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Is the setting up aid mitigating the generational renewal problem in farming?

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Abstract

This study is the first to evaluate the setting up aid (SUA), in the Rural Development Programme. For Sweden, we investigate if the aid, firstly, speeds up the transition process to become manager of a farm and, secondly, affects income from farming and survival of the farm. The approach builds on a regression discontinuity design and explores an age 40–the eligibility requirement in the SUA. We find that the SUA has an impact on the transition to farm management, as well as it increases income from farming and farm survival. Consequently, the aid is likely to fulfil its aim of attracting young people into farming.

Keywords: generational renewal, young farmers, Setting up aid, Rural Development Programme, farm management, income from farming

JEL classification: J43, Q12, Q18

1 Introduction

The European Commission has flagged for a shortage of young farmers in Europe (Regidor, 2012; Zagata *et al*., 2017), and agriculture's generational renewal problem is increasing (Matthew, 2018). In Sweden, the share of farmers younger than 35 has decreased from 10 to 4 per cent between 1997 and 2015. At the same time, farmers older than 55 has increased from about 30 to over 60 per cent (see Figure 1). A shortage of young farmers may harm the modernisation of the sector because young farmers are more likely to be profit oriented (Gorton *et al*., 2008; Grubbström *et al*., 2014; Hamilton *et al*., 2015) and to consider themselves as entrepreneurs (Gonzales and Benito, 2001; Vesala and Vesala, 2010; McDonald *et al*., 2014; Stenholm and Hytti,

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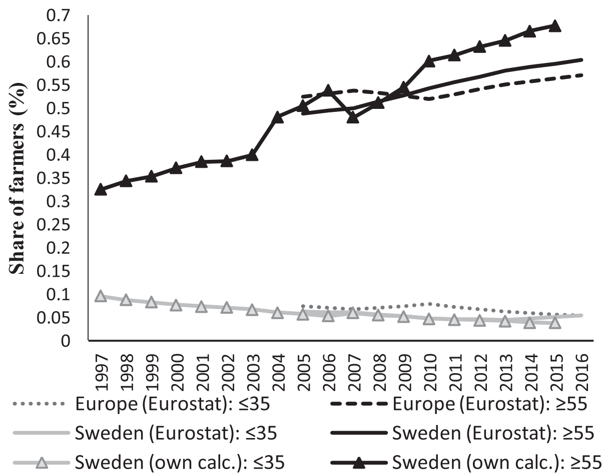

Fig. 1. Share of farmers aged ≤35 and ≥ 55, in Europe and Sweden, respectively, 1997–2016.

2014). Also, young farmers have stronger preferences for sustainability (Comer *et al*., 1999; Vanslembrouck *et al*., 2002), organic farming (Lobley *et al*., 2009; Laepple and Van Rensburg, 2011) and animal welfare (Mann, 2005).

The main obstacle hindering young farmers, both successors and new entrants, to become managers of their own farm is the access to land (Regidor, 2012). In the UK. inheritance is regarded the only way to become a farmer (Symes, 1990; Lobley, 2010). Other obstacles are low returns to farming (Nordin *et al*., 2016; Nordin and Höjgård, 2019), a lack of capital assets, higher off-farm incomes (Ahearn *et al*., 1985; Ahearn *et al*., 2006; El-Ostra *et al*., 2008; Hill and Bradley, 2015), and late succession (Gale, 1994; Regidor, 2012).

As a first measure to tackle the generational renewal problem, EU introduced early retirement schemes at the national level in the 1960s, which the Mac Sharry CAP reform of 1992 later lifted to the EU level (EEC, 1992). Since 1981, EU Member States can choose to grant an aid to young farmers (EEC, 1972), and since 2000, the Rural Development Programme (RDP) includes a setting up aid (SUA) (EEC, 1999). In addition, a compulsory Young Farmer Payment was added to the first Pillar in 2015. In 2007–2020, EU has allocated 9.6 billion euro (18.3 billion euro including co-financing from Member States) to the generation renewal project where about 70 per cent of the funding is for the SUA and about 30 per cent is for the Young Farmer Payment (ECA, 2017).

The early retirement schemes have been found unsuccessful in increasing the generational renewal (Mazorra, 2000; Bika, 2007; Ingram and Kirwan, 2011). To our knowledge, there has not been an empirical impact evaluation of the SUA or the Young Farmer Payment on generational renewal. In a general assessment of these measures, the European Court of Auditors concludes that the policies are 'based on a poorly defined intervention logic, with no expected results and impact specified' (ECA, 2017). Also, case studies of seven Member states find that the subsidies assist 'with capitalisation and financing of intergenerational succession, but is not sufficient for the establishment of a new farming business' (Zagata *et al*., 2017).

With detailed individual register data for the full population of farmers in Sweden, merged with subsidy data for the years 1997–2015, we contribute with new findings on the impact of the SUA.[1] We investigate whether the SUA affects, firstly, farmers' transition process of becoming farm manager and, secondly, income from farming, off-farm income and farm survival. We use a regression discontinuity design (hereafter RDD) to evaluate the impact of the SUA. The RDD differs from other pre–post group designs by its method to assign individuals to either the treatment or the comparison group. In RDD, assignment is made on the basis of a cut-off score on a treatment assignment variable. Intuitively, if nothing but the probability of receiving treatment changes at the cut-off, any jump in the conditional expectation of the outcome variable at the cut-off can be attributed to the effects of treatment. RDD has been described as the 'close cousin' of randomised experiments (Lee and Lemieux, 2010; Dinardo and Lee, 2011).

Because a farmer has to be 40 or younger to be eligible for the SUA, a cut-off requirement can be exploited in an RDD to estimate the causal effect of the SUA. This cut-off provides idiosyncratic variation in the probability of receiving the SUA as, arguably, farmers who are just eligible for the SUA (age ≤ 40) are comparable with farmers who just missed the eligible cut-off (age > 40). As the validity of the RDD hinges on the existence of a cut-off effect, we precede the results and show that such a cut-off is present in our data (see Figure 2, which we will return to in more detail later). At the age of the subsidy requirement, the probability of taking managerial control of a farm (among persons with a background as *hired*[2] farmers) drops: at age 40, the probability decreases with almost 2 percentage points (or around 25 per cent).

The succession of a farm is related to the incumbent farmer's (often the parent's) retirement decision. Research shows that the relationship between the incumbent farmer's age and the timing of succession is nonlinear (Glauben *et al*., 2009)[3]. A late succession is, therefore, likely determined by both unobserved farm and farmer characteristics, affecting also the post-transition business performance and income from the farming. Consequently, the age-40 cut-off effect may be biased if a late transition also captures unobserved factors

1 The Young Farmer Payment is included in Pillar I from 2015 but has no observed impact on our results. That is, if we exclude 2015 from the study period the results do not change.

2 It is reported that prospective successors often work as a hired worker before the farm transition takes place (Errington and Lobley 2002; Uchiyama et al., 2008; Lobley, 2010). However, we do not know if the hired worker is a family member, non-family member or a part of the extended family. As a hired worker, the successor may be involved in the management of the farm but the incumbent farmer often fails to involve the successor in the financial management of the farm (Chiswell, 2016).

3 Others to study the relationship between transition and age is Kimhi (1994), who finds that parents transfer the farms earlier when the age differential between the parent and the child is large, and Mishra *et al*. (2010) find that the probability of having a succession plan increases with the age of the farm operator.

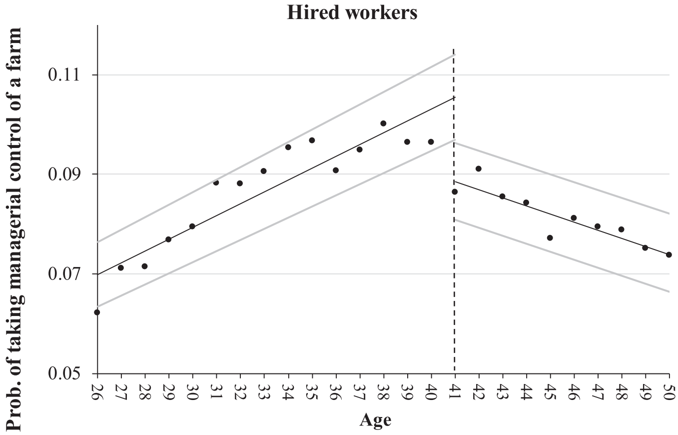

Fig. 2. Probability of taking managerial control of a farm for hired workers (in the years 1998–2015) for each age from 26 to 50. Shaded lines show 95 per cent coefficient intervals.

(see Burton, 2006 for a discussion on age as an indicator). However, a correct modelling of the assignment variable in an RDD (in our case, the age of the prospective successor) on both side of the cut-off implies an unbiased cut-off effect (Lee and Lemieux, 2010). So, if age is an important determinant of both farm succession and the post-transition business performance, conditioning on the prospective successor's age solves the problem.

This study reveals that the SUA has a significant impact on the transition to farm management. It also shows a very large drop in incomes when a hired farmer becomes farm manager. To our knowledge, the literature has not analysed the impact of gaining management control of a farm on income from farming for hired workers; consequently, the finding of a large negative impact is new. Though we are not able to explain the fall in income, we document that the SUA subsidy mitigates its fall. Affecting both the timing of the succession and post-succession incomes, the SUA is likely to contribute to a generational renewal of the sector. A back-of-the envelope calculation shows that farmers become managers 1.1 years earlier with the SUA. Yet, the finding of a large drop in incomes after the transition (also for SUA receivers) indicates that the current policy only mitigates rather than solving the generational renewal problem.

2 The generational renewal problem in Sweden and Europe

Figure 1 illustrates how the generational renewal problem has developed over time by reporting the share of farmers that are (i) younger than 35 and (ii) older than 55. These two thresholds are set by Eurostat, and following their reporting has become standard in the literature. Apart from Eurostat's findings for Sweden and Europe as a whole, we add own calculations for Sweden based on our data. As the cut-off for receiving a generational renewal subsidy is 40, an unfortunate difference between statistics and policy exists (Zagata and Sutherland, 2015). Eurostat's statistics reports the shares for the period 2005–2016, while our data go back until 1997. According to Eurostat's statistics, the shortage of young farmers is larger in Sweden than in Europe: the share below 35 and the share above 55 is smaller and larger in Sweden than in Europe, respectively. The numbers for Sweden based on our data show a higher share of older farmers than in the Eurostat statistics (mainly in the end of the period), suggesting that the 'demographic gap' in Sweden might be even larger than previously known.[4] However, this difference may be due to different setups in the two datasets. Eurostat classifies farmers as a 'sole holder' of an agriculture holding, while there could be more than one holder in our data, contributing mainly to a higher number of older farmers. Moreover, our longer period for Sweden contributes by showing similar trends before and after 2005. Note also that the kink around 2005, and the relatively high share of old farmers in 2005–2007, is due to the decoupling reform.[5]

3 Data and descriptive analysis

3.1 The data set

The data comes from the Longitudinal Integration Database for Health Insurance and Labour Market Studies (LISA), which includes all individuals 16 years of age and older, registered in Sweden as of December 31 each year. The sample we start off with is a panel containing everyone who has ever worked in agriculture over the period 1997–2015. For each year, an industry code[6] determines who received farming incomes from work or business. We then merged this data with subsidy data from the Swedish Board of Agriculture for the period 2000–2015.

Next, we restrict the sample to prospective successors. First, we select individuals who has worked as a hired farmer for at least 1 year during 1997–2015, so that all potential transitions to farm management during the period can be observed, i.e. individuals who start of as managers are not included in the sample. The transition to become a farm manager is identified from information describing if the individual is a manager of a sole proprietorship or a corporation in agriculture. Managers of both types of juridical bodies are eligible for the SUA. The individual does not necessarily has to be a sole

4 When compared to the total Swedish population, we see that the changes for farmers are partly (but merely to a minor extent) due to general changes in demographics. For example, during 1997–2016, the share ≤35 decreased with 8% in the farming population, while it only decreased with 1% in the total population

5 In 2004 (when farmers could apply for the decoupled single farm payments for the first time), retired individuals who still had some agricultural land was classified as farmers. A change in 2007, requiring that the land holding was a minimum of four hectares, substantially decreased the number of registered farmers.

6 The Swedish Standard Industrial Classification (SNI) code is identical to the classification of economic activities in the European Community *(NACE)*.

holder, and there could be more than one holder/manager of a farm.[7] Second, as the RDD analysis compare people around the cut-off age of 40, we remove individuals far from the cut-off, ≤ 25 and ≥ 50, who are less comparable. Individuals younger than 26 may still be investing in (agricultural) education and individuals older than 50 are no longer likely to become managers. Third, the individual is removed from the sample when leaving farming.

We follow individuals over time, both before and after the transition to become manager. The pooled number of farmers across time—both hired workers and farm managers—is 32,183 and the average yearly sample of farmers is 7,384. About 9.7 per cent of the hired workers transit to management each year.

Apart from the probability of becoming farm manager, the other two outcome variables are incomes and farm survival. Incomes in the LISA dataset are collected from tax records and include farmer's individual incomes from work or business. Based on industry codes, we determine (for up to five income sources) if the income is from farming or another sector (off-farm income). Thus, unlike most other studies analysing *farm* income, we use *individual* gross income (before income tax is deducted but after corporate- and payroll taxes are deducted), and not, e.g. farm family income, which is measured at the farm/family level (before taxes). Using individual incomes probably has a small impact on the result, because in Sweden, only spouse contributes with about 15 per cent of the total households' farm incomes (Nordin and Höjgård, 2019). Farm survival is defined as having remained as a farmer 5 years after the transition to farm management.

The dataset provides a set of covariates that we use as control variables along with farm-level and calendar year fixed effects. The covariate years of schooling, gender, and if the farmer has an education in farming[8] are known to affect outcomes such as income and survival. Table 1 report descriptive statistics for the variables used in this study.

For the descriptive regression analysis in the next section, we add subsidy data measured at the firm level to our individual-level sample. For 38.5 per cent of the subsidies, we are not able to identify a receiver; therefore, some receivers are classified as non-receivers[9]. This caveat, is, however, not a problem for our main analysis, because RDD identifies the subsidy effect from the age cut-off at 40 (which we describe in the next section) and not from the subsidy information, per se.

7 To make sure that the business management is within agriculture and not some other activity, we have to restrict the sample to farmers with a main income from farming. This is not a problem because individuals without a main income from farming are very unlikely to become managers and receive the SUA; to be eligible for the SUA, a basic requirement is that you are a committed farmer. Thus, even if they may become managers, they are not likely to receive the SUA.

8 The educational variables are constructed from The Swedish Education Terminology (SUN), which is adapted to the international terminology International Standard Classification of Education 1997 (ISCED 97).

9 Also, to determine the timing of the subsidy is somewhat problematic. In the data, the application year is often different from the disbursement year, and neither corresponds with the year the individual transits to a manager position.

Table 1. Descriptive statistics of outcomes and covariate

	Mean	Standard deviation
Farm managers (%)	8.42	0.278
$T \leq 40$ (%)	62.80	0.483
Age	37.46	7.24
Years of schooling	11.7	1.86
Education in farming (%)	47.7	0.499
Women (%)	26.4	0.441
Year	2005.8	5.16
Ln farm income	7.38	0.867
Ln off-farm income	2.56	2.68
Farm survival in year 5 (%)	60.0	0.490
SUA receivers	2,959	
Observations	132,920	
Individuals	32,183	

Another potential data drawback is that we cannot explore the transition into agriculture for individuals who enter farming from outside and has not worked as a hired worker before they become managers.[10] However, this group is probably very unlikely to receive the SUA, because it requires (apart from being younger than 41) that the 'farmer [. . .] possesses adequate occupational skills and competence'[11], and if you never worked as a hired worker, you probably lack adequate farming skills. Also, we cannot tell from the data if the transition is a succession, but we assume that most transitions are. In Sweden, family members are contracted as hired workers, but we do not know if the hired workers are family members, extended family members (e.g. sons-in-law) or non-family members (see footnote 2). Nevertheless, this should not be a problem because remuneration to family members without a contract is illegal. Also, due to a general tax deduction of Swedish Kronor (SEK) 18,000, there are tax reasons to pay wages to young hired family members. Prospective hired successors should therefore be in our study sample.

3.2 Pre- and post-transition incomes in a descriptive regression analysis

With a descriptive analysis of the economic impact of becoming a farm manager, we pinpoint a potential bias in the comparison of individuals with and without an SUA subsidy, a bias which the RDD methodology aims to solve. We look at the individuals' income from farming longitudinally by regressing

10 Anyone who worked as a hired farmer are included, even those who did not grew up on a farm. The definition of new entrants is not clear (Zagata et al., 2017) as it could either refer to a successor taking over the family farm or to someone who begins farming (and did not grew up on a farm).

11 European Commission Regulation No. 1305/2014, Article 2 paragraph n.

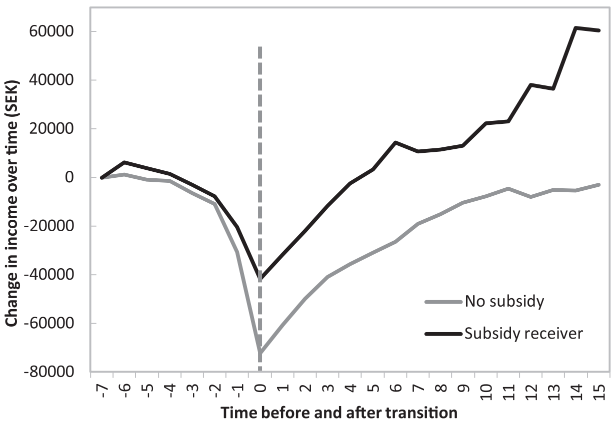

Fig. 3. Longitudinal analysis where we follow individuals' income from farming over time; before and after getting managerial control of a farm.

income on a set of pre- and post-transition dummies. To remove a positive trend in individual incomes due to increasing experience and consequent better farming skills, we control for age and age squared. In addition, we remove a general increase in income equal to all farmers with a set of year dummies (Nordin and Höjgård, 2019). For this analysis, we do not have to know *when* the subsidy is received. Assuming that the SUA is received close to the transition to management is enough. The result of this exercise is shown in Figure 3, separately for subsidy receivers and non-receivers. We use the first period in time (7 years prior to becoming a manager) as the reference. However, as the subsidy receivers are underreported, the comparison of SUA receivers and non-receivers has to be done with caution. A correct classification of SUA receivers and non-receivers may change the result. It could be that the incomes of non-receivers is biased in the direction of the receivers (so that the true gap in income between the receivers and the non-receives is larger than observed in Figure 3), but it could also be the opposite.

The figure shows a significant penalty (i.e. the fall in income between year −1 and 0) of transiting from a hired farmer to a farm manager that possibly is related both to transition and investment costs and to postponed income. The penalty in year zero is smaller for farmers who receive the SUA: around SEK 20,000 and 40,000 (about €2,000 and €4,000) for those with and without SUA, respectively. These penalties in absolute values correspond to 12.5 and 25 per cent. The smaller drop in income for SUA receivers appear to persist over time, as farmers who received the SUA have higher incomes than non-receivers, up to 15 years after the transition to farm management.

Notice, before the transition the income falls with SEK 15,000. Precisely why this is so unclear, but certain pre-transition costs are probably an explanation. It could also be due to how the data are reported. In the data, firm management is reported in November and for farmers who become managers late during the year the timing of the transition is mismeasured.

To sum up, the smaller income penalty in the group who receives the SUA indicates an impact. The long-run differences between receivers and non-receivers implies that it is not merely a direct impact of the monetary transfer, but probably also an indirect effect on management, plausibly on investment decisions, etc. However, the effect could also be due to selection in the uptake of aid, as indicated by the small difference in income already in the early periods prior to transition. For example, because a solid business plan and an education in agriculture are required for receiving the aid, SUA receivers are likely to differ compared to other farmers transitioning to farm management. In addition, our subsidy data contain a measurement error that might bias the effect. To handle the selection problem and the measurement error in the subsidy data, we use the RDD approach, which by its design aims to estimate a causal subsidy effect.

4 Empirical strategy

4.1 The starting point—a naïve individual fixed effect model

To explain and build the formal representation of the RDD model, we start by presenting a simple *naïve* individual fixed effect model e.g. income from farming and gradually work our way towards the more complex RDD model for estimating the cut-off effect on income from farming on the probability of becoming farm manager at age 40[12]. The *naïve* model for income estimates the impact of the transition to farm management, M for individual i, on income from farming, Y, in year t:

$$Y_{it} = \alpha_i + \delta_t + \beta_0 M_{it} + \beta_1 SUA_{it} + \gamma X + \epsilon_{it} \tag{1}$$

where α_i and δ_t are individual and year fixed effect, respectively. β_0 is the income effect of gaining management control (represented by the indicator variable M, $M = 1$ after transition). γ are the effects of a set of covariates, X, i.e. observable characteristics affecting the outcome and SUA (including age). The subsidy indicator variable, SUA[13], captures the impact, β_1, of the subsidy. According to Figure 3, β_1 is positive due to the smaller drop in income for subsidy receivers than for non-receivers. However, selection in uptake is likely and we also have the problem with measurement errors in the subsidy data. Consequently, this model is *not* estimated. Still, this *naïve* model is informative as it helps us to understand the more complicated RDD model.

12 Because the section focuses on selection issues, we start by presenting the model for analysing the effect of management (with and without SUA) before presenting the model for analysing the effect of SUA on becoming manager.

13 Note that SUA is a subset of M because SUA is conditional on transfer to management.

4.2 RDD model of income from farming, off-farm income and farm survival

RDD is a quasi-experimental method where the researcher assigns individuals to the treatment or the control group on the basis of a single assignment variable (in this case age) with a specified cut-off value (age ≤ 40). Even though the assignment is not randomised, selection is not causing the assignment as in the naïve model above where SUA receivers are compared to non-receivers. By comparing the outcome in the treatment group (age ≤ 40) to the counterfactual outcome in the control group (>40), we can estimate the treatment effect without observing who actually gets the treatments (SUA). The intuition behind the RDD is that individuals around the cut-off are very similar, not just in age, but also in other observed and unobserved ways. In an RDD, manipulation of the cut-off is instead a problem, but section 4.4 will alleviate this concern.

Figure 2 revealed a clear cut-off effect in the probability of becoming farm manager at age 40. We exploit this cut-off as the age eligibility requirement in the RDD. Formally, SUA is the treatment and the time-varying continuous variable age, A, is the assignment variable. An individual is eligible for the subsidy if A ≤ 40 (indicated by a dummy variable, $T_{\leq 40}$, which equals one after turning 40) but, as this is merely an eligibility requirement and not the treatment status, we replace *SUA* in equation (1) with $M_{it} \times T_{\leq 40}$ in equation (2):

$$Y_{it} = \alpha_i + \delta_t + \beta_0 M_{it} + \beta_1 M_{ij} \times T_{\leq 40} + f(A) + \gamma X + \epsilon_{it} \quad (2)$$

where Y_{it} is either income from farming, off-farm income or farm survival. $M_{it} \times T_{\leq 40}$ describes that the individual has taken management control and has potentially received a SUA. Because treatment status is a stochastic function of age, and not a deterministic one, it qualifies as a fuzzy rather than a sharp RDD. Consequently, β_1 gives the reduced form estimate of the cut-off effect, i.e. a weighted effect for SUA receivers and non-receivers. Thus, $\beta_1$answers if those who become managers before 41 are affected differently by this transition compared to those who become managers at 41 or later. This cut-off effect is attributed to the SUA. By weighting β_1 with the share of subsidy receivers in the farm population (about 52 per cent of those who gain management control when younger than 41)[14], we get the treatment effect on the treated. $f(A)$ is a low-order polynomial of A (the assignment variable)[15], modelled separately on both sides of the cut-off. This approach is non-parametric and is often called local linear regression.

It is standard to estimate a RDD model with different bandwidth (i.e. the age intervals before and after the cut-off) and with different polynomials of

14 Subsidy receivers to population who gain management control before the age of 40.

15 With a discrete assignment variable, a recent study by Kolesár and Rothe (2018) shows that it is not recommended to cluster the standard errors on the assignment variable; robust standards errors are preferred. Their finding is generated from a similar research design as ours where an age-40 treatment effect is estimated on wages.

A. To avoid estimating a treatment effect caused by nonlinearities in A, a small interval (bandwidth) around the cut-off point is recommended (Hahn *et al.*, 2001; Lee and Lemieux, 2010). We use the ages 26–50 and 30–45 as bandwidths, and linear and quadratic polynomials. Parametric regression, where the full sample is used, does not change the result.

4.3 Model of the probability of transition

In addition to the different measures of income and farm survival, we study if the age-40 cut-off affects the farmer's probability of becoming manager (i.e. an econometric modelling of Figure 2). The model is an adaptation of equation (2):

$$M_{it} = \delta_t + \beta_1 T_{\leq 40} + f(A) + \gamma X + \epsilon_{it} \qquad (3)$$

where M is the outcome variable and therefore not interacted with $T_{\leq 40}$. β_1 answers if individuals are more (or less) likely to become managers before rather than after the age of 41; i.e. if the SUA affects the transition probability.

4.4 Does the RDD assumptions hold?

The RDD assumes that individuals are, conditional on A, randomly distributed as farm managers around A_{40}. If this assumption holds, then the design ensures that those who just barely received the SUA are comparable to those who just barely did not. To assess randomness in assignment around the cut-off, Lee and Lemieux (2010) recommend a histogram of the assignment variable to look for bunching around the cut-off. Such bunching is a strong indication of manipulation of the assignment variable, meaning that individuals have influenced whether or not they made the cut-off to become treated. In our case, it seems plausible to expect bunching if more foresighted farmers consider the SUA eligibility requirement and, thereby, become farm managers earlier, before turning 41. Bunching could also be the result of an optimal transfer date (see Kimhi, 1994). However, Figure 4, a histogram of age when becoming manager shows no indication of bunching in frequency at age 40.

A formal test for bunching is proposed by McCrary (2008). This test, first, computes the frequencies for each bin (each age) and, second, estimates a regression of the (logarithmic) frequencies on a cut-off indicator variable (when controlling for A). Table 2[16] reports a small and insignificant McCrary test statistic. Thus, farmers do not appear to speed up the transition to farm management and selection is therefore rejected.

A balancing test analyses if there is a jump in background factors at the cut-off; i.e. if farmers around the cut-off are different. Table 2 tests for discontinuity around 40 for gender, year of schooling and farm education. For farm education and gender, a discontinuity around 40 is not found. For years of schooling, it

16 For the tests in this section, we use model 2 in Table 3 with one polynomial of A; which we consider our preferred model.

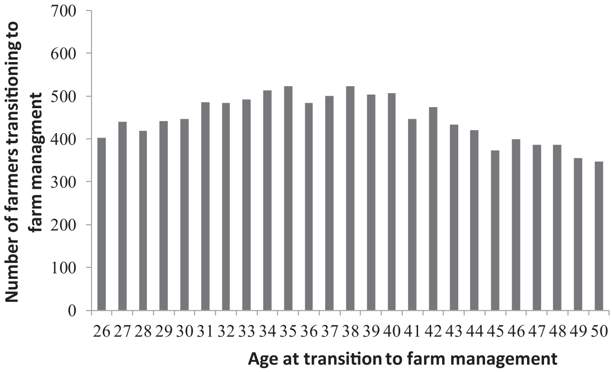

Fig. 4. Histogram of the farmers' age when transitioning to farm management.

Table 2. Balancing test of covariates and the McCrary test

	Woman	Years of schooling	Education in farming
$T_{\leq 40}$	0.0015	0.199***	0.0269
	(0.0157)	(0.0675)	(0.0232)
Observations	11,190	11,175	11,190
R-squared	0.011	0.059	0.052
McCrary test (estimate of $A = 40$)		1.391	
		(10.75)	

Note: The models are estimated with Ordinary Least Squares (OLS). The dependent variables in the upper panels are farmer characteristics measured at the age of transition to farm management. In the McCrary test, the dependent variable is the frequencies of age at transition to farm management. Linear age polynomials are included separately above and under the cut-off.

***Significant at 1% level. Robust standard errors.

is more unclear: we find a small but significant cut-off effect of 0.2 (i.e. at the cut-off, the difference in schooling is 0.2 years). However, this difference is not problematic as we control for years of schooling,[17] but it may indicate selection on other characteristics as well. Nevertheless, when considering both the McCrary test and the differences in background factors, we conclude that selection around 40 is a minor problem and any potential selection will be removed by the individual fixed effects and the covariates in the RDD model.

5 RDD results

5.1 Probability of transition

Beginning with the probability of transition, Table 3 presents results from equation (3)—the age-40 cut-off effect on farm management. Columns (1)

17 The fixed effects control for between individual differences in education and the years of schooling variable control for individual changes in years of schooling over time.

Table 3. Estimated age-40 cut-off effect on farm management

	(1)	(2)	(3)	(4)
$T_{\leq 40}$	0.0209***	0.0210***	0.00616	0.0205***
	(0.00271)	(0.00271)	(0.00387)	(0.00344)
Bandwidth	26–50	26–50	26–50	30–45
Polynomials	1	1	2	1
Covariates	No	Yes	Yes	Yes
R-squared	0.040	0.040	0.043	0.039
Observations	132,929	132,929	132,929	84,348
Individuals	32,183	32,183	32,183	22,255

Note: The models are estimated with OLS. The dependent variable is the farm management. Covariates include years of schooling, education in farming and year dummies.
***Significant at 1% level. Robust standard errors.

and (2) include a linear age control (modelled separately on either side of the cut-off) and in column (3), we add squared age. In columns (1)–(3), we use the ages 26–50 as our bandwidth and in column (4), we use a smaller bandwidth of 30–45. The cut-off effect is 2.1 percentage points in columns (1)–(2) and (4), showing that hired workers younger than 41 are around 25 per cent (calculated at the mean probability of transitioning to farm management) more likely to take management control compared to hired workers older than 40. We find no effect when including quadratic age in column (3). This finding is in line with Figure 2 were age appears to affect the probability lineally, and when including quadratic age, we probably remove the effect by introducing to many age controls on a few number of bins. Our impression from Figure 2 and the estimated cut-off effect are that the eligibility requirement of the SUA, undeniably, affects the probability of farm management. Nevertheless, the SUA effect could overlap with an optimal transfer date effect, but this is unlikely because the assignment variable and age should capture such an effect.

It is difficult to assess the impact of the SUA on the age structure, i.e. how much the SUA rejuvenates the farming population. Using the estimated (from Table 3, column 2) change in transition probability due to the SUA, we do a back-of-the-envelope calculation[18], which shows that average age when taking managerial control of a farm decreases with 1.1 years. However, this calculation does not take into account the change in age structure for those above 40.

5.2 Income from farming, off-farm income and farm survival

Next, we estimate equation (2) for income from farming, off-farm income and farm survival. Table 4 reports results that are in line with the finding in Figure

18 For each age group in our study population (26–51), we use the true number of farm managers, and the predicted number of farm managers without the SUA, to calculate the average age of managers with and without the SUA. To predict the number of farm managers without the SUA, we use the SUA effect to document the change in probability for each age group.

Table 4. Estimated age-40 cut-off effect on income from farming, off-farm income and farm survival

	Income from farming			Off-farm income	Income from farming in year 5	Farm survival in year 5
	(1)	(2)	(3)	(4)	(5)	(6)
M	−0.111***	−0.109***	−0.106***	−0.0730*	0.241***	
	(0.0131)	(0.0132)	(0.0158)	(0.0428)	(0.0165)	
$M^{*} T_{\leq 40}$	0.0500**	0.0532**	0.0473	−0.252***	0.0508	0.0421*
	(0.0247)	(0.0248)	(0.0305)	(0.0775)	(0.0312)	(0.0228)
Bandwidth	26–50	26–50	30–45	26–50	26–50	26–50
Polynomials	1	2	1	1	1	1
Covariates	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.087	0.087	0.065	0.013	0.738	0.065
Observations	132,929	132,929	84,348	132,929	103,904	7757
Individuals	32,183	32,183	22,255	32,183	25,374	7757

Note: The models are estimated with OLS. The dependent variables are logarithmic income from farming (1)–(3), logarithmic off-farm income (4), farm survival (5) and logarithmic income from farming 5 years after transitioning to farm management (6). Farmer fixed effects are included in (1)–(5). Covariates include years of schooling, education in farming and year dummies.
*Significant at 10% level. Robust standard errors.
**Significant at 5% level.
***Significant at 1% level.

3: a negative impact of farm management on income from farming of 0.11 percentage points (columns 1–3). For individuals younger than 41, the effect is counteracted by a cut-off effect of around 0.05, which we interpret as a positive impact of the SUA. Neither a smaller bandwidth nor an increased number of polynomials impacts the size of the effect (see columns 2 and 3), but a smaller bandwidth increases the standard errors, turning the effect insignificant. We weight the reduced form estimate in Table 4 with the share of managers with the SUA (about 52 per cent of those who gain management control when younger than 41) to receive the average effect for the treated instead of the average effect of the potentially treated.[19] This estimate is 9.7 (0.05/0.52) percentage points, meaning that the net impact of farm management for subsidy receivers is almost zero (9.7–11).[20]

Turning to column (4), we find that management decreases off-farm income, particularly for subsidy receivers. Because off-farm incomes are low on average, small absolute changes imply large relative changes (and farm management often implies an end to an off-farm engagement).

19 Like in instrument variable estimation, the IV-estimate is $\frac{\textit{Reduced form estimate}}{\textit{First stage estimate}}$.

20 We cannot visualize the cut-off effect on income from farming, even if it is standard to do so. Without a control for management, *M*, the cut-off effect captures the net effect of management (which is negative on income from farming) *and* the subsidy effect (which is positive on income from farming).

Table 5. Estimating placebo cut-off effects when assuming age eligibility cut-offs of 35 or 37

	Farm management		Income from farming	
	Age ≤ 35	Age ≤ 37	Age ≤ 35	Age ≤ 37
$A_{\leq 35\ or\ 37}$	−0.0015	−0.0057**		
	(0.00289)	(0.00289)		
$M^{*}A_{\leq 35\ or\ 37}$			0.0184	0.0066
			(0.0245)	(0.0247)
Bandwidth	26–50	26–50	26–50	26–50
Polynomials	1	1	1	1
Covariates	Yes	Yes	Yes	Yes
Observations	132,929	132,929	132,929	132,929
R-squared	0.042	0.041	0.086	0.086
Number of Persons	32,183	32,183	32,183	32,183

Note: The models are estimated with OLS. The dependent variables are farm management and logarithmic income from farming. Farmer fixed effects are included in columns (3)–(4). Covariates include years of schooling, education in farming and year dummies.
**Significant at 5% level.
*Significant at 10% level. Robust standard errors.

As a next step, we estimate the SUA effect on income from farming 5 years after transition (column 5) and farm survival (column 6). We use the same specification as in column (1).[21] We find that the cut-off effect on income from farming in year 5 is similar to the effect in year 0 (but insignificant due to larger standard errors), while the general impact of farm management has turned positive. Finally, the results, in column (6), show that farmers who receive the SUA have a higher probability of surviving as farmers[22].

5.3 Placebo test

One way of testing the accuracy of the results is to execute a placebo test. For farm management and income from farming, we model the age eligibility cut-off to be 35 and 37 instead of 40. Table 5 reports these placebo cut-off effects. For farm management, we find a small cut-off effect at age 37 (about a fourth of the effect at age 40). But, the overall finding from the placebo analysis supports our empirical strategy as the incorrect assignment of individuals to treatment and comparison groups provide insignificant estimates.

6 Conclusions

Our results indicate that the SUA mitigates the generational renewal problem. We find that the age-40 eligibility requirement of the SUA has a significant

21 The other two specifications provide similar results (not reported).

22 Because farm survival is conditional on having become manager, the sample is much smaller as non-managers and the panel dimension are lost.

impact on the transition to become farm manager. A higher probability of transitioning before age 41 likely decreases the average age of farm managers.

Moreover, we document a fall in income when transitioning to farm manager that the SUA mitigates, both in the short and long run. The aid also increases the probability of farm survival. The long-run impact indicates that the SUA affects investments, for example, through returns to investments or through reducing borrowed capital, lowering the interest costs. At the same time, the SUA decreases off-farm income, possibly because farm management competes with other engagements.

Since EU recently added the Young Farmer Payment, which is similar to the SUA, it is important to discuss whether the results may apply also to the Young Farmer Payment. Like the SUA, the Young Farmer Payment has an age-40 requirement, but it is paid out for 5 years after taking over or starting up a farm. As it is included in the first pillar, the payments is general and based on hectares of agricultural land.

We argue that the SUA is more likely to increase generation renewal than the Young Farmer Payment. First, as everyone aged 40 or younger is eligible for the Young Farmer Payment, it probably has lower precision than the SUA. Second, to receive the SUA, the farmer has to produce a business plan, which obliges the farmer to elaborate on the future and how to develop the farm. The SUA may, therefore, part from having a monetary impact, encourage change and well-thought-out management. Finally, as we find a large fall in incomes at the transition date, a lump sum may better stimulate investments than spreading the payments over 5 years. Taken together, these reasons suggest that EU may want to give priority to the SUA as a policy for targeting generational renewal.

7 Conclusion

Whether the SUA affects the probability of *becoming* a farm manager for young hired farmers, and not only *becoming manager sooner rather than later,* cannot be empirically analysed in this setting. Nevertheless, as the SUA reduces the transition age and increases income from farming, the aid appears to make farming more attractive for young people. This study, therefore, concludes that the aid is likely to fulfil its aim of increasing the share of young persons in farming. Some words of caution are still warranted. Even if generational renewal probably will modernise the sector and contribute to continued farm survival, it may also have adverse consequences as an increased inflow of young farmers may decrease the ongoing structural change; i.e. it may imply fewer large and competitive farms in the long run.

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