then for h sufficiently small, firm value is increasing in kinship.

Proof: See the Appendix.

Proposition 12 shows that unless the cost of monitoring c is very high relative to the expected cash flow, $\bar{p}\,\bar{x}$, owner value is increased by some degree of kinship with the manager. This result is not surprising the light of Proposition 1 which shows that the adverse monitoring effect of kinship is relatively small at low kinship levels. Thus, in this case, the loyalty hold-up effect dominates. The fact that some degree of kinship increases owner value does not preclude higher levels of kinship from reducing owner value. In fact, as quasiconcavity suggests, owner value is typically maximized at an interior kinship level.

5.3.2 The manager's value

Because, in the labor market setting, there are no effort costs, the manager's value is just the expected cash flow received by the manager. It is given by

$$v_M^{L*} = \bar{p}\,((1-m^*)\,\sigma^*\,\bar{x} + (1-\sigma^*)\,w_M^{L*}). \tag{41}$$

The effect of kinship on the manager's value function is somewhat subtle. Recall, that the reservation constraint is always binding at the equilibrium compensation contract if the limited liability constraint is satisfied. However, this condition only ensures that the manager's utility from accepting employment is constant not that the value of accepting employment is constant. Utility incorporates indirect internalized family gains and direct value gains. Introducing kinship altruism generates internalization gains for the manager and thus, keeping utility fixed requires a reduction in the value of compensation. However, increasing kinship from a sufficiently high starting point can actually increase the manager's value. This perhaps counter intuitive effect results because an increase in kinship increases monitoring expense and thus lowers family value. Thus, at higher kinship levels, the manager has less family gain to internalize. Hence, to keep the manager's utility constant, the manager's direct gains must increase.

Proposition 13. *The the labor market setting, the manager's value is strictly quasiconvex in kinship, h and thus manager value is maximized at extreme values of kinship.*
Proof: See the Appendix.

5.4 External candidate managers in the labor market setting.

In the labor market setting, the agency frontier is closed: The family firm cannot use internalized gains to improve effort incentives and increase output. The only frontier on which kin altruism can operate is the manager's participation frontier, which is fixed by the value of the manager's outside options. In this setting, the family owner uses a loyalty holdup to exploit the family manager's willingness to accept lower compensation because of kinship. The loyalty holdup reduces family value but may increase firm, i.e., owner, value. The holdup works because the human capital required to manage the firm is family specific. As human capital becomes less specific, and thus alternative candidate managers become available, the force of the loyalty holdup diminishes and the manager's reservation compensation demands increase. In general, determining the equilibrium compensation for the family manager when rival candidate managers exist is fairly complex because compensation of the family manager affects the difference in firm value under the family and external manager while, at the same time, this difference in value affects compensation. In the interests of brevity, we do not consider the entire feasible range of human capital specificity but rather simply contrast family-specific human capital with completely general human capital. That is, we assume that a "clone" candidate external manager exists who provides exactly the same production technology, is monitored at the same cost, c, and has the same reservation compensation value, v_R as the family manager. As in the agency model analysis of the hiring decision, we superscript value and utility variables with K when the owner hires the family (kin) manager and with E when the external manager is hired. We assume that the family owner first approaches the family manager and makes a take-it-or-leave-it compensation offer; if the offer is rejected, the family manager works outside the firm receiving a value of $v_R > 0$ and the family owner hires the external clone. If the owner's offer is accepted, the family manager works for the family firm. Value and utility are determined by the results in Section 5, with h set to 0 in the case where the family owner hires the clone external manager. Our basic result is that when human capital is general, family owners not only are not nepotistic, they will actually always prefer hiring an external manager of equal competence to hiring the family manager.

Proposition 14. *In the labor market setting, when human capital is completely general, family*

owners follow anti-nepotistic hiring policies, i.e., a family owner will strictly prefer to hire a clone external manager rather than a family member.
Proof: See the Appendix.

The intuition behind this result is that, when a clone external candidate exists, rejecting the family owner's offer will not impose costs on the family as a whole. Thus, the family manager does not internalize a loss in family value from rejecting the family owner's employment offer. For this reason, the loyalty holdup has no force and the family manager's compensation demands are the same as those of the clone. Given the same level of compensation, as shown in Section 3, monitoring expense is greater under family ownership. Because increased monitoring expense is not offset by reduced compensation, the owner prefers to hire outside the family.

6 Extensions

6.1 Founders vs. Descendants

In this section, we show that kin altruism both rationalizes the creation of descendant firms through bequest and predicts the direction of divergence between founder and descendant preferences over the policies followed by the descendant firm. The ability of founders to shape the policy followed by the firm after ownership as passed to descendants will be constrained by legal environment in which the firm operates and analyzing these constraints is beyond the scope of this paper. However, simply understanding founder preferences will generate determinant predictions concerning the differences between founder and descendant hiring and compensation policies.

Consider the preferences of a firm founder at date -1, the last date before control passes to descendants. Suppose, that founder knows she will die between date -1 and date 0. Thus, the founder derives no direct payoff from the descendant firm. The founder's preferences will be determined by kin altruism. The founder has two descendants: S and N. We represent the kinship between the founder and S with h_S, the kinship between the founder and N by h_N, and the kinship between N and S by h_{NS}. We assume that

$$0 \le h_N < h_S \le 1/2 \text{ and } 0 \le h_{NS} \le 1/2.$$

Expression (6.1) implies that the kinship between the founder and S is greater than the kinship between the founder and N. We assume that S is incapable of managing the firm but N is capable of managing the firm. The value under N given an uptick is $\bar{x} = \bar{x}^N$. Assume, without loss of generality, that $\bar{x}^N = 1$. Consider the founder's preferences over the value received by N and S subsequent to her demise. The founder's utility is the relationship-weighted sum of N's and S's values, i.e., the utility of the founder is given by $u_F = h_S v_S + h_N v_N$, where v_S, and v_N represent value to N and S. Next, note that the founder's utility function is only unique up to increasing affine transformations. Thus, dividing by h_S, we can and will express the founder's utility in the following equivalent form:

$$u_F = v_S + h_F v_N, \quad h_F = h_N / h_S.$$

As in the baseline model, the descendants' preferences are given by the kin altruism utility function. Thus, S's preferences are given by $u_S = v_S + h_{NS} v_N$, and N's preferences are given by $u_N = v_N + h_{NS} v_S$. For example (assuming no inbreeding) if S is the son of the founder and N is the founder's nephew, then $h_S = 1/2$, $h_N = 1/4$, $h_{NS} = 1/8$, $h_F = 1/2$.

Ax expression (5) shows, family members' decisions trade off family welfare against selfish gain. For the founder, $h_F = h_N/h_S$ represents the degree to which her preferences are aligned with family value as opposed to the value received by S while h_{NS} represents the degree to which N and S weigh family value relative to their selfish value. If $h_F > h_{NS}$, then we will term the founder's preferences *benevolent*.

If founder preferences are benevolent, her preferences tilt more toward family value as opposed to the value received by particular family members. Are founders benevolent? A model of altruism based on social connectedness or friendship would provide little guidance in answering this question. However, the logic of kinship-based altruism provides us with a fairly definitive answer—typical family structures imply founder benevolence.

Proposition 15. *The following conditions are sufficient for founder benevolence:*

i. *The founder is not inbred, S is the son of the founder, N is not a descendant of S, and the coefficient of relation between the founder's spouse and N, represented by h'_N, is less than three times the coefficient or relation between the founder and N, h_N.*

ii. *The founder is not inbred, N is not a direct descendant of either the founder or founder's spouse but is related to the founder, and the family tree is unilateral, i.e., all indirect lines of descent between collateral relatives pass through only one of the relatives' parents. In this case, the founder's benevolence exceeds S's by a considerable margin, i.e., $h_F \geq 4\, h_{NS}$.*

Proof: See the Appendix.

The logic behind Proposition 15 is transparent given the mathematics of kinship relations. If S and N are collateral relatives, and the family tree is not too bushy, either because of consanguineous or affinity marriages, the primary path connecting collateral relatives runs through the founder. Thus, the primary path connecting the founder to S and N is shorter than the path connecting S and N to each other. Because relatedness declines geometrically with the number of arcs connecting relatives, collateral relatives are less closely related to each other than each is related to the founder. Given the weak restrictions on family pedigree required to support founder benevolence, we will focus on this case in the subsequent analysis.

The most direct consequence of founder benevolence is that the founder, if restricted to a simple bequest of the entire firm to one of the descendants, may prefer to bequest the firm to the more distant relation, N. To see this, consider the case where no rival candidate manager to N exists. The founder's utility from bequeathing the firm to N is the same as the utility the founder would have if the founder were the owner of the firm and the founder hired N to manage the firm but set N's compensation equal to the entire cash flow, $\bar{x}$. In both the agency and labor market models, we have shown that if $(1-h)\bar{x} < c$, the owner's preferred policy is to hand ownership to the manager. Thus, if $(1-h_F)\bar{x} < c$, the founder's utility from bequest to N will exceed the founder's payoff from any other compensation policy. If the founder bequests the firm to S, then the founder's payoff is $u_F = v_S + h_F\, v_N$. Because h_{NS} satisfies the restriction that $(1-h_{NS})\bar{x} > c$, S will never offer compensation equal to the entire cash flow to the manager. Benevolence implies that $h_F > h_{NS}$, and in the simplest case of unilateral family trees it is greater by a considerable margin. Thus, it is quite possible for $(1-h_F)\bar{x} < c$ even when $(1-h_{NS})\bar{x} > c$. In which case, the founder will prefer a simple bequest of the firm to N to a simple bequest to S. In essence, the simple bequest to N increases efficiency by eliminating the agency conflict and thus increases family value at the cost of value to S. The benevolent founder is more willing to accept reductions in S's payoff that increase family value than S.

In contrast if h_F is sufficiently close to 0, the founder will never bequest the firm to the more distant relative, N. In this case, absent a viable external candidate manager, ownership and management will be separated, with N managing a firm owned by S. This is the case considered in the baseline model. In the presence of rival candidate managers of sufficient quality so that both N and S would hire one of these candidates, bequests to distant relatives will also not occur. In this case, N and S would set the same compensation policy for the external candidate manager and both, if bequeathed the firm, would receive the owner's value. Because value is the same under both N and S, the founder would prefer that her closer relative receive this value.

If the founder bequests the firm to N, then N will either manage that firm or hire an external manager. In either case, N's decisions will not affect the value received by S. N will be the only family member involved in the firm and N's actual policy choices will align completely with the preferences of the founder. The situation is more complex if the founder bequests the firm to S. In this case, because N is a potential manager of the family firm, the compensation and manager selection policies adopted by S affect both N's and S's value. Thus, because of founder benevolence, it is conceivable that the preferences of the descendant owner S will not coincide with the preferences of the founder. The next proposition shows that, in fact, in the labor market setting, founder preferences over the compensation of non-managing relatives are generally aligned with heir preferences. In contrast, their preferences are never aligned in the agency setting.

Proposition 16. *If the founder bequests the firm the closer relative, S then*

i. In the agency setting, when the founder's preferences are benevolent,

   a. If the more distant relation, N, is hired to manage the firm, the compensation offered by the founder's closer relative, S, to N will always be less than the compensation level preferred by the founder and the founder's preference for hiring the kin manager N as opposed to an external manager will always be stronger.

ii. In the labor market setting, provided the manager's compensation is positive, the compensation policy and hiring policy of the descendant owner will coincide with the founder's preferred actions.

Proof: See the Appendix.

The logic behind this result is that, in the agency setting, increasing the compensation of the related manager increases output and lowers monitoring expense and thus increases family value. Because the founder weighs family value more than S, she will prefer more generous compensation for N. Similarly, because the founder internalizes more of N's agency rents, the founder will have a stronger preference for hiring N than the descendant owner, S. In the labor market setting, where labor market value rather than the pay/performance tradeoff determines compensation, both the owner and founder prefer to put the distant relative, N, on his reservation utility level. They will be able to do this so long as they are not blocked by the limited-liability constraint. If N accepts employment elsewhere, N will also capture his reservation utility. As equation 4 shows, between alternatives that leave N's reservation utility fixed, both S and N will prefer the alternative that maximizes family value. Thus, their preferences are aligned.

From the above discussion it is clear that, in the labor market setting, simple bequests either to the closer or more distant relative, go a long way to implementing founder preferences for descendant firm policies. However, in the agency setting, when the firm is bequeathed to the closer relation S, the founder's preferences over descendant firm policies will not always coincide with the policies that S will actually adopt. In this case, kin altruism predicts that the founder has an incentive to design more complex mechanisms aimed at entrenching and increasing the compensation of managing relatives. A number of mechanisms might be employed to achieve this goal, e.g., bequests of non-controlling stakes, long-term employment contracts, severance payments, and executive pensions.

6.2 *Outside ownership, monitoring and the cost of capital*

The baseline model assumed that the firm is entirely family owned. The advantage of this modeling approach is that it permits us to abstract from agency conflicts generated simply by minority share ownership. Such agency conflicts are important but they are not per se caused by family ownership. In this section, we extend the baseline model to consider the effect of passive external capital on family firm dynamics. Our approach is to consider the marginal effect of introducing external capital into the family firm. We focus on two issues: the marginal effect of external capital on the monitoring reporting problem and the marginal cost of outside capital.

Specifically, we assume that outside shareholders own a fraction o of the firm's equity and consider the marginal effect of outside ownership as $o \to 0$.[13] Because only reported cash flows are verifiable, the outside owners' claim is written on reported cash flows in excess of compensation. Thus, if reported cash flow equal $\bar{x}$, outside shareholders will receive $o\,(\bar{x}-w)$, the family owner receives $(1-o)\,(x-w)$, and the family manager receives w. When reported cash flow equals 0, outside shareholders receive 0 and the payoffs to the family owner and manager are the same as in the baseline model. That is, if the owner does not monitor the owner receives 0 and the manager captures the cash flow (which can equal either 0 or $\bar{x}$). If the owner monitors, the owner incurs the monitoring cost c and captures the cash flow.

First, consider the effect of marginal outside capital on the monitoring and reporting problem. Note that monitoring only occurs when reported cash flows equal 0 and, when reported cash flows equal 0, all cash flows are received by family members. Thus, conditioned on a report of 0, the value received by family members is unaffected by the introduction of outside shareholdings. Because owners monitor only in response to a report of 0, and because the equilibrium probability of underreporting is fixed to make monitoring by the owner a best response, the equilibrium probability of underreporting, σ^* is not affected by outside capital. The tradeoffs governing the monitoring probability are different. The monitoring probability is set to deter managerial underreporting. The utility gain from underreporting is affected by outside ownership. When the cash flow equals $\bar{x}$ and the manager truthfully reports, the manager's utility equals $w+h(1-o)(\bar{x}-w)$, where the second term reflects internaliza-

[13]Because we will only evaluate marginal injections of outside capital, we do not need to reformulate our parametric conditions and restrictions to accommodate this extension.

tion of the cash flow accruing to the family owner. If the manager underreports his utility is $(1-m)\bar{x}+m0+h(m(\bar{x}-c)+0(1-m))$, where the second term represents the manager's internalization of the effect of underreporting on the owner. Solving for the monitoring probability that equates the manager's utility from underreporting with his utility from truthful reporting yields the equilibrium probability of monitoring zero reports in the presence of outside ownership, m^{o*}, given by

$$m^{o*} = \frac{(1-h(1-o))(\bar{x}-w)}{ch+(1-h)\bar{x}}.$$

From inspection it is clear that

$$\frac{\partial m^{o*}}{\partial o} > 0 \text{ and } \frac{\partial^2 m^{o*}}{\partial o \partial h} > 0.$$

Because the probability of underreporting, σ^*, is not affected by outside ownership and the probability of monitoring underreports increases with outside ownership at a rate that is increasing in kinship we have established the following result.

Lemma 2. *For any fixed uptick probability, p and compensation level, w, increasing outside ownership increases monitoring expense and the rate of increase is increasing in kinship, h.*

This result is not too surprising. Within the family firm, the gains to the owner from reported income are partially internalized by the manager and this effect deters underreporting. Outside ownership transfers some of these gains to outside shareholders thus increasing diversion incentives. To counter this effect, the intensity of monitoring must increase, thereby increasing monitoring expense.

What happens when we endogenize compensation? In the labor market setting, the results are particularly simple and striking. Thus, we will first consider this setting. In order to focus on the interesting case, we assume that the limited liability constraint is not binding, i.e., the manager's compensation is positive. If we follow the same approach to determining the compensation as used in the labor market analysis in Section 5, but replace m^* with m^{o*}, and, in the family-owner value function, account for the fact that the family owner receives $(1-o)(x-w)$ of reported cash flows rather than $x-w$, we obtain the compensation for the family manager, which we represent by w^{oL}.

$$w^{oL} = w^{L*} + oh(p\bar{x}-v_R)\frac{(ch+\bar{x}(1-h))}{(1-h)(1-h(1-o))(ch+(1-h)p\bar{x})}, \tag{42}$$

where w^{L*} is the compensation schedule in the labor-market setting (absent outside ownership) provided by equation (39) in Section 5. Our first observation is that the family manager's compensation is always increased by outside ownership. Kinship's effect on the outside capital–

compensation relation is given by the cross-partial derivative of compensation with respect to kinship and outside ownership evaluated at $o = 0$.

$$\left.\frac{\partial^2 w^{oL}}{\partial o \partial h}\right|_{o=0} = \frac{c\,(1+h)+\bar{x}\,(1-h)}{(1-h)^3} > 0.$$

Thus, the rate at which compensation increases with the introduction of outside ownership is increasing in the degree of kinship between the owner and manager. Outside capital reduces the losses to the family from the manager rejecting the owner's compensation offer and thus outside ownership weakens the force of the loyalty hold up. The higher the degree of kinship, the more significant the loyalty hold up and thus the greater the effect of loosening the hold up generated by outside capital. If we insert the equilibrium compensation level into the monitoring probability function m^{o*} we can determine the equilibrium probability of monitoring zero reports in the labor market setting, which we represent by m^{oL}:

$$m^{oL} = \frac{p\,\bar{x} - v_R}{c\,h + (1-h)\,p\,\bar{x}}.$$

As one can see by inspecting (6.2), this function is invariant to the level of outside capital. This result follows because, while the introduction of outside capital increases the monitoring probability for any fixed level of compensation, outside capital also increases compensation sufficiently to exactly counter this effect. In the labor market setting, family value is determined by monitoring expense which in turn is determined by the probability of monitoring. As we have shown, these probabilities are not affected by outside ownership. Therefore, family value is not affected. The introduction of outside capital generates a 1–1 transfer of value from the owner to the related manager. Hence, outside capital increases the value and utility of the family manager and reduces the value and utility of the family owner.

Now consider the marginal cost of capital. We define the marginal cost of capital for the owner as the marginal cost to the owner of selling $do \approx 0$ fraction of the firm to outside passive investors before negotiating compensation with the manager. Assuming perfect competitive and risk neutral capital markets, the price received for shares sold will equal their expected payoff based on outside investors' conjectures regarding the compensation, monitoring, and diversion policies followed by the family owner and family manager. In equilibrium, outsiders' conjectures will be correct. The above analysis shows that this cost will always be positive for family owners and will be zero when the owners and managers are unrelated. Thus, family owners are "allergic" to outside capital in the labor market setting because outside capital reduces their leverage over the family manager.

In the agency setting, computing the marginal cost of capital is more involved because outside ownership affects the owner's willingness to concede agency rents to the manager in exchange for a higher uptick probability, p. Thus, to determine the owner's marginal cost of outside capital, more explicit calculations are required: If the owner sells o fraction of the firm to outside investors, the owner's value will equal the value of the portion of the firm he retains plus the value of shares sold, i.e., the owner's value will equal total firm value, the value of the family owner's claim plus the outsiders' claim. Represent total firm value by V. We assume, as in the labor market discussion, that the owner sells before setting compensation policy and thus, at the time the family owner and manager choose their actions, the proceeds of the sale are fixed and thus do not affect incentives. As in the labor market model, we can solve for the actions chosen by the family manager and owner using the baseline model. We use the agency analysis in Section 4 but replace the monitoring function m^* with m^{o*}, and adjust the family owner value function to account for the fact that the family owner receives $(1-o)(x-w$ of reported cash flows rather than $x-w$. Then, we compute the total firm value given these actions, V^{oA*}, and the manager's value, v_M^{oA*}. The marginal effect of introducing outside capital on the owner is given by

$$\frac{\partial}{\partial o}\left(V^{oA*}+h\,v_M^{oA*}\right)\bigg|_{o=0}.$$

We define the owner's marginal cost of outside capital as the negative of this expression and represent the owner's marginal cost of outside capital with MCC. Preforming the required calculation yields

$$\mathrm{MCC}=-\frac{\partial}{\partial o}\left(V^{oA*}+h\,v_M^{oA*}\right)\bigg|_{o=0}=h\,\frac{(1+h)\,(1-h\,(1-\chi))^2\,(1-h-\chi)}{(1-h)^2\,((1-h)\,(2+h)+h\,\chi)^2} \tag{43}$$

Inspection of (43) shows that the marginal cost of outside capital is positive if and only if the owner and manager are related, i.e., $h>0$. In the agency setting, the kin manager's willingness to exert effort is attenuated by outside ownership because the manager only internalizes the family owner's portion of value. Thus, at a fixed compensation level, output falls with outside ownership. In addition, at fixed compensation, outside ownership increases monitoring expense both by increasing the probability of monitoring zero reports and, by reducing effort, and thus increasing the probability of truthful zero reports. At the same time increased outside ownership, by reducing the family owner share of firm cash flow, increases the fraction of owner gains that result from internalizing payoffs to the kin manager. Thus, the owner's willingness to increase the family manager's compensation also increases with outside ownership. Thus, outside ownership leads to increased managerial compensation and reduced firm value. These effects are anticipated by outsiders buying into the family firm and reflected in the price of shares issued to outsiders. These results on the effect of outside capital are summarized in the following Lemma.

Lemma 3. *The marginal cost to the owner of passive outside capital is always higher for family* *firms.*

7 Discussion and concluding remarks

This paper explored the effects of inclusive fitness on family firms. A number of implications were derived, some consistent with empirically documented regularities and others potentially testable. Of course, the explanatory power of the kin altruism hypothesis for family business behavior can, ultimately, only be determined by empirical research.[14] However, such research is not possible without models that clearly specify the effects of injecting inclusive fitness into standard models of governance and compensation. Modeling is required because, as we have seen, the effects are by no means obvious. The inclusive fitness paradigm does unambiguously predict kinship altruism, However, kinship altruism produces inefficiency, conflict, and exploitation in some environments, and efficiency and cooperation in others.

Since the core prediction of the inclusive fitness paradigm is kin altruism, for the model to deliver determinant predictions about the effect of family ownership, family firms must differ systematically from non-family firms with respect to kin altruism. This raises the question of the extent to which other intra-agent bonds generate or mimic kin altruism. We argue, based on considerable research, that the bonds between family firm agents, with the definition of "family" perhaps somewhat broadened to encompass affinity relationships, induce altruism effects that are unlikely to be stimulated by the bonds between non-family firm agents.

First, consider bonds created by affinity, i.e., bonds arising from marriage into a family. Such bonds are fairly easy to incorporate into the kin altruism paradigm. Affine relations have offspring who are genetically related. Thus, if agents' actions primarily affect the fitness of their descendants, the conditions for kin altruism are satisfied by affinity bonds (see Hughes (1988)). For example, under the Japanese practice of adopting candidate CEOs into the family, which is usually accompanied by marriage of the adopted son to a family member, adopted and blood relations should exhibit kinship altruism.[15] Thus, there are good reasons to conjecture that the kinship altruism model extends to firms owned and managed by affine relations and tests of the model should probably count firms where agents are connected through affinity rather than kinship as family firms.

Next consider the more complex case of friendship bonds. There are two approaches to arguing

[14]The most plausible alternative hypothesis for explaining systemic differences between family and non-family firms is that the differences arise not because of any defining characteristic of family firms but rather because being a family firm is highly correlated with other, non-defining characteristics, e.g., operating in environments with weak governance, facing capital constraints, or being small in scale, which generate the differences. See for example Burkart et al. (2003) or Almeida and Wolfenzon (2006).

[15]See Mehrotra et al. (2013) for an empirical analysis of Japanese adoption practices and corporate governance.

for substitutability between kinship and friendship. The first is to argue that both friendship and kinship bonds are encompassed by the inclusive fitness paradigm. The second is to argue that kinship bond and friendship bonds are produced by different mechanisms but that friendship bonds happen to have essentially the same properties as kinship bonds, i.e., friendship mimics kinship. We consider each argument in turn.

Theoretically, friendship bonds might be the product of inclusive fitness maximization. Generalizations of Hamilton's model show that the necessary and sufficient condition for inclusive-fitness-based altruism between two agents is that the probability of an altruism allele being present in one agent, conditioned on the presence of the allele in the other agent, exceeds the population mean. Hamilton's classic model of inclusive fitness assumes random mating and no inbreeding. Under these assumptions, inclusive-fitness-based altruism can only occur between agents related by descent. However, in general, selection for inclusive-fitness-based altruism only requires a positive correlation between the altruism alleles of the agents. A number of researchers have documented that friends share more genes than non-friends (Fowler et al., 2011). Thus, actual friendships, to the extent that they reflect genetic similarity, should mimic kin altruism. However, whether the degree of genetic similarity between friends is sufficient to have any meaningful effect is seriously disputed (Roberts and Dunbar, 2011). Thus, to the extent that friendship bonds are founded on inclusive fitness, we would expect "friendly" managers and owners to behave altruistically toward each other. However, non-family owners and managers would exhibit much lower levels of altruism.

The question remains as to whether friendship bonds between unrelated agents mimic the effects of kin altruism. Kinship altruism is symmetric between kin, limited by the degree of relatedness, stable over time, and not dependent on reciprocal benefits or continuous social interaction. Whether friendship altruism between close friends has these characteristics is disputed. For example, Korchmaros and Kenny (2001) argues that altruism between close friends mimics kinship altruism while Roberts and Dunbar (2011) presents evidence that friendship bonds and kin bonds are fundamentally different. If intimate friendships mimic kin bonds, then we would expect firms in which shareholders and managers are close, intimate, friends to behave much like family firms.

However, even if friendship bonds to some extent substitute for kinship altruism, the altruism level, h in our model, is likely, on average, to be far greater among related owners and managers. The genetic similarity between friends is far less than between relatives, and even advocates of substitutability between friendship and kinship altruism concede that substitutability is restricted to intimate friendships. Intimate friendships between unrelated owners and managers are likely to be present only in a small subset of non-family firms. Almost all of our results concern the effects of continuous variation in the altruism parameter, h and thus these results do not depend on the altruism coefficient for non-family firms equaling zero, only on the altruism coefficient for family firms, on average, being substantially greater than the altruism coefficient for non-family firms.

In summary, we have developed a model of family firms, based on their defining characteristic—relatedness. Relatedness is modeled using a standard paradigm in the social and biological sciences— inclusive fitness. Based on extant research, we have every reason to believe that inclusive fitness will produce substantial differences between the level of altruism in family and non-family firms, and, as our analysis shows, these level differences have determinate effects on the resolution of standard principal/agent governance problems within firms.

Of course, this paper is only a first step in addressing the role of kin altruism in business relations. The analysis was developed within very simple economic frameworks. Extending the analysis beyond these frameworks would no doubt yield greater insights and more interesting predictions. As well as the obvious technical extensions of the analysis, e.g., enlarging the space of potential cash flow realizations, the most interesting directions for extension are dynamics and scope. Dynamics are interesting at two time scales: the dynamics within a single generation and the dynamics of inter-generational inheritance. Within a single generation, an interesting issue is how kin altruism affects dynamic compensation and retention strategies. Across generations, the question of how founding owners might implement family altruistic policies through bequests is both interesting and rather subtle. With regard to scope, the obvious extension is to expand the analysis of outside capital to consider active capital, e.g., private equity. This paper provides a foundation for such research.

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Appendix: Proofs of selected results

Intended for online publication as a supplement to the manuscript.

Proof of Lemma 1. We start by demonstrating i. Differentiating u_O^A twice with respect to p yields

$$\frac{\partial^2 u_O^A}{\partial^2 p} = -\frac{\bar{x}\left(ch + \left(2 - h - h^2\right)\bar{x}\right)}{(1-h)\bar{x} - c}.$$

The denominator is positive by assumption (12). Because the numerator is positive for all $h < 1$ and thus *a fortiori* for $h < 1/2$, $ch + \left(2 - h - h^2\right)\bar{x} > 0$. Thus, $\partial^2 u_O^A / \partial^2 p < 0$, showing that u_O^A is strictly concave. Next consider ii. We need to show that neither $p = p_{\min}$ nor $p = 1$ are optimal solutions to problem (24). Note that

$$u_O^A(p) = \bar{x}\hat{u}_O(p),$$

where

$$\hat{u}_O(p) = \frac{2p\left(1 + h + \alpha + h\alpha^2\right) - 2\alpha(1 + h\alpha) - p^2(2 + h + h\alpha)}{2(1-\alpha)} \quad \text{and } \alpha = \frac{c}{(1-h)\bar{x}}.$$

$\hat{u}_O$ is simply a scaled version of u_O^A where the cost of monitoring, c, is expressed as a fraction of $(1-h)\bar{x}$. Thus, the sign of derivative $\hat{u}_O$ with respect to p is always the same as the sign of u_O^A. Note also that assumption (12) implies that $\alpha \in [0,1)$. Expressing $p^{w=0}$ in terms of α yields

$$p^{w=0} = \frac{h(1+\alpha)}{1+h\alpha}.$$

We first show that $p^A > p^{w=0}$. We differentiate $\hat{u}_O$ with respect to p and evaluate the derivative at $p = p^{w=0}$. This yields

$$\left.\frac{\partial \hat{u}_O}{\partial p}\right|_{p=p^{w=0}} = \frac{\left(1 - h - h^2\right) + \left(1 - h - h^2\right)\alpha + \left(2h - h^2\right)\alpha^2 + h^2\alpha^3}{(1-\alpha)(1+h\alpha)}.$$

Because $h \in [0, 1/2]$ and $\alpha \in [0,1)$, this expression is always positive. This implies, given result i of this lemma, that $p^A > p^{w=0}$. Now consider, $p = \alpha = c/(x(1-h))$. Evaluating the derivative of $\hat{u}_O$ at α yields $\hat{u}'_O = 1 + h > 0$; thus, again, $p^A > \alpha$. Hence, $p^A > \max[p^{w=0}, \alpha] = p_{\min}$. Finally, consider $p = 1$. Following the same approach as followed for $p = p_{\min}$ shows that

$$\left.\frac{\partial \hat{u}_O}{\partial p}\right|_{p=1} = -(1 + h\alpha) < 0.$$

Thus, $p^A < 1$. Hence, result ii has been established. Finally, result iii follows from i and ii. □

Proof of Proposition 2. The functional form of p^A, given in equation (25) is obtained, after some significant manipulation, from solving the first-order condition of Lemma 1.iii.

To prove i, we simply compute the derivative of p^A with respect to h. Tedious algebraic manipulations of this expression yield

$$\frac{\partial^2 p^A}{\partial h} = \frac{(1-h)+(2-h)\,h\,\alpha+(1+h)\,(1+2h)\,\alpha^2+h^2\,\alpha^3}{(1-h)\,\left((2+h)^2+2h\,(2+h)\,\alpha+h^2\,\alpha^2\right)}, \tag{A-1}$$

where $\alpha = \chi/(1-h)$. Assumption (8) ensures that $\alpha \in [0,1]$. Thus, inspection of the expression (A-1) shows that $\partial p^A/\partial h > 0$.

To prove ii, we compute the cross partial derivative, $\partial^2 p^A/\partial h \partial \chi$. Tedious algebraic manipulations of this expression yield

$$\frac{\partial^2 p^A}{\partial h \partial \chi} = \frac{(1-h)^3\,h\,\left(2+2h-h^2\right)+(1-h)^3\,(2+5h)\,\left(2+2h+h^2\right)\,\alpha+3\,(1-h)^3\,h^2\,(2+h)\,\alpha^2+(1-h)^3\,h^3\,\alpha^3}{(1-h)^5\,(2+h)^3+3\,(1-h)^5\,h\,(2+h)^2\,\alpha+3\,(1-h)^5\,h^2\,(2+h)\,\alpha^2+(1-h)^5\,h^3\,\alpha^3}, \tag{A-2}$$

where $\alpha = \chi/(1-h)$. Assumption (8) ensures that $\alpha \in [0,1]$. Thus, inspection of this expression for the cross partial, (A-2), shows that $\partial^2 p^A/\partial h \partial \chi > 0$.

Next consider iii. Note that the manager's utility along the equilibrium compensation schedule w_M^A is given by

$$u_M^A(p, w_M^A(p)) = \frac{(1-h)p^2 - 2\,h\,\chi\,(1-p)}{2\,(1-h)}.$$

Thus, the sign of $u_M^A(p, w_M^A(p))$ is determined by

$$\mathrm{SS}(p) = \frac{p^2}{1-p} - \frac{2\chi h}{1-h}.$$

$\mathrm{SS}(p)$ is increasing in p and from equation (25) we see that $p^A > (1+\delta)/2$. Thus,

$$\mathrm{SS}(p^A(h,\chi)) > \mathrm{SS}((1+\delta)/2) = \frac{(1+\chi)^2}{2(1-\chi)} - 2\,\chi\,\frac{h}{1-h}. \tag{A-3}$$

By assumption (2), $h < 1/2$. Thus, $h/(1-h) < 1$. Thus,

$$\mathrm{SS}((1+\delta)/2) > \frac{(1+\chi)^2}{2(1-\chi)} - 2\,\chi > 0, \quad \chi \in [0,1]. \tag{A-4}$$

Expressions (A-3) and (A-4) yield the result that $\mathrm{SS}(p^A(h,\chi)) > 0$. Because, *SS* determines the sign of $u^A_M(p, w^A_M(p))$, $u^A_M(p, w^A_M(p)) > 0$ and iii is established. □

Proof of Proposition 3. Define σ^A as the probability of underreporting given uptick probability p, kinship h and normalized cost of monitoring χ. Equation (13) provides the probability underreporting, σ^A, given p. Thus, σ^A is given by rewriting equation (13) in terms of χ. This yields,

$$\sigma^A(p,h,\chi) = \frac{(1-p)\chi}{p(1-h-\chi)}. \tag{A-5}$$

If we substitute in the equilibrium probability of monitoring given by equation (25) and differentiate with respect to h, we obtain

$$\frac{\partial}{\partial h}\sigma^A(p^A(h,\chi),h,\chi) = \frac{\chi\left(2h(1-h)^2 + \left(1+h+2h^2\right)\chi(1-h)\right)}{\left(1-h-h^2+h^3+\chi-h\chi+h\chi^2\right)^2}.$$

Inspection shows that this expression is always positive. □

Proof of Proposition 4. Define

$$\hat{w}^A(p,h,\chi) = \frac{p(1-h(1-\chi)) - h(1-h+\chi)}{(1-h)^2} \tag{A-6}$$

$$w^A(p,h,\chi,\bar{x}) = \bar{x}\,\hat{w}^A(p,h,\chi) \tag{A-7}$$

$\hat{w}^A$ represents the equilibrium compensation in the agency setting to the manager, w^A_M defined in equation (17) expressed in terms of the normalized cost of monitoring, χ when $\bar{x} = 1$. w^A represents the equilibrium compensation expressed in terms of χ for a general choice of $\bar{x}$. Since the sign of the relation between kinship, h, and compensation does not depend on $\bar{x}$ we will analyze the effect of h on $\hat{w}^A$. Substituting p^A into equation (A-6) and differentiating with respect to h yields

$$\frac{\partial}{\partial h}\hat{w}^A(p^A(h,\chi),h,\chi) = \frac{(1-h)(1-h(1-\chi))\frac{\partial}{\partial h}p^A(h,\chi) - (1-h(1-\chi)+\chi)(1-p^A(h,\chi))}{(1-h)^3}.$$

This expression will have the same sign as

$$\frac{\frac{\partial}{\partial h}p^A(h,\chi)}{1-p^A(h,\chi)} - \left(\frac{1-h(1-\chi)+\chi}{(1-h)(1-h(1-\chi))}\right). \tag{A-8}$$

For the sake of signing this expression we compute the negative of the log derivative of $1-p^A$

below:

$$-\frac{\partial}{\partial h}\log\left(1-p^A(h,\chi)\right)=\frac{\partial_h p^A(h,\chi)}{1-p^A(h,\chi)}=$$
$$\frac{\chi}{(1-h)(1-h-\chi)}+\frac{(1-h)^2-\left(1+h^2\right)\chi}{(1-h(1-\chi))\left((1-h^2+\chi(1+h))+(1-h-\chi)\right)}. \quad \text{(A-9)}$$

If we apply equation (A-9), simplify, and then apply the variable transformation, $\chi=\alpha(1-h)$, we obtain the following form of expression (A-8).

$$\frac{2\alpha\left(-1+\alpha+\alpha^2\right)h^2+\left(-2-\alpha+6\alpha^2+\alpha^3\right)h+\left(-1+3\alpha^2\right)}{(1-h)(1-\alpha)(1+h\alpha)(2+h+h\alpha)}.$$

The denominator of this expression is positive so the sign of expression (A-17) is determined by its numerator. We can write the numerator in the following fashion:

$$\begin{aligned}\text{NUM}(h)&=C_2(\alpha)h^2+C_1(\alpha)h+C_0(\alpha),\\ C_2(\alpha)&=2\alpha\left(\alpha^2+\alpha-1\right),\\ C_1(\alpha)&=\alpha^3+6\alpha^2-\alpha-2,\\ C_0(\alpha)&=-3\alpha^2-1.\end{aligned}$$

If $\alpha\le 1/\sqrt{3}$, C_1, C_2, and C_3 are all non positive and one of these terms at least is negative. Thus, if $\alpha<1/\sqrt{3}$, NUM <0. Now suppose that, $\alpha\ge 1/\sqrt{3}$, then C_0 is nonnegative and thus NUM evaluated at 0 is nonnegative. NUM, evaluated at $h=1/2$, equals $1/2(2\alpha+1)\left(\alpha^2+6\alpha-4\right)$. The function $\alpha\hookrightarrow 1/2(2\alpha+1)\left(\alpha^2+6\alpha-4\right)$ is a polynomial that has only one root in the unit interval, $\sqrt{13}-3$, and the function increasing at its root. If $\alpha<\sqrt{13}-3$, then,

$$\text{NUM}(h=0)\ge 0 \text{ and } \text{NUM}(h=1/2)\le 0.$$

$\alpha<\sqrt{13}-3$ implies that $C_1<0$ and $C_2<0$, and hence NUM is decreasing. Hence, if $\alpha<\sqrt{13}-3$ and $\alpha\ge 1/\sqrt{3}$, NUM has a unique root on the interval $[0,1/2]$. If $\alpha>\sqrt{13}-3$,

$$\text{NUM}(h=0)>0 \text{ and } \text{NUM}(h=1/2)>0. \quad \text{(A-10)}$$

In this case, if NUM has any roots in $(0,1/2)$ it would have to have two roots in the interval $(0,1/2)$. For this to be possible, it would have to be the case that NUM is convex, i.e., $C_2>0$. We argue that these condition cannot be satisfied. If NUM had two roots in $(0,1/2)$ it would also have to have minimum in $(0,1/2)$. The minimum of NUM is achieved at $(-C_1)/(2C_2)$. For this minimum to be less than $1/2$ it would have to be the case that $C_2>-C_1$. For NUM to have a root, its discriminant must be positive, i.e., $(-C_1)^2\ge 4C_2C_0$. $C_2>-C_1$ implies that

$(-C_2)^2 \geq 4C_2C_0$ or $C_2 > 4C_0$. However,

$$C_2 - 4C_0 = 2\left(\alpha^3 - 5\alpha^2 - \alpha + 2\right). \tag{A-11}$$

This polynomial is concave, negative, and decreasing in α at $\alpha = \sqrt{13} - 3$. Thus, the polynomial is negative, for all $\alpha > \sqrt{13} - 3$. Thus, no root exists for $\alpha > \sqrt{13} - 3$ thus, by expression (A-10), for $\alpha > \sqrt{13} - 3$, NUM is positive. □

Proof of Proposition 5. If we express the equilibrium probability of monitoring zero reports, m^* given by (13) in terms of χ and replace w with its equilibrium value defined by equation (A-7) we obtain m^A which represents the probability of monitoring zero reports given that compensation is determined by (A-7). This yields

$$m^A(p,h,\chi) = \frac{(1-h)(1-\hat{w}^A(p,h,\chi))}{1-h(1-\chi)} = \frac{1-p}{1-h}. \tag{A-12}$$

The equilibrium level of monitoring is obtained by evaluating this expression at p^A. Thus, the equilibrium probability of monitoring is given by

$$m^{A*} = m^A(p^A(h,\chi),h,\chi) = \frac{1-p^A(h,\chi)}{1-h}.$$

The derivative of this expression with respect to h will have the same sign as

$$\frac{1}{1-h} - \frac{\frac{\partial}{\partial h} p^A(h,\chi)}{1-p^A(h,\chi)}. \tag{A-13}$$

If we apply equation (A-9), simplify, and then apply the variable transformation, $\chi = \alpha(1-h)$, we obtain the following form of expression (A-13).

$$\frac{1-\alpha(2+\alpha)+h\left(2-6\alpha^2\right)-2h^2\alpha\left(-1+\alpha+\alpha^2\right)}{(1-h)(1-\alpha)(1+h\alpha)(2+h+h\alpha)}. \tag{A-14}$$

The denominator of this expression is positive so the sign of expression (A-14) is determined by its numerator. We can write the numerator in the following fashion:

$$\begin{aligned}
\text{NUM}(h) &= C_2(\alpha)\,h^2 + C_1(\alpha)\,h + C_0(\alpha),\\
C_2(\alpha) &= 2\alpha\left(1-\alpha-\alpha^2\right),\\
C_1(\alpha) &= 2\left(1-3\alpha^2\right),\\
C_0(\alpha) &= 1-2\alpha-\alpha^2.
\end{aligned}$$

If $\alpha < \underline{\alpha}_m = \sqrt{2}-1$, then all three coefficients are positive and thus NUM > 0. If $\alpha \geq \underline{\alpha}_m$, then $C_0 \leq 0$. Next note that, when $\alpha \geq \underline{\alpha}_m$, if $C_2 < 0$ then $C_0 < 0$ and $C_1 < 0$. Thus, if $C_2 \leq 0$, then NUM < 0. Thus, NUM can have a real roots only when $\alpha > \underline{\alpha}_m$ and $C_2 > 0$. Over this region NUM is strictly convex and, because $C_0 < 0$, NUM will have one root if NUM$(h = 1/2) \geq 0$. Otherwise, NUM will have no roots and NUM < 0. Because NUM$(h = 1/2) \geq 0$ if and only if $4 - \alpha^3 - 9\alpha^2 - 3\alpha \geq 0$, if a root exists, NUM is positive when h is less than the root and negative when h is greater than the root. The root itself is provided by the quadratic formula used to define equation (iii). □

Proof of Proposition 6. First note that monitoring expense is given by $c\,m\,(1-p\,(1-\sigma))$. Since monitoring expense is proportional to the total monitoring probability $m\,(1-p\,(1-\sigma))$, for fixed c, we will determine the effect of kinship on the probability of monitoring rather than the cost of monitoring. Using equations (A-5) and (A-12), we see that the equilibrium probability of monitoring is given by

$$\begin{aligned}\mathrm{PM}^{A*} = \mathrm{PM}^{A}(p^A(h,\chi),h,\chi) &= m^A(p^A(h,\chi),h,\chi)\,(1-p^A(h,\chi),h,\chi)\,(1-\sigma^A(p^A(h,\chi),h,\chi)))\\ &= \frac{(1-(p^A(h,\chi),h,\chi))^2}{1-h-\chi}.\end{aligned} \tag{A-15}$$

Differentiation with respect to h yields

$$\frac{\partial}{\partial h}\mathrm{PM}(p^A(h,\chi),h,\chi) = \frac{(1-p^A(h,\chi))\left((1-p^A(h,\chi))-2\,(1-h-\chi)\,\frac{\partial}{\partial h}p^A(h,\chi)\right)}{(1-h-\chi)^2}.$$

This expression will have the same sign as

$$\frac{1}{2\,(1-h-\chi)} - \frac{\frac{\partial}{\partial h}p^A(h,\chi)}{1-p^A(h,\chi)}. \tag{A-16}$$

If we apply equation (A-9), simplify, and then apply the variable transformation, $\chi = \alpha\,(1-h)$, we obtain the following form of expression (A-16).

$$\frac{\alpha\,\left(3-3\,\alpha-2\,\alpha^2\right)\,h^2+\left(3-\alpha-6\,\alpha^2\right)\,h-2\,\alpha^2}{(1-h)\,\left(4\,(1-\alpha)+2\,h^2\,(1-\alpha)\,\alpha\,(1+\alpha)+2\,h\,(1-\alpha)\,(1+3\,\alpha)\right)}. \tag{A-17}$$

The denominator of this expression is positive so the sign of expression (A-17) is determined by its numerator. We can write the numerator in the following fashion:

$$\begin{aligned}\mathrm{NUM}(h) &= C_2(\alpha)h^2 + C_1(\alpha)h + C_0(\alpha),\\ C_2(\alpha) &= \alpha\left(3-3\alpha-2\alpha^2\right),\\ C_1(\alpha) &= 3-\alpha-6\alpha^2,\\ C_0(\alpha) &= -2\alpha^2.\end{aligned}$$

We consider the sign of NUM. When $\alpha = 0$, $\mathrm{NUM} = 3h \geq 0$. Now suppose that, $\alpha \in (0,1]$. In this case C_0 is negative, C_2 is a quadratic function of α which is positive between $(0, r_2)$, $r_2 = \frac{1}{4}\left(\sqrt{33}-3\right)$ and non positive otherwise. C_1 is a quadratic function of α which is positive between $(0, r_1)$, $r_1 = \frac{1}{12}\left(\sqrt{73}-1\right)$ and non positive otherwise. $r_2 > r_1$ thus for $\alpha \geq r_2$ both coefficients, C_1 and C_2 are non positive. Because C_0 is negative, it is thus not possible for NUM to have a root when $\alpha \geq r_2$. When $\alpha < r_2$, C_2 is positive and thus NUM is convex. Thus, because $C_0 < 0$, NUM has a root between 0 and 1/2, if and only if, when evaluated at $h = 1/2$, NUM is non-negative. Otherwise NUM as no root. NUM is non-negative when evaluated at $h = 1$ if and only if $\alpha \leq \frac{1}{2}\left(\sqrt{145}-11\right)$. This unique root NUM, used in equation (ii) is provided by the quadratic formula:

$$\mathrm{NUM}(h) = 0 \Leftrightarrow h = \frac{-6\alpha^2 - \alpha - \sqrt{(1-\alpha)^2(2\alpha+1)(2\alpha+3)(3-4\alpha)} + 3}{2\alpha(\alpha(2\alpha+3)-3)}. \tag{A-18}$$

If h is greater than the right hand side of (A-18), NUM is positive. Otherwise it is negative. This is the characterization provided in the proposition and thus completes the proof. □

Proof of Proposition 7. First note that total firm value is given by output, $\bar{x}p$ less expense, $cm(1-p(1-\sigma))$, and less the manager's effort cost, $1/2\bar{x}p^2$. As in Section 2.3 , we can express family value as

$$\bar{x}\left(p - \chi m^A(p,h,\chi)(1-p(1-\sigma^A(p,h,\chi))) - 1/2\,p^2\right).$$

Using the definition of the equilibrium monitoring and diversion strategies provided in equations (13), and substituting out w using equation (18), we can express family value as a function of p, the uptick probability as

$$v^A(p,h,\chi,\bar{x}) = \bar{x}\,\hat{v}^A(p,h,\chi), \quad \hat{v}^A(p,h,\chi) = \tfrac{1}{2}(p + p(1-p)) - \frac{\chi(1-p)^2}{1-h-\chi}.$$

Evaluating this expression at p^A, given by equation (25), yields

$$\frac{\partial}{\partial h}\hat{v}^A(p^A(h,\chi),h,\chi) = \frac{(1-p^A(h,\chi))\left(\left((1-h)^2-\chi^2\right)\frac{\partial}{\partial h}p^A(h,\chi)-\chi(1-p^A(h,\chi))\right)}{(1-h-\chi)^2}.$$

This expression will have the same sign as

$$\frac{\frac{\partial}{\partial h}p^A(h,\chi)}{1-p^A(h,\chi)} - \frac{\chi}{(1-h)^2-\chi^2}. \tag{A-19}$$

If we apply equation (A-9), simplify, and then apply the variable transformation, $\chi = \alpha\,(1-h)$, we obtain the following form of expression (A-19).

$$\frac{\frac{\partial}{\partial h}p^A(h,\chi)}{1-p^A(h,\chi)} - \frac{\chi}{(1-h)^2-\chi^2} = \frac{\text{NUM}}{\text{DENOM}}. \tag{A-20}$$

$$\begin{aligned}
\text{NUM} &= (1-h) - \left(1+h^2\right)\alpha + (1+2h)\alpha^2 + (1+h)\,(1+2h)\alpha^3 + h^2\,\alpha^4,\\
\text{DENOM} &= (1-h)\,(1-\alpha)\,(1+\alpha)\,(1+h\,\alpha)\,(2+h+h\,\alpha),\\
\alpha &= \frac{\chi}{1-h}.
\end{aligned} \tag{A-21}$$

Note that the parameter restriction given by equation (12), implies that $\alpha \in [0,1]$. This implies, combined with our parameter restriction that $h \in [0, 1/2]$, that DENOM is always positive. Thus sign the of NUM/DENOM will depend on the sign of NUM. Evaluated at $\alpha = 0$, NUM $= 1-h > 0$; Evaluated at $\alpha = 1$, NUM $= (1+h) + (1+h)\,(1+2h) > 0$. Thus if NUM were ever negative for $\alpha \in (0,1)$ it would have to have at least two roots in this interval. For a fixed h, NUM is a polynomial in α and, under our assumption that $h \in [0, 1/2]$, has only one sign change. Thus, by Descartes rule of signs, NUM has at most one real root. Thus NUM has no roots and hence NUM > 0. Because DENOM > 0, this implies, by equation (A-20), that $\frac{\partial}{\partial h}\hat{v}(p^A(h,\chi),h,\chi) > 0$ and thus family value is increasing in kinship, h. □

Proof of Proposition 8. We prove part i of the proposition. The derivation of part ii is quite similar and thus is omitted. Owner value is given by

$$\bar{x}\,p - \left(p\,\left(\sigma\,(m0 + (1-m)\bar{x}) + (1-\sigma)\,w\right) + (1-p)\,0\right) - c\,m\,(1-p\,(1-\sigma))$$

Owner value consists of the total expected terminal cash flow, $\bar{x}\,p$, less the manager's payoff (excluding effort costs), and monitoring expense. When the cash flow is $\bar{x}$, the manager's payoff which equals w if the manager does not underreport and the cash flow is $\bar{x}$. If the manager underreports, the manager's payoff is $\bar{x}$ if the owner does not monitor and 0 if the owner monitors. If the cash flow is 0, the manager's payoff is 0. Monitoring expense equals the cost of monitoring multiplied by the probability of monitoring. If the owner monitors a low report, then monitoring will occur unless the cash flow is $\bar{x}$ and the manager does not underreport. Thus, the probability of monitoring is $m(1-p(1-\sigma)$. Using the definitions of σ^A, m^A and w^A provided in (A-12), (A-12), and (A-7), we can express owner value for a given uptick probability p as follows:

$$\begin{aligned} v_O^A(p,h,\chi,\bar{x}) &= \bar{x}\,\hat{v}_O^A(h,\chi) \\ \hat{v}_O^A(p,h,\chi) &= \frac{(1-p)\left((1-h)^2 p - \chi\,(1-h((1-h)+(1-\chi)))\right)}{(1-h)^2\,(1-h-\chi)} \end{aligned} \tag{A-22}$$

Because owner value, v_O^A is a positive scale multiple of normalized owner value, $\hat{v}_O^A$, we will assume without loss of generality that $\bar{x}=1$ and thus owner value equals normalized value. Substituting the definition of p^* from equation (25) into $\hat{v}_O^A$ defined by equation (A-22), and then differentiating with respect to h yields the marginal affect of kinship on owner value:

$$\frac{\partial \hat{v}_O^{A*}}{\partial h} = \frac{\text{NUM}}{\text{DENOM}}, \tag{A-23}$$

$$\begin{aligned} \text{NUM} = &-h^3\,(2h+1)\chi^5 - h^2(h+2)(4h+3)(1-h)\chi^4 - h\left(10h^2+18h+9\right)(1-h)^2\chi^3 + \\ &2h\left(2h^2+3h+3\right)(1-h)^4\chi + 2\left(h^2+h+1\right)(1-h)^5 - \\ &\left(-2h^4-4h^3+2h^2+9h+4\right)(1-h)^3\chi^2, \end{aligned} \tag{A-24}$$

$$\text{DENOM} = (1-h)^4\left(2-h-h^2+h\chi\right)^3. \tag{A-25}$$

The sign of this expression depends only on the numerator, NUM. If we make the substitution and $\chi = \alpha\,(1-h)$ in the numerator and then divide out the common positive factor, $(1-h)^5(1+\alpha h)$, we obtain the polynomial $\mathscr{P}$ which has the same sign as $\partial v_O^{A*}/\partial h$.

$$\begin{aligned} \mathscr{P}(\alpha,h) &= C_0(h) + C_1(h)\,\alpha - C_2(h)\,\alpha^2 - C_3(h)\,\alpha^3 - C_4(h)\,\alpha^4, \\ C_0(h) &= 2\left(1+h+h^2\right), \\ C_1(h) &= 2h\left(2+2h+h^2\right), \\ C_2(h) &= 4+9h+6h^2, \\ C_3(h) &= h\,(1+h)\,(5+4h), \\ C_4(h) &= h^2\,(1+2h). \end{aligned} \tag{A-26}$$

Because, C_2, C_3, and C_4 are positive and $\alpha \geq 0$, $\mathscr{P}$ is strictly concave in α. Evaluated at $\alpha = 0$, $\mathscr{P} > 0$ and evaluated at $\alpha = 1$, $\mathscr{P} < 0$. Thus, there exists a unique $\alpha_0(h)$ such that, $\mathscr{P}(\alpha_0(h),h) = 0$ and, for all for all $\alpha < \alpha_0(h)$, $\mathscr{P}(\alpha,h) > 0$ and for all $\alpha > \alpha_0(h)$, $\mathscr{P}(\alpha,h) <$

0. Next note that the partial derivatives of $\mathscr{P}$ are given by

$$\frac{\partial \mathscr{P}}{\partial h} = 2(1+2h)+2\left(2+4h+3h^2\right)\alpha-3(3+4h)\alpha^2-\left(5+18h+12h^2\right)\alpha^3-2h(1+3h)\alpha^4.$$
$$\frac{\partial \mathscr{P}}{\partial \alpha} = 2h\left(2+2h+h^2\right)-2\left(4+9h+6h^2\right)\alpha-3h(1+h)(5+4h)\alpha^2-4h^2(1+2h)\alpha^3.$$

Like $\mathscr{P}$, both $\partial\mathscr{P}/\partial h$ and $\partial\mathscr{P}/\partial\alpha$ are concave in α, positive at $\alpha=0$, and negative at $\alpha=1$. Because they are concave and cross the x-axis from above, $\partial\mathscr{P}/\partial h$ and $\partial\mathscr{P}/\partial\alpha$ are decreasing whenever they are nonpositive.

Now, let $b=3/5$. Note that, evaluated at b,

$$\mathscr{P}(\alpha=b,h)=\frac{2}{625}(175+h(25+4h(13+6h)))>0.$$

Thus, $\alpha_0(h)$, the root of $\mathscr{P}$, is greater than b, i.e.,

$$\alpha_0(h)\in(b,1). \tag{A-27}$$

Now consider the partial derivative of $\mathscr{P}$ with respect to α evaluated at b,

$$\left.\frac{\partial \mathscr{P}}{\partial \alpha}\right|_{\alpha=b} = -\frac{1}{125}\left(600+1525h+1723h^2+506h^3\right)<0. \tag{A-28}$$

Because $\partial\mathscr{P}/\partial\alpha$ is decreasing in α whenever it is negative, inequality (A-28) implies that

$$\frac{\partial \mathscr{P}}{\partial \alpha}<0, \quad \alpha\in[b,1]. \tag{A-29}$$

Expression (A-27) and inequality (A-29) then imply that

$$\frac{\partial \mathscr{P}}{\partial \alpha}(\alpha_0(h),h)<0. \tag{A-30}$$

Next, we show that it is also the case that

$$\frac{\partial \mathscr{P}}{\partial h}(\alpha_0(h),h)<0. \tag{A-31}$$

The proof of (A-31) is a bit more involved. To establish (A-31), we will show that

$$\frac{\partial \mathscr{P}}{\partial h}<\mathscr{P}(b,h), \quad \alpha\in[b,1]. \tag{A-32}$$

To establish inequality (A-32), first consider the difference between $\partial\mathscr{P}/\partial h$ and $\mathscr{P}$ evaluated at b. This difference is given by

$$\mathscr{P}(b,h) - \frac{\partial \mathscr{P}}{\partial h}(b,h) = \frac{12}{25} - \frac{158h}{625} - \frac{8h^2}{125} + \frac{48h^3}{625} > \frac{211}{625} > 0, \tag{A-33}$$

where the last inequality is obtained by dropping the positive cubic term from the middle equation and maximizing the negative terms by setting $h = 1/2$.

Now, consider the difference between the derivatives of $\partial\mathscr{P}/\partial h$ and $\mathscr{P}$ with respect to α. We claim that

$$\frac{\partial}{\partial \alpha}\frac{\partial \mathscr{P}}{\partial h} < \frac{\partial}{\partial \alpha}\mathscr{P}, \quad \alpha \in [b,1]. \tag{A-34}$$

To see this, note that

$$\frac{\partial}{\partial \alpha}\left(\frac{\partial \mathscr{P}}{\partial h} - \mathscr{P}\right) = 2\left(2+2h+h^2-h^3\right) - 2\left(5+3h-6h^2\right)\alpha - \\ 3\left(5+13h+3h^2-4h^3\right)\alpha^2 - 4h\left(2+5h-2h^2\right)\alpha^3.$$

$\partial/\partial\alpha\Big(\partial\mathscr{P}/\partial h - \mathscr{P}\Big)$ is decreasing in α because the coefficients associated with the positive powers of α are all negative for $h \in [0, 1/2]$. Because $\partial/\partial\alpha\Big(\partial\mathscr{P}/\partial h - \mathscr{P}\Big)$ is decreasing, to show that it is negative for $\alpha \in [b,1]$ we need only show that it is negative when evaluated at b. Evaluating at b yields,

$$\frac{\partial}{\partial \alpha}\left(\frac{\partial \mathscr{P}}{\partial h} - \mathscr{P}\right)(b,h) = -\frac{37}{5} - \frac{1921h}{125} + \frac{41h^2}{25} + \frac{506h^3}{125} \leq -\frac{37}{5} < 0, \tag{A-35}$$

where the last inequality follows because $h \in [0,1/2]$. Inequality (A-35) establishes inequality (A-34) which, together with inequality (A-33), establishes inequality (A-32). Inequality (A-32) and expression (A-27), together with the fact that, by definition, $\mathscr{P}(\alpha_0(h),h) = 0$, imply that

$$0 = \mathscr{P}(\alpha_0(h),h) > \frac{\partial \mathscr{P}}{\partial h}(\alpha_0(h),h),$$

which establishes inequality (A-31).

Inequalities (A-31) and (A-30) imply, via the implicit function theorem, that,

$$\alpha_0'(h) = -\frac{\frac{\partial \mathscr{P}}{\partial h}(\alpha_0(h),h)}{\frac{\partial \mathscr{P}}{\partial \alpha}(\alpha_0(h),h)} < 0.$$

Therefore, α_0 is decreasing in h. Because $\mathscr{P}$ has the same sign as $\partial v_O^{A*}/\partial h$ and $\mathscr{P} < 0$, when $\alpha > \alpha_0(h)$, $\partial v_O^{A*}/\partial h < 0$ when $\alpha > \alpha_0(h)$. Because α_0 is decreasing, a sufficient condition for $\partial v_O^{A*}/\partial h < 0$ is for $\alpha > \alpha_0(0) = 1/\sqrt{2} \approx 0.707$. Similarly, a sufficient condition for $\partial v_O^{A*}/\partial h >$

0 is $\alpha < \alpha_0\,(1/2)$. $\alpha_0\,(1/2)$ is the unique root between 0 and 1 of the polynomial, $-6-10\alpha+19\alpha^2+18\alpha^3+3\alpha^4$ and is approximately equal to 0.624. □

Proof of Proposition 9. The manager's value function, v_M^A, in the agency model, expressed in terms of χ, is given by

$$p\left(\sigma^A(p,h,\chi)\left(m^A(p,h,\chi)0+(1-m^A(p,h,\chi))\,\bar{x}\right)+(1-\sigma^A(p,h,\chi))w^A(p,h,\chi)\right) \\ +(1-p)\,0-\frac{p^2}{2}. \quad \text{(A-36)}$$

Using the definitions of σ^A, m^A and w^A provided in (A-12), (A-12), and (A-7) we can express this the manager's value as for a fixed uptick probability, p, as follows:

$$\begin{aligned} v_M^A &= \bar{x}\,\hat{v}_M^A(p,h,\chi), \text{where} \\ \hat{v}_M^A(p,h,\chi) &= \frac{1}{2}\left(1+(1-p)\left((1-p)\left(\frac{2(1-\chi)}{1-h-\chi}-1\right)-\frac{2(1-h(1-\chi))}{(1-h)^2}\right)\right). \end{aligned} \quad \text{(A-37)}$$

Manager value in the agency setting, v_M^{A*} is then obtained by substituting the equilibrium uptick probability function p^A in equation (A-37), i.e.,

$$v_M^{A*} = \bar{x}\,\hat{v}_M^A(p^A(h,\chi),h,\chi). \quad \text{(A-38)}$$

First note that an inspection of equations (28) and (30) shows that the share-value gain from hiring the external manager exceeds the family owner's gain by $h\,v_M^K$. Thus, it is clear that the family owner's utility gain from hiring external manager is always less than the share-value gain. To prove that the family owner's gain from hiring the external manager exceeds the social welfare gain, we proceed as follows. First note that,

$$\Delta_O^E-\Delta_{\text{SW}}^E = (1-h)\,v_M^K - v_M^E. \quad \text{(A-39)}$$

Thus, if we can show that the right-hand side of equation (A-39) is negative the proof of i will be complete. We establish this result in two steps. From expression (A-37), the value of the external manager, v_M^E, equals $e\,\hat{v}_M^A(p^A(h=0,\chi),h=0,\chi)$. Because for the family manager, $\bar{x}=1$ by assumption, the value of the family manager, v_M^K, is given by $\hat{v}_M^A(p^A(h,\chi),h,\chi)$, where $h>0$. Thus, we can express equation (A-39) as

$$\Delta_O^E-\Delta_{\text{SW}}^E = (1-h)\,\hat{v}_M^A(p^A(h,\chi),h,\chi) - e\,\hat{v}_M^A(p^A(h=0,\chi),h=0,\chi). \quad \text{(A-40)}$$

In fact, we will show that

$$(1-h)\,\hat{v}_M^A(p^A(h,\chi),h,\chi) - \hat{v}_M^A(p^A(h=0,\chi),h=0,\chi) < 0, \tag{A-41}$$

which, because by assumption $e > 0$, and the fact that the external manager's value is always positive, establishes that the right-hand side of equation (A-40) is negative. To establish (A-41), first note that, using the definition of the manager's value given by equation (A-37) and the definition of p^A given by equation (25), we see that

$$\hat{v}_M^A(p^A(h=0,\chi),h=0,\chi) = \frac{1}{8}(1+\chi)^2. \tag{A-42}$$

The expression for $\hat{v}_M^A(p^A(h,\chi),h,\chi)$ where $h > 0$ is considerably more complex but is obtained in the same fashion. Substituting the definition of p^A into the definition of $\hat{v}_M^A$ given in equation (A-37) yields

$$\begin{aligned}
\hat{v}_M^A(p^A(h,\chi),h,\chi) &= \frac{\text{Num}}{\text{Denom}}, \\
\text{Num} &= (1-h)^4\left(1-h-3h^2-h^3\right) + (1-h)^3 2\left(1-h-2h^2-h^3\right)\chi, \\
&\quad + (1-h)^2\left(1+5h-2h^2-2h^3\right)\chi^2 + (1-h)\left(2h+4h^2\right)\chi^3 + h^2(1+h)\chi^4 \\
\text{Denom} &= 2(1-h)^3\left(2-h-h^2+h\chi\right)^2.
\end{aligned} \tag{A-43}$$

Thus expression (A-41) is equivalent to

$$(1-h)\,\text{Num} - \left(\frac{1}{8}(1+\chi)^2\right)\text{Denom} < 0. \tag{A-44}$$

Using equation (A-43), we can express condition (A-44) as a polynomial, $\mathscr{P}$ in χ with coefficients C_i determined by h

$$\begin{aligned}
\mathscr{P}(\chi;C_1(h),\ldots C_4(h)) &= (1-h)\,\text{Num} - \left(\frac{1}{8}(1+\chi)^2\right)\text{Denom} = \\
&C_0(h) + C_1(h)\,\chi^1 = C_2(h)\,\chi^2 + C_3(h)\,\chi^3 + C_4(h)\,\chi^4,
\end{aligned}$$

where

$$
\begin{aligned}
C_0(h) &= -\frac{1}{4}(1-h)^4 h\left(8+13h+4h^2\right),\\
C_1(h) &= -\frac{3}{2}(1-h)^3 h\left(2+2h+h^2\right),\\
C_2(h) &= \frac{1}{4}(1-h)^2 h\left(16-2h-6h^2-h^3\right),\\
C_3(h) &= \frac{1}{2}(1-h)h\left(2+10h+h^2-h^3\right),\\
C_4(h) &= \frac{1}{4}h^2\left(3+6h-h^2\right).
\end{aligned}
\tag{A-45}
$$

Note that for all $h \in [0, 1/2]$, C_2, C_3, and C_4 are positive. Thus, $\mathscr{P}$ is convex and for fixed C thus always attains its maximum at extreme values of χ. Because the range of permissible values of χ is 0 to $1-h$, we see that

$$
\begin{aligned}
&\mathscr{P}(\chi; C_1(h), \ldots C_4(h)) \leq \max[\mathscr{P}(0; C_1(h), \ldots C_4(h)), \mathscr{P}(1-h; C_1(h), \ldots C_4(h))] = \\
&\qquad \max\left[-\frac{1}{4}(1-h)^4 h\left(8+13h+4h^2\right), -(1-h)^4 h^2 (1+h)^2\right] < 0,\ \forall h \in (0,1].
\end{aligned}
$$

Thus, i is established.

To establish ii note that as $\alpha \to 1$, $v^A \to 0$. Thus shareholders always prefer the external manager. As $\alpha \to 1$ the utility of the family owner under the family manager converges to $h/2$ and the utility of the family owner under the external manager converges to $(e/2)(h/2)$. Thus if $e < 2$ the family owner prefers hiring the family manager, i.e., the hiring decision is share value nepotistic. The proof of iii is provided through a numerical example furnished by Figure 3. □

Proof of proposition 12. First consider part i of the proposition. Let $\bar{h}$ be defined as follows:

$$
\bar{h} = \max\{h \in [0, 1 - c/(\bar{p}\bar{x})] : w^*_M(h) \geq 0\}. \tag{A-46}
$$

After considerable algebraic simplification, we can express the value of the family firm as a function of h, restricted to the domain $[0, \bar{h}]$ as follows:

$$
\begin{aligned}
v^{L*}_O(h) &= (\bar{p}\bar{x} - v_R)\frac{\mathbf{N}(h)}{\mathbf{D}(h)},\\
\mathbf{N}(h) &= \left(\left(c^2 + (1-h)\bar{x}(\bar{p}\bar{x} - c)\right) - \frac{c^2}{1-h}\right),\\
\mathbf{D}(h) &= ((1-h)\bar{x} - c)(hc + (1-h)\bar{p}\bar{x}).
\end{aligned}
$$

The functions, $h \hookrightarrow \mathbf{N}(h)$ and $h \hookrightarrow \mathbf{D}(h)$ are both positive under the assumptions given in (34) and (35). The term $\bar{p}\bar{x} - v_R$ is a positive and constant in h and thus can be ignored in the subsequent derivation. Because the functions **N** and **D** are smooth and positive over their domain, and the second derivative of **N** is negative while the second derivative of **D** is positive, implies that $\mathbf{N}(\cdot)$ is strictly concave and positive and $\mathbf{D}(\cdot)$ is strictly convex and positive. This implies that the ratio $\mathbf{N}(h)/\mathbf{D}(h)$ is strictly quasiconcave over $[0,\bar{h}]$ (Boyd and Vandenberghe, 2004, Example 3.28). The value function is strictly decreasing over $h \in [\bar{h}, 1/2]$, and is continuous at $\bar{h}$. Thus, the value function is strictly quasiconcave over the entire range of h, $[0,\bar{h}]$.

To establish part ii, note that at $h = 0$ the reservation constraint is always binding. Differentiating v_O^{L*} and evaluating $h = 0$ yields,

$$v_O^{L*\prime}(0) = \frac{(\bar{p}\bar{x} - v_R)\left(-c^3(1-\bar{p}) + c^2\bar{x} - 2c\bar{p}\bar{x}^2 + \bar{p}^2\bar{x}^3\right)}{\bar{p}^2(\bar{x}-c)^2\bar{x}}. \tag{A-47}$$

Note that the denominator of the right-hand side of equation (A-47) is always positive so to sign the relation consider the numerator of (A-47). If we expressing the numerator using the normalized monitoring costs, χ, we obtain

$$\bar{x}^3(\bar{p}\bar{x} - v_R)\chi^2\left(\left(\frac{\bar{p}}{\chi} - 1\right)^2 - (1-\bar{p})\chi\right).$$

This expression has the same sign as

$$\left(\frac{\bar{p}}{\chi} - 1\right)^2 - (1-\bar{p})\chi.$$

Thus, if

$$\frac{\bar{p}}{\chi} > 1 + \frac{1}{2}\sqrt{\chi^4 + 4(1-\chi)\chi} - \frac{\chi^2}{2},$$

then $v_O^{L*\prime}(0) > 0$. Next note that

$$1 + \frac{1}{2}\sqrt{\chi^4 + 4(1-\chi)\chi} - \frac{\chi^2}{2} \leq 1 + \frac{1}{2}\sqrt{1 + 4(1-\chi)\chi}.$$

The maximizer of $1 + 4(1-\chi)\chi$ is $\chi = 1/2$. Replacing χ with its maximizer shows that

$$1 + \frac{1}{2}\sqrt{1 + 4(1-\chi)\chi} \leq 1 + \frac{1}{\sqrt{2}} \approx 1.71.$$

□

Proof of Proposition 13 . The manager's value is the maximum of the manager's value when the limited liability constraint binds, i.e., $w = 0$ and manager's value when the reservation constraint binds. The maximum of strictly quasiconvex functions is strictly quasiconvex. The manager's value is clearly increasing in h on the limited liability constraint. Thus, we only need to show that the manager's value is quasiconvex when compensation is determined by the reservation constraint. To see this, note that, the manager's value when the manager's value is determined by the reservation constraint, which we represent by v^p_M, can be simplified to obtain

$$v^p_M(h) = \bar{p}\bar{x} - (\bar{p}\bar{x} - v_R)\,\mathbf{F}(h), \tag{A-48}$$

$$\mathbf{F}(h) = \frac{\mathbf{N}(h)}{\mathbf{D}(h)}, \tag{A-49}$$

$$\mathbf{N}(h) = \frac{(1-h)^2\,\bar{p}\bar{x}(\bar{x}-c) - c^2 h}{(1-h)\bar{x} - c}, \tag{A-50}$$

$$\mathbf{D}(h) = (1-h)\,(c\,h + (1-h)\,\bar{p}\bar{x}). \tag{A-51}$$

Next note that $\mathbf{N}$ is strictly concave and positive and $\mathbf{D}$ is strictly convex and positive. Thus using an argument identical to the one used in the proof of Proposition 12 we can verify that $\mathbf{F}$ is quasiconcave. Because $\mathbf{F}$ is quasiconcave and the term multiplying $\mathbf{F}$ in equation (A-48) is negative and constant in h, we see, from inspecting (A-48) that v^p_M is quasiconvex.

Next note that when $h = 0$ the reservation constraint binds so

$$v^p_M(h) - v_M(0) = v^p_M(h) - v^p_M(0) = v^p_M(h) - v_R.$$

Using the representation of v^p_M given in (A-48) we obtain,

$$v^p_M(h) - v_R = (1 - \mathbf{F}(h))\,(\bar{p}\bar{x} - v_R). \tag{A-52}$$

By the parametric restrictions imposed in (7) we see that $\bar{p}\bar{x} - v_R > 0$, because $\mathbf{F}$ is less than 1 over the region of admissible parameters,

$$(1 - \mathbf{F}(h))\,(\bar{p}\bar{x} - v_R) > 0. \tag{A-53}$$

Combining (A-52) and (A-53) shows that

$$v^p_M(h) < v_M(0), \quad h \neq 0.$$

Because v_M is quasiconvex in h, v_M attains is maximum on the extreme points of its domain. These extreme points are $h = 0$ and $h = \min[1/2, 1 - c/(\bar{p}\bar{x})]$. If the reservation constraint binds at $1 - c/(\bar{p}\bar{x})$ we have shown that this point cannot be a maximizer of v_M. Thus, the maximal value of v_M is attained either at $h = 0$ or the at $h = \min[1/2, 1 - c/(\bar{p}\bar{x})]$ and in this case the reservation constraint is not binding. □

Proof of Proposition 14. First note that if an equilibrium exists in which the family owner hires the family manager, the owner will make a compensation offer that equates the family manager's utility when working for the family firm and working outside. Thus (4) show that the family owner will only hire the family manager when family value is weakly higher under family management, i.e.,

$$v^K(w^K) \equiv v^K_O(w^K) + v^K_M(w^K) \geq v^E_O(w^E) + v^E_M(w^E) = v^E(w_E). \tag{A-54}$$

The family manager's utility is the same from accepting the family owner's offer and working outside the firm. Using expression (5) we can express this condition as

$$h\,v^K(w^K) + (1-h)\,v^K_M(w^K) = h\,v^E(w^E) + (1-h)\,v^E_M(w^E). \tag{A-55}$$

Expressions (A-54) and (A-55) imply that

$$v^K_M(w^K) \leq v^E_M(w^E). \tag{A-56}$$

Next, note that at any fixed compensation, the value of the family manager is higher when working for the family owner. This implies that the manager's value is higher at compensation w^E, i.e.,

$$v^E_M(w^E) < v^K_M(w^E). \tag{A-57}$$

Expressions (A-56) and (A-57) imply that

$$v^K_M(w^K) < v^K_M(w^E). \tag{A-58}$$

Because the manager's value is increasing in compensation, (A-58) implies that

$$w^K < w^E.$$

Increasing compensation increases total value because it reduces monitoring, m and does not affect the probability of underreporting low cash flows σ. Thus, it must be the case that

$$v^K(w^K) < v^K(w^E). \tag{A-59}$$

Family value when the related manager and owner are not matched equals the value of the owner's firm plus the value of the manager's compensation. The value of the owner's firm equals the total value, less the value of compensation to the unrelated manager, less monitoring expense. The value of compensation to the external manager working for the family owner equals the value of the compensation received by the kin manager working outside the family firm. Thus, the family value when the owner and manager are not matched equals total value under the external manager less monitoring expense under the external manager. This is the same as the total firm value when the manager and owner are unrelated as derived in Section 2.3. From Proposition 1 of this section we see that at a fixed compensation level, family value is always higher when the manager and owner are not related (i.e., $h = 0$). Thus,

$$v^K(w^E) < v^E(w^E). \tag{A-60}$$

Expressions (A-59) and (A-60) imply that

$$v^K(w^K) < v^E(w^E). \tag{A-61}$$

However, (A-61) contradicts (A-54) and thus establishes our result. □

Proof of Proposition 15. First consider condition i. Note that by Malécot's formula (see Malécot (1948) or Chapter 5 of Lange (2002)),

$$h_{NS} = \frac{1}{2}\left(h_N + h'_N\right). \tag{A-62}$$

Because the founder is not inbred and S is her son, $h_S = 1/2$. Using this fact and equation (A-62) we have that

$$\frac{h_{NS}}{h_N/h_S} = \frac{1}{4}\left(1 + \frac{h'_N}{h_N}\right),$$

and the result follows.

To prove condition ii, first note that by assumption N is not a direct descendant of the founder or the founder's spouse. Thus, all lines of descent connecting N and S are indirect. By the assumption that the family tree is unilateral and that the founder and N are related, all indirect lines of descent connecting S and N pass through the founder. Thus, each of these lines of descent also connects the founder to N. Thus, for each path from S to N, there exists a path from the founder to N, which is shorter by at least one arc. By Wright's formula for the coefficient of relationship (Wright, 1922), we see that the contribution of a path from S to N to relatedness is at most half of the corresponding path from the founder to N. Therefore, the coefficient of relationship between N and S, h_{NS}, which is the sum of all the path contributions by the Wright formula, is at most one half of the coefficient of relationship between the founder and N, h_N, i.e., $h_{NS} \leq h_N/2$. Because the founder is not inbred, $h_S \leq 1/2$. Thus, $h_N/h_S \geq 2\,h_{NS}$. The result follows. □

Proof of Proposition 16. First consider part i. First note that, using expression (5), we can express family member utility as follows:

$$u_S = h_{NS}\,v + (1-h_{NS})\,v_S, u_N \qquad = h_{NS}\,v + (1-h_{NS})\,v_N, u_F = h_F\,v + (1-h_F)\,v_S,$$

where $v = v_S + v_N$ represents family value.

Assume $\bar{x} = 1$ without loss of generality. If the founder fixed compensation at w then the founder rationally anticipates that the manager, N, will exert effort based on the manager's kinship altruism toward the owner, S. Moreover the monitoring and reporting decisions of the descendants will be the same as the in the baseline model given the degree of kinship altruism between the manager and owner, h_{NS}. The values received by the manager and owner, for a fixed compensation level, are only affected by kin altruism in so far as kin altruism affects, effort, monitoring and reporting. Thus,h_{NS} the kin altruism between the owner, S and manager, N, will for fixed uptick probability and compensation policy be determined in exactly the same fashion as they were in Sections 3 and 4 except that the altruism between the two agents will be given by $h = h_{NS}$. Because of the monotone increasing relation between the uptick probability p and compensation w, the founder's preferences for higher compensation than the compensation level selected by S is equivalent to the founder's preference for a higher uptick probability. Thus utility of the founder and S for a given uptick probability when S inherits the firm and hires N to manage the firm is given by

$$\begin{aligned} u_F(p) &= (1-h_F)v_O^A(p) + h_F\,v^A(p), \\ u_S(p) &= (1-h_{NS})\,v_O^A(p) + h_{NS}\,v^A(p). \end{aligned}$$

Therefore,

$$u_F(p) = u_S(p) + (h_F - h_{NS})\,(v^A(p) - v_O^A(p)) = u_S(p) + (h_F - h_{NS})\,v_M^A(p).$$

At S's preferred policy, the first-order condition implies that

$$\left.\frac{\partial u_S}{\partial p}\right|_{p=p^A} = 0.$$

Thus,

$$\left.\frac{\partial u_F}{\partial p}\right|_{p=p^A} = \left.\frac{\partial u_S}{\partial p}\right|_{p=p^A} + \left.\frac{\partial (u_F - u_S)}{\partial p}\right|_{p=p^A} = \left.\frac{\partial (u_F - u_S)}{\partial p}\right|_{p=p^A}.$$

Because,

$$u_F(p) - u_S(p) = (h_F - h_{NS})\,v_M^A(p), \tag{A-63}$$

the founder's marginal utility at S's optimal choice of p is given by

$$\left.\frac{\partial u_F}{\partial p}\right|_{p=p^A} = \left.\frac{\partial (u_F - u_S)}{\partial p}\right|_{p=p^A} = \left.\frac{\partial v_M^A}{\partial p}\right|_{p=p^A}.$$

By the assumption of benevolence, $h_F - h_{NS} > 0$. u_F is concave by the same argument given for the concavity of u_0^A in Lemma 1. Thus, to show that the founder's preferred policy implies a higher uptick probability (and thus higher compensation for N) we need only show that evaluated at p chosen by S, $u'_F(p^A) > 0$. To see this, use expressions total and owner value given by Proposition 7 and equation (A-22) respectively. Next, differentiate equation (A-63), substitute in p^A. Finally, simplify the expression using the transform $\chi = \alpha(1 - h_{NS})$ used in the analysis in Section 4. This yields

$$\left.\frac{\partial v_M^A}{\partial p}\right|_{p=p^A} = \frac{(1+\alpha)(1+h\alpha)}{(1-h)(2+h+h\alpha)} > 0.$$

Thus the founder's preference for higher compensation is established. The founder's preference for hiring N relative to an external manager is quite easy to verify given the results in Section 4.3. In expression (30) replace, K with N to represent hiring N and replace O with S to represent the fact that S is the descendant owner. These replacement yield Δ_S^E the utility gain to S from hiring a external manager as opposed to N. The utility gain to the founder if E is hired is similarly represented by Δ_F^E. Next using, (30) with the modifications noted above, one sees that

$$\Delta_S^E - \Delta_F^E = (h_F - h_{NS})\, v_N.$$

Founder benevolence implies that $h_F - h_{NS} > 0$ and thus $\Delta_S^E < 0$ implies that $\Delta_F^E < 0$, i.e., cases where S prefers hiring N are a subset of cases where F prefers hiring N. □