Succession and investment in New Zealand farming

William C.C. Wright, Pike Brown

Abstract

Farm operations in New Zealand are traditionally run as family businesses in which land and capital are handed down from one generation to the next. Such family businesses have time horizons that are measured in generations rather than years, and the identification of a successor encourages long-term planning that farms without successors cannot justify. Simultaneously, farms that invest in productive capital have higher future earnings potential, *ceteris paribus*, and therefore be more attractive to potential successors. Both of these relationships imply a correlation between succession planning and investment. In this paper we separate the causal effect succession planning has on investment using two-stage ordered probit regression with instrumental variables, namely, the extent farmers report they farm due to family tradition and the number of generations that the family has farmed in New Zealand. Our results show that the presence of a successor does in fact raise investment.

Key words

farm planning; intensification; demographics; age; instrumental variables; Survey of Rural Decision Makers

William C.C. Wright
Landcare Research, Auckland, New Zealand
e-mail: wrightw@landcareresearch.co.nz

Pike Brown
Landcare Research, Lincoln, New Zealand
e-mail: brownp@landcareresearch.co.nz

Introduction

Farm operations in New Zealand are traditionally run as family businesses in which land and capital are handed down from one generation to the next. As such, time horizons are measured in generations rather than years, and therefore the identification of a successor encourages long-term planning that farms without successors cannot justify. A longer planning horizon incentivizes farmers to invest in productive capital even as they near retirement. In contrast, older farmers without successors may underinvest in productive capital and consume their material assets as they approach retirement (Calus et al. 2008).

Currently, only 30% of New Zealand farms have identified successors. So few farms having identified successors has implications for the efficiency of the New Zealand agricultural sector because farms without successors may be under capitalised as current farmers approach retirement. Meanwhile, the New Zealand Government has articulated a goal of doubling the value of primary-production exports between 2012 and 2025 (MPI 2013). In order to achieve this goal, land currently in primary production must be used efficiently.

Previous research on farm succession has largely focused on of the question of *whether* a successor has been identified. For example, the age of the current farm operator has been shown to have a strictly positive influence on the probability of a successor having been identified (Corsi 2006, Mishra and El-Osta 2008, Glauben et al. 2009, Mishra et al. 2010, Chang 2013) although in other cases, the relationship between age and whether a successor has been identified is shown to be non-monotonic (Stiglbauer and Weiss 2000, Kimhi and Nachlieli 2001, Glauben et al. 2004). However, the literature does agree that farms with female heads are more likely to have identified successors (Stiglbauer and Weiss 2000, Corsi 2006, Chang 2013), possibly because female-headed farms are disproportionately likely to be operated by married couples.

Much of the preceding literature on the relationship between farm growth and succession planning suggest that succession planning follows causally from investment. For example, farms with higher expected returns have been shown to be more likely to have identified successors, as have farm size (Stiglbauer and Weiss 2000, Hennessy and Rehman 2007, Glauben et al. 2009, Chang 2013); farm income, standard gross margin, and farm profit (Glauben et al. 2004, Corsi 2006, Glauben et al. 2009); farm assets (Mishra et al. 2010, Mishra and El-Osta 2008); farmers' willingness to intensify production (Sottomayor et al. 2011); and on-farm diversification (Stiglbauer and Weiss 2000, Meert et al. 2005, Sottomayor et al. 2011). Conversely, Kimhi and Nachlieli (2001) find that farm area has a negative effect on the probability of identifying a successor. Finally, the relationship between growth and succession planning is empirically ambiguous: Stiglbauer and Weiss (2000) report a negative correlation between growth and succession planning while Glauben et al. (2004) and Mishra and El-Osta (2008) report a positive correlation.

However, both Stiglbauer and Weiss (2000) and Glauben et al. (2004) argue for caution in interpreting the causal effect of on-farm investment on succession planning. Specifically, they argue that farmers without identified successors or with low probabilities of identifying successors rationally lack the incentives to expand their enterprises. Similarly, Mishra et al. (2010) express concern about simultaneity between farm assets and succession planning.

A smaller body of research has focused on the causal effect of successorship on on-farm investment. For example, Potter and Lobley (1992, 1996) show that farms with positive succession prospects are more likely to increase farm area and to make larger investments than farms with poorer prospects for succession. Similarly, Calus et al. (2008) find that farms with identified successors have higher average farm assets and higher growth in farm assets. Calus and Van Huylenbroeck (2008) use panel data to argue that farms with high probabilities of identifying successors invest more in farm assets throughout farmers' lifetimes. Further, Toma et al. (2011) show that land managers' intentions to pass businesses on is the strongest determinant of intentions to increase business size. Similarly, Lefebvre et al. (2014) and Fischer and Burton (2014) find that not having a successor has a negative effect on intentions to invest in land and buildings. Finally, Mishra et al. (2014) find a negative correlation between a potential successor being present on farm and the probability of a households exit from primary farming. Although concluding that identifying a successor has a causal effect on on-farm investment decisions, Potter and Lobley (1996), Calus and Van Huylenbroeck (2008), and Toma et al. (2011) each acknowledge that simultaneity concerns remain.

Asset fixity theory (Johnson 1955, Hsu and Chang 1990) provides a theoretical argument for a causal effect of successorship on on-farm investment. According to this theory, farm assets will remain fixed provided that their expected marginal benefit is lower than their expected marginal cost and that their marginal benefit remains higher than their marginal benefit in another use. The expected marginal benefit of an additional unit of assets on any given farm will be higher if a successor has been identified because the presence of a successor will provide the farm with a longer time horizon, particularly if the current farmer is nearing retirement. Therefore, the presence of a successor will stimulate on-farm investment. Furthermore, most farm equipment does not have alternative uses outside agriculture, so no potential buyer of old farm equipment will have a reservation price above the depreciation cost. Therefore, farmers will not invest in new equipment if they plan to close their farm operations in the near future as the liquidation price of equipment will be below the depreciation cost.

Thus, in this paper, we argue that the presence of successors encourages New Zealand farmers to make capital investments, even controlling for age and other correlates of investment. To address simultaneity concerns, we use two individual measures of farming history (specifically, the extent to which farmers report that they farm due to family tradition and the number of generations that the family has farmed in New Zealand) as instrumental variables for succession planning. Each of these variables is a strong predictor of having identified a successor while remaining plausibly exogenous to the dependent variable. After instrumenting, we find that successorship has a positive and significant effect on on-farm investment. This result is consistent across different indicators of investment, different instrumental variables for a successor having been identified, and for both parsimonious and more structured model specifications.

In the following section of the paper, we describe the data used and summarize key variables. Section three outlines the empirical strategy used in the analysis. Section four presents the results. Section five concludes.

Data

The empirical analysis is based on the 2015 Survey of Rural Decision Makers (SRDM) (Brown 2015), a large, Internet-based survey that covers both commercial production and lifestyle farming in all 16 regions in New Zealand. The survey consists of 288 questions, including detailed information on demographics; values; objectives; land-use change; farm management; future planning; and succession. It was conducted in late 2015.

The sampling strategy relied primarily on contacting farmers via email through the National Animal Identification and Tracing database, industry and sector group membership lists, and individuals who responded to an earlier round of the Survey of Rural Decision Makers. Industry and sector groups that circulated information about the survey among their members included Beef + Lamb New Zealand, the Farm Forestry Association, Federated Farmers, the Foundation for Arable Research, Horticulture New Zealand, New Zealand Wine, the QEII Charitable Trust, and Rural Women. In addition, invitations were posted by mail to approximately 40% of all commercial farmers in the Statistics New Zealand business registry to invite them to participate in the survey. A $10 donation was made to charity for each completed survey. The survey took 27 minutes to complete, on average.

In total, 2,839 respondents completed the survey, including 1,984 commercial farmers. This sample of commercial farmers closely approximates the population of farmers reported in the 2012 New Zealand agricultural census by both geography and industry (Statistics New Zealand 2012), although sheep and/or beef farmers and farmers from Auckland and Wellington are slightly over-represented and foresters and farmers from Waikato are slightly underrepresented; the inferential analysis incorporates fixed effects for both industry and region as a result. Only commercial farm operators who identified themselves as being owners, equity partners, share milkers, or representatives of a trust were asked whether a successor had been identified. Restricting the sample to these respondents provides a final sample of 1222 responses. Summary statistics of variables used in the analysis are presented in Table 1.

Two proxies for investment can be derived from the 2015 SRDM. The first indicator is debt as a percentage of farm value because on-farm investment in New Zealand is typically debt financed. For example, debt funding is common in modern dairy farming (Greig 2010), and the Reserve Bank of New Zealand attributes a surge in farm debt in the middle and late 2000s to rapid increase in land prices, a flurry of dairy conversions, and significant on-farm investment (RBNZ 2015). The question asking respondents about the level of debt on their farm is worded: *Approximately what is the level of debt in relation to the total value of owned land, productive assets (including livestock, trees, and vines), and other capital (including buildings and machinery), excluding seasonal borrowing?* Responses where collected as a categorical variable in which respondents selected the level of debt between 0% and 100% with increments of 10%. The mean level of debt relative to farm assets in the sample is 20.8%. Figure 1 shows the distribution of debt relative to farm assets across the sample, the most common level of debt is 0, making up over a quarter of the sample. A further 45% of the sample has a debt level between 0% and 30% of total farm assets. Only 10% of the sample has a debt level over 90% of the value of total farm assets.

The second indicator of investment is a binary variable that indicates whether land use change, intensification, or some other change with high capital requirements has recently been made on the farm. Survey respondents were asked what land uses were new in the previous 10 years and what land uses had been intensified in the previous ten years. Of the possible land-use and land-management changes, conversion to or intensification of dairy farming, kiwifruit growing, grape growing for use in wine production, and other fruit production; construction of a feed pad, standoff pad, winter barn, or winter lanes in dairying; and the adoption of novel technologies including drones, windmills, robotics, computers, sensors, and Lucerne grass are used to indicate investment given the high capital requirements. From these measures, we construct two dummy variables to indicate recent investment: the first includes all of the land-use change and management practices above while the second is a stricter definition that only includes land-use change to land uses with high capital requirements and the construction of a barn for winter-stock management. Some 66.4% and 41.9% of the sample have undertaken recent investment under these “loose” and “strict” definitions, respectively.[1]

The SRDM contains two measures of family farm history that are potential instruments for succession planning when debt relative to farm assets is used to proxy investment, namely the degree to which the farmer reports that he or she farms because he or she is committed to family tradition and the number of generations that the decision maker’s family has been farming in New Zealand. The extent to which farmers choose to farm because of family tradition is measured using an 11-point scale, ranging from 0 (indicating that family tradition does not influence the decision) to 10 (indicating that family tradition exerts a very strong influence. The average score is 4.24. The average number of generations that families have been farming in New Zealand is 3.18. When the

[1] As these indicators are binary, they do not capture the scale of investment. Furthermore, not all major investments are captured by these indicators, (e.g., investment in machinery such as harvesters and tractors). For these reasons, we use second measure of investment as a robustness check.

dummy variables indicating recent land use change and recent adoption of capital-intensive land-management practices are used to proxy investment, family tradition is an inappropriate instrument for successorship because farmers who farm due to family tradition may be less likely to change land uses. Therefore, for models estimated with this dependent variable, we use the number if generations farming in New Zealand as an instrument for succession planning.

In the more structured model specifications, we include several control variables that are likely to influence farm owners' investment decisions. Primary land use is expected to be a determinant of investment because land uses with high capital requirements such as dairy farming, grape growing for wine production, and kiwifruit growing require more investment that other land uses. Primary land use is therefore included as a fixed effect. Respondents self-identified their primary industries as follows: sheep and beef (47.1%), dairy (24.4%), deer (2.7%), livestock graving (5.5%), other livestock (2.5%), arable (3.6%), forestry (2.9%), fruit and nut (5.2%), and vegetables, flowers, kiwifruit and wine (6.1%).

Farms with larger total areas may experience economies of scale leading to increased marginal returns to capital; therefore, larger farms should receive more investment in capital. The mean area of each farm in the sample is 400 hectares, although the standard deviation is large (1167 hectares).

The age of the farm decision maker should have a negative impact on investment because the expected marginal returns to investment will be lower for older farmers who are near retirement. The average age of respondents in the sample is 57 years compared to the national average of 56 (Statistics New Zealand 2012). Finally, 75% of respondents are male.

Methods

We estimate the two-equation system describing investment (y_i^*) and succession planning (S_i)

$$y_i^* = \boldsymbol{x}_i'\boldsymbol{\beta} + \delta S_i + u_i \quad (1)$$

$$S_i^* = \boldsymbol{z}_i'\boldsymbol{\alpha} + v_i \quad (2)$$

where z and x are vectors of explanatory variables, and δ is interpreted as the marginal effect of succession planning on investment.

Ordered probit is used to estimate equation 1 such that

$$y_i^* = \boldsymbol{x}_i'\boldsymbol{\beta} + \delta S_i + u_i, u \sim N(0, \sigma^2) \quad (3)$$

where y_i^* is a latent variable underlying the unobserved categorical variable, y_i. x is a vector of explanatory variables. The error term, u, is assumed to be normally distributed. Thus, for an ordered categorical dependent variable with N categories we have:

$$y = \begin{cases} 0 \; if \; y^* \leq 0 \\ 1 \; if \; 0 < y^* \leq \gamma_1 \\ 2 \; if \; \gamma_1 < y^* \leq \gamma_2 \\ \dots \\ N \; if \; \gamma_{N-1} < y^* \end{cases}$$

Where the γ are unknown at to be estimated alongside the β. The ordered probit model is estimated as a maximum likelihood function such that

$$\Pr(y_i \neq 0|x) = \int_{-\infty}^{x'\beta} \phi(t)dt = \Phi(-\boldsymbol{x}'\boldsymbol{\beta})$$

$$\Pr(y_i \neq 1|x) = \Phi(\boldsymbol{\gamma_1} - \boldsymbol{x}'\boldsymbol{\beta}) - \Phi(-\boldsymbol{x}'\boldsymbol{\beta})$$

$$\Pr(y_i \neq 1|x) = \Phi(\boldsymbol{\gamma_2} - \boldsymbol{x}'\boldsymbol{\beta}) - \Phi(\boldsymbol{\gamma_1} - \boldsymbol{x}'\boldsymbol{\beta})$$

$$\vdots$$

$$\Pr(y_i \neq J|x) = 1 - \Phi(\boldsymbol{\gamma_{J-1}} - \boldsymbol{x}'\boldsymbol{\beta})$$

The standard probit model used to estimate equation 2 is the special case of the ordered probit where *J* =2.

A similar equation structure with a standard probit replacing the ordered probit in equation one is used when the recent investment dummy variables replace debt relative to farm value as the proxy for investment.

Results

Table 2 presents the results of the first stage equation from the two-stage ordered probit with debt relative to farm assets used as a proxy for investment. In columns 1 to 3, family tradition is used to instrument for succession while the number of generations that the family has farmed in New Zealand is used to instrument for succession in columns 4 to 6. The three columns for each instrument build from a parsimonious specification (columns 1 and 4) that includes only a fixed effect for primary industry to a more structured specification (columns 3 and 6) that includes fixed effects for primary industry and region as well as controls for farm area and the age and sex of the decision maker. The sample size in each of the models is reduced in the more structured models because some questions (e.g. age) are optional.

For the models with family tradition as the instrument, the z statistic on the coefficient for family farming tradition is always greater than 6, implying that this is a strong instrument (Stock and Yogo 2005) For models with the number of farming generations as an instrument, the z statistic ranges between 2.8 and 4.0., also valid as an instrument per Stock and Yogo (2005).

Both farm area and decision maker's age have strongly significant ($p<0.01$) and positive effects on the probability successors having being identified. These results are both consistent with previous results in the literature (Stiglbauer and Weiss 2000, Corsi 2006, Hennessy and Rehman 2007,Mishra and El-Osta 2008, Glauben et al. 2009, Mishra et al. 2010, Chang 2013). Intuitively, larger farms have higher expected returns, and therefore taking over the farm is more desirable for potential successors. Younger farmers are less likely to have identified successors because their children are likely to be younger. The gender of the decision maker also has a significant effect ($p<0.1$) on the probability of a successor being identified, with female decision makers more likely to have a successor. This result is also consistent with previous literature (Stiglbauer and Weiss 2000, Corsi 2006, Chang 2013).

Table 3 presents the results from the second stage equation of the two-stage ordered probit model with debt relative to farm value used as a proxy for investment. The first three columns use family tradition to instrument for the presence of a successor while the columns 4 through 6 use the number of generations that the family has farmed in New Zealand as an instrument. Again, the three models for each instrument build from a parsimonious to more structured specifications. In all model specifications, the presence of a successor has a positive and statistically significant effect on debt relative to farm assets. This result supports the hypothesis that the presence of a successor encourages farm investment.

All other variables included in the model have the expected effect on debt relative to farm assets. The total area of the farm has a positive and strongly significant effect on debt, consistent with the notion that larger farms experience economies of scale, have a higher marginal return to capital, and therefore invest in more capital. The age of the farmer has a negative and significant effect on debt relative to farm value, a result that is consistent with our hypotheses that, holding the presence of a successor constant, older decision makers make lower investments in productive capital.

Table 4 presents the results from the second-stage equations of the probit model in which dummy variables indicating recent investment are used as a proxy for investment. Columns 1 to 3 show results where recent investment is defined loosely while columns 4 to 6 show results using the stricter definition. In all six specifications, for the number of generations that the family has farmed in New Zealand is used to instrument succession planning.

Consistent with the findings when debt relative to farm value is used to proxy investment, the presence of a successor is found to positively and significantly influence whether a farm has received significant recent investment. This result is consistent across both definitions of recent investment and all model specifications. Total area and age positively and significantly affect the probability of recent investment. Again, these findings are consistent with those when debt relative to farm value is used to proxy for investment. In these models, we also find that female decision makers more likely to make a significant capital investment, consistent with Stiglbauer and Weiss 2000, Corsi 2006, and Chang 2013.

Dairy farming being a farms primary industry is positively associated with both debt relative to farm value and the probability that large capital investments have recently been made. An alternative explanation for this correlation is dairy farms are carrying more debt because they are struggling financially and taking on debt for survival. However, the recent investment dummy variable does not capture debt held for survival. Furthermore, the debt relative to farm assets excludes seasonal borrowing. Therefore, we can be confident that the positive effect dairy farming has on debt is at least partially driven by investment[2].

Similar positive correlations are found between debt and kiwifruit farming and grape growing for wine production is some of the model specifications while in others there is no significant correlation. These correlations are similarly found in the recent investment dummy models. Fruit and nut growing has a positive correlation with debt when tradition is used to instrument succession but when maximum number of family generations farming is used as the instrument, the correlation is negative. No model specifications find a negative correlation between fruit and nut farming and investment in the recent investment dummy models, but for the loose definition of investment the correlation is positive for all specifications.

Discussion

According to asset fixity theory (Johnson 1950), successors on family farms encourage decision makers to make planning decisions with longer time horizons than if successors are not present. Extending the planning horizon implies that the expected marginal benefit of any on-farm investments will increase. It therefore follows that the presence of a successor on a family farm leads to higher on-farm investment. However, the direction of causality in the relationship between succession planning and investment is not unambiguous. A farm that invests in new productive capital will have higher expected income. Higher expected income increases the attractiveness of the farm to successors. Hence, care must be taken when investigating the correlation between investment and succession planning, and in particular when assigning causality. The existing empirical literature has frequently identified a correlation between succession planning and investment, but has often not paid close attention to the question of causality.

[2] We find similar relationships for other capital-intensive primary land uses, with coefficient being either positive and significant or insignificant. The exception to this is the coefficient on fruit and nut growing when debt is the dependent variable and generations is the instrument. We expect this sign change is caused by the choice of instrument and that families with well-established orchards they have owner for several generations do not need to borrow large amounts to maintain these orchards.

To address potential simultaneity, we use two-stage estimation with instrumental variables. We identify two strong instruments for this purpose, namely, the degree to which a farm decision maker farms because of family tradition and the number of generations that the decision maker's family has been farming in New Zealand. These instruments remain strong across different indicators of investment and the inclusion of various control variables.

We use debt relative to farm income as a proxy for investment in an ordered probit model with instrumental variables and find that identifying a successor has a causal effect on investment. As a robustness check of this result, we use a constructed dummy variable of recent land-use change and/or intensification as a proxy for investment in a probit model with instrumental variables. The estimates of this model imply that farms with identified successors are more likely to have made recent investments. Our analysis therefore provides evidence to support the hypothesis that the presence of a successor has a causal effect on on-farm investment. For both proxies of investment, the result is robust to the inclusion of a wide set of control variables.

A causal effect of identifying a successor on on-farm investment implies that farms without successors will underinvest as farm managers approach retirement. This underinvestment has implications for the productive capacity of New Zealand's land resources as undercapitalised farms will not operate efficiently. Underinvestment may also negatively impact environmental performance if, for example, there is underinvestment in construction of facilities for wintering stock off paddock during New Zealand's wet winters.

Most available advice about succession planning in New Zealand comes from banks and other private sources. Our findings suggest a role for central and local government in providing support for succession planning in New Zealand agriculture. Such support could take the form of local government providing seminars and resources to assist in the succession planning process. Alternatively, policy could encourage investment among farm owners who are nearing retirement, but have not yet identified a successor.

There is scope to repeat this analysis with a direct measure of on-farm investment in future work. Other future work could look in more detail at what areas of investment are being most neglected when a successor is not identified and whether this results in reduced productivity, reduced environmental performance, or both. There is also a need to investigate what is driving the low rate of succession planning on New Zealand farms, and the difficulties many families have when undertaking the planning process.

References

BROWN, P. Survey of Rural Decision Makers. Landcare Research NZ Ltd. Available: www.landcareresearch.co.nz/srdm2015. 2015. DOI: 10.7931/J28913S8

CALUS, M. & VAN HUYLENBROECK, G. The succession effect within management decisions of family farms. 12th Congress of the European Association of Agricultural Economists–EAAE 2008.

CALUS, M., VAN HUYLENBROECK, G. & VAN LIERDE, D. 2008. The relationship between farm succession and farm assets on Belgian farms. *Sociologia Ruralis,* 48**,** 38-56.

CHANG, H.-H. 2013. Old farmer pension program and farm succession: Evidence from a population-based survey of farm households in Taiwan. *American Journal of Agricultural Economics***,** aat004.

CORSI, A. Which Italian family farms will have a successor. Poster Paper presented at the 26th Conference of the International Association of Agricultural Economists, Gold Coast, Australia 2006. 12-18.

FISCHER, H. & BURTON, R. J. 2014. Understanding farm succession as socially constructed endogenous cycles. *Sociologia Ruralis,* 54**,** 417-438.

GLAUBEN, T., PETRICK, M., TIETJE, H. & WEISS, C. 2009. Probability and timing of succession or closure in family firms: a switching regression analysis of farm households in Germany. *Applied Economics,* 41**,** 45-54.

GLAUBEN, T., TIETJE, H. & WEISS, C. R. 2004. Intergenerational succession in farm households: Evidence from upper Austria. *Review of Economics of the Household,* 2**,** 443-462.

GREENE, W. H. 2011. *Econometric Analysis (7th Edition),* New Jersey, Pearson Education.

HENNESSY, T. C. & REHMAN, T. 2007. An investigation into factors affecting the occupational choices of nominated farm heirs in Ireland. *Journal of Agricultural Economics,* 58, 61-75.

HSU, S.-H. & CHANG, C.-C. 1990. An adjustment-cost rationalization of asset fixity theory. *American Journal of Agricultural Economics,* 72, 298-308.

JOHNSON, D. G. 1950. The nature of the supply function for agricultural products. *The American Economic Review,* 40, 539-564.

JOHNSON, G. L. 1955. Results from production economic analysis. *Journal of Farm Economics,* 37 206-222.

KIMHI, A. & NACHLIELI, N. 2001. Intergenerational Succession on Israeli Family Farms. *Journal of Agricultural Economics,* 52**,** 42-58.

LEFEBVRE, M., PALOMA, G. Y. & VIAGGI, D. EU farmers' intentions to invest in 2014-2020: complementarity between asset classes. 2014 International Congress, August 26-29 2014, Ljubljana, Slovenia 2014. European Association of Agricultural Economists.

MEERT, H., VAN HUYLENBROECK, G., VERNIMMEN, T., BOURGEOIS, M. & VAN HECKE, E. 2005. Farm household survival strategies and diversification on marginal farms. *Journal of rural studies,* 21**,** 81-97.

MISHRA, A. K. & EL-OSTA, H. S. 2008. Effect of agricultural policy on succession decisions of farm households. *Review of Economics of the Household,* 6**,** 285-307.

MISHRA, A. K., EL-OSTA, H. S. & SHAIK, S. 2010. Succession decisions in US family farm businesses. *Journal of Agricultural and Resource Economics***,** 133-152.

MISHRA, A. K., FANNIN, J. M. & JOO, H. 2014. Off‐Farm Work, Intensity of Government Payments, and Farm Exits: Evidence from a National Survey in the United States. *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie,* 62**,** 283-306.

MPI 2013. Ministry for Primary Industries Statement of Intent 2013-2018. Wellington, New Zealand: Ministry for Primary Industries.

POTTER, C. & LOBLEY, M. 1992. Ageing and Succession on Family Farms: The Impact on Decision‐making and Land Use. *Sociologia Ruralis,* 32**,** 317-334.

POTTER, C. & LOBLEY, M. 1996. The farm family life cycle, succession paths and environmental change in Britain's countryside. *Journal of Agricultural Economics,* 47**,** 172-190.

RBNZ 2015. Bulletin December 2015 Vol. 78 No. 8. Wellington: Reserve Bank of New Zealand.

SOTTOMAYOR, M., TRANTER, R., COSTA, L., SOTTOMAYOR, M., TRANTER, R. & COSTA, L. 2011. Likelihood of succession and farmers' attitudes towards their future behaviour: evidence from a survey in Germany, the United Kingdom and Portugal. *International Journal of Sociology of Agriculture and Food,* 18**,** 121-133

STATISTICS NEW ZELAND. (2012). 2012 Agricultural Census. http://www.stats.govt.nz/browse_for_stats/industry_sectors/agriculture-horticulture-forestry/2012-agricultural-census-tables.aspx

STIGLBAUER, A. & WEISS, C. 2000. Family and non-family succession in the Upper-Austrian farm sector. *Cahiers d'Économie et Sociologie Rurales,* 54**,** 5-26.

STOCK, J. H. & YOGO, M. 2005. Testing for Weak Instruments in Linear IV Regression. *In:* STOCK, J. H. & ANDREWS, D. W. K. (eds.) *Identification and Inference for Econometric Models: Essays in Honor of Thomas J. Rothenberg.* Cambridge: Cambridge University Press.

TOMA, L., SUTHERLAND, L.-A., BARNES, A., RENWICK, A. W., MCCRUM, G. & BLACKSTOCK, K. Policy Implications of a Behavioural Economics Analysis of Land Use Determinants in Rural Scotland. 2011 International Congress, August 30-September 2 2011, Zurich, Switzerland 2011. European Association of Agricultural Economists.

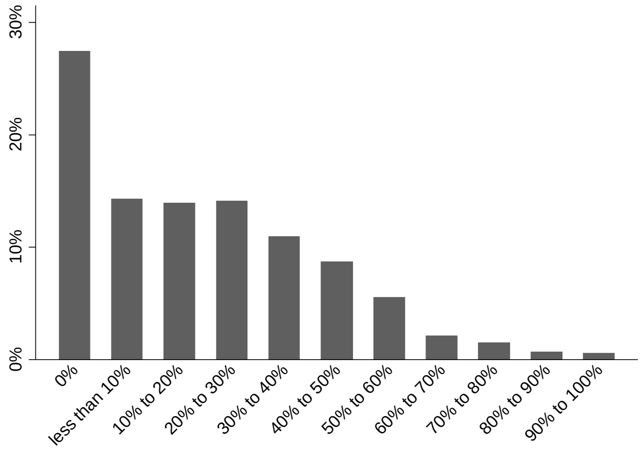

Figure 1 Distribution of level of debt across survey respondents

Table 1 Summary statistics

Variable	Unit	Mean	Standard deviation
Debt relative to total farm assets	Percentage	20.84688	21.17607
Recent investment (loose)	0/1	0.6644845	0.4723637
Recent investment (strict)	0/1	0.4189853	0.493595
Farm because of family tradition (10 point likert scale)	0 to 10	4.141571	2.782375
Maximum family generations farming in NZ	Number	3.182746	1.550451
Total area	Hectares	399.2716	1166.997
Total area (log scale)		4.768231	1.716957
Age	Years	56.79769	10.89906
Male	0/1	.7722772	.4195359
Auckland	0/1	.0417349	.2000645
Bay of Plenty	0/1	.0769231	.2665785
Canterbury	0/1	.1481178	.3553622
Gisbourne	0/1	.0171849	.1300133
Hawke's Bay	0/1	.0703764	.2558851
Manawatu / Whanganui	0/1	.1096563	.3125888
Marlborough	0/1	.0278232	.1645335
Northland	0/1	.0777414	.2678739
Otago	0/1	.0842881	.2779331
Southland	0/1	.0662848	.2488811
Taranaki	0/1	.0515548	.221217
Tasman	0/1	.0343699	.182252
Waikato	0/1	.1260229	.3320111
Wellington	0/1	.0490998	.2161649
West coast	0/1	.0188216	.1359503
Sheep/Beef	0/1	.471464	.4993916
Dairy	0/1	.2440033	.4993916
Deer	0/1	.0272953	.1630099
Grazing	0/1	.0545906	.2272733
Other stock	0/1	.0239868	.1530712
Arable	0/1	.0355666	.1852836
Veg/Flowers	0/1	.0157155	.1244239
Kiwi	0/1	.0231596	.1504726
Wine grapes	0/1	.0223325	.1478237
Fruit/Nuts	0/1	.0521092	.2223392
Forestry	0/1	.0297767	.170041
Observations			1222

Table 2 Probit estimates for probability of a successor being identified

Dependent variable	Successor identified					
	(1)	(2)	(3)	(4)	(5)	(6)
Committed to family farm tradition	0.106***	0.105***	0.0881***			
	(8.06)	(8.01)	(6.09)			
Maximum family generations farming in NZ				0.115***	0.116***	0.0816***
				(4.02)	(4.02)	(2.80)
Total area (log scale)			0.204***			0.233***
			(6.19)			(6.70)
Age			0.0303***			0.0304***
			(7.26)			(6.79)
Male			-0.181*			-0.216**
			(-1.85)			(-2.06)
Primary industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Regional fixed effects	No	Yes	Yes	No	Yes	Yes
Constant	-1.035***	-0.894***	-3.483***	-0.960***	-0.947***	-3.550***
	(-12.52)	(-4.64)	(-9.10)	(-8.43)	(-4.28)	(-8.69)
Observations	1209	1209	1189	1202	1202	1183

z statistics in parentheses * p<0.1, ** p<0.05, *** p<0.01

Sheep and Beef farming and Auckland are omitted categories for the fixed effects

Table 3 Ordered probit estimates for debt as a percentage of farm value

Dependent variable	Debt (% of total farm value)					
	(1)	(2)	(3)	(4)	(5)	(6)
Instrument	Tradition			Maximum generations		
Successor identified	0.522*	0.588**	0.510*	0.412*	0.441*	0.672**
	(1.66)	(2.03)	(1.95)	(1.80)	(1.95)	(2.39)
Dairy	1.228***	1.466***	1.375***	0.750***	0.800***	0.734***
	(9.59)	(9.94)	(9.23)	(9.90)	(9.70)	(8.40)
Deer	0.412*	0.361	0.452*	-0.279	-0.280	-0.110
	(1.71)	(1.47)	(1.85)	(-1.45)	(-1.46)	(-0.55)
Grazing	-0.202	-0.152	-0.0617	-0.128	-0.111	0.0476
	(-1.26)	(-0.90)	(-0.36)	(-0.87)	(-0.76)	(0.35)
Other stock	-0.439*	-0.402*	-0.119	-0.0351	0.0481	0.433*
	(-1.86)	(-1.66)	(-0.45)	(-0.17)	(0.22)	(1.72)
Arable	-0.0185	-0.245	-0.284	0.214	0.165	0.141
	(-0.09)	(-1.06)	(-1.19)	(1.45)	(1.06)	(0.89)
Veg/Flowers	-0.506*	-0.480	-0.147	-0.281	-0.201	0.137
	(-1.68)	(-1.51)	(-0.46)	(-0.89)	(-0.64)	(0.44)
Kiwifruit	0.297	0.579**	0.974***	-0.305	-0.226	0.300
	(1.22)	(2.23)	(3.57)	(-1.13)	(-0.81)	(1.08)
Wine grapes	0.436*	0.501	0.938***	0.214	0.389	0.937***
	(1.66)	(1.49)	(2.71)	(0.99)	(1.36)	(3.23)
Fruit/Nuts	0.498***	0.577***	1.027***	-0.513***	-0.443***	0.112
	(2.78)	(2.97)	(4.84)	(-3.15)	(-2.72)	(0.62)
Forestry	-1.084***	-1.198***	-1.009***	-0.825***	-0.730**	-0.396
	(-4.26)	(-4.53)	(-3.68)	(-3.01)	(-2.56)	(-1.39)
Total area (log scale)			0.0941***			0.121***
			(2.67)			(3.36)
Age			-0.0475***			-0.0465***
			(-12.98)			(-11.69)
Male			-0.0152			-0.0371
			(-0.20)			(-0.47)
Regional fixed effects	No	Yes	Yes	No	Yes	Yes
Observations	1209	1209	1189	1202	1202	1183

z statistics in parentheses * p<0.1, ** p<0.05, *** p<0.01

Sheep and Beef farming and Auckland are omitted categories for the fixed effects

Table 4 Probit estimates for probability of sizable investment

Dependent variable	Sizable investment (loose)			Sizable investment (strict)		
	(1)	(2)	(3)	(4)	(5)	(6)
Successor identified	0.522*	0.588**	0.510*	0.490*	0.566**	0.684***
	(1.66)	(2.03)	(1.95)	(1.91)	(2.07)	(2.61)
Dairy	1.228***	1.466***	1.375***	1.337***	1.351***	1.328***
	(9.59)	(9.94)	(9.23)	(12.01)	(10.70)	(10.42)
Deer	0.412*	0.361	0.452*	-0.0350	-0.0474	-0.0426
	(1.71)	(1.47)	(1.85)	(-0.15)	(-0.20)	(-0.18)
Grazing	-0.202	-0.152	-0.0617	-0.141	-0.127	-0.111
	(-1.26)	(-0.90)	(-0.36)	(-0.83)	(-0.72)	(-0.62)
Other stock	-0.439*	-0.402*	-0.119	-0.244	-0.263	-0.299
	(-1.86)	(-1.66)	(-0.45)	(-0.97)	(-1.05)	(-1.14)
Arable	-0.0185	-0.245	-0.284	-0.329	-0.443*	-0.489**
	(-0.09)	(-1.06)	(-1.19)	(-1.44)	(-1.84)	(-2.00)
Veg/Flowers	-0.506*	-0.480	-0.147	-0.612*	-0.623*	-0.692*
	(-1.68)	(-1.51)	(-0.46)	(-1.73)	(-1.81)	(-1.94)
Kiwifruit	0.297	0.579**	0.974***	-0.567*	-0.482	-0.499
	(1.22)	(2.23)	(3.57)	(-1.92)	(-1.53)	(-1.52)
Wine grapes	0.436*	0.501	0.938***	-0.0902	0.356	0.324
	(1.66)	(1.49)	(2.71)	(-0.35)	(1.12)	(0.99)
Fruit/Nuts	0.498***	0.577***	1.027***	-0.219	-0.191	-0.236
	(2.78)	(2.97)	(4.84)	(-1.22)	(-1.03)	(-1.20)
Forestry	-1.084***	-1.198***	-1.009***	-1.449***	-1.466***	-1.459***
	(-4.26)	(-4.53)	(-3.68)	(-3.49)	(-3.58)	(-3.64)
Total area			0.151***			-0.0397
			(4.04)			(-1.17)
Age			-0.00976**			-0.0153***
			(-2.09)			(-3.42)
Male			0.0434			0.0262
			(0.41)			(0.26)
Regional fixed effects	No	Yes	Yes	No	Yes	Yes
Observations	1209	1209	1189	1209	1209	1189

z statistics in parentheses * p<0.1, ** p<0.05, *** p<0.01

Sheep and Beef farming and Auckland are omitted categories for the fixed effects