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Daniele Cavicchioli and Danilo Bertoni

FARM SUCCESSION, OCCUPATIONAL CHOICE AND FARM ADAPTATION AT THE RURAL-URBAN INTERFACE: THE CASE OF ITALIAN HORTICULTURAL FARMS

ABSTRACT

The survival of family farming in Europe is a crucial issue, as it assures landscape maintenance in marginal areas and provides transmission and accumulation of site-specific knowledge in agricultural activity. Using data from a sample of Italian horticultural farms, we explored the multiple forces driving farm succession in a high value added sector. In addition to the traditional factors examined in the literature (farm, farmer and family features), we treated the farm transfer choice as the complement of the decision to migrate out of the agricultural sector, testing the effects of local labour market conditions (employment, income gap between farm and non-farm sector) and population density around the farm, as a proxy of rural-urban interface relationships. It has been shown that both traditional factors and territorial and labour market conditions influence the probability of farm succession. Interestingly labour market conditions exerted an effect in line with occupational choice theory only in less inhabited areas; in more densely populated regions a rural-urban linkage effect seems to prevail, creating an environment that fosters succession of young horticultural farmers. Peri-urban areas may thus be a favourable location for professional and specialized horticultural farms, as well as multifunctional and de-specialized ones, if their assets are properly protected against farmland subtraction. More generally, these findings confirm the validity of a more comprehensive approach toward farm succession, which takes occupational choice theory and rural-urban farm adaptation strategies into account.

Keywords: Farm transfer; farm migration; young farmers; peri-urban agriculture; horticulture

1. INTRODUCTION

A substantial proportion of European farms are operated as family farms, where the farmer's household is directly engaged in business management. According to Eurostat, in 2013 about 30% of European farms were managed by a farmer aged 65 years or older and in some countries this figure is even higher, e.g. Spain (33%), Italy (40%) and Portugal (50%). In this demographic context farm survival is, at least in part, linked to the availability of a successor within the family. Lack of intra-family farm succession implies two major drawbacks: the loss of farm-specific knowledge which has accumulated within the family and an uncertain destiny of the assets (land) of the non-inherited farm (Carillo et al., 2013). It can be argued that in marginal areas such land is at high risk of abandonment and consequent environmental and territorial degradation (MacDonald et al., 2000; Corsi, 2009). However, even if in more productive areas the land owned by farms without

successors may be acquired by surrounding farms (thereby increasing their scale of production), it is not clear-cut whether such efficiency gains offset the loss of human capital and farm-specific knowledge. In any case, given the structure of European agriculture, the nature of the destiny of family farms (which depends on the outcome of the succession process) may have an impact on and implications for agricultural land use (Burton and Fischer, 2015; MacDonald at al., 2000; Raggi et al., 2013; Demartini et al., 2015). For these reasons, a growing international and academic interest in family farming (Wymann von Dach et al., 2013) has arisen. Family farm succession has been investigated by agricultural economists and social scientists from various perspectives. Some have examined the topic using qualitative analysis tools that are typically used in social sciences (Lobley et al., 2012; Dumas et al., 1995; Keating and Little, 1997; Mann, 2007b; Otomo and Oedl-Wieser, 2009; Inwood and Sharp, 2012; Gatè and Latruffe, 2015), whereas another strand of research has tackled this issue in a more empirical fashion using quantitative data and statistical inference, albeit from a different perspective. Some quantitative studies analysed the temporal relationship between retirement and succession (Kimhi, 1994; Kimhi and Lopez, 1999; Glauben et al., 2004), others examined the complex relationships between farm assets, performances and succession (Calus et al., 2008; Carillo et al., 2013; Mann et al., 2013) and the effect of agricultural policies (Mishra et al., 2010).

In general, quantitative analyses have used binary dependent variable regression to explore factors affecting the probability of farm succession within the family. This approach isolates the effects of various farm, farmer and family factors on the probability of intra-family succession (Stiglbauer and Weiss, 2000; Kimhi and Nachlieli, 2001; Glauben et al., 2004; Simeone, 2006; Aldanondo Ochoa et al., 2007; Corsi, 2009; Glauben et al., 2009; Cavicchioli et al., 2015).

In this strand of literature, the effect on succession exerted by conditions around the farm has been rarely accounted for, with some notable exceptions (Glauben et al., 2004, Aldanondo Ochoa et al., 2007; Corsi, 2009). It is worth pointing out that if contextual factors do play a role in decisions about family farm succession, their exclusion from the analysis may lead to misinterpretation of the effects of other variables (farm, family and individual characteristics). In particular two categories of external factors have not been thoroughly examined in farm succession analysis: i) local labour market conditions, and ii) the effect of the degree of rurality or urbanization and the consequent adaptation strategies adopted by the farms (namely the rural-urban interface effect). Interestingly, the effect of local labour market conditions has been instead examined in the occupational choice theory (Todaro ,1969; Mundlak, 1978; Barkley, 1990 and Larson and Mundlak, 1997), that studies a phenomenon complemental to farm succession, that is the migration out of the agricultural sector.

We also noted that previous farm succession studies have mainly followed a territorial approach, with data being collected on samples or populations of farms in a particular area, controlling for effects of farm size and specialisation in the analysis. To the best of our knowledge research on determinants of farm succession has rarely focused on a particular sector or type of farming, with few notable exceptions (Kerbler, 2008; Cavicchioli et al., 2015).

This paper moves beyond the existing literature from different viewpoints. Firstly we treat the choice of carrying on the family business as a complement to the decision to migrate out of the agricultural sector. To do so we plug the occupational choice theory into farm succession analysis, testing the effect of local labour market conditions.

Secondly, we also test the effect of population density around the farm, as a proxy of rural-urban interface relationships, comparing and contrasting the results with the literature on farm adaptation in peri-urban areas (i.e. Inwood and Sharp, 2012; Zasada, 2011; Zasada et al., 2011). We argue that the inclusion of the above mentioned variables provides a more comprehensive and accurate picture of family farm succession determinants.

Lastly, we examine traditional and new drivers of farm succession in a particular type of agricultural enterprises, namely horticultural farms, in Italy. This sector is peculiar with respect to the other agricultural branches as it is strongly oriented to innovation and highly integrated along the food supply chain.

The rest of the paper is organised as follows: section 2 summarizes the main literature on farm succession and briefly explains the occupational choice theory; section 3 describes the horticultural sector in Italy, sample and variables and the methodology used in the analysis; section 4 describes the main results, which are discussed in section 5. Section 6 draws main conclusion and policy implications.

2. LITERATURE

The literature on determinants of family farm succession indicates that three main categories of variables are important, namely farm, farmer and farm household characteristics. The probability of succession increases with the physical and economic dimensions of the farm (Corsi, 2009; Mishra et al., 2010; Glauben et al., 2004; Aldanondo Ochoa et al., 2007), whereas the probability of succession appears to be negatively related to the proportion of rented land (Kimhi and Nachieli, 2001; Glauben et al., 2009). Some studies have reported a positive linear relationship between farmer age and farm succession (Glauben et al., 2009; Kimhi and Lopez, 1999; Mishra and El-Osta,

2008; Mishra et al., 2010), whereas others have detected a non-linear bell-shaped effect of farmer age (Corsi, 2009; Glauben et al., 2004; Kimhi and Nachlieli, 2001; Stiglbauer and Weiss, 2000) with the notable exception of Aldanondo Ochoa et al. (2007), that found a u-shaped relationship. Whilst empirical evidence is consistent with respect to the positive effect of female farm-holders on farm succession, evidence on the effect of farmer educational level is discordant: in some studies, the probability of succession increases with farmer educational level but others report an opposite relationship (Corsi, 2009; Mishra et al., 2010). The evidence on the effect of off-farm labour on succession is puzzling; a negative association was reported in two studies (Simeone, 2006; Stiglbauer and Weiss, 2000) and a positive association in two others (Kimhi and Lopez, 1999; Corsi, 2009). All the studies found higher probabilities of succession associated to male heirs in the family farm. Aldanondo Ochoa et al. (2007) and Cavicchioli et al. (2015) reported that potential heirs' educational level was negatively associated with probability of succession. Finally, a large age gap between the farmer and his/her children depresses the probability of succession (Kimhi and Nachlieli, 2001; Glauben et al., 2009).

Along with internal factors (farm, farmer and family features) environmental or contextual factors may also affect the likelihood of intra-household succession. These factors include the interplay between farm and territorial factors (rural-urban relationships) and the opportunity cost associated with finding alternative employment in non-agricultural sectors. The effect of these factors on succession has received scant attention, with the notable exceptions of studies by Aldanondo Ochoa et al. (2007), Glauben et al. (2004) and Corsi (2009). Aldanondo Ochoa et al. found that the probability of farm succession reduces as the distance of the farm from the nearest urban centre increases. Corsi found that higher employment rates reduced the probability of succession, whilst the size of the agricultural sector was positively associated with probability of succession. Using these variables to explain farm succession is of particular interest if farm succession is viewed as the counterpart of labour migration from the agricultural sector. In other words, intra-family succession can be seen as an outcome of occupational choice. According to occupational choice theory (Todaro ,1969; Mundlak, 1978; Barkley, 1990 and Larson and Mundlak, 1997) farm household members decisions about whether to remain in farming or to leave the sector are based on considerations that maximize their expected utility; in particular, the decision is influenced by the income difference between agriculture and other sectors and by the probability of finding an alternative job (in another sector) as well as by individual and farm factors. Following this line Olper et al. (2014) investigated how Common Agricultural Policy (CAP) payments influenced farm labour migration in EU regions, controlling for local labour market conditions (unemployment and labour share of agriculture), population density and the income difference between agriculture and

other sectors. Interestingly it emerged that all of these control variables played a role in decisions about remaining in or leaving the agricultural sector. With the exception of income difference the same variables were also shown to affect off-farm labour choices in Canada (Alasia et al., 2009). Consequently, we think these contextual factors should be taken into account in analyses of intra-family farm succession.[1]

3. DATA AND METHODOLOGY

3.1 The horticultural sector in Italy

In 2014, horticultural crops accounted for about 14.5% of the value of Italian agricultural production at basic prices and 27.3% of the crop productions one (7.3 billion EUR in absolute value). In 2010, the area of cultivation amounted to 300,000 hectares (11% of which was under greenhouse), representing a 2.3% of the total utilised agricultural area. The majority of horticultural production is sold as fresh, unprocessed produce or as frozen or processed products, with an increasing proportion devoted to the production of ready-prepared fresh vegetables (RPFV). This last category is produced by a group of farms with specific characteristics which differentiate them from other horticultural farms. The group consists of 700 specialised farms operating on an area of 6,500 hectares; about 80% of them are located in two regions, namely Lombardy, in Northern Italy, and Campania, in Southern Italy (Casati and Baldi, 2011).

As RPFV incorporates high added value, they require advanced technologies and high investments to be produced and are intended for consumers with an higher willingness to pay. These features have shaped both the size and structure of farms producing RPFV and their relationships along the entire supply chain. To sustain the required high investment in the processing stage and provide the large retail chains with constant quantity and quality of product, the farms have been clustered into producer organisations (POs)[2]. In the rest of agricultural and horticultural sector POs are mainly aimed at counterbalancing the purchasing power of retailers, in the case of RPFV, these groups are also needed to ensure that products comply with the higher standards required by private labels (that are trademarks of large retail chains) and to improve vertical coordination in the supply chain.

3.2 Sample description and variables

In order to analyse various determinants of farm succession in the horticultural sector, we used data from a survey carried out in 2010 on a sample of farms belonging to the biggest consortium of

[1] Although Corsi (2009) considered some of these factors this study did not consider the effects of population density and the income gap between agriculture and other sectors.
[2] Bagged vegetable producers are organised into 12 first-level producer organisations (POs) and a second-level organisation collects 90% of national production.

horticultural POs in Italy (AOP UNOLOMBARDIA) (see Frisio et al., 2012, for further details). The farms were located in 5 northern Italian regions, Lombardy, Veneto, Emilia-Romagna and Piemonte, and Campania, in southern Italy. Such survey was designed within this POs consortium for self-informative purposes, covering about 95% of their associated farms. The resulting sample of 362 horticultural farms represents about 8% of enterprises specialised in horticulture in the above mentioned regions (Agricultural Census data). In any case results from the analysis of this sample should be intended to be representative of the smaller group of firms highly specialized, capital-intensive operating in horticulture and more integrated along supply chains through the POs. Starting from 362 horticultural farms, our analysis was based on 143 where the farm-holder was older than 50 years and had at least one child over 15 years old, as we wanted to limit the analysis to those farms potentially concerned in planning for family/farm succession (see also Mishra et al., 2010).

The average area of interviewed farms is 33.8 hectares, but the area devoted to horticulture limits to 13.4 hectares on average. The number of workers employed was substantially higher than in the rest of agricultural sector, at 8 units on average, and only 28% of the workforce was members of the holder family. A large percentage of non-family workers are employed on short-term contracts during labour-intensive cultivation phases such as harvest; this means that measured in terms of days worked, the proportion of hired labour falls to 41.1%. Thirty percent of farms rely solely on family labour. 41.3% of these farms were involved in RPFV branch.

Although the survey was not designed to examine farm succession patterns, it provides some useful information on both family farm succession (based on farmers' expectations) and on factors identified as potential determinants in the literature (reported in Section 2). From survey data, we selected a set of covariates, whose effect on intra-family succession was tested. All covariates, referred to farm, farm holder and family characteristics, were coded at the farm level. To estimate the effect of non-agricultural labour market conditions and surrounding demographic features on farm succession, we integrated the dataset with specific variables calculated according to the Local Labour System to which the farms belonged. Local Labour Systems are established by ISTAT (Italian National Institute of Statistics) as aggregation of municipalities with similar characteristics in terms of labour market features, such as demand and supply of labour[3]. Their average dimension is intermediate between LAU 2 (Local Administrative Units 2) and NUTS 3 levels, defined by Eurostat.

[3] For further information see www.istat.it/en/archive/142790

Obtaining data on actual succession is not straightforward as it involves following a sample of farms over time, perhaps using data from a series of agricultural censuses (e.g. Kimhi, 1994; Stiglbauer and Weiss, 2000). When such information is out of reach, the second best alternatives are to assume that at least one of the heirs working on the farm will take it over (Kimhi and Nachlieli, 2001; Aldanondo Ochoa et al., 2007; Corsi, 2009) or to make an inference about intra-family succession based on direct interviews with members of the farm household (Kimhi and Nachlieli, 2001; Simeone, 2006; Aldanondo Ochoa et al., 2007; Mann, 2007a; Kerbler, 2008; Cavicchioli et al., 2015).

We have adopted the last strategy as our survey data were available for only one year. In fact, this data structure did not allow to observe the actual farm succession process and therefore we had to use the reported expectations of the farm-holder as a proxy. However, there is some evidence of inconsistencies between declared plans and actual succession (Väre et al., 2010), so this variable may not accurately represent the true destiny of the family farm after the current holder's retirement.

According to the survey data, 75 out of 143 farms would be passed on to the next generation and 64 would not (this figure does not include 4 non-respondents), with an intra-family succession rate of 54%. This pattern suggests a higher rate of family succession than those reported in similar studies of other agricultural branches (e.g. 27% for apple farms; Cavicchioli et al., 2015). Even if such succession rate seems to be high, it should be taken into account that the farms examined are among the most thriving within the agricultural sector and, consequently, more appealing for succession. Similar percentages have been reported by Lobley et al. (2010) and Chiswell and Lobley (2015), that consider them comforting for a continuation of family farming; differently Burton and Fischer (2015) judge them as insufficient to prevent a succession crisis in European agriculture.

Our dataset consisted of a proxy of intra-family succession as the dependent variable, and a set of potential explanatory variables selected on the basis of previous research in the field. These covariates were expected to exert an effect on farm succession and were grouped into three broad categories: farmer variables, farm variables and contextual variables.

Table 1 shows the list and definition of variables used in the analysis; table 2 provides detailed descriptive statistics.

Table 1 - Description of variables

Category	Variable	Definition of the variable (reference to justify the inclusion of the variable)	Unit of measurement
Dependent variable	Succession	Farmer thinks that the next generation takes over the farm (Kimhi and Nachlieli, 2001)	1= yes; 0=no
Farmer	Farmer children	The number of farmers' children aged over 15 years old in the farm (Stiglbauer and Weiss, 2000)	In number of children
	Farmer age	The age of the farm-holder (Glauben at al., 2004)	In years
	Farmer gender	Farmer's gender (Corsi, 2009)	1 = male; 0 = female
	Farmer degree	Farmer has a degree (Kimhi and Lopez, 1999)	1= yes; 0=no
Farm	Nonagr school	At least 1 child in the farm has an ISCED 3 level of education (upper secondary education) - except for agricultural field (Cavicchioli et al., 2015)	1= yes; 0=no
	Farm duration	Years since the farm foundation	In years
	RPFV farm	The horticultural farm belongs to the ready prepared fresh vegetables (RPFV) branch	1= yes; 0=no
	Greenhouse	Number of hectares under greenhouse (Kimhi and Lopez, 1999)	In hectares
	Emplwork	Share of employed worked days on total annual worked days in the farm (Kerbler, 2008)	In %
	Workdays	The annual worked days in the farm both by holder family and employees (Mishra et al., 2010)	In days
Labour market and surrounding conditions	Popdens	The population density at the Local Labour Systems level (Olper et al., 2014)	In inhabitants per km^2
	Empl	The employment rate at the Local Labour Systems level (Corsi, 2009)	In %
	Agrshare	The share of agricultural employment on total employment at the Local Labour Systems level (Corsi, 2009)	In%
	Incgap	Income gap between non-agricultural sectors and agricultural sector in each province (NUTS 3). Income is measured as the ratio between Gross Value Added of the sector and workers in that sector (Olper et al., 2014)	in thousands of EUR
	Hills dummy	Farm is located in the hills (Corsi, 2009)	1= yes; 0=no
	Regional dummies	Farm is located in a specific NUTS 2 region	1= yes; 0=no

Table 2 - Descriptive statistics of variables used in the analysis of farm succession

Variable	Total households (cases = 136)		Household with succession (cases = 73)		Household without succession (cases = 63)	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Farmer children	1.83	0.90	1.96	0.95	1.68	0.82
Farmer age	54.89	9.61	54.26	9.84	55.62	9.37
Farmer gender	0.87	0.34	0.88	0.33	0.86	0.35
Farmer degree	0.06	0.24	0.03	0.16	0.10	0.30
Nonagr school	0.62	0.49	0.44	0.50	0.83	0.38
Farm duration	30.84	23.79	34.25	25.77	26.89	20.78
RPFV farm	0.41	0.49	0.55	0.50	0.25	0.44
Greenhouse	2.57	4.94	3.36	5.96	1.65	3.21
Emplwork	42.05	34.35	45.32	32.26	38.26	36.52
Workdays	1,341.35	1,367.97	1,606.85	1,349.32	1,033.70	1,334.63
Popdens	459.10	525.16	480.79	450.44	433.97	603.07
Empl	47.11	5.08	46.45	5.58	47.87	4.34
Agrshare	5.84	3.81	5.45	3.20	6.29	4.40
Incgap	24.29	5.56	23.79	5.18	24.87	5.96
Hills dummy	0.07	0.25	0.11	0.31	0.02	0.13
Regional dummies (NUTS 2 Regions)						
Campania	0.24	0.43	0.33	0.47	0.14	0.35
Emilia-Romagna	0.05	0.22	0.05	0.23	0.05	0.21
Lombardia	0.53	0.50	0.49	0.50	0.57	0.50
Piemonte	0.12	0.32	0.04	0.20	0.21	0.41
Veneto	0.06	0.24	0.08	0.28	0.03	0.18

Among farm characteristics, the variable *workdays* was used as a proxy for the economic size of the farm (as continuous economic data were not available). For the same reason we also included the area under greenhouse (*greenhouse*) as a proxy of farm investment intensity.

Labour market and surrounding conditions variables have been included to plug the theory of occupational choice between farm and non-farm sector (Todaro, 1969; Mundlak, 1978; Barkley, 1990; Larson and Mundlak, 1997) in farm succession analysis. To do this, we tested the effect of income difference between non-agricultural and agricultural sectors (*incgap*); a higher income difference should make non-agricultural employment more attractive to potential family successors and thus lower farm succession rates. However, the attraction of employment in other sectors also depends on the probability of obtaining employment outside the agricultural sector and on the transaction costs associated with the transition. We therefore included in our analysis the employment rate (*empl*), agricultural employment as a proportion of total employment (*agrshare*) and population density (*popdens*) for the area surrounding the farm. The first two variables capture the probability of finding alternative employment, whilst the latter can be considered a proxy for the transaction costs of finding a new job. Based on occupational choice theory we expected that a higher employment rate and smaller proportion of farm employment (*agrshare*) would increase the probability of finding an alternative job and hence depress the probability of intra-family farm

succession. Similarly, as the population density of the surrounding area increases, the transaction costs associated with finding an alternative job should decrease and hence the attraction of succeeding to the family farm would be lower.

Interestingly, the population density approximates not only the probability of finding a job, but also the degree of urbanisation around the farm, so it allows us to explore the effect of rural-urban interplay on farm succession in horticulture. The population density variable thus represents a bridge among farm succession, occupational choice theory and farm adaptation at the rural-urban interface (Inwood and Sharp, 2012; Zasada, 2011; Zasada et al., 2011).

3.3 Methodology

Since the dependent variable in our model was binary we used a probit regression model (Scott Long and Freese, 2014) to determine the factors which influence the probability of intra-family farm succession (outcome variable based on farm-holder's report). As the interpretation of probit parameter estimates (called odds ratios) is not straightforward we also computed marginal effects at the means (MEMs) for the probability of farm succession to clarify the effects the predictor variables. To explore potential non-linear effects we also tested quadratic specifications for continuous variables. Our cross-sectional sample was also quite small (136 observations). For these reasons, our empirical results should be treated with caution.

The sign and statistical significance of the effect exerted by each explanatory variable on the likelihood of intra-family farm succession are reported in the second and third columns of table 3. The statistical tool used in the analysis (probit regression model) allows to isolate the effect of each explanatory variable on farm succession, taking into account simultaneously the effect played by other covariates, as if they were held constant (*ceteris paribus*). The smaller the $P>|z|$ value, the higher the probability that the variable in question exerts an effect on the dependent variable; by convention *P*-values greater than 0.1 denote that the explanatory variable has negligible effect. However, a more easily interpreted way of quantifying the magnitude of explanatory variables on the probability of succession is represented by MEMs, reported in the last column (explained in footnote *a* of Table 3); the MEM is the change in probability of succession for a one-unit change in the continuous explanatory variable, with other variables held at their means. As the continuous explanatory variables (e.g. *farmer age, workdays, empl, incgap*) are expressed in different units, a one-unit change may have a remarkable or a negligible effect so comparisons of marginal effects based on MEMs are not appropriate. To address this shortcoming we computed the change in probability as a consequence of a 1% increase over the mean of the explanatory variable (all the

other variables at their means); this value is given in the last column. Probabilities computed in this way are comparable across continuous explanatory variables. For binary variables the MEM represents the probability change as the covariate changes status (from 0 to 1).

3 RESULTS

Table 3 shows the effects of explanatory variables on the reported probability of succession, as explained in section 3.3. Taken together the set of explanatory variables (henceforth 'model') explained a fair amount of variability in the dependent variable; the value of pseudo R-squared was 0.48 and the percentage of correct predictions was 80.2%.

Table 3 - Results of estimated probit model of farm succession

Variables	Parameter estimates	P>|z|	Marginal effect at the means (dy/dx)[a,b]	Pr change for 1% increase in x (dy/Δ1%x)[b]
Farmer children	0.306	0.071	11.10	
Farmer age	0.003	0.722	0.12	0.07
Farmer gender	0.613	0.095	19.43	
Farmer degree	-1.407	0.024	-32.18	
Nonagr school	-0.991	0.007	-36.21	
Farm duration	0.013	0.033	0.47	0.14
RPFV farm	0.883	0.000	32.09	
Greenhouse	0.061	0.013	2.20	0.06
Emplwork	-0.010	0.216	-0.36	-0.15
Workdays	0.001	0.014	0.02	0.25
Workdays squared	-1.7E-07	0.007		
Popdens	-0.006	0.000	-0.15	-0.66
Popdens squared	2.7E-06	0.000		
Empl	3.889	0.026	18.54	8.81
Empl squared	-0.036	0.050		
Agrshare	-0.088	0.177	-3.17	-0.19
Incgap	-1.612	0.013	13.51	3.43
Incgap squared	0.041	0.004		
Intercept	-89.985	0.039		
Regional dummies (NUTS 2 Regions)	Yes			
Hills dummy	Yes			
Log pseudolikelihood	-48.697			
Pseudo R^2	0.481			
% of obs. correctly classified	80.2%			
yes=1	81.9%			
no=0	78.1%			

[a] The Marginal Effect at the Means (MEMs) is the change in the probability that intra-family farm succession takes place as a consequence of 1-unit change in the explanatory variable x_i (around its mean value), keeping all other variables at the mean value. For binary variables MEM renders how the probability changes as the variable changes from 0 to 1. For a matter of clarity MEMs have been multiplied by 100

[b] Pr change is computed at the mean value of all other covariates. 1% change in the explanatory variable x_i has been computed using the mean value of x_i as starting point. For a matter of clarity the Pr changes have been multiplied by 100

Among farmer characteristics, the number of children is positively associated with the probability of succession, specifically the MEM suggests an increase of 11.1% in the probability when the number of children increases from 2 to 3. This illustrates what computed MEMs represent: they give the change in probability of the dependent variable for an increase in the variable of interest of

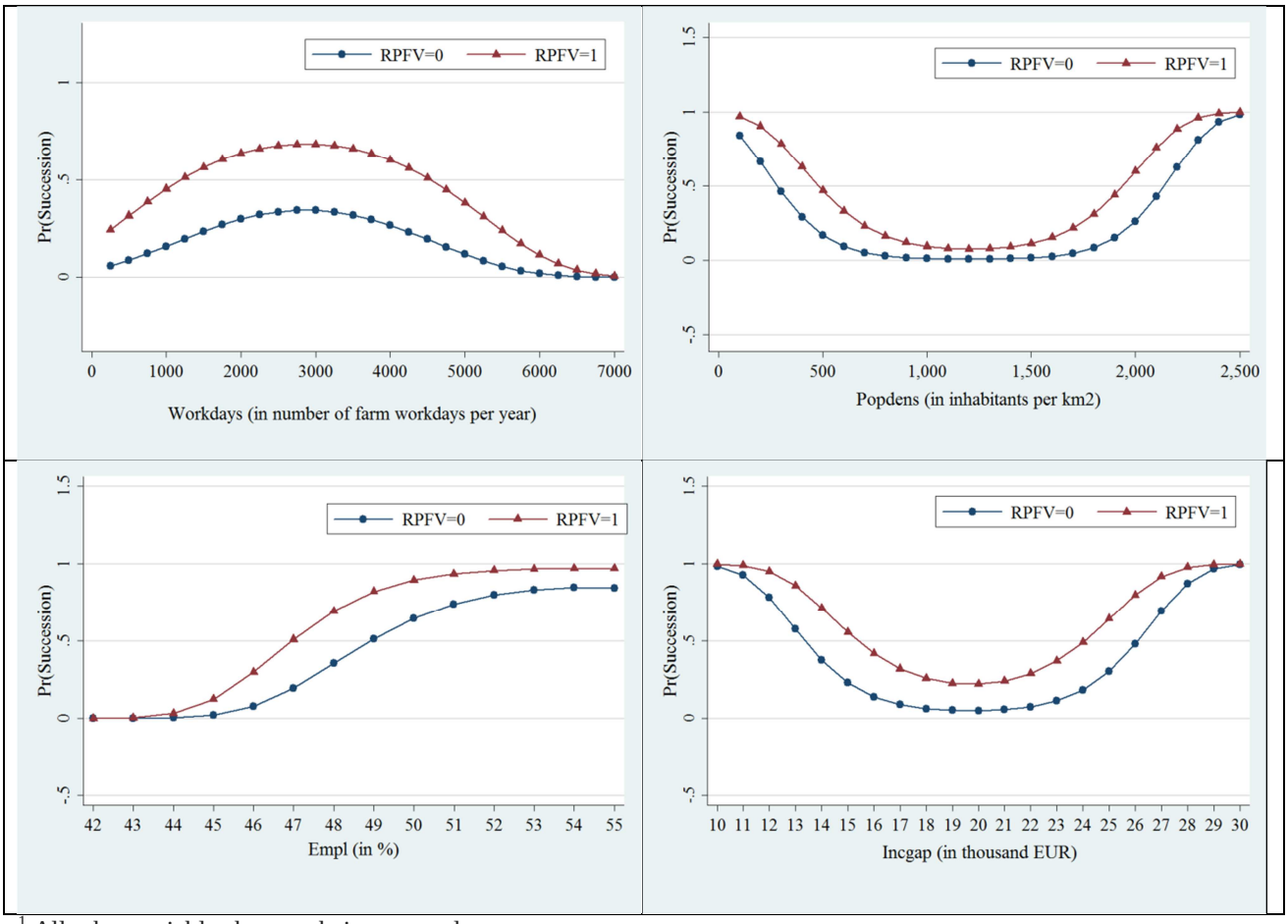
1 unit from its mean value, when all other variables are held at their means. As the underlying statistical model (probit) is based on a non-linear estimator (maximum likelihood) the change in marginal effect also depends on the starting value of the explanatory variable (even when other variables are held constant). The age of the farm-holder does not exert any effect on succession, although gender does. In fact, our analysis suggests that a farm managed by a man is 19.4% more likely to have a successor than a similar farm led by a woman (P = 0.095). In this case, i.e. where the dependent variable is binary, MEM gives the change in probability as the variable of interest (*farmer gender*) changes from zero to one (holding all other variables at their means). If the farmer has a university degree the probability of having a successor falls dramatically (-32.2%) relative to that for similar farms held by a non-graduate.

Concentrating our attention on farm characteristics, we note that the older the farm (*farm duration*) the higher the probability of succession; this probability is estimated to be 42% for a farm founded 50 years ago, but only 28% for a similar farm founded 20 years old farm (all the other variables held at their sample means). The same applies to RPFV farms whose overall succession probability is 32.1% higher than for other horticultural farms. Farm investment also exerts strong positive effect on family farm succession; in our model this was represented by a proxy variable *greenhouse,* i.e. hectares of farm area covered by greenhouses, and at the variable mean value the MEM was +2.2%. Having at least one child in the family with at least a high school diploma in non-agricultural subjects discourages succession: MEM = -36.2% ($P < 1\%$). The proportion of labour carried out by hired personnel does not affect farm succession. As previously mentioned, we included a *workdays* variable in the model as a continuous proxy for the economic size of the farm and we also tested its nonlinear effect by introducing its squared value. The linear and the quadratic terms for *workdays* were statistically significant indicating that this variable has a nonlinear effect on succession. In particular, as the linear coefficient was positive and the squared coefficient (although far smaller) was negative, the nonlinear effect of *workdays* on succession would be expected to be bell-shaped. The calculation of MEM for a non-linear variable takes into account both the linear and the quadratic terms, however the plot of the nonlinear effect of the variable (within sample values) is far explicative than the MEMs. Figure 1 reports the effect of *workdays* on succession for RPFV and non-RPFV farms with a maximum around 3,000 farm workdays (about 10 full-time workers). Interestingly the effect is more pronounced in RPFV farms.

The variables linked to the labour market and the economic and social context were a key component in our analysis, and yielded interesting results. All the variables in this category, with the exception of *agrshare,* had statistically significant estimated parameters and MEMs ($P \leq 0.05$).

Furthermore, with the exception of *agrshare*, all the labour market variables exerted a non-linear effect on farm succession. For example, population density in the surrounding municipalities (*popdens*) had a negative effect as a linear term and a small positive effect as a squared term, such that the combined effect was U-shaped (see Figure 2). The local employment rate (*empl*) had a strong positive effect as a linear term that seems to counteract the negative effect of the squared term, with a positive MEM of 18.5%. The above mentioned feature is more evident when looking at the S-shaped plot of succession probability against employment for sample observations (Figure 3).

Figures 1, 2, 3, and 4 – Estimated probabilities of farm succession for different values of workdays, popdens, empl and incgap in RPFV and non-RPFV farms[1]



[1] All other variables kept at their mean values

The effect of income difference between non-agricultural and agricultural sector in the areas around the farm (*incgap*) on farm succession takes an U-shaped fashion, as shown in Figure 4; the non-linear effect is less pronounced for RPFV farms. Interestingly labour market and other contextual variables have more effect on farm succession than other variables, when the effect is measured in

terms of the change associated with a 1% increase above their mean value. We controlled for unobserved territorial and geographical variability by including regional and altimetry dummies in our estimated model.

4 DISCUSSION

In accordance to previous studies, our analysis found that factors related to farm, farmer and farm household characteristics exert a significant influence on the probability of family farm succession. In this regard it is worth remembering that our dependent variable is based on farmers' expectation on the destiny of the family farm business; as shown by Väre et al. 2010, such statements may diverge with respect to actual succession plans. Furthermore we have used a dataset designed to informative purposes on horticultural farms associated to a POs consortium, exploiting its information for farm succession analysis. For this reason the results should be considered representative of professional horticultural farms, engaged in POs.

Our evidence suggests that number of children is positively related to succession probability, a result also reported by Stiglbauer and Weiss (2000). Male gender of the farm-holder also had a positive effect on farm succession rate; previous research on this variable has produced opposite results: Stiglbauer and Weiss (2000), Glauben et al. (2004), Corsi (2009) and Cavicchioli et al. (2015) reported that the probability of succession is higher in farms with a female farm-holder. We do not exclude the possibility that our result is due to the specific dynamics of the sector examined.

We found that higher education of farmers had a strong negative effect (-32%) on intra-family farm transfer; we agree with others who have reported similar effects (Corsi, 2009; Mishra et al., 2010) that this may reflect an inter-generational correlation between the educational attainment of farm-holders and their children, which means that the children of graduate farmers are likely to be highly educated and hence have a higher potential off-farm salary. Although we did not have individual data on the educational attainment of potential farm heirs (we used a farm-level dataset) this hypothesis is at least partially confirmed by the observation of a fall in succession probability (-36%) in farms with at least one child with upper education in a non-agricultural subject (*nonagr school*). Relatively low farm-holder educational attainment (high school diploma) was associated with a higher rate of intra-family farm transfer (Kimhi and Lopez, 1999; Kimhi and Nachlieli, 2001; Stiglbauer and Weiss, 2000) suggesting that farm-holder education has a non-linear effect on succession.

Turning to farm characteristics, the longer the farm has been in existence (*farm duration*), the higher the probability of succession (+0.5% for an additional year above the sample mean). This may be because in cases of farms with a long history, human capital and farm-specific skills which have been passed down through generations and accumulated over time convey a competitive advantage which makes the family business more attractive to potential heirs. This is a relatively new finding, as the effect of length of farm history on succession probability has very rarely been tested, and when tested (Glauben et al., 2009) was not found to be significant.

Turning now to structural factors, we used the number of workdays as a proxy for the structure and economic dimension of the farm. A similar approach has been followed in previous studies controlling the effect of farm economic dimension and performances on succession. In particular a positive effect of farm asset values (Mishra and El-Osta, 2008), gross margins (Corsi, 2009; Kerbler, 2008) and farm profit (Glauben et al., 2009; Mishra et al., 2010) has been found on intra-family transfer. It is intuitively plausible that to potential family heirs, larger and thriving farms would be more attractive than off-farm employment. Our results partially confirm the earlier findings, although we also found that above a certain threshold the economic dimension of the farm had a negative effect on succession probability (see Figure 1). The limited convergence between our results and the earlier studies may be due to the peculiarities of the horticultural sector and differences between the variables used to approximate the economic dimension of farms (we used number of workdays, whereas other studies have used explicit economic variables). Furthermore, the number of observations on the increasing part of the curve is greater than the number of observations in the decreasing part of the curve. This means that the positive effect of farm economic dimension on succession probability is prevalent. In any case, the existence of a direct, positive relationship between farm assets magnitude and succession probability (previously found by Mishra and El-Osta, 2008; and Mann et al., 2013) is also supported by the strong, positive effect exerted on succession by the variable *greenhouse*, which to some extent reflects the level of investment in the farm.

We assume that potential farm heirs aim to be adequately economically remunerated in their future job, but the gratification derived from operating in a stimulating, challenging working environment may also be a driver of succession. If this is the case, then the RPFV sector, one of the most dynamic branches of horticulture (Fearne and Hughes, 1999; Fouayzi et al., 2006; Russo Spena and Colurcio, 2010), may be appealing to young farmers as it offers incentives such as the opportunity to use innovative production technologies, improve one's skills and develop strong relationships with economic agents throughout the supply chain (e.g. POs, food industry and retail sector),

thereby overcoming the traditional isolation experienced by workers in the most of the farming sector. The strong statistical significance and the large estimated marginal effect of the *RPFV farm* variable confirms this hypothesis.

The last group of variables, those related to local labour market conditions, were included to allow us to apply occupational choice theory to the analysis of farm succession. As explained in previous sections the decision for leaving the agricultural sector (modelled in the occupational choices theory) can be viewed as the complement of the choice to carry on the family farm business. The main driver of both of these options is the income difference between agriculture and other sectors; the higher such difference the greater the expected propensity for potential farm heirs to choose to work outside the agricultural sector rather than carrying on the family business. In other words a high income gap is assumed to increase outward migration from farms (Barkley, 1990; Larson and Mundlak, 1997; Olper et al., 2014) and discourage intra-family transfer. Surprisingly, our analysis only partially confirmed this effect; *incgap* exerted a non-linear effect on succession (see Figure 4). Such partial incongruence with respect to previous works on farm labor migration is not easily explainable; we propose, as a possible interpretation, the combination of two divergent effects due to increasing levels of income gap on farm succession. At levels of *incgap* below a certain threshold, we observed the effect predicted by occupational choice theory: the probability of farm succession decreases as the income gap increases and non-agricultural employment becomes more attractive. Above a given threshold, however, the above mentioned phenomenon is counterbalanced by the pro-succession effect of being in an area where average disposable income is higher and hence opening new and larger market opportunities for horticultural farms. This explanation is plausible given that consumers of higher socio-economic status tend to purchase more fruit and vegetables, as their dietary habits include bigger shares of such items (Mackenbach et al., 2015). The same argument is congruent with and can be applied to the positive effects of population density (*popdens*) and employment (*empl*) on succession; the more urbanised and wealthy the surrounding area, the higher the probability that potential heirs could find non-agricultural employment, but, at the same time, the greater the opportunities for farm business and family. Our evidence suggests that the latter effect is stronger than the former.

The pro-succession effects of this group of variables may be explained in terms of advantages both for farm horticultural activity and for family farm members (especially potential heirs). Being in or contiguous with a densely populated and relatively rich area gives a farm preferential access to large, thriving markets with a higher propensity to consume vegetables (Mackenbach et al., 2015; Jackson-Smith and Sharp, 2008; Inwood and Sharp, 2012). Furthermore, such conditions decrease

the transaction costs toward these markets due to relative proximity and higher availability of transport, communications and connection facilities, that are supposed to be more available in densely populated areas. On the family farm side, the pro-succession effect played by population density (and then urban proximity) may be explained by the availability of an improved bundle of services for family farm members in more populated areas. Overall the relationship between population density and succession probability in our sample is in line with the findings of Aldanondo Ochoa et al. (2007), Simeone (2006) and with previous studies on farm exit at detailed regional scale (Glauben et al., 2006; Landi et al., 2016), although at a more aggregated level the direction of the effect appears to be the opposite (Breustedt and Glauben, 2007). Additional confirmations come from the literature on spatial analysis and peri-urban farming. For instance, Lange et al. (2013) found a positive relationship between the degree of urbanisation and continuance of farm businesses. More specifically, Zasada et al. (2011) reported that greenhouse and horticultural farming benefits from higher population densities. In this case the main argument is the activation of farm diversification pathways such as direct marketing (short supply chains) provided by small scale farms. More in general this strand of literature (Zasada, 2011), along with those on Rural-Urban Interface (Sharp and Smith, 2004) focus their attention on the opportunities for multifunctional and diversified farms due to the proximity to urban centres. Interestingly, our findings indicate that not only small, diversified farms, but also specialized high-value added farms, like those in our sample, benefit from being near highly populated, relatively wealthy areas (as cities and urban areas tend to be).

5 CONCLUSIONS

We analysed determinants of farm succession in a sample of Italian horticultural farms. As well as investigating the effects of various factors traditionally included in research on farm succession (farm, farmer and family characteristics) we also incorporated variables designed to capture the influence exerted by surrounding conditions such as territorial and local labour market characteristics. In particular we tried to integrate concepts drawn from farm migration studies and knowledge about farm adaptation strategies in peri-urban areas with the conventional variables used in analysis of farm succession. Table 3 summarises the results of the analysis, clearly indicating that the territorial and socio-economic characteristics of the region in which a farm operates are important determinants of the probability that a potential successor takes over the farm. Furthermore, many traditional factors were found to have statistically significant relationship with succession probability. In some cases the estimated effects had an unexpected direction, highlighting the peculiarity of horticultural farms with respect to other agricultural branches. In

other cases different phenomena seem to simultaneously influence farm succession probability, sometimes in a contrasting way. This is the case of the income gap between agriculture and other sectors. Below a certain threshold the relationship between income gap and succession probability is negative, which is in line with occupational choice theory's predictions about the effects of inter-sector competition on labour forces. However, above this threshold the direction of the relationship changes, presumably because the positive effect of being situated in an economically wealthy area begins to predominate. This explanation is supported by evidence that population density and local employment rate are both positively related to succession probability, indicating that more urbanised and wealthier areas represent a favourable context for continuing high value-added farming activities, and horticulture specifically. This evidence challenges the argument that farms in peri-urban areas - and densely populated regions more generally - are disadvantaged because of the competition for use of land and labour. In contrast, our results are in line with much recent research on the adaptation strategies of farms in peri-urban areas, which has shown that densely inhabited areas may represent a potential market for diversified farms that sell their products directly to consumers. Interestingly, our findings seem to extend the site-specific advantages of rural-urban interface location, traditionally reported to apply to multifunctional and diversified farms, also to technologically advanced enterprises specialising in high added value products, like the horticultural farms examined in this study.

This suggests that the traditional definition of peri-urban agriculture should be widened, and that the distinction between non-specialist, multifunctional and specialised (horticultural) farms is less important than previously thought. For both specialist and non-specialist farms the benefits of being at the rural-urban fringe offset the potential disadvantages of pressures associated with urbanisation, such as competition for land. Nevertheless the latter aspect should deserve careful consideration as an unregulated subtraction of agricultural land at the rural-urban interface would result in loss of both multifunctional and specialised farms that would otherwise thrive. Losing specialised horticultural farms would contribute to the disconnection of urban areas from local food suppliers and thus increase their dependence on long-range and imported products (Paül and McKenzie, 2013). Furthermore, unrestricted loss of farmland might also cause a break in inter-generational transmission of farm-specific knowledge in one of the most efficient agricultural branches. For these reasons Paül and McKenzie's (2013) scheme for peri-urban farmland protection and alternative food networks should be implemented and extended to include specialised, professional farms.

Another result worth noting is the higher probability of succession in RPFV farms, which appears to indicate that being part of an innovative sector and working in a stimulating, dynamic environment act as incentives to young entrepreneurs to remain in the agricultural sector. Policy makers should take heed of this and develop policies for improving human capital and increasing innovation in agriculture in order to make employment opportunities for younger farmers more comparable with those of their peers in other sectors.

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