Of Women and Land:
How Gender Affects Successions and Transfers of Iowa Farms

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Abstract: Using 589 responses to the 2019 Iowa Farm Transfer Survey, we examine factors in farm successor choices among Iowa farmers with a focus on female successors and landowners. Among those with identified successors, 57% chose sons and 8% chose daughters. We find a 12.4% probability a female farmer will choose a daughter, but only 5.9% for a male farmer. Agriculture experience increases the probability of choosing a daughter from 5.4% to 20.7% and from 36.3% to 65.2% for a son. Our paper reveals striking evidence of gender imbalance in farm succession, transfer, and inheritance decisions of U.S. farms.

Keywords: Farm Succession, Land Inheritance, Gender Imbalance, Son Preference, Land Ownership, Succession Planning, Overlapping Generations Model

JEL Codes: Q12, Q14, Q15, J16

Traditionally, farmers have been depicted as men, as for centuries farms have passed from father to son, while the farmer's wife has been depicted as taking care of the homestead, ready to greet her husband with a hot stew on the table, à la Meryl Streep in *The Bridges of Madison County.* However, times have changed and more women are now farming their own land (Trauger 2007). The 2014 U.S. Department of Agriculture (USDA) Tenure, Ownership, and Transition of Agricultural Land (TOTAL) survey shows that 37% of non-operator principal landowners in the United States are women; and, on average, women own more acres to rent out than their male counterparts (Bigelow, Borchers, and Hubbs 2016). Nationally, 76% of land with a female non-operator landowner is controlled by someone older than 65.

Successors are farmers' self-reported intended choices, defined as those who will eventually take over the "management," as opposed to the "ownership," of their farm businesses. Thus, succession decisions, especially those involving women landowners or women successors, are of considerable importance to the farming community and the future structure of the agricultural sector (Bigelow, Borchers, and Hubbs 2016).

However, the gender gap in the agricultural industry does not seem to narrow. First, daughters tend to be excluded in the farm business management (Vera and Dean 2005; Wang 2010). Second, women landowners tend to be less involved in land management decisions than men. In particular, the 2014 USDA TOTAL survey reveals decisions about land owned by women are more likely to be made by the tenant, including cultivation practices, participation in government programs, and permanent conservation practices (Bigelow, Borchers, and Hubbs 2016). While tenants and owners may generally have conflicting incentives regarding conservation practices or land access for beginning farmers, it seems women face greater challenges. This situation is exacerbated because many women landowners in Iowa currently do not farm, live out of state, or are 80 years of age or older (Zhang, Plastina, and Sawadgo 2018a).

When compared to male landowners, women landowners, especially those 80 years of age or older, own a disproportionally higher percent of land they have never visited or do not know the crop yields of (Zhang, Plastina, Sawadgo 2018b). Land in Iowa owned by women landowners is more likely to be held in trusts and less likely to be sold to others outside the family. This often results in additional social pressures and obstacles in addition to the knowledge gaps faced by women landowners (Zhang, Plastina, and Sawadgo 2018b). There appears to be a dearth of extension or academic publications designed to meet the succession needs of this audience. Transition and estate planning materials generally target retiring farmers (Hofstrand 2016; Eggers 2012; Ferrell, Jones, and Hobbs 2014; Opheim 2017), and other materials are directed toward understanding the current transition landscape rather than educating current landowners (Cox and Duffy 2014). Publications on farm lease issues are generally aimed at operators or a more general landowner audience and do not address unique needs of women landowners, many of whom have never farmed (Tidgren 2017; Sawadgo, Zhang, and Plastina 2021). Research in Great Lakes counties finds women landowners are less likely to be involved in conservation decision making on their land if they inherited the land, co-owned the land with a sibling (Petrzelka and Marquart-Pyatt 2011), or when the tenants are relatives (Eells 2008). In addition, research finds women feel uncomfortable talking to family members or tenants about making changes in farm management practices. Women often 'inherit' a tenant along with farmland (Carolan 2005; Petrzelka and Sorensen 2014), who may be a neighbor, friend, or family member, or part of her community. These papers, however, are not studies focusing on the gender gap in the inheritance or succession decisions of farmers.

Although gender imbalance in inheritance decisions have been analyzed in several countries, most focus on developing countries (Quisumbing and Doss 2021) such as India (Bhalotra, Brule, and Roy 2020; Agarwal 1994), Bangladesh (Anderson and Eswaran 2009), the Philippines (Estudillo, Quisumbing, and Otsuka 2001), and China (Hare, Yang, and Englander 2007). Due to widespread preference for sons over daughters (Edlund 1999) and historical gender roles (Hansen, Jensen, and Skoysgaard 2015), women in many developing countries are significantly disadvantaged relative to men with regards to their agricultural resources (Quisumbing and Doss 2021) and land rights (FAO 2018), with the share of women landowners ranging from 5% in the Middle East to 18% in Latin America. However, the evidence of gender imbalance in farm succession and inheritance in developed countries is scant. Leckie (1996) shows that girls on Canadian farms could have limited resources, gendered roles, and less decision-making power even when they work on the farm. Bennedsen et al. (2007) states that male-first child firms in Denmark are more likely to pass on control to a family CEO than are female first-child firms. According to Barbercheck et al. (2009), women farmers in the state of Pennsylvania reported discrimination and isolation from other farmers and agricultural providers. The 2017 U.S. Census of Agriculture shows that only 29% of all U.S. principal producers are women, suggesting a clear gender gap in farm management and succession. This imbalance is even more striking when considering the findings across many countries that women farmers are not less agriculturally productive than their male counterparts (Quisumbin 1995; Palacios-Lopez, Christiaensen, and Kilic 2015; Doss 2018).

The first objective of this paper is to provide solid empirical evidence on gender imbalance in U.S. farm successions; and, the second objective is to study the underlying motifs that make a farmer choose a son instead of a daughter as the main successor of the farm with a focus on the U.S. Corn Belt. That is, why are women not commonly chosen as the main successors inheriting the land of their parents, often fathers? This is because successors, in terms of management, are less common and not well-understood: more women inherit land with equal shares as other siblings as "tenants in common," or jointly with spouse as "joint tenants" (Zhang, Plastina, Sawadgo 2018b), but according to the 2017 U.S. Census of Agriculture, only 25.9% of farms in the Midwest have women as their principal operator (USDA-NASS 2019). Many women also decide to sell their share to their male co-owners as many of them have little experience in farming or feel pressured to do so (Zhang, Plastina, and Sawadgo 2018a).

Using a two-period overlapping generations (OLG) model, we hypothesize that the probability of a farmer choosing a female successor is larger when: (*a*) the female successor demonstrates farming experience; (*b*) the farmer is female or the farm is a husband/wife partnership; (*c*) when the farm has a shorter history of farming; and, (*d*) when the farmer only has daughters. Our analysis relies on 589 farmer responses on successor choices from the 2019 Iowa Farm Transfer Survey, a statewide survey that collects extensive information about farmers' succession, retirement, and farm transfer plans. We employ a series of logistic regressions (for rare event data) to explain the probability of choosing a daughter as the main farm successor using a host of farm, farmer, and successor characteristics. We use the firthlogit method (Williams 2019) for rare event data analysis and our results are robust to the King and Zeng (2001) method.

Our main results confirm our four hypotheses and provide insights on the drivers of gender imbalance in farm succession. First, we find evidence of a significant gender gap in the choice of farm successors—among those who have identified a successor, 57% indicated their son(s) as primary successor and only 8% indicated their daughter(s). Second, our logistic regressions show that if the farmer is a woman, then they will most likely choose a daughter as successor, possibly because they are already actively breaking agricultural society's stereotypes and traditions. Third, the probability of a daughter being chosen as the main successor increases if the daughter has farming experience or an agriculture-related job. However, there is still a noticeable difference—having an agriculture-related job increases the probability of a son being chosen as the main successor from 36.3% to 65.2%, while the probability for a daughter with an agriculture-related job only increases from 5.4% to 20.7%. Fourth, our results show that male farmers who partner with their wives on a farm operation are more likely to choose a daughter as the main successor. In contrast, older farmers and those who have more years of farming experience are less likely to choose a female successor.

Our paper provides at least two important contributions to the literature on gender imbalance in inheritance and succession decisions. First, we provide one of the few studies with first-hand survey data and empirical evidence of significant gender imbalance in the contemporary selection of farm successors in the context of the United States. Sons are far more likely to be chosen as the main successor than daughters, possibly reflecting cultural norms of gender roles and disparate farming-related investments and education for sons and daughters. It is also possible that sons face more pressure to take over the farm regardless of his outside interests while daughters choose another career path. Second, by focusing on the factors that drive the probability of choosing a daughter as the main farm successor, our paper identifies the key barriers and possible pathways to alleviate the existing gender imbalance in farm succession. In particular, our results show that a female successor having an agriculture-related job or farming experience, or if the farm operation is a joint partnership that involves the wife, could significantly increase the probability of a daughter being chosen as the main successor. These findings suggest value to involving women landowners in farming operations and educating women, especially young women, on farm management decisions, which will help enable women to choose farming as a career path, help close the gender gap in farmland access and succession, and could help encourage and empower women and girls in agriculture.

The remainder of the paper is presented in the following manner—we first present a theoretical model using the OLG model and then introduce the survey data as well as our empirical strategy. Next, we present the regression findings and the associated marginal effects, followed by a discussion of policy implications and a conclusion.

Theoretical model

Pioneered by Samuelson (1958), the OLG model has become one of the dominating frameworks of analysis in the study of life-cycle behavior such as saving for retirement, fertility decisions, or intergenerational transfers (Weil 2008). By incorporating an aggregate neoclassical production into the model, Diamond (1965) further extends the model's popularity and use in the analysis of public policies. In this article, we use the Samuelson-style stationary OLG model where agents live for two periods (young and old). Agents are inactive when young and their consumptions are determined by their parents and their innate productivity.

An old-age parent with characteristics i, which includes age, gender, education, family history, etc., cares about his or her old-age consumption $c^p = a^p L$, where a^p is the innate ability of the parents, and L denotes the acres of land the agent possesses. The parent also cares about the total consumptions of her potential successors. $\sum_{k,j\in\{f,m\}} \gamma_{k,j} I_{\{n_k>0\}} c_k^c$. $c_k^c = a_k^c L$ represents successors with gender k's total consumption, where a_k^c denotes the children's innate productivity or farming experience and $I_{\{n_k>0\}}$ is an indicator function that takes the value 1 if the parent has successors with gender k, that is, $n_k > 0$. If a successor with gender k is chosen, his or her innate ability can be explored the most. That is, we assume $\gamma_{k,k} > \gamma_{k,j}$, gender k's consumption has more value if they are chosen than if j is chosen. Furthermore, the parent also values the farm as an asset within the family, the value of which depends on the chosen successors and might include economic and sentimental values. If the agent chooses successors with gender j, the value is $\beta_j^i u(L|s)$ with parameter $\beta_j^i > 0$. $I_{\{b=j\}}$ is an indicator function equal to 1 if agent j is chosen as the successor. The parent's utility when making bequest choices b, which takes two values—f, m—is thus

$$u(b|i) = c^p + \sum_{j\in\{f,m\}} \beta_j^i I_{\{b=j\}} u(L|i) + \sum_{k,j\in\{f,m\}} \gamma_{k,j} I_{\{n_k>0\}} c_k^c + \varepsilon_{ij}, \quad (1)$$

where ε_{ij} denotes the error term measuring some unobservable factors that will affect the agent's utility if choosing j as the successor.

The utility difference of choosing female instead of male successors is

$$u(b=f|i) - u(b=m|i)$$

$$= \left(\beta_f^i - \beta_m^i\right) u(L|i) + \left(\gamma_{f,f} - \gamma_{f,m}\right) I_{\{n_f>0\}} c_f^c + \left(\gamma_{m,f} - \gamma_{m,m}\right) I_{\{n_m>0\}} c_m^c + \varepsilon_{if} - \varepsilon_{im} \quad (2)$$

$$\equiv \beta_0 u(L|i) + \beta_1 I_{\{n_f>0\}} c_f^c + \beta_2 I_{\{n_m>0\}} c_m^c - \varepsilon,$$

where β_0, β_1, β_2 are the parameters that need to be estimated. We expect β_0 to be negative since it is more likely the farm will stay with the family surname if the farmer transfers it to the son(s). The magnitude, however, depends on the characteristics of the parents, i. $\beta_1 > 0$, $\beta_2 < 0$ since $\gamma_{k,k} > \gamma_{k,j}$ by assumption. The probability of choosing females as successors is

$$Pr(u(b=f|i) - u(b=m|i) > 0) \quad (3)$$

$$= Pr\left(\varepsilon < \beta_0 u(L|i) + \beta_1 I_{\{n_f>0\}} c_f^c + \beta_2 I_{\{n_m>0\}} c_m^c\right),$$

where ε follows logistic distribution with mean 0 and variance σ^2. We then have the following hypotheses.

Hypothesis 1:

If the innate productivity of the potential female successor is larger (e.g., higher education, more involved in agricultural work), that is, a_f^c or c_f^c is bigger, the probability of choosing a female successor is larger; otherwise, the probability of choosing the male successor is larger.

Hypothesis 2:

If the parent has a more gender inclusive outlook on farm succession (e.g., the parent is female or younger) and might not think the value of keeping the land within family is large, that is, $u(L|i)$ is smaller, the probability of choosing a female successor is larger if β_0 is negative; otherwise, the probability of choosing a male successor is larger.

Hypothesis 3:

If the farm has a shorter history of farming or has less economic value to the family (e.g., the land condition is not considered as good or excellent), the parent is more likely to choose females as the successor because $u(L|i)$ is smaller[1]; otherwise, the probability of choosing a male successor is larger.

Hypothesis 4:

If the parent only has female successors (e.g., only has daughters), the probability of choosing a female successor is larger because $I_{\{n_m>0\}} = 0$ in this case; otherwise, the probability of choosing a male successor is larger.

[1] The term u(L | i) might not only include economic values, but also include sentimental values. In 2017, 29% of Iowa farmland is owned primarily for family or sentimental reasons (Zhang et al. 2018a), and it is reasonable to assume that a farm with a longer history could yield a higher sentimental value for the family. This is consistent with the recognition and celebration of historic farms by state and federal governments such as Iowa's Century & Heritage Farms Program (IDALS 2022).

Data and Empirical Strategy

The data used for this research come from the 2019 Iowa Farm Transfer Survey, which was sent to 3,000 Iowa crop or livestock farmers responsible for the day-to-day operation of their farming business who earned $100,000 or more in gross farm income in 2018. This stratified random sample comes from Dynata, a private company that collects records of farmers who participated in federal commodity and conservation programs. The data represent all counties across Iowa's nine crop reporting districts. Following Dillman's Tailored Survey Design method (Dillman, Smyth, and Christian 2014), we sent the first invitation to complete the questionnaire online to a sample of farmers on July 15, 2019. We sent printed questionnaires on July 30, 2019, and a second follow-up mailing on August 23, 2019 (with the option of responding online), to farmers who had not completed the questionnaire by the time of distribution. We closed the data collection on October 15, 2019. The survey received a high return rate—almost 30%—from 886 farmer respondents, which shows the strong feelings farmers have about their future. Of the 886 respondents, 739 indicated that they were going to farm in 2019 and 589 provided answers to their successor choice questions—those 589 farmers represent the key regression sample used for our article. We received data from all 99 Iowa counties. Respondents are well-established Iowa farmers, mostly multigenerational, and results show that their retirement plan is well connected with their farm's future plans. Of respondents, 4.85% identify as female and 95.19% as male. The majority of respondents have 2 children, with a minimum of 0 and a maximum of 12, and the mean number of sons and daughters is equal at 1. Maule, Zhang, and Baker (2020) presents more information about the survey.

The survey asked farmers about their demographic information, retirement options, and succession plans, as well as their successors' demographics. In particular, we asked all farmer respondents whether they have a formal succession plan, whether they have identified a successor, and if so, who are the main, second, and third successors. Successor is defined as the one who will eventually take over the management, as opposed to the ownership, of the farm business. Successors are farmers' self-reported intended choices instead of the actual successor choice. Figure 1 shows that in 2019, 40% of respondents claimed that they had identified a successor, 31% had not, and 29% claimed it was too early to say. Figure 2 further shows that among those who have identified a successor, 57% indicated their son(s) as primary successor and only 8% indicated their daughter. Other common answers are niece/nephew and other non-relatives. Furthermore, 25% and 32% of respondents who identified a successor have chosen their daughter as the second or third successor, respectively. Figure 4 shows the sample description.

Using these responses, we identify several dependent variables that we think best fit our model, which we analyze separately. The first dependent variable*, Succ_Daughter,* is a categorical variable that takes a value of 1 if the main successor is one of the daughters, 0 otherwise. The second dependent variable, *Succ_female*, is a categorical variable that takes the value of 1 if the main successor is female, including daughter, niece, daughter-in-law, granddaughter, or wife. The third dependent variable is *Succ_23_Daughter*, which takes the value of 1 if the second and/or third successor is one of the daughters, 0 otherwise. The fourth dependent variable is *Succ_All_Daughter,* which takes the value of 1 if either the main, second, and/or third successor is one of the daughters. The final dependent variable is *Succ_Son*, which assumes the value of 1 if the main successor is one of the sons, 0 otherwise.

Corresponding to our aforementioned binary dependent variables, our empirical strategy is logistic regressions or firthlogit method. As shown in our theoretical model, the utility of farmer *i* choosing successor of type *j* (e.g., daughter or son) can be described as $U_{ij} = V_{ij} + \varepsilon_{ij}$, where V_{ij} is the representative utility that could be explained by the observed characteristics of the farmer, the successors, and the farm, and ε_{ij} is the remaining unobserved component that is assumed to be independently and identically distributed type I extreme value. Notably, the difference between two extreme value variables $\varepsilon_{ij} - \varepsilon_{ik}$ or ε^{*}_{njk} is distributed as logistic: $F(\varepsilon^{*}_{njk}) = \varepsilon^{*}_{njk}/(1 + \varepsilon^{*}_{njk})$.

A rational farmer would only choose successor type *j* when it yields the highest utility of all choices. This means that the probability of farmer *i* choosing successor type *j* is

$$P_{ij} = Prob\left(V_{ij} + \varepsilon_{ij} > V_{ik} + \varepsilon_{ik} \ \forall\, k \neq j\right) \qquad (4)$$
$$= Prob\left(\varepsilon_{ik} < V_{ij} + \varepsilon_{ij} - V_{ik} \ \forall\, k \neq j\right)$$

After some algebraic manipulation of the integrals and under the aforementioned distributional assumptions, this logit choice probability P_{ij} leads to the following succinct, closed-form expression (Train 2009):

$$P_{ij} = e^{V_{ij}} \Big/ \textstyle\sum_j e^{V_{ij}} \qquad (5)$$

We could explain the representative utility using observable characteristics $V_{ij} = \beta'_{farmer}X_{i,farmer} + \beta'_{successor}X_{ij,successor} + \beta'_{farm}X_{i,farm}$. With this linear in parameters specification, the above logit probabilities in equation (2) now becomes the following, which will be the basis of our regression:

$$P_{ij} = \frac{e^{\beta'_{farmer}X_{i,farmer} + \beta'_{successor}X_{ij,successor} + \beta'_{farm}X_{i,farm}}}{\sum_j e^{\beta'_{farmer}X_{i,farmer} + \beta'_{successor}X_{ij,successor} + \beta'_{farm}X_{i,farm}}} \qquad (6)$$

where $y_{ij} = 1$ if person i chooses j and 0 otherwise. The score equation for logit regression is

$$\sum_i \sum_j (y_{ij} - P_{ij}) X_{ik} = 0 \quad (7)$$

where $k = farmer, successor, farm$.

For the firthlogit method (Firth 1993; Heinze and Schemper 2002; Williams 2019[2]), the score equation is replaced by the modified score equation

$$\sum_i \sum_j \left(y_{ij} - P_{ij} + h_j \left(\frac{1}{2} - P_{ij} \right) \right) X_{ik} = 0 \quad (8)$$

where the h_j's are the jth diagonal elements of the matrix

$H = W^{1/2} X (X^T W X)^{-1} X^T W^{1/2}$ with $W = diag\{P_{ij}(1 - P_{ij})\}$.

Following our theoretical framework, we include several explanatory variables that could relate to successor choices. First, the demographics of the current farmer and landowner of the farm, including the age of the farmer (Schmidt, Goetz, and Tian 2021), whether the farmer is female (Kubicek and Machek 2019), if the farmer has a college education (Mishra, EI-Osta, and Johnson 2004; Ball, 2020), and if the farmer has a plan to retire. We hypothesize that holding other things constant, a female farmer, or a male farmer partnering with their wife in the farm operations, or more educated farmers, are more likely to choose a daughter as the main successor because they might be more open-minded or less stereotyped. Second, the characteristics of possible successors, including variables such as if the farmer only has daughters (Wang 2010), if the son is the oldest child, the number of sons, whether the successor worked on the farm or on another farm, and if they had an agriculture-related job (Vera and Dean 2005; Kubicek and Machek 2019; Ball, 2020). As explained in our theoretical model, the probability of choosing daughter(s) as farm successor(s) will increase when the farmer only has daughters, or when their successor has farming experience or an agricultural job. In contrast, we expect farmers are less

[2] Williams (2019) notes that King and Zeng (2001) is an alternative method to deal with the rare events in logistic regressions, and we will show later that our results are robust to this alternative method.

likely to choose daughters as successors when their son is the oldest child or they have more sons because sons, especially the oldest, are usually chosen as the main successor for family businesses. In particular, figure 3 shows that among farmers that only have sons, over 89% chose their son as the main successor; whereas for farmers who have both sons and daughters, the share of farmers who chose sons as the main successors decreases to 63%. In addition, 6% of respondents stated that they will give the land to their in-laws, particularly their son-in-law, which was not a response given by those who only have sons.

We also include several control variables that proxy the characteristics and conditions of the farm—total acres of the farm operation (Schmidt, Goetz, and Tian 2021), whether the farm only produces row crop (i.e., corn and soybeans), and the year the farm was established. The latter assumes values between 1776 and 2016. We also take into account the condition of the farm, specifically if it is in "good" or "excellent" condition. As we have hypothesized, the earlier the farm was established, the better the condition of the farm, and the more valuable the farm to the family, the smaller the probability of transferring the farm to daughters because sons can keep the farm within the family surname. Table 1 lists the main variables we use to test our hypotheses, and table 2 presents the summary statistics by type of variable. There are slight differences in the number of observations as not all the respondents answered every question in the survey. Additionally, we only consider those who farmed in 2019.

Results

Table 3 presents our main results explaining farmers' successor choices, and in particular, the probability of choosing a daughter as the main successor. Appendix table A1 shows results using the King and Zeng (2001) method. Models 1–4 are all firthlogit regressions with *succ_daughter* as the dependent variable. Compared to model 1, model 2 adds two variables representing the successor's farming experience, while models 3 and 4 further add two variables on the farmer's education level as well as whether they partner with their spouse on their farm operation. Models 1–3 are simple firthlogit regressions incorporating farm- and farmer-specific characteristics, and model 4 further controls for the remaining time-invariant regional unobservables using spatial fixed effects at the crop-reporting-district level. For example, northeast Iowa is home to Swedish and Norwegian immigrants, while Dutch immigrants are clustered in central Iowa, and Danish immigrants mostly reside in southwest Iowa. We hypothesize that the crop-reporting-district fixed effects would capture some cultural differences (Kubicek and Machek 2019) or time-invariant regional land variations, such as major soil associations. As a result, model 4 is our preferred specification.

The results presented in table 3 largely support our four hypotheses. First, model 1-2 shows the variable *female_farmer* is statistically significant and positively related, while the size of the coefficients in models 3 and 4 are similar, meaning that if the farmer is a woman, then she is most likely to choose a daughter as a successor. This result also reflects hypothesis 2 and can be explained by the possibility that female farmers are more used to breaking the stereotypes of the agricultural industry and are keener to choosing what is seen as an unusual successor. Furthermore, models 1–4 show that *Age* is negative and statistically significant for choice of daughter; that is, for every year increase in the age of the farmer, the log-odds of choosing a daughter as main successor decrease by 0.186–0.251, holding all other variables constant. This confirms hypothesis 2, that older individuals are more likely to follow a more traditional approach when choosing an heir and transfer the land from father to son. We also find that *College_degree* groups those farmers who have a college degree. Models 3 and 4 suggests that if the farmer is educated, he or she is more likely to choose a female successor, possibly explaining hypothesis 2. Similarly, those who farm in a partnership with a spouse are also more likely to choose a daughter. These events can be explained by the fact that if a farmer is more educated or running the farm alongside their wife, then they are more exposed to environments that carry less of the patriarchal structure that still saturates agriculture.

Model 1-4 also explains hypothesis 4, as it shows that if the farmer only has daughters, then they are more likely to choose one as a successor. Furthermore, table 3 also provides supportive evidence for hypothesis 1. In Model 4, the variable *work_farm* is positive and statistically significant; that is, if the daughter currently works on the farm, her log-odds of being chosen as a primary successor increase by 1.25 units. Similar results appear for the variable *succ_agjob*, which accounts for daughters that have an agriculture-related job. In other words, children with ag-related jobs and active farming experience are seen as more viable and equipped with skills that can help them manage the farm properly. However, Leckie (1996), which examines girls who grew up on a farm in southern Ontario, Canada, suggests that even though the girls actively work on the farm, their role is still gendered and marginal. Leckie (1996) argues that women are often excluded from important resources, including information, meaning that even if they work on the farm, they are still not seen as productive enough to be chosen as a successor because they lack the knowledge that usually they did not have a chance to gather. This specific topic could be a subject of future research.

However, the variables *work_farm* and *succ_agjob* are about all the successors not just the daughters. We create two control variables, *farm_not_son* and *ag_not_son*, as the cross products of *work_farm* and *succ_agjob* with the dummy variable that "the main successor chosen by the farmer is not son". Table A2 in the Appendix shows the main results. Having farming experience or agricultural related job still contributes to the probability of choosing a daughter as the main successor.

Finally, we expect the variable *yr_started_farming* to be statistically significant and negative because it reflects hypothesis 3. Agricultural families are very attached to the family history and family name, and most take great pride in owning multigenerational family farms. The cultural norm of the wife taking the husband's surname after marriage might explain the negative association between *yr_started_farming* and choosing a daughter as the main successor.

The regressions in table 3 also include several control variables accounting for farm characteristics. In particular, model 4 shows that *farm_good*, which indicates farms that are considered by the owner to be in good or excellent condition, is statistically significant and negatively related to choosing a female successor. We expect this variable to be statistically significant and positively related to choosing either a son or daughter as successor because we expect that those farmers whose land is in good condition are more likely to earn higher farm income or collect higher cash rent, and thus they regard the better grounds as more desirable to remain in the family. The regression shows that this variable is statistically significant for both sons and daughters; however, it negatively correlates to choosing a daughter, but positively correlates with choosing a son as the main successor (table 4 column 4). This suggests that most well-functioning farms are going to be inherited by a son, possibly due in part to the disparately higher investments in sons than daughters with respect to farming. These investments could include hands-on production decisions, agriculture-related trainings at high schools and colleges, and participation in 4-H events or organizations such as FFA (Future Farmers of America). This is in support of our hypothesis 3, where daughters are less likely chosen successors for a farm that has more value to the family.

We thought A*cre_total* would be statistically significant—we predicted that the bigger the farm, the less likely the farmer would be to pick a daughter as successor. However, the variable is not significant, which might be due to its correlation with other variables such as *farm_good* and *rowcroponly*. The variable *son_is_oldest* is not significant in any of the four models shown in table 3.

Table 4 presents several robustness checks using alternative measures of dependent variables and shows the results usingthe standard logit regression. Table A3 in the Appendix shows our results using the firthlogit method. All the regressions are similar to table 3 model 4 and include crop-reporting-district fixed effects. In particular, column (1) uses the choice of daughter as the second or third successor as the dependent variable, the dependent variable in column (2) equals 1 if a daughter is chosen as any of the main, second, or third successor, and column (3) includes other females (e.g., niece, granddaughter, wife) in the main successor choice and is the binary choice of choosing a female main successor as opposed to daughters. In contrast, column (4) examines the choice of sons as main successors. Table 4 shows that if the farmer only has daughters, the log-odds of choosing a daughter as the second or third successor decrease by 0.298 units and the log-odds of choosing a son as the main successor decrease by 4.146 units. These results corroborate with the findings of our main results in table 3 and highlight that if the farmer only has daughters, she is more likely to choose a daughter as the *main* successor, which means she is less likely to choose a son in favor of choosing a daughter. If a daughter has been chosen as the main successor, she is less likely to be chosen as the second or third, thus explaining the negative correlation. Additionally, *daughter_only* also positively relates to having a daughter as at least one of the successors and the daughter being first, second, or third in line, and it also increases the log-odds of choosing a female successor by 1.825 units.

Altogether, these results seem to show that there is a strong correlation between having only daughters and choosing a female successor, either a daughter or someone else, thus supporting our original hypothesis. We can make a similar interpretation of the variable *female_farmer*, though it is not statistically significant. *succ_agjob* is not statistically significant for choosing a daughter as successor two or three and for the regression in which daughter is selected as at least one of the successors. We believe that having an agriculture-related job matters less when choosing a second or third successor, which explains this finding. Farmers do not seem to give a second or third successor having an agriculture-related job much importance because usually only the main successor directly works the land. *succ_agjob* positively relates to choosing a female successor and choosing a son for the same reasons as for choosing a daughter—the successor is considered more productive because they are thought to have more interest, experience, and knowledge. Being in a partnership with a wife is not statistically significant for all robustness checks for the same reasons listed above—second and third successor are not seen as important. It is interesting that operating in a partnership with a wife does not relate to choosing a son—a possible explanation is that this does not challenge cultural norms.

To more intuitively explain our results, we also present the marginal effects for six specifications in table 5. The specifications correspond to table 3 models 3 and 4, and all four models in table 4. Focusing on table 3 model 4, our main specification, the probability of choosing a daughter as a successor when the farmer is female is 12.4%; whereas when the farmer is male the likelihood drops to 5.9%. If the farmer is in a partnership with their wife, then the probability is 9.3%, compared to only 5.3% when they are not in a partnership. It is striking that even if the farmer only has daughters, the probability of choosing one of the daughters as the main successor is only 24.8%. These results give a deeper insight to the disparities in succession that prevent women from entering farming as a full-time profession. To reiterate, it seems very important for the farmer to have a successor with some agriculture-related experience because that experience is believed to better equip a successor to run the farm. This is reflected in the fact that the probability of choosing a daughter is 13.8% if she works on the farm and 20.7% if she has an agriculture-related job. However, this is still a huge difference from choosing a son (table 4 model 4), which has a probability as high as 55.6% if he works on the farm and 65.2% if his job relates to agriculture. The likelihood of choosing a son is almost four times higher and is the result that best highlights the need to close the significant gender gap in land inheritance. This might reflect the fact that even though daughters are involved in an agriculture-rated work, they are less likely to get as much informational training as sons (Leckie 1996).

Policy Implications

Despite significant progress in gender equality in recent decades, our findings show there is still a cultural stereotype or implicit bias against women in agriculture. We find that landowners in Iowa are more likely to choose sons instead of daughters as their main successor. The additional pressure faced by men to take over the farm despite their outside interests could also play a role. Women are usually less represented in many fields—They make up only 28% of the workforce in science, technology, engineering, and math (STEM) fields (Hill, Corbett, and Rose 2010; Corbett and Hill 2015). Women only comprise 24%, 26%, and 20% of the soil scientists in academic faculty positions, federal agencies, and private industry, respectively (Vaughan et al. 2019). As for agricultural economics, women accounted for about one-third of undergraduates in the largest departments in 2020, one-third of agricultural economics doctorates in 2019, and about 20% of all full professors in agricultural economics (Offutt and McCluskey 2022).

In regards to management positions in agriculture, only two of 15 members serving on the Board of National Corn Growers Association are women, and the corresponding ratio for the National Soybean Association is two of 57! Even for the National Future Farmers of America, in which three of seven national officers are female, the board of directors only has four women out of 14 members. The significant increase in women achieving high scores in mathematics tests, once thought to measure innate ability, suggests that cultural factors might be at work (Hill, Corbett, and Rose 2010). The negative association of age and farming experience with choosing daughters as main successors confirms this implicit bias. This is, in part, similar to the belief a generation ago that at Halloween girls should only dress as nurses as opposed to doctors. It is also common for a farmer to put an eight-year-old boy on a tractor but to ask their daughters to do the office work, which shows a significant gender-specific investment gap in agriculture-related skills. Therefore, it is crucial to take measures to support all genders with an interest in production agriculture.

Our empirical results show that a farmer is more likely to choose a daughter as the main successor if the farmer is female or more educated. Research shows that recruiting and promoting female faculty and providing a broader overview of STEM fields in introductory courses leads to higher female student recruitment and retention. Similarly, the USDA, state departments of agriculture, agricultural industry commodity groups, and the agricultural media should make a concerted and conscious effort to promote successful female farmers and offer them leadership positions in groups such as Women, Land, and Legacy and leading agricultural companies. Like the CSWEP (Committee on the Status of Women in the Economics Profession) committee that promotes gender equity in the economics profession, the agricultural sectors and related organizations should consider setting up committees to collect data on the current status of female representation in agriculture and help improve gender equity. Annie's Project is a nonprofit organization that aims to provide educational programs designed to strengthen women's roles in the modern farm enterprise. Land grant universities, and especially the Cooperative Extension Service, should help empower women in agriculture in general and offer case-specific assistance or training on issues like developing a business plan that evaluates the opportunity to return to the farm or to co-own farmland. Iowa State University's Women Planning Ag Businesses sets a good example. It is also important to not only put women in women-focused groups, which could implicitly reduce their chances for leadership roles in non-gender-specific organizations.

Our results also highlight the importance of agriculture-relevant skillsets and training of women as shown by the positive coefficients for ag-related jobs and/or education. Measures should be taken to help women build up these skillsets early in life. For example, universities could set up and fund agriculture-related clubs (e.g., the agriculture business club at land grant universities) to help women with an interest in farming better acquire production agriculture knowledge as well as participate in entrepreneurship activities. More synergistic efforts could be made to help women more easily enter and thrive in agribusinesses, which, according to our results, could serve as a gateway back to the farm. Furthermore, it is important to stress that with the advent of various precision agriculture machinery, the ideal skillsets for a successful farmer have shifted from physical demands and agronomy-centered knowledge to those focused on marketing, finance, computer skills, and entrepreneurship or deal-making. This shift with less demand for manual work also potentially increases the chance of female farmers succeeding in today's agricultural production environment because women are less likely to be inferior to men in acquiring these non-labor-intensive skills.

Finally, USDA and state governments could evaluate how they can revitalize their lending and commodity and conservation programs to help assist female farmers, ranchers, and landowners. USDA does have a female farmers and rancher loan priority program that provides targeted funding to women leveraging the designation of Socially Disadvantaged Applicant funding (USDA-FSA 2021). Some females might work in other fields that are not relevant to agriculture, but they might want to return to farming. In these cases, the opportunity cost of returning to farming will be large. Therefore, financial support from USDA or other organizations might help these women make better transitions.

In summary, although about one-third of landowners are female according to Ag Census data, few females manage the farm. It is important for USDA or state governments, non-profit organizations, universities, or committees to better equip women with farm management skills.

Conclusion

Using 589 Iowa farmer responses to a 2019 survey, we analyze the factors that influence the succession decisions on Iowa farms with a focus on the gender gap in farm successor choices. Our key findings from the logistic regression models confirm our four major hypotheses outlined using an overlapping generations (OLG) model. In particular, our main results show that the probability of choosing daughters as the main farm successor increases when the farmer is female, when the farmer only has daughters, when the daughters have farming experience or an agriculture-related job, and when the farm operation is a partnership with a wife. Our results reveal the significant gender imbalance in farm succession decisions in the contemporary United States, which are in part based on traditional and often archaic assumptions of females being less productive and less fit to run a farm than their male counterparts. This assumption is shown in the fact that older farmers and farmers who own multigenerational family farms are less likely to choose a daughter as primary successor. Our findings of greater gain from farming experience or agriculture-related jobs for sons than daughters are also revealing and alarming. This could also be a result of less farming-related investment or education for females during their childhood or adolescence years, even for females who grow up on a farm.

We base our model solely on data from one survey conducted in one U.S. state, Iowa, in 2019, thus it is limited both in geography and time. However, we believe that our model gives an accurate snapshot of the current situation in Iowa and the U.S. Corn Belt, one of the world's most critical breadbaskets. Future research could potentially extend our analysis to multiple years and a regional or national scale. Furthermore, our dependent variables are farmers' self-reported intended successor choices, which may change during the actual time of farm transfers. That said, we do believe this is a good proxy for the actual successor choices since in many cases these intended successors are clearly identified in formal succession plans. Third, our survey does not have questions that allow us to directly measure or explain the farmer's preferences for sons over daughters, nor the preferences or attitudes of potential successors, male or female, regarding inheriting the family farms. Besides, we do not consider whether there exist gendered roles in the farm management, which might be a good future direction of research (Campbell and Minguez-Vera, 2008). Finally, Similar to other surveys such as the 2017 Iowa Farm and Rural Life Poll, our surveyed farmers are older, have larger farm size, and are mostly male, and thus may not be statistically representative of Iowa farmers. While our findings may not extend to other regions such as the U.S. Delta, they are salient and relevant for understanding the role of gender in farm succession and disparate treatment of women successors in the U.S. Midwest.

Given the farm succession decisions involving women has been understudied in the literature, we feel that this is a fruitful area for future research especially using data from other regions.

Despite presenting the aforementioned limitations, our study has important implications for future research, farm policy, and land grant universities with extension or outreach missions. We provide a useful framework to contextualize and analyze what drives the inheritance gender gap in Iowa farms. Our findings suggest that farming experience and knowledge matter and it is critical to gauge the educational needs of female farmers and successors, create targeted educational materials for them, and help women landowners get more involved in their farm's decision-making process. Programs targeted to young female farmers can be used to address the knowledge gap, build leadership, and create an incentive to work on the family farm. Incentives targeted to young female graduates in agriculture-related fields, whether monetary or in other forms, could potentially help create a female farm workforce. Additionally, understanding the dynamics of how and why the gender imbalance happens will make it easier to create projects tailored to male farmers and educate them about the archaic knowledge and traditions they carry forward and involve them in closing the gender gap. The recent advances in precision-agriculture and the reduced demand on manual labor also make it easier for women to be successful in the current farming environment. By educating women to not be afraid to make their voice heard, and by showing men that their assumptions are often misogynistic and unfounded, it is possible to create tangible change, and we believe our study can be a strong starting point for that to happen.

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Table 1. Key variables of interest

Hypotheses (when the probability of choosing a female successor is larger)	Variables to test the hypothesis and expected sign of the coefficient
Hypothesis 1: If the innate productivity of the female is larger	work_farm: the primary successor works on the farm (+)
	succ_agjob: the successor has an agriculture-related job (+)
Hypothesis 2: If the parent has a more gender inclusive outlook on farm succession	female_farmer: the farmer is female (+)
	college_degree: the farmer has a college degree (+)
	partner_spouse: the farm is a partnership with a spouse (+)
Hypothesis 3: If the farm has a shorter history of farming or has less economic value to the family	farm_good: the farm condition is considered good or excellent (−)
	yr_start_farm: year the farm was established (−)
Hypothesis 4: If the parent only has female successor	daughter_only: The farmer only has daughters (+)

Table 2. Summary statistics

Variable	Description	Obs	Mean	Std Dev	Min	Max
succ_daughter	The primary choice of successor is a daughter	589	.051	.22	0	1
succ_all_daughter	First, second, and/or third successor is daughter	589	.143	.35	0	1
succ_23_daughter	Second and/or third successor are daughters	589	.1	.3	0	1
succ_female	The primary choice of successor is female	589	.088	.284	0	1
succ_son	The primary successor is a son	589	.399	.49	0	1
age	Age of the farmer	589	61.7	11.3	26	97
age_sq	Age of farmer accounting for nonlinear effect	589	3938	1347	676	9409
female_farmer	The farmer is female	589	.056	.23	0	1
daughter_only	The farmer only has daughters	589	.138	.345	0	1
retire	The farmer plans to retire at some point	589	.212	.409	0	1
acre_total	Total acres owned by farmer	589	430	554	0	8000
rowcroponly	The farm only produces row crop (e.g., corn/soybeans)	589	.543	.499	0	1
yr_start_farm	Year the farm was established	589	1927	39.5	1776	2016

farm_good	The farm condition is considered good or excellent	589	.547	.498	0	1
son_is_oldest	Son is the oldest child	589	.54	.499	0	1
num_son	The number of sons	589	1.207	1.024	0	6
sole_propr~p	The farm is a sole proprietorship	589	.413	.493	0	1
partner_spouse	The farm is a partnership with a spouse	589	.244	.43	0	1
partner_kid	The farm is a partnership with children	589	.07	.255	0	1
partner_other	The farm is a partnership with someone else	589	.029	.168	0	1
college_degree	The farmer has a college degree	589	.292	.455	0	1
work_farm	The primary successor works on the farm	589	.136	.343	0	1
work_anofarm	The primary successor works on another farm	589	.039	.194	0	1
work_anyfarm	The primary successor works on the farm and/or another farm	589	.175	.38	0	1
succ_agjob	The successor has an agriculture-related job	589	.115	.32	0	1
crd	Crop reporting district	586	4.27	2.37	1	9

Table 3. Firthlogit regression results that explain choosing a daughter as main successor

	Model 1	Model 2	Model 3	Model 4
age	-.202**	-.251***	-.207**	-.186**
	(.087)	(.085)	(.088)	(.087)
age_sq	.002**	.002***	.002**	.001**
	(.001)	(.001)	(.001)	(.001)
over_65	-.027			
	(.654)			
female_farmer	1.361**	1.246**	1.027*	1.004*
	(.554)	(.559)	(.581)	(.589)
daughter_only	2.051***	2.344***	2.548***	2.506***
	(.614)	(.649)	(.575)	(.587)
retire	.305	.447	.401	.566
	(.453)	(.466)	(.465)	(.478)
acre_total	0	0	0	0
	(0)	(0)	(0)	(0)
rowcroponly	.357	.443	.437	.395
	(.419)	(.421)	(.422)	(.427)
yr_start_farm	-.008*	-.009**	-.009**	-.008*
	(.004)	(.004)	(.004)	(.004)
farm_good	-.43	-.63	-.728*	-.82*
	(.402)	(.419)	(.438)	(.449)
son_is_oldest	-.341	-.405	-.405	-.389

	(.554)	(.558)	(.565)	(.572)
num_sons	-.085	-.107		
	(.309)	(.31)		
work_farm		1.059**	1.122**	1.248**
		(.538)	(.555)	(.575)
succ_agjob		1.769***	1.827***	1.992***
		(.593)	(.608)	(.626)
college_degree			1.059**	1.032**
			(.423)	(.421)
partner_spouse			.784*	.72
			(.436)	(.44)
intercept	18.05**	21.387**	19.038**	15.886*
	(8.629)	(8.856)	(8.989)	(9.007)
Observations	589	589	589	586
Crop reporting district FE	No	No	No	Yes

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4. Robustness checks using alternative measures of dependent variables

	(1)	(2)	(3)	(4)
	succ_23_daughter	Succ_all_daughter	succ_female	succ_son
age	-.085	-.14**	-.184**	-.139**
	(.087)	(.07)	(.077)	(.067)
age_sq	0	.001	.001**	.001*
	(.001)	(.001)	(.001)	(.001)
female_farmer	-.665	.517	.76	-.05
	(.841)	(.492)	(.549)	(.446)
daughter_only	-.298	.555	1.825***	-4.146***
	(.446)	(.345)	(.412)	(1.03)
retire	-1.005**	-.293	.012	-.582**
	(.494)	(.339)	(.407)	(.25)
acre_total	0	0	0	0
	(0)	(0)	(0)	(0)
rowcroponly	-.278	-.121	.179	-.268
	(.305)	(.262)	(.336)	(.211)
yr_start_farm	-.002	-.003	-.007*	-.004
	(.004)	(.003)	(.004)	(.003)
farm_good	.358	.106	-.87**	.651***
	(.312)	(.269)	(.348)	(.208)
son_is_oldest	.38	.21	.121	-.668***
	(.318)	(.283)	(.398)	(.2)

college_degree	.108	.451*	.038	.058
	(.34)	(.274)	(.353)	(.227)
partner_spouse	.396	.474	.455	-.279
	(.343)	(.289)	(.364)	(.239)
work_farm	.291	.655*	1.351***	.99***
	(.427)	(.354)	(.436)	(.294)
succ_agjob	.321	.661*	1.122**	1.614***
	(.466)	(.391)	(.522)	(.323)
intercept	4.662	9.005	16.101**	11.9**
	(7.608)	(6.337)	(7.728)	(5.512)
Observations	586	586	586	586
Pseudo R2	.115	.098	.17	.222
Crop reporting district FE	No	No	No	Yes

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5. Marginal effects of key explanatory variables in driving farm successor choice (in percentage %)

Variables	Value	Succ_daughter Table 3 Model 3	Succ_daughter_FE Table 3 Model 4	Succ_23_daughter Table 4 Model 1	Succ_all_daughter Table 4 Model 2	Succ_female Table 4 Model 3	Succ_son Table 4 Model 4
female_farmer	0	5.389***	5.852***	10.123***	13.797***	8.265***	40.150***
		(0.890)	(0.918)	(1.221)	(1.400)	(1.104)	(1.796)
	1	11.707***	12.350***	5.751	20.315***	14.695***	39.251***
		(4.434)	(4.659)	(4.172)	(6.843)	(5.456)	(7.722)
daughter_only	0	3.318***	3.692***	10.293***	13.052***	5.972***	45.023***
		(0.775)	(0.823)	(1.340)	(1.489)	(1.042)	(2.039)
	1	23.969***	24.774***	8.042***	19.952***	24.932***	2.003
		(6.367)	(6.440)	(2.742)	(4.430)	(5.554)	(1.958)
partner_spouse	0	4.847***	5.336***	9.124***	12.859***	7.860***	41.276***
		(0.971)	(1.027)	(1.303)	(1.520)	(1.223)	(2.027)
	1	8.933***	9.309***	12.571***	18.474***	11.212***	36.307***

		(2.235)	(2.326)	(2.845)	(3.262)	(2.534)	(3.667)
succ_agjob	0	5.068***	5.434***	9.609***	13.364***	8.048***	36.288***
		(0.837)	(0.863)	(1.232)	(1.407)	(1.070)	(1.902)
	1	17.886***	20.658***	12.438***	21.795***	18.106***	65.218***
		(5.351)	(5.867)	(4.228)	(5.408)	(5.605)	(4.618)
work_farm	0	5.183***	5.564***	9.571***	13.138***	7.354***	37.436***
		(0.882)	(0.909)	(1.251)	(1.428)	(1.074)	(1.921)
	1	11.899***	13.764***	12.116***	21.427***	20.024***	55.574***
		(3.905)	(4.477)	(3.744)	(4.794)	(4.979)	(4.791)
Observations		589	586	586	586	586	586

Figure 1. Whether respondents have identified a successor (2019)

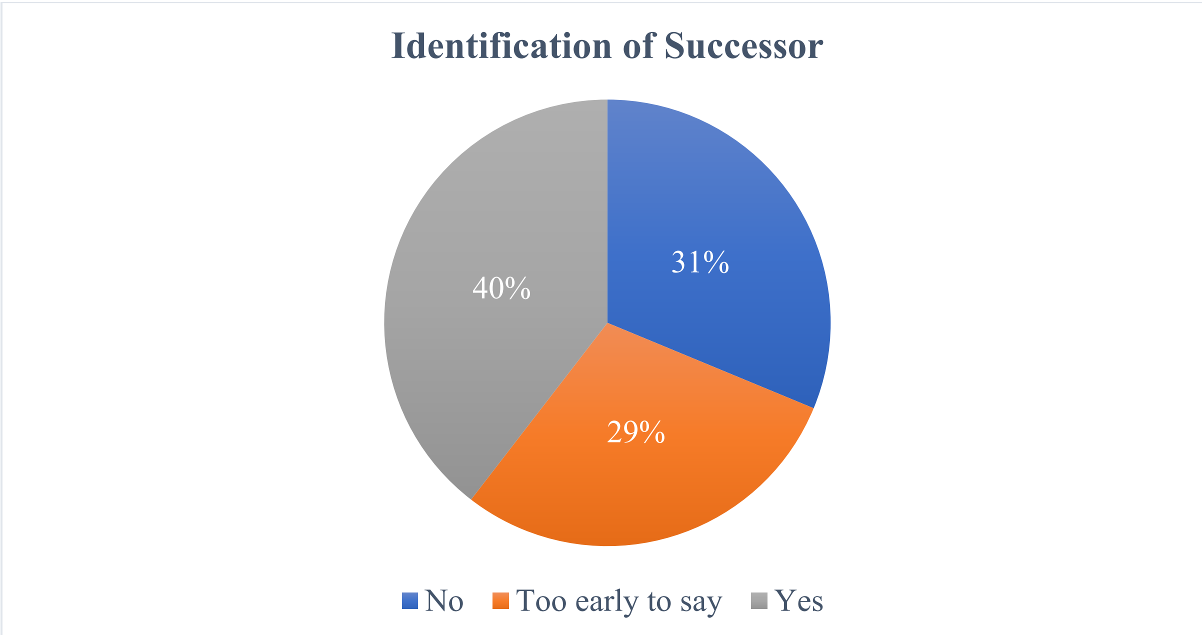
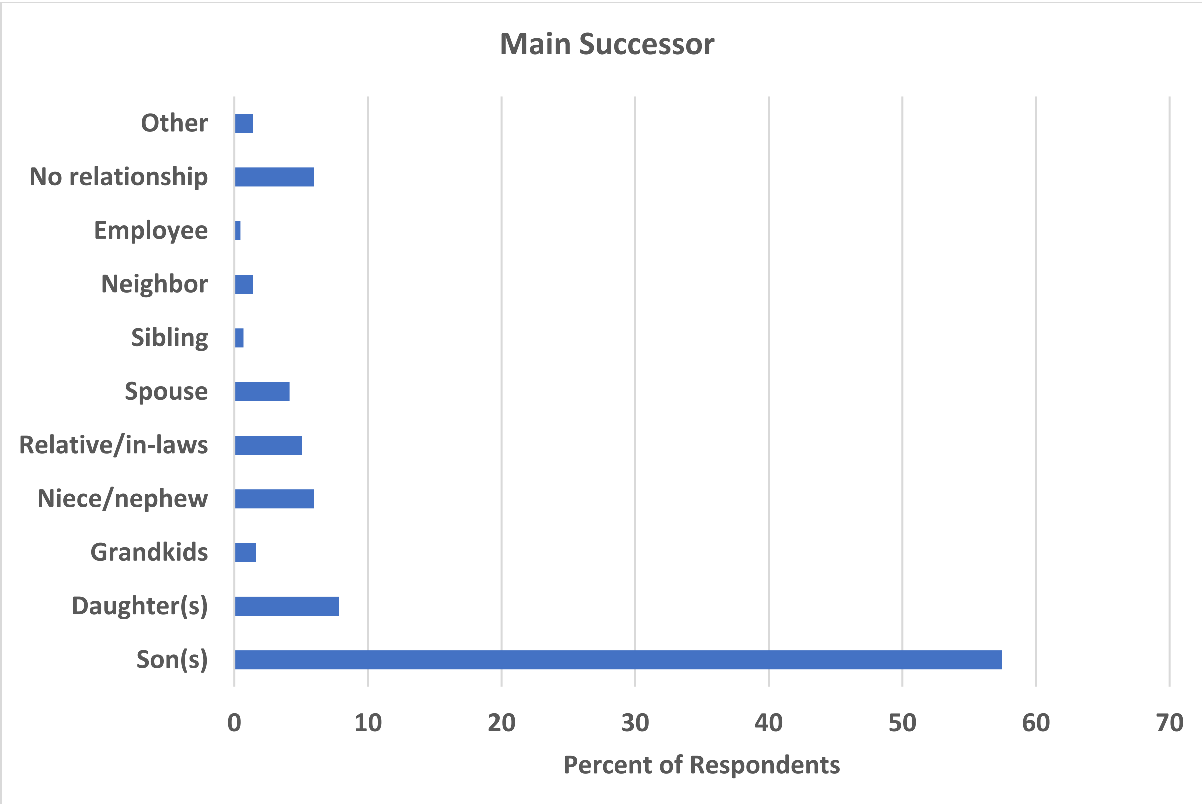


Figure 2. The distribution of main successors chosen by survey respondents who have identified a successor



Note: Successor is defined as someone who will eventually take over the management of the farm.

Figure 3. Distribution of main successor choices by successor gender and the farmer's family structure

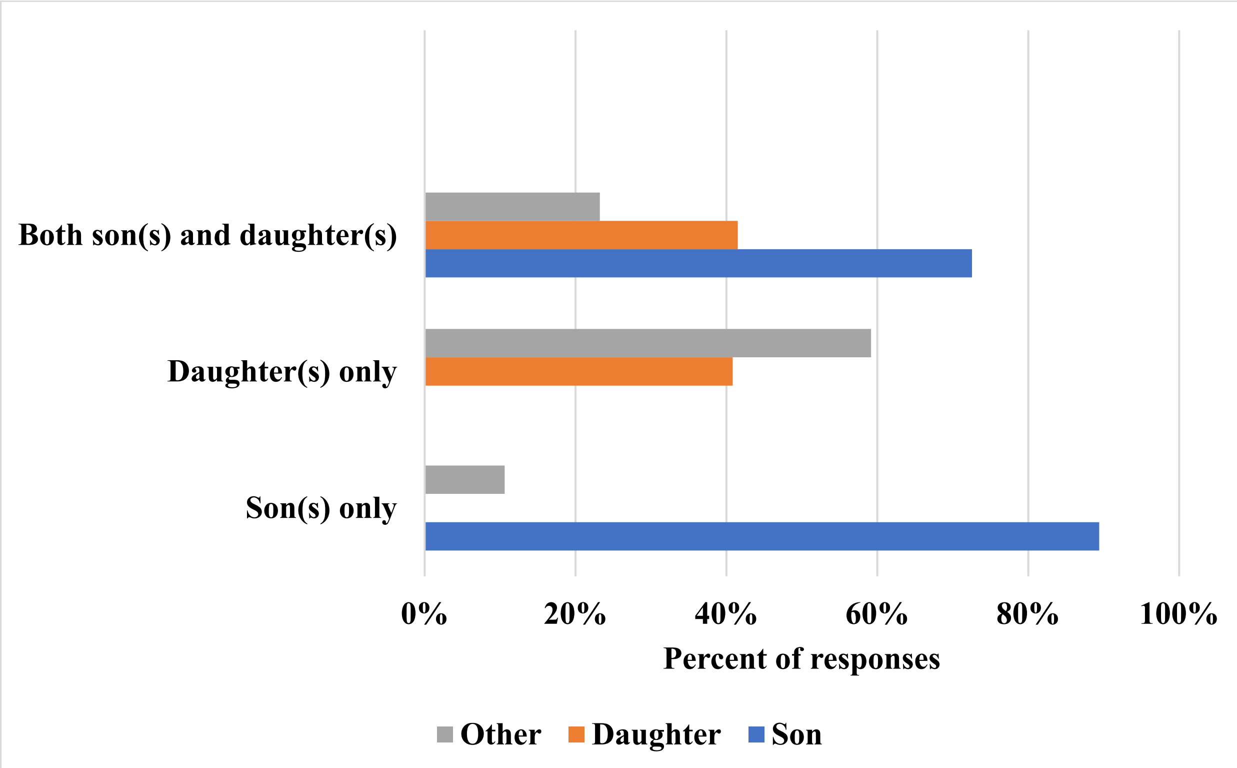


Figure 4. Sample description by successor types.

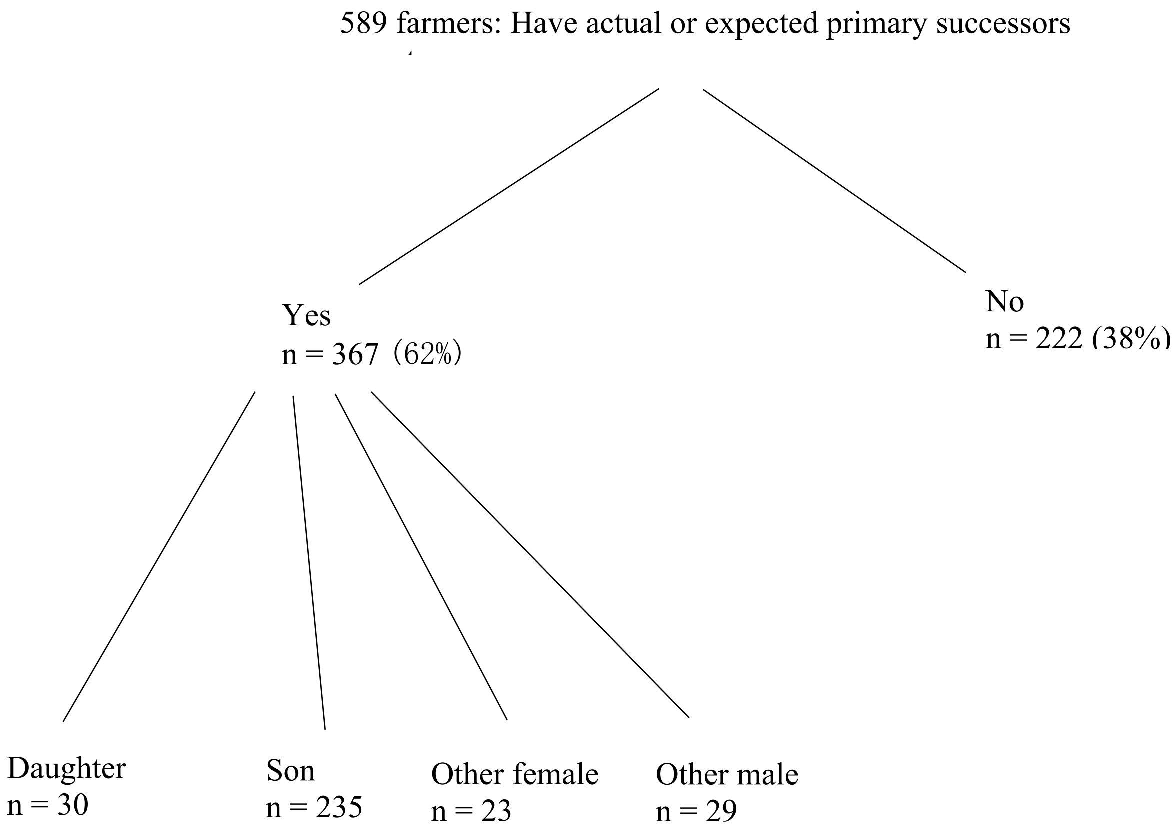


Table A1. Regression results that explain choosing a daughter as main successor, King and Zeng method

	Model 1	Model 2	Model 3	Model 4
age	-.202**	-.253***	-.209**	-.187**
	(.094)	(.091)	(.083)	(.084)
age_sq	.002*	.002***	.002**	.001**
	(.001)	(.001)	(.001)	(.001)
over_65	-.026			
	(.699)			
female_farmer	1.367**	1.234**	1.014	.989
	(.588)	(.627)	(.631)	(.621)
daughter_only	2.032***	2.331***	2.549***	2.502***
	(.525)	(.605)	(.626)	(.641)
retire	.307	.451	.406	.577
	(.473)	(.517)	(.51)	(.52)
acre_total	0	0	0	0
	(0)	(0)	(0)	(0)
rowcroponly	.356	.442	.435	.391
	(.421)	(.424)	(.434)	(.441)
yr_start_farm	-.008*	-.009**	-.009**	-.008
	(.005)	(.005)	(.005)	(.005)
farm_good	-.428	-.629	-.729*	-.822*
	(.398)	(.396)	(.405)	(.426)
son_is_oldest	-.329	-.404	-.412	-.395
	(.612)	(.609)	(.602)	(.572)
num_sons	-.084	-.107		
	(.179)	(.193)		
work_farm		1.06	1.123*	1.251**

		(.665)	(.634)	(.624)
succ_agjob		1.783***	1.845***	2.016***
		(.631)	(.659)	(.638)
college_degree			1.063**	1.032**
			(.414)	(.408)
partner_spouse			.784*	.716*
			(.41)	(.394)
intercept	18.038*	21.457**	19.024**	15.816*
	(9.63)	(9.558)	(9.243)	(9.51)
Crop reporting district FE	No	No	No	Yes

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A2. Firthlogit regression results that explain choosing a daughter as main successor (robust check)

	Model 1	Model 2	Model 3	Model 4
age	-.202**	-.254***	-.207**	-.185**
	(.087)	(.087)	(.089)	(.087)
age_sq	.002**	.002***	.002**	.001*
	(.001)	(.001)	(.001)	(.001)
over_65	-.027			
	(.654)			
female_farmer	1.361**	1.274**	.97	.907
	(.554)	(.573)	(.6)	(.62)
daughter_only	2.051***	2.366***	2.338***	2.27***
	(.614)	(.667)	(.584)	(.592)
retire	.305	.44	.467	.579
	(.453)	(.476)	(.475)	(.486)
acre_total	0	0	0	0
	(0)	(0)	(0)	(0)
rowcroponly	.357	.418	.33	.368
	(.419)	(.425)	(.428)	(.432)
yr_start_farm	-.008*	-.01**	-.01**	-.009*
	(.004)	(.004)	(.005)	(.004)
farm_good	-.43	-.556	-.666	-.668
	(.402)	(.427)	(.449)	(.456)

son_is_oldest	-.341	-.39	-.501	-.479
	(.554)	(.573)	(.588)	(.604)
num_sons	-.085	.134		
	(.309)	(.326)		
work_farm		-.479	-.366	-.105
		(1.485)	(1.484)	(1.498)
farm_not_son		1.942	1.84	1.625
		(1.545)	(1.522)	(1.538)
succ_agjob		-.424	-.293	-.113
		(1.474)	(1.484)	(1.49)
ag_not_son		3.272**	3.058**	2.953*
		(1.526)	(1.523)	(1.524)
college_degree			1.055**	1.026**
			(.439)	(.44)
partner_spouse			.682	.587
			(.445)	(.453)
intercept	18.05**	23.783***	21.358**	17.952**
	(8.629)	(9.147)	(9.4)	(9.158)
Observations	589	589	589	586
Crop reporting district FE	No	No	No	Yes

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A3. Robustness checks using alternative measures of dependent variables (firthlogit method)

	(1)	(2)	(3)	(4)
	succ_23_daughter	Succ_all_daughter	succ_female	succ_son
age	-.088	-.136**	-.175**	-.13**
	(.083)	(.066)	(.072)	(.065)
age_sq	0	.001	.001**	.001*
	(.001)	(.001)	(.001)	(.001)
female_farmer	-.431	.531	.775	-.052
	(.743)	(.466)	(.514)	(.431)
daughter_only	-.245	.537	1.675***	-3.607***
	(.426)	(.333)	(.39)	(.843)
retire	-.887*	-.255	.039	-.556**
	(.466)	(.327)	(.387)	(.244)
acre_total	0	0	0	0
	(0)	(0)	(0)	(0)
rowcroponly	-.261	-.115	.166	-.256
	(.295)	(.255)	(.322)	(.206)
yr_start_farm	-.002	-.003	-.006*	-.004
	(.003)	(.003)	(.004)	(.003)
farm_good	.333	.101	-.802**	.626***
	(.301)	(.261)	(.333)	(.203)
son_is_oldest	.359	.203	.132	-.642***

	(.307)	(.275)	(.381)	(.196)
college_degree	.106	.43	.048	.058
	(.328)	(.265)	(.338)	(.221)
partner_spouse	.377	.453	.42	-.264
	(.33)	(.28)	(.348)	(.233)
work_farm	.308	.639*	1.257***	.946***
	(.407)	(.342)	(.412)	(.286)
succ_agjob	.347	.655*	1.082**	1.536***
	(.443)	(.376)	(.492)	(.313)
intercept	4.761	8.697	15.03**	11.267**
	(7.277)	(6.125)	(7.34)	(5.351)
Observations	586	586	586	586
Crop reporting district FE	No	No	No	Yes

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.