

The role of financing frictions in agricultural investment decisions: an analysis pre and post financial crisis

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The role of fundamental Q and financing frictions in agricultural investment decisions: an analysis pre and post financial crisis

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Abstract

This paper uses a fundamental Q model of investment to consider the role played by financing frictions in agricultural investment decisions, controlling econometrically for censoring, heterogeneity and errors-in-variables. Our findings suggest that farmer's investment decisions are not driven by market fundamentals. We find some evidence that debt overhang restricts investment but investment is not dependent on liquidity or internal funds. The role of financing frictions in determining investment decisions changes in the post-financial crisis period when debt overhang becomes a significant impediment to farm investment. The evidence suggests that farmers increasingly rely on internal liquidity to drive investment. Finally, we find no evidence that farmers use off-farm capital to fund on-farm investment.

Keywords: Credit Constraints, Firm Level Investment, Tobin's Q, Debt

JEL classification: G31, G32, F34

1 Introduction and background

Investment is of critical importance to economic development, driving productivity and efficiency in production and enhancing firm profitability. Given this important role, there has been significant research into the determinants of investment expenditure by firms and the factors that influence their investment behaviour. This paper's contribution is twofold. First, building on research concerning investment in European agriculture (Huettel et al. (2010), Sckokai and Moro (2009), Vercaemmen (2007)), this paper uses Q theory (Tobin and Brainard (1976)) to evaluate the role played by fundamentals and financing frictions in determining on-farm investment. Second, the paper contributes to the methodology appropriate for analysing lumpy investment decisions by simultaneously addressing issues of censoring, heterogeneity and errors-in-variables in panel data.

This research specifically looks at the contrasting role played by expectations about future profitability, and financial considerations namely debt overhang, liquidity and off-farm income in driving on-farm investment behaviour. It also considers the impact of changes in the credit operating environment on investment behaviour. A number of structural changes have occurred to financial and capital markets and the credit environment in Europe in the last number of years, namely the introduction of the euro as well as the recent financial crisis. This paper considers the effect of these major changes to the operating environment on access to credit for on-farm investment.

Using farm level data from Ireland over the period 1996-2009, a fundamental Q model of investment is estimated with financing frictions included in the empirical investment equation. To estimate values for Q, the GMM panel vector autoregression (VAR) approach outlined in Gilchrist and Himmelberg (1995) is used. This method has been extended to consider issues of investment in agriculture by Bierlen and Featherstone (1998) and Benjamin and Phimister (2002).

The second contribution relates to the methodological approach as a number of econometric challenges are addressed in this paper. The nature of the data, as well as the research question under review raises three econometric issues, namely censoring of the dependent investment variable, mis-measurement in the estimate of Q and unobserved heterogeneity that arises in a normal micro-data situation. We use an instrumental variables fixed effects model with the Symmetrically Censored Least Squares (SCLS) approach of Powell (1986) and Chay

and Powell (2001) to cater for censoring, individual heterogeneity and errors-in-variables.

A number of important conclusions emerge from our research. Firstly, the results indicate that fundamentals do not appear to drive investment activity. While the coefficient for Q is not significant in the majority of regressions, the actual sign on the coefficient is negative; the opposite to a-priori expectations. This is difficult to interpret. One explanation may be that some farmers, observing declining fundamentals, are attempting to invest to turn the position around instead of exiting the market or consolidating. Choosing to remain active in farming may be motivated by non-economic reasons such as lifestyle, tradition or other social factors.

Considering the impact of financing frictions on investment, there is some evidence that debt overhang negatively impacts on investment. This effect is greatest for middle-aged farmers. Over the whole sample, we find no impact of liquidity on investment thus are not dependent on internal funds This is not a surprising finding for two reasons. Firstly, most farmers have a high net worth due to the large land holdings they own. These land holdings are a significant source of collateral which can be used in accessing credit from financial institutions. Our finding in terms of liquidity would corroborate the fact that, due to the high net worth, farmers are not constrained by current income or liquidity in accessing investment credit. Additionally, the period in which our data covers in Ireland is one of significant increases in the value of land which provided an additional boost to farmers' collateral. The second issue relates to the security of income from farming in the EU. The significant level of subsidisation in both pre and post decoupling environments provides income streams of relatively low risk and volatility. The security of income would reduce the risk and provide farmers with better access to debt financing. This result corroborates the findings of Vercaemmen (2007) who posits that direct payments may stimulate investment by reducing the risk of bankruptcy and increasing the expected value of marginal investment. This result is also highlighted in Sckokai and Moro (2009).

In terms of the role played by off-farm income on investment, we find no evidence of a direct impact whereby it supplements internal funds used for investment purposes. There is also no evidence found in regard to the indirect channel whereby off-farm employment eases credit constraints by influencing the decision of lenders to take off-farm employment into account when making loan decisions.

Finally, the impact of the credit cycle on financing frictions is investigated. Our findings

indicate that in the pre-crisis period, following Ireland adopting the euro currency, credit constraints did not bind and neither did debt overhang or liquidity impact on investment. This was a period in which credit was abundant in the overall economy, as Irish banks accessed international and euro credit markets with relative ease. It is no surprise that farmers, who have access to significant collateral due to their land holdings, were not credit constrained. However, since the onset of the financial crisis, both debt overhang and liquidity have become significant determinants of investment. Debt overhang is found to have a significant and negative impact on investment following the crisis while liquidity is found to have a positive impact on investment since the crisis. This indicates that farmers are now dependent on their internal funds to drive investment.

2 Measuring Q and the empirical investment equation

Central to the estimation of Q theory models of investment is the choice of empirical proxy for the theoretical marginal Q. In this paper, the approach outlined by Gilchrist and Himmelberg (1995), and applied in an agricultural micro-data context by Benjamin and Phimister (2002) and Bierlen and Featherstone (1998), is used to estimate Q from firm level fundamentals. This approach allows the estimation of a Q statistic for enterprises with no financial market listings and is therefore a very important tool for considering the role of fundamentals in farm level investment decisions. The forcing process for firm fundamentals is specified as an AR(1) stochastic vector process. The vector includes firm level fundamentals which relate to the profitability of the organisation. The panel VAR is outlined as follows:

$$\mathbf{x}_{it} = \mathbf{A}\mathbf{x}_{i,t-1} + \kappa_i + \gamma_t + \mathbf{u}_{it} \quad (1)$$

$$q_{it} = (\mathbf{c}'[\mathbf{I} - \lambda\mathbf{A}]) \mathbf{x}_{it} \quad (2)$$

In regard to which of the firm level fundamentals are included in the model, different authors have used varying combinations of fundamentals in this system. Beirlen and Featherstone (1998) and Benjamin and Phimister (2002) include the marginal value product of capital (mvpk) and total sales in their system VAR, \mathbf{x}_{it} . We include the mvpk ¹ and the

¹Following as Bierlen and Featherstone (1998) we have defined mvpk as gross output minus total costs divided by the capital stock which basically provides a measure of the return per unit capital stock

sales to capital ratio. The estimation procedure for the panel VAR uses the GMM approach outlined in Holtz-Eakin, Newey and Rosen (1988) and Gilchrist and Himmelberg (1995).

In this paper, our focus is on estimating the impact of financing frictions on investment. The structural model developing the Q approach relies on the assumption of perfect capital markets (Hayashi, 1983) which implies that, when evaluating the profitability of investment decisions, firm managers are not constrained by issues relating to access to capital. Empirically this means that when an investment equation includes a good proxy for Q, no additional variables should be significant, including financials, if the model's assumptions are correct.

For many firms especially SME's, assuming perfect capital markets is not realistic as they face issues relating to asymmetric information in credit markets. This results in current levels of leverage, the availability of collateral and the availability of internal funds impacting on investment choices. We include three specific financing frictions in the empirical investment equation; the level of debt overhang, a measure of liquidity, and an off farm income indicator. Our empirical specification is outlined as follows:

$$\frac{I_{it}}{K_{i,t-1}} = \alpha_0 + \alpha_1 q_{it} \pm \alpha_2 X_{it} + c_i + \eta_t + \epsilon_{it} \quad (3)$$

where X_{it} is a vector of debt overhang, off farm income, liquidity, interactions of these and general controls.

3 Data and Econometric Methodology

This section presents the data and outlines the econometric approach used to deal with each of the aforementioned issues.

3.1 Data

The data used in this paper are taken from the Irish National Farm Survey. The total sample contains some 15,700 observations. The main variables in the model relate to investment and financing frictions. For the dependent variable on business investment, the farm survey has annual values for net new on-farm investment. In terms of Irish agriculture, investment was reasonably static over the period 1996-2006, a significant investment spike occurred in the period 2007 - 2008. This coincided with the significant government incentives that were

offered during this time.

3.2 Sample Selection

A significant issue that arises with investment data is the occurrence of zero observations on the dependent variable. Many investment programmes, especially for farms, are lumpy and infrequent. These type of data also contain negative observations on firms that are divesting and potentially leaving the industry. These considerations raise concerns about sample selection and present challenges to standard estimation techniques.

This paper uses a methodology drawing on the work of Jones and Labeaga (2002) to treat the issue of repeated zero observations and censoring. The sample is split into those farms that never invest and those that are potential investors. Non-investors are defined as those farms that post a zero investment level in all years in the sample. Potential investors may or may not have positive investment in year t but must have made at least one positive investment in the sample period. Splitting the sample along these lines is particularly important in the agriculture sector due to the existence of hobby and part-time farmers. These individuals may not respond to market incentives and are active in the industry due to non-economic, social or historical reasons. Removing the non-investors potentially induces sample selection bias. Following Jones and Labeaga (2002) and Wooldridge (1995), we use an inverse mills ratio (IMR) test for sample selection bias.

3.3 Censoring

An innovation of this paper is applying sample selection techniques so as to appropriately treat the behaviour of investors and exclude those that are not investors from the sample. Having excluded non-investors, the remaining zero observations must be controlled for. The intuition behind using a censoring technique comes from the latent style behaviour of investment. The observed outcomes are realisations of unobservable preferences of investors. These underlying preferences may actually indicate a negative view towards investment but the only observed values are positive or zero. This view should be related to the information contained in current market fundamentals. The Q model assumes that these fundamentals provide the signals to farmers regarding investment choices. It is important to pick up this latent behaviour using a censoring technique. Methods for dealing with censoring, such as the tobit and double-hurdle

models, have become standard in the literature Keelan et al. (2008). However, both methods require strong distributional assumptions (for example, homoscedasticity and normality of the errors) which will lead to inconsistent estimates if violated. Furthermore, when using panel data unobserved heterogeneity across units cannot be controlled for using fixed effects due to the incidental parameters problem. In this paper, we avoid these issues by using the Symmetrically Censored Least Squares (SCLS) approach of Powell (1986) and Chay and Powell (2001). This approach assumes that the latent dependent variable is symmetrically distributed around the regression function. Given that the observed dependent variable will have an asymmetric distribution symmetry is restored by symmetrically trimming the upper tail of the distribution of the dependent variable to correspond with the censoring at zero. With this transformation least squares estimation procedures, incorporating fixed effects, are valid.

3.4 Errors-in-variables and heterogeneity

Our GMM proxy for Q is subject to measurement error due to the fact that an estimate of the present discounted value of the firm is replaced by an estimate using the fundamental VAR. To obtain a consistent estimate of this model, the problem of errors-in-variables must be treated correctly. In addition, as individual heterogeneity is present in this panel data setting, a fixed effects transformation is required to ensure consistent estimates. Fixed effects within group transformations are not valid in this setting as this would require a strong exogeneity assumption along the lines of $E[u_{it}/c_i, x_{i1}, \dots, x_{i1}, \dots, x_{iT}]$. This would invalidate the use of lags as instruments. Therefore, in line with Gilchrist and Himmelberg (1995), a first difference approach is used to control for heterogeneity. The weak exogeneity condition that provides a basis for the selection of instruments using this methodology is $E(\Delta u_{it}x_{i,t-s}) = 0 \forall s > 1$. Given these assumptions all available years data in levels for the independent variables, the other than the first lag, are valid instruments.

4 Empirical Results

The model is estimated using OLS and instrumental variables (IV) methods with robust standard errors and SCLS methods with bootstrap standard errors. The investment equation

is estimated with different combinations of fundamental Q and the financing frictions: debt overhang; internal funds; off-farm income; and interactions. Time, age, size and investment grant controls are included in all regressions.

Prior to presenting the main results, some important econometric tests are completed. The sample selection test outlined in section 4 is conducted to evaluate the impact of the restrictions imposed on the exclusion of observations. The results indicate a t-statistic on the IMR of -1.16 , and a p-value of 0.246 . This value indicates that there is no problem of sample selection and we can proceed with the sample excluding the non-investors. The third lag level of the mvpk was selected for use as the appropriate instrument.

4.1 Fundamentals and debt overhang

The empirical model was estimated with Q alone using both the IV and SCLS methods. Using OLS and IV techniques, the results indicate a negative relationship between Q and investment. It is significant at the 90 percent level. The impact of using the IV approach to treat the measurement error can be seen in the fact that the impact on Q increased from -0.15 to -0.93 when we move from the OLS to IV methods. The negative sign on Q is a finding that runs counter to the neoclassical theoretical framework and our a-priori expectations. One possible explanation is that farm operators observe the declining profitability and shrinking size of the agricultural sector in Ireland. This is represented by declining fundamentals. Despite this environment, farmers are disinclined to exit this industry and sell their farm holding. This choice may be driven by non-economic factors. They therefore see investing as a method of potentially reversing this decline i.e. their hope is that investing now may turn around poor profitability in the future. However, when we use the SCLS approach, fundamentals appear not to have a significant impact on investment but Q still retains its negative sign.

Debt overhang is found to be negatively related to investment and significant at the 90 percent level using the IV method. This would indicate that having outstanding debts coming into the period has a significant and negative impact on current year investment activities for farmers. However this effect becomes insignificant when we use the SCLS approach. Additional data is available on the term structure of debt from the NFS. This data does not equate fully to the total debt overhang used previously as it comes from additional survey questions but it is accurate and representative. Using both the SCLS and IV methods, medium

to long and short term debt are both significant, the IV at the 99 percent level and SCLS at the 95 percent level. It can be seen that it is actually short-term debt that has a larger impact, as measured by the size of the coefficient. This is an interesting finding and could reflect the fact that poor short term debt management such as an over reliance on overdraft facilities and other short term facilities could be an indicator of poor credit worthiness of the borrower. This evidence indicates that leverage plays a negative role in the decisions of farmers looking to invest on the farm. However the variable is insignificant for total debt overhang using the SCLS approach.

It is interesting to split the sample up to ascertain whether certain types of farm operations are more or less impacted by the availability of credit. Two important characteristics of farms controlled for in the previous table, are the age of the farm operator and the size of the economically active farm area. Interacting the age and size effects with debt overhang, we attempt to establish whether the impact of leverage is greater for certain size farms or certain age farmers.

Debt overhang has a negative impact on farmers in the mid range age. Leverage is not an impediment to investment for young farmers or old farmers. One might expect banks to be less likely to extend credit to older farmers given their closeness to retirement and ceasing economic activity in which case the result for older farmers is contrary to expectations. It is more likely however that the impact is on the demand side in the context that older farmers are not investing actively therefore do not demand credit to finance investment resulting in an insignificant effect. The behaviour of older farmers may also be influenced by the existence of a successor. If a successor is present, the financial institution may take this into account when making lending decisions and age therefore may not restrict access to capital. In regard to whether the size of the farm impacts on whether debt overhang restricts investment, one would expect larger farms with more collateral to be in a position to take on considerably more debt. Our results however indicate no significant impact of the size of the farm on the role of debt overhang in investment financing.

In general, these results point to a negative impact of debt overhang on investment but the result does not hold for all the models tested. It must be noted that the period in which we are considering was one of significant credit availability in the wider economy in Ireland and it is unlikely that farmers, within the wider credit operating environment, would have

had difficulty raising capital regardless of initial leverage levels. Having significant levels of collateral in the form of land holdings, coupled with the widespread availability of capital in the economy, may explain why a stronger impact of debt on investment is not found here. The subsidies paid to farmers with the EU Common Agricultural Policy scheme would also have provided farmers with a relatively secure and predictable income stream. Credit providers may have seen lending on this back of this payment structure was relatively low risk.

4.2 Fundamentals and liquidity

The second financial consideration relates to the role of liquidity or internal funds on investment. To evaluate this impact we include the ratio of interest to current income. This ratio captures the ability of the firm to cover its short term obligations with its short term assets. We include income in the denominator of this metric, to avoid missing observations where interest payments are zero. As such, if farms are reliant on internal funds to drive investment, we would expect a negative relationship between this ratio and investment. The sample size for the models including this variable falls slightly due to missing observations. Full regression results are included in the longer paper version.

We find no significant impact of fundamentals on investment in these models. Using the IV and SCLS approaches, the results indicate that, while carrying the correct sign, there is no role for liquidity in driving on-farm investment. This indicates that farmers are not reliant on internal funds to drive investment over the whole sample. Some evidence is found for a liquidity impact using the OLS method but these estimates are inconsistent.

We also interact liquidity and both the age and size cohort effects. Using the more efficient SCLS approach, it appears that neither the age of the farm operator or the size of the farm play a role in determining whether liquidity impacts on investment behaviour, thus reinforcing the findings for the whole sample.

As was noted above in regard to impact of the wider credit operating environment on debt overhang, the finding that liquidity is not a determining factor for farmers investment behaviour is not surprising. Within the period reviewed both the security of income through the EU farm payments scheme as well as the availability of credit - with their high net worth as collateral - would have allowed farmers easy access to external debt.

4.3 Off-farm income and investment

The final financing friction we consider is the role played by off-farm income and off-farm employment in driving on-farm investment. We include a dummy for whether a farm operator has an off-farm job. There is no impact of the off-farm dummy on investment using any of the OLS, IV and SCLS methods. Farmers with off-farm employment are not systematically investing more than those with no off-farm jobs. We also find that off-farm employment is not a driver of on-farm investment for any of the three age categories and size categories considered.

The results of the interaction between off-farm income and both debt overhang and liquidity are also considered. Interacting off-farm employment and debt does not seem to support the hypothesis that off-farm employment eases credit constraints for investment. While both the off farm employment dummy and the debt overhang level effect are not significant individually, their interaction is significant and negative. It suggests that farmers that have off-farm employment are more constrained by access to finance than those that do not have off-farm jobs. There are a number of possible explanations. First, it may be that those farmers that have off-farm jobs have small farms thus would not have as much access to collateral to secure loans. Alternatively, farmers with high levels of on-farm debt might have obtained off-farm jobs to try and ease debt burdens.

Considering the interaction of off-farm employment with liquidity, no significant impact is found. Our results suggest that farmers with off-farm jobs are not dependent on internal funds to drive investment and are not directly using off-farm income to add to internal funds to pay investment expenditures.

4.4 Financial operating environment and investment

The overall financial and macro operating environment and general credit availability are both very much cyclical in nature, following the general business cycle as well as being driven by financial innovation. In this section, we test whether financing frictions had a different impact on farmer investment behaviour for the pre-crisis Irish euro membership period as well as the financial crisis itself. To assess whether the impact of financing constraints differed with the overall credit environment, we use a structural break approach, defining dummies for pre crisis euro period as years 2002-2007 and the financial crisis for the years 2008 and

2009. The results for the interactions with debt overhang are include in Table 1.

Table 1: **First Difference Regression Results**

| | OLS | IV | SCLS | OLS | IV | SCLS |
|----------------------------|----------------------|---------------------|---------------------|----------------------|--------------------|-------------------|
| Q (DO) | -0.110 (0.089) | -0.913 (0.598) | -0.900 (0.730) | -0.097 (0.092) | -0.908 (0.604) | 0.217 (0.648) |
| Debt overhang | -0.129*** (0.042) | -0.072 (0.070) | -0.074 (0.079) | -0.162*** (0.056) | -0.136 (0.088) | -0.164 (0.070) |
| Financial crisis | 0.005 (0.003) | -0.001 (0.006) | -0.020 (0.012) | | | |
| DO × FC | -0.320*** (0.105) | -0.290** (0.114) | -0.288** (0.118) | | | |
| Pre Crisis Euro Membership | | | | -0.007** (0.003) | 0.007** (0.003) | -0.002 (0.007) |
| DO × Euro | | | | 0.000 (0.082) | 0.051 (0.115) | -0.019 (0.103) |
| System and Time Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| n | 9,433 | 6,171 | 6,171 | 9,433 | 6,171 | 6,171 |

Cells show coefficients and standard errors

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

There is no evidence of debt overhang impacting investment prior to the financial crisis as indicated by the insignificant coefficient on the debt overhang variable using the IV and SCLS methodologies. However the findings indicate a significant and negative role of debt overhang on investment following the financial crisis. Given that the financial operating environment since 2008 has been, and continues to be extremely challenging, the results would indicate that access to additional credit was a significant impediment to investment for leveraged farmers since the financial crisis. This is an important finding given that the financial climate will remain challenging going forward.

Considering the pre-crisis euro membership period, the results indicate that debt overhang was not an impediment to investment in this period as indicated by the insignificant

coefficients for all econometric methodologies. This is no surprise due to the wider credit environment at this time. We now consider the impact of liquidity in each of these two periods. The results are presented in Table 2.

Table 2: **First Difference Regression Results**

| | OLS | IV | SCLS | OLS | IV | SCLS |
|----------------------------|----------------------|----------------------|----------------------|----------------------|---------------------|---------------------|
| Q | -0.115 (0.092) | -0.784 (0.581) | -.783 (0.667) | -0.111 (0.092) | -0.767 (0.583) | -0.767 (0.681) |
| $\frac{r}{CF}$ | -0.013 (0.009) | 0.023 (0.019) | 0.023 (0.020) | -0.047*** (0.013) | -0.030 (0.023) | -0.030 (0.024) |
| Financial crisis | 0.010*** (0.003) | 0.012*** (0.003) | -0.011 (0.013) | | | |
| $\frac{r}{CF} \times FC$ | -0.114*** (0.032) | -0.156*** (0.040) | -0.156*** (0.039) | | | |
| Pre Crisis Euro Membership | | | | -0.000 (0.003) | -0.011** (0.005) | 0.008 (0.008) |
| $\frac{r}{CF} \times Euro$ | | | | 0.050*** (0.016) | 0.060*** (0.023) | 0.059*** (0.022) |
| System and Time Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| n | 8,764 | 5,773 | 5,773 | 8,764 | 5,773 | 5,773 |

Cells show coefficients and standard errors
* p<0.05, ** p<0.01, *** p<0.001

While the results indicate liquidity is not significant over the whole sample, the interaction of liquidity with the financial crisis is significant and negative at the 99 percent level using the IV and SCLS methods. This indicates that since the financial crisis farmers now depend on their internal funds in making investment decisions.

The overall results from our assessment of the impact of the wider credit environment on the role played by financing frictions on investment indicates that in the pre-crisis euro membership period, credit constraints did not bind for farmers and there was no impact of debt overhang or liquidity on investment. However for the period since the onset of the financial crisis, debt overhang is significant and negatively related to investment and liquidity is positively related to investment. These results are in line with Bierlen and Featherstone (1998) who found that credit constraints varied with business and credit cycles.

5 Conclusion

A number of overall conclusions emerge from our research. Firstly, there is no evidence that fundamentals drive investment for Irish farmers. The empirical proxy for the Q statistic that is included in the analysis is statistically insignificant when the SCLS approach is used for all models. An explanation for this negative sign relates to the reaction of farmers to the declining returns to agriculture in recent years. As farmers may be reluctant to leave a declining industry or consolidate to drive scale economies, on observing declining fundamentals, they may be attempting to invest as a way to enhance future profitability. It is also highly likely that some of this relationship can be explained by the requirement of farmers to undertake compliance based investment for environmental reasons.

In relation to financing frictions, there is some limited evidence that debt overhang, when considered on its own, has a negative impact on investment. The result is strongest for middle-aged farmers but the impact of debt overhang does not change depending on the size of the farm. We find no impact of liquidity on investment overall in the data. Farmers are not dependent on internal funds to drive investment expenditure over the whole sample. There are a number of potential explanations as to why farmers were not subject to credit constraints over the period evaluated. Both their relatively high net worth from land holdings and the wider credit environment would have provided significant access to external capital. Additionally, the security of income provided under the EU CAP support system may have

been viewed as relatively low risk and secure by lenders when evaluating loan applications. Our finding supports the work of Sckokai and Moro (2009) and Lagerkvist (2005).

With regard to off-farm income and employment, we found no evidence of the direct impact whereby off-farm income supplements internal funds that are used to cover investment expenditure. This result holds with regard to the age of the farm operator and the size of the farm. Neither the dummy for off-farm employment nor its interactions with liquidity yields a significant result. There is no indication that farmers are substituting off-farm capital for on-farm labour. There is also no evidence found in regard to the indirect channel whereby off-farm employment eases credit constraints by influencing the decision of lenders to take off-farm employment into account when making loan decisions.

The impact of the credit cycle on whether credit constraints are binding is also evaluated. The findings indicate that in the pre-crisis period following Ireland adopting the euro currency, credit constraints did not bind and neither debt overhang or liquidity impacted investment. As this was a period in which credit was abundantly available in the overall economy, as Irish banks accessed international and euro credit markets with relative ease, it is no surprise that farmers, who have access to significant collateral due to their land holdings, and secure subsidies under CAP, were not credit constrained. However, since the onset of the financial crisis, both debt overhang and liquidity have become significant determinants of investment. Debt overhang is found to be a significant and negative determinant of investment following the crisis while liquidity is found to have a positive impact on investment since the crisis. This indicates that farmers are now dependent on their internal funds to drive investment. These are important findings for the sector and, if agriculture is to develop through business investment, access to credit issues will need to be addressed going forward.

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