Alternative Measures of Family Farm Viability – Incorporating Gap Measures

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Abstract

The measurement of farm economic viability has received intermittent academic interest with limited attention given to the conceptual framework surrounding the issue. This paper focuses attention on farm economic viability in Ireland where there are growing concerns about a two-tiered agricultural sector with increasing levels of economic vulnerability. The measurement of farm economic viability is usually based on the headcount ratio, which identifies whether a farm business is viable or non-viable and does not inform about the extent of non-viability. Therefore, it is necessary to develop alternative techniques to provide more clarity on viability levels. This paper draws on concepts from the poverty literature to develop a viability gap measure and a viability severity measure. The trends in farm economic viability are sensitive to the choice of indicator with notable differences between the headcount ratio and the viability gap. The results point to a significant cohort of acutely non-viable cattle and sheep farms. The headcount ratio provides the basis for an incomplete assessment of viability levels and multiple indicators should be considered in monitoring viability levels.

Keywords Farm Economic Viability, Conceptual Framework, Headcount Ratio, Viability Gap, Severity Index.

JEL code I32, J31, Q12

1 INTRODUCTION

The family farming model is the dominant form of farming globally accounting for more than 550 million farms in the world and supplying 80 per cent of the world's food in value terms (Lowder et al 2019). Garner et al (2014) conclude that the reliance on family labour is the most defining characteristic of these farms emphasising the coevolution and combination of their "economic, environmental, reproductive, social and cultural functions". Family farms can contribute to agricultural sustainability, the safeguarding of cultural heritage and rural development (Balaine 2019). Concurrently, family farms are tied into broader networks and structures making them vulnerable to distant events including commodity price fluctuations and agricultural policy reforms (Woods and McDonagh 2011) and other pressures including the inequality and consolidation within the agribusiness sectors (Graeub et al 2016). Despite these challenges, many on the ground observations point to the persistance and resilience of family farms (Inwood and Sharp 2012; Darnhofer 2014; Macken-Walsh et al 2020).

Farm viability is a concept frequently used in policy analysis in relation to both sustaining farm incomes and as a basis for competitive returns to factors used in farming. Farm viability is the basis of the second objective of the Common Agricultural Policy (CAP) as outlined in Article 39 of the Treaty of Rome, where the objective is "to ensure a fair standard of living for the agricultural community, in particular by increasing the individual earnings of persons engaged in agriculture". The productive return on factors employed is the basis of the first objective of Article 39 relating to agricultural productivity, the promotion of technological progress and "the optimum utilisation of the factors of production, in particular labour". Cardwell (2015) explains the close connection and tensions between these two objectives with numerous examples of EU policy decisions involving a compromise between both objectives.

More recently, viability and competitiveness are both included as two of the nine key policy objectives for the future of the CAP, with the viability objective aiming to "support viable farm income and resilience across the Union to enhance food security"[1]. The objective for competitiveness is to "increase competitiveness and

[1] https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/future-cap/key-policy-objectives-future-cap_en

productivity in a sustainable way to meet the challenges of higher demand in a resource constrained and climate uncertain world". Appropriate statistics are therefore required to assess the extent to which these objectives are being achieved. This paper is concerned with the development of statistics in relation to quantifying the CAP fair income objective and as we will define later, primarily the focus on returns on assets employed.

Family Farm Viability is discussed and documented over a number of decades internationally (Commins 1980; Frawley and Commins 1996; Argilés 2001; Matus and Paloma 2012; Barnes et al 2020). Barnes et al (2020) define Farm Viability according to Salant et al (1986) who considered viability as achieved where the "farm household that receives enough income from all sources to cover minimum family living expenses, cash farm operating costs and capital replacement costs at the same time as it improves its net worth by making scheduled principal payments on its debts". Elsewhere, Graddy-Lovelace and Diamond (2017) define Farm Viability in broader terms as 'the ability of small and mid-sized growers to maintain a decent livelihood and farm in a way that does not degrade ecosystems or rural communities". Graddy-Lovelace and Diamond draw from Karl Polanyi's concept of the double movement and conclude that while farm subsidies provide income support to farmers, these payments also act to suppress the tensions and dysfunctions within the agricultural sector.

Despite the significant volume of empirical studies, the conceptual framework used by many researchers to study farm viability is largely absent. The existing empirical literature has largely provided weak theoretical foundations for the methodological choices to analyse farm economic viability. One clear challenge offered therefore is to develop a farm business income measure, which would provide a stronger foundation for the analysis of farm viability. Some suggestions have emerged from the recent literature, such as, O'Donoghue et al. (2016) who suggest a path forward through measuring viability based upon the gap or distance from a specified threshold. This approach would allow researchers to provide a better account regarding the scale of the non-viability problem. The poverty gap approach is widely practiced in the poverty literature (Heuveline and Weinshenker 2008; Gradín et al 2012; Leventi et al 2019).

Elsewhere, Spicka et al (2019) have closely examined alternative approaches to the estimation of farm-level economic viability with a view towards improving the measurement of viability in the Czech Republic where non-family farming accounts for the majority of farm labour. Due to the importance of corporate farms in Czech agriculture, Spicka et al focused attention on the treatment of long-term assets in forming a definition of farm viability. Slavickiene and Savickiene (2014) address the different approaches towards the measurement of farm economic viability in Lithuania and conclude that a combination of methodologies would result in a more efficient assessment of the economic viability of agricultural holdings.

The measurement of farm viability appears to be strongly influenced by the context. Frawley and Commins (1996) examined, in an Irish context, the issue of farm viability in terms of farm survival in the transition towards free trade under the World Trade Organisation GATT agreement. More recently, Hennessy et al. (2008) discuss the viability of farming in Ireland in the context of the persistence of "the small farm problem". In the European context, Barnes et al. (2014) discuss farm viability as a concept to understand the criteria for "failure at the farm level and to identify factors which determine a switch from viable to non-viable and the consequences of consistent under performance in the sector" (p.4). Barnes et al. (2015) use panel data to distinguish between long run and short run viability among farms in Scotland and Sweden and find that Scottish farms have a greater likelihood of viability than Swedish farms in both the short-term and long-term. Aggelopoulos et al. (2007) modelled the financial viability of farms within the Greek agricultural sector and the necessity to measure farm viability in order to avail of financial aid.

There are, however, a number of comparatives throughout all the literature discussed above. The measure of welfare is not explicitly referred to by the authors yet all discuss the importance of measuring some form of farm survival; particularly of farms operating at the fringes of being viable, this points to viability as a measure of welfare. Farm viability relates to the achievement of a discrete welfare objective. In many ways, this is akin to the objectives of the poverty literature, which focuses on evaluating the achievement and challenges associated with monetary poverty reduction; again the goal achieving a discrete welfare measure. Although the reduction of household poverty and the improvement of farm viability are manifestly

different, methodologically and theoretically they are similar. Previous research has specifically dealt with the issue of poverty among farm households in Ireland (Frawley et al. 2000; Commins 2004) and the wider rural society (Shubin 2007).

Farm viability measurement as a welfare measure requires attention and this paper aims to provide a basis to develop this discussion further.We explore alternative methodological choices in terms of measurement and we analyse the implications of these choices. This paper thus examines the measurement of the economic viability of farms. Given the relative importance of agriculture in its rural economy, we select Ireland as a case study for this paper (O'Donoghue and Hennessy 2015).

In this paper, we critically assess farm economic viability indicators with reference to other measurement literatures, particularly poverty. Drawing on the experience of other disciplines, we propose a new approach and demonstrate the benefits of applying it to farm accountancy data. Poverty measurement literature is drawn upon due to the similarities that exist between poverty and viability measurement; both reflect welfare. While the context used to demonstrate this concept is farming in Ireland, the framework is internationally applicable. This paper seeks to provide a framework to discuss the issues and contribute to the development of a methodology to specifically gain a more detailed understanding of the economic viability of the farm enterprise, while acknowledging the restrictions of available data.

2 DATA AND METHODS

In this section, we develop a methodology to be used to answer the individual research questions highlighted in the previous section in relation to the measurement of viability and issues associated. There are many practical decisions to be made when comparing the welfare of different units.

These decisions include the following:

- the measure to be used,
- the unit of analysis,
- the size of the unit,
- the type of income and the
- period of analysis.

Measuring Viability

In terms of measurement methodologies, there is no uniformity in the literature and different variations are used. As mentioned, Slavickiene and Savickiene (2014) undertook a review of existing measurement methodologies. A collage of the current methods are prescribed, while the authors suggest a need for the development and discussion of tools to aid the process. Farm viability measurement in Ireland draws on the work of Frawley and Commins (1996) who point out that farm viability is a "multidimensional concept", simplified to the definition of "(i) economic/income factors and (ii) demographic factors, or more accurately, the age composition of the household" (p.21).

2.1 Poverty measurement as a Comparator

In developing a methodological approach to the sensitivity of viability measurement, we draw upon the poverty literature, whose issues and objectives are similar but in a different context. Ravillion (1996) points out that when examining poverty measurement, there are a number of key questions. Firstly, does poverty exist? Secondly, the choice of welfare indicator and thirdly, how can poverty be measured including the choice of poverty line. Poverty as defined in this way relates to a distributional measure from the perspective of income below a particular threshold. The challenges in defining the poverty line are largely similar to that of defining the farm economic viability line; the question of where to locate the line or threshold is a key challenge.

However we must pose the normative question as to whether viability relates to a return on factors and thus a test of whether sufficient resources are generated to continue in business or a welfare measure of the household are different. One could of course have a viable farm, but a poor family. However the latter requires information about the wider family, portfolio of incomes and the nature of the poverty line.

In the 1990s, the poverty literature developed from a headcount measure and towards providing much more detail. It appears however, that farm viability measurement almost paused from this point in time. Meanwhile, the concept of poverty measurement has received much more research attention and thus developed onwards. While a headcount measure can provide an indication of how many people are in a

defined situation, this measure represents only a crude representation of poverty, lacking deeper understanding (Sen 1976; Sen 1979; Atkinson 1987). Fundamentally, a reliance on the headcount measure would make it possible to have an unchanged headcount figure for those below the line in circumstances where the level of poverty for that group may increase (Blank 2008, p. 233). A similar outcome could emerge in farm viability studies where the headcount ratio is applied. The poverty gap measure aims to understand these issues through considering the total shortfall from the poverty line, divided by (i) poverty line, or (ii) total income (Barr 1998).

From the perspective of the unit of analysis for farm viability, there is a choice between farm, the farm household and the individuals in the farm household. There is a secondary issue as to which incomes are considered. Therefore one could choose income from farming or income from the wider household. Typically the former is measured in gross terms, given the fact that income taxation typically depends upon a broader income concept[2], while for the latter a net concept is used or alternatively expenditure might be an alternative proxy for long term welfare (Elbers et al., 2003).

As Atkinson (1998) considers, drawing upon the work of Nolan and Callan (1994), using a headcount ratio to assess the poverty rate in Ireland finds that the trend in the poverty rate differs, depending upon whether one counts individuals or households. From a farm viability perspective, farm income (to be defined below) is the income definition used. From a unit of analysis perspective, the farm and the farm household, produce the same result when using farm income and are relevant for returns on factors employed. The use of individual data is necessary when considering questions of producing minimum sufficient income to support a family, but in the context of the wider portfolio of income, relating to Hill's (1999) point of income from farming and the income of farmers.[3]

In the context of agriculture and farm economic viability, a farm i can be considered non-viable where the farm income falls below a pre-defined income threshold Z_i i.e. where $Y_i < Z_i$. The headcount ratio H can be represented in the following:

[2] In some countries, particularly in a development setting, farm income is taxed independently to the rest of the household, (Khan, 2001)

[3] On a related point counting the numbers of individuals in a household assumes that there is perfect sharing of resources within a household, which may not be the case (Cantillon and Nolan, 2001).

$$H = \frac{q}{n} \quad (1)$$

where q represents the number of farms where $Y_i < Z_i$ and n represents the number of farms in the sample. This represents the proportion of farms with incomes, which are lower than a viable level.

The income gap g_i for a farm i can be described in the following:

$$g_i = Z_i - Y_i \quad \text{, where } Y_i < Z_i \quad (2)$$

This represents the distance or shortfall of each farm from the viability threshold, where the family farm income lies below that viability threshold.

Sen (1976) emphasised the importance of the next step in evaluating poverty—the aggregation step. As Sen explained in the context of poverty, the gap approach could potentially be silent on the number of farms sharing the gap. Another issue of relevance is the reporting of viability indicators (either headcount or gap) in relation to sub-sectoral disagregation. To address this issue, we normalise the data to produce a viability gap ratio I in the following:

$$I = \sum_{i=1}^{q} \frac{g_i}{nZ_i} \quad (3)$$

This normalised viability gap corresponds with the normalised poverty gap measure described in (Sen 1976, p.223). This measure amounts to the average income shortfall of all farms from the viability threshold. A value of zero is allocated to viable farms. Relative to the headcount ratio, this viability gap ratio can provide the basis for a more nuanced assessment regarding the scale of the viability challenge on Irish farms.

This measure satisfies the monotonicity axiom (Sen, 1976) whereby a reduction in the income of a non-viable farm must, ceteris paribus, increase the non-viability measure. This measure does not however, satisfy the transfer axiom whereby a pure transfer of farm income from a non-viable farm to a higher income farm must increase the non-viability measure. A number of options are available to satisfy this transfer axiom including the possible use of ordinal weights as outlined in Sen (1976).

Foster et al (1984) introduced a cardinal approach by allocating greater weight to the units with the lowest incomes. Foster et al introduced the parameter α to provide

greater weight to the lowest incomes. As α becomes very large I_{FGT} approaches a "Rawlsian" measure, which considers only the position of the lowest income farm household (Rawls 1971).

$$I_{FGT} = \sum_{i=1}^{q} \frac{{g_i}^{\alpha}}{n{Z_i}^{\alpha}} \quad (4)$$

A value of one for the α parameter is essentially the normalised viability gap measure in Eq. 3. A value of zero is consistent with the headcount ratio described in Eq. 1. In the poverty literature, a value of two is described as a poverty severity index. In the context of farm viability, we can consider this to be a viability severity index. Foster et al (2010) comprehensively outline the range of axioms, which are satisfied under this approach. Viet Cuong (2011) used this severity indicator to examine the impact of agricultural production on household poverty in rural Vietnam but this measure has not been applied to the analysis of farm household welfare in developed countries nor in farm viability measures.

2.2 Viability Line or Threshold

As a discrete welfare measure that depends upon incomes being above a particular threshold, the choice of the threshold is particularly important. In the Irish context, we define a viability threshold of a minimum income level, officially defined in Statutory Instrument by the Agricultural Workers Joint Labour Committee of the Irish Labour Court[4], and a return on investment, which takes into account the development of the farm enterprise. In the poverty literature, the calculation of the poverty line is complicated by a number of issues including the need to adjust household income for differences in household size (Madden 2000). The use of the minimum agricultural wage reflects the opportunity cost of farm labour, which could be employed on the farm or providing labour as an agricultural contractor to other farms. However, this to some extent depends upon whether a farmer is fully employed.

Equally in the context of farm viability, there are complications in defining the relevant threshold Z_i. The relevant threshold differs between farms due to differences in the amount of the labour input and the level of non-land assets. The threshold for each farm is calculated in the following:

[4] http://www.irishstatutebook.ie/eli/2007/si/190/made/en/print

$$Z_i = (L_i * M_i) + (A_i * ROI) \quad (5)$$

where L_i represents the total annual farm unpaid labour hours, M_i represents the minimum agricultural hourly wage, A_i represents the value of the farms non-land assets and ROI represents the percentage return on investment, with a value of 5% applied in previous studies.

In the current negative interest rate environment, the use of a 5% rate for return is much higher than could be achieved, even if it is frequently used in the literature. Using a constant rate of return allows for inter-temporal comparisons. In this study, we test the sensitivity of viability measures to the value of the return on investment parameter and the value of the hourly wage. For the minimum hourly wage, we first apply the agricultural national minimum wage and then test the sensitivity of the results to the application of a living wage as defined by the living wage technical group in Ireland (Living Wage Technical Group 2019). Focusing the return on factors employed, rather treating viability as a welfare measure, we ignore family size. Rather the labour employed reflects the family contribution.

2.3 Farm Income

In this study, we apply the FADN definition of **family farm income** as the remuneration to fixed factors of production of the family (work, land and capital), remuneration to the entrepreneur's risks (loss/profit) in the accounting year and farm subsidies (EC 2015, p. 15). The measurement of farm income is crucial, as it is a key variable in determining farm economic viability. There are a number of choices in this measure. If we exclude the wider farm household disposable income in this paper, there are a range of choices that can be made in relation to farm income. Phimister et al., (2004) employ two other measures in a study of farm incomes, net farm income broader than the definition of family farm income, incorporating imputed rent and labour costs (including imputed labour for unpaid family labour) and cash income, which is a narrower version excluding labour, rent and depreciation

Article 39 of the Treaty of Rome referred to "a fair standard of living for the agricultural community" and the "individual earnings of persons engaged in agriculture", while one of the 9 objectives of the CAP relates to fair income, however the objective of "a fair standard of living" is not well defined as concluded by the

2003 European Court of Auditors (ECA) report (Report no 14/2003). For this reason, we apply some sensitivity analysis in our methods.

2.4 Data

In this section, we describe the main data source used for the analysis. The analysis is based on the Teagasc National Farm Survey (NFS). Since 1972, the Teagasc NFS has collected detailed financial and production data from farms as part of the EU Farm Accountancy Data Network. This survey contains rich data on farm incomes, labour inputs and self-reported asset values. Between 900 and 1,000 farms are randomly sampled each year to represent approximately 90,000 farms in Ireland. The random sample of farms is selected by the Central Statistics Office in Ireland. Due to attrition and to maintain representivity, approximately 5-10% of surveyed operations are cycled out of the NFS annually. Approximately two-thirds of the sample are contained in the panel dataset for all years concerned. We rank the farms in the dataset according to the ratio of family farm income to the relevant viability threshold. We trim the data by excluding the top and bottom one percent of cases to remove outliers.

The Teagasc NFS is used to assess the financial situation on Irish farms by measuring the level of gross output, costs, income, investment and indebtedness across the spectrum of farming systems and sizes. The data is used to measure the current levels of, and variation in, farm performance and provides a database for economic and rural development research and policy analysis. Our study is based on an unbalanced panel covering the period from 2010 to 2018.

The choice of time period is based on data availability. FADN specifies that farms must exceed a certain economic size in order to be defined as commercial farms and form part of the field of observation. This means that very small farms are excluded from the sample. Due to the different farm structures in the European Union, it is necessary to specify separate thresholds for each Member State. In 2011, the FADN network initiated changes to the thresholds for entry into the survey. In the case of farms in Ireland, the lower output threshold increased from €4,000 to €8,000 in the value of standard output (European Commission 2021). The Teagasc Agricultural Economics and Farm surveys department have reweighted the 2010 data to be consistent with this methodology. However, the pre-2010 data is not consistent with

subsequent years. We therefore concentrate the analysis on the period from 2010 onwards.

In table 1, we report the mean and standard deviation for a series of variables, which are relevant for this study. We find that the average Family Farm Income during this period was €24,700 with a standard deviation of €31,921 implying relatively high variability. The basic payments comprises the largest component of Government Subsidies (European Commission 2020). During this period, Government Subsidies (including the basic payment scheme) account for a large share of Family Farm Income with an average basic payment of €13,068 and an average value of other subsidies of €4,712. These other subsidies include payments under the Areas of Natural Constraints (ANC) Scheme and payments linked to environmental practices. The Areas of Natural Constraint were known as Less Favoured Areas (LFA) until the beginning of 2015 (DAFM 2019, p. 532). The average age of the farm operator is approximately 56 years old while the average number of unpaid family labour units is close to 1.09, which equates to approximately 1,950 working hours per annum.

The majority of farms in Ireland are located in ANC areas with 74 per cent of farms located in these areas. A very small minority of farm households are headed by females. Only 4 per cent of farm operators are female although females contribute labour and management to the farm enterprise and the farm household. The average farm size is approximately 44 hectares with a standard deviation of 39.6 implying high variability between farms. The average household size of 2.9 is much greater than the average number of unpaid family labour units suggesting that non-agricultural sources of income tend to be important for the overall household income.

Table 1 Summary Statistics for the Teagasc NFS Farm Survey 2010 to 2018

Variable	Sample Mean	Standard Deviation
Family Farm Income (€)	24,700	31,921
Basic Payments (€)	13,068	11,894
Other Subsidies (€)	4,712	5,278
Total Non-Land Assets (€)	128,867	136,674
Total Unpaid Labour Units	1.09	0.46

Age of the Farm Operator	56.25	11.74
Area of Natural Constraint (0,1)	0.74	0.44
Gender of the Farm Operator (0,1)	0.04	0.20
Farm Size (Ha.)	44.15	39.61
Household Size	2.90	1.51

Source: Authors calculations using Teagasc National Farm Survey

We interrogate the Teagasc NFS data further to describe the economic situation on farms for those in receipt of payments under the ANC Scheme relative to all other farms. Table 2 reports the ratio of farm characteristics of farms in ANC areas relative to all other farms from 2010 to 2018.

The key message from Table 2 is that the gap in Family Farm Income between ANC farms and non-ANC farms has narrowed through time. A convergence in the value of the basic payments contributes towards this narrowing of the farm income gap. In 2010, the average basic payment for farms located in ANC areas was approximately 77 per cent of the average value in non-ANC areas. In 2018, the average basic payment for farms located in ANC areas was approximately 85 per cent of the average value in non-ANC areas. Although smaller in absolute value, other subsidies (including ANC payments) played an important role in narrowing the income gap. These payments have tended to be much larger for farms located in ANC areas.

Table 2: Summary Statistics: Ratio of ANC Farms to Non-ANC Farms

	Family Farm Income	**Unpaid Labour Units**	**Basic Payments**	**Other Subsidies**
2010	0.66	1.02	0.77	1.87
2011	0.64	1.03	0.71	1.88
2012	0.67	1.06	0.74	2.34
2013	0.64	1.09	0.75	2.00
2014	0.67	1.05	0.73	2.83
2015	0.61	0.95	0.69	2.92
2016	0.77	1.07	0.82	3.41
2017	0.73	1.03	0.85	3.93
2018	0.80	1.03	0.88	3.45

Source: Authors calculations using Teagasc NFS data (2010-2018)

3 RESULTS

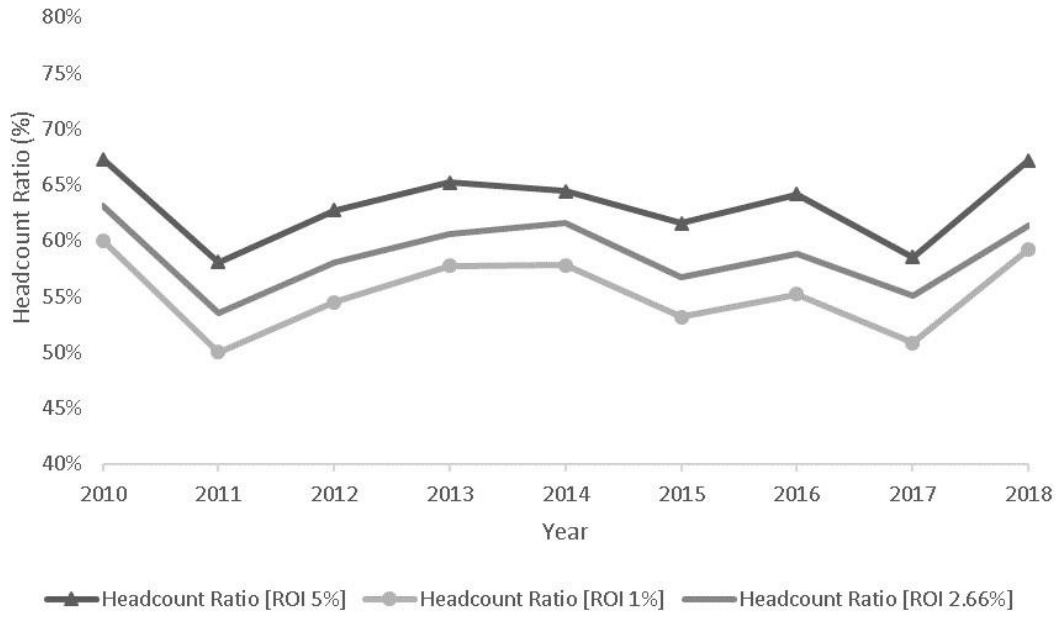
A minimum target of public policy is to facilitate farmers achieving a reasonable income from their farm. To date, public policymakers have relied on the headcount ratio statistics. O'Donoghue and Hennessy (2015) plotted the share of farms, which could be classified as viable and identified a gradual downward trend in farm viability from 1997 until 2009 with an improvement observed in 2010 and 2011. O'Donoghue and Hennessy highlighted the significant differences in viability rates between farmers under 66 years old and farmers aged over 66 years old. Conefrey (2019) emphasised differences in the farm viability headcount ratio between farming systems and the risks to farm viability associated with Brexit and further trade liberalisation.

In Figure 1, we report the trend in the headcount ratio since 2010. The results are presented with three alternatives values for the risk-free return on non-land assets i) 1 per cent ii) 5 per cent iii) 2.66 per cent. The rate of 2.66 per cent is applied by the Department of Public Expenditure and Reform (DEPR) in discounting project cashflows for projects of between 10 and 20 years duration. The results show the sensitivity of the headcount ratio to the value of this parameter. The headcount ratio is notably lower when a 1 per cent return on non-land assets is included as opposed to the 5 per cent value, which has been used frequently in previous studies. In the current context, a value of 1 per cent is more realistic as savings deposit rates are close to 1 per cent (Central Bank of Ireland 2019).

Under the assumption of a 1 per cent return on non-land assets, the headcount ratio has fluctuated between 50 and 60 per cent over time. This means that farm viability has fluctuated between 40 per cent and 50 per cent over time. A notable improvement in the headcount ratio is reported in 2011 relative to 2010 with disimprovement in 2012 and 2013 as the macroeconomy began to recover. The headcount ratio improved in 2015 and 2017, as dairy farm incomes expanded. The headcount ratio declines notably in 2018, with the negative impact of drought and the consequent increase in the use of feed inputs and input expenditures (Dillon et al. 2018, p. 3). There appears to be no clear trend in the headcount ratio over time. A mild improvement is detected between 2014 and 2017. The year-to-year changes in the headcount ratio are statistically significant at the 95 per cent level in 2011, 2017 and 2018. The results suggest that cyclical factors play an important role in determining the viability of

farms with some farms periodically entering and exiting a state of viability. This result is also evident in the poverty literature where the distinction is made between structural and cyclical components (Hoynes et al 2006; Bitler and Hoynes 2016).

Figure 1: Headcount Ratio over time



Source: Teagasc National Farm Survey and Author's Calculations

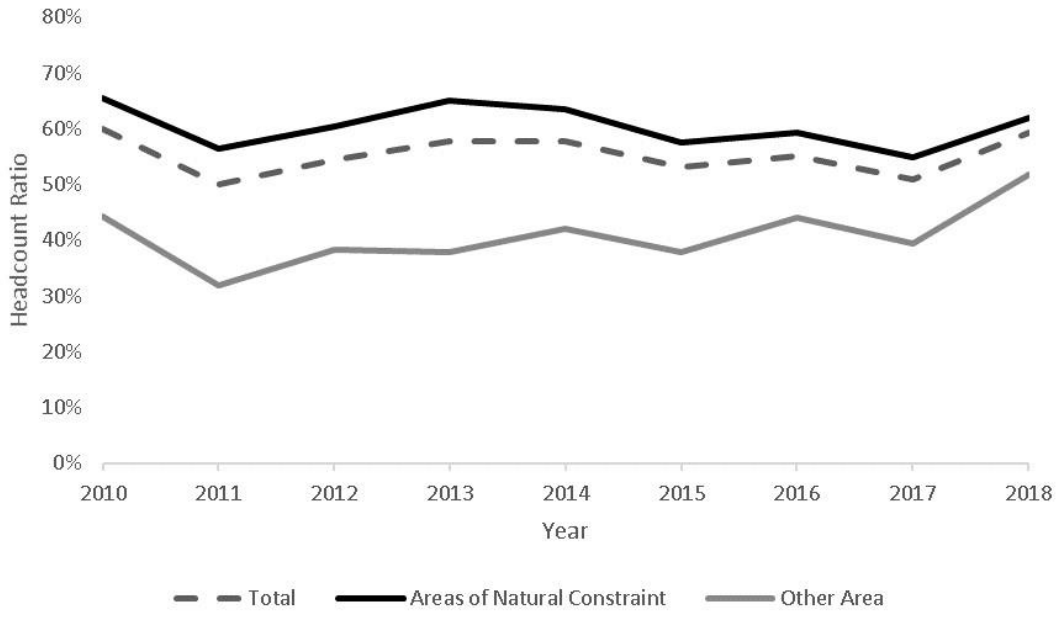
Under the assumption of a 5 per cent return on investment, the headcount ratio is consistently higher through time indicating a poorer farm viability performance relative to that identified with a lower return on investment. However, the assumption of a lower rate of return on investment seems appropriate in the current era of low interest rates. In 2018, the headcount ratio was 59 per cent under the assumption of a 1 per cent return on investment. This means that 41 per cent of farms were viable under the assumption of a 1 per cent return on investment. Under the assumption of a 2.66 per cent return, as applied by DEPR, the headcount ratio would have been 61 per cent in 2018 indicating that 39 per cent of farms were viable. These findings underlines the sensitivity of the estimates to some methodological choices.

In figure 2, we further decompose this viability trend into the Areas of Natural Constraint (ANC) and other areas (Non-ANC). In Figure 2, we assume a 1 per cent return on non-land assets. We note the pattern of lower viability in LFA/ANC areas throughout the period, a pattern also observed in Barnes et al (2020) in relation to the

uplands in Scotland. We have tested the statistical significance of the differences in the headcount ratio between the ANC and Non-ANC areas using the approach of Kakwani (1993, p.634) and find that the differences between the two areas are statistically significant at the 95 per cent level for all years concerned. We note the gradual and statistically significant improvement in viability rates in the ANC areas from 2013 to 2017. This implies a decrease in the spatial inequality of farm incomes, which is line with previous policy simulations (O'Donoghue et al 2015b). The results indicate that the redistribution of farm subsidies under the CAP 2014-2020 programme is helping reduce the spatial inequality of farm incomes.

In other geographical areas, the headcount ratio increases slightly. This implies a dis-improvement in viability rates as input cost inflation erodes output price gains. The increase in the headcount ratio in non-ANC areas may appear surprising given the importance of the dairy sector to non-ANC areas. However, it is important to consider that tillage and cattle finishing farms account for a large share of farms in these regions. Secondly, there is some evidence of a decline in the level of direct payments accruing to farms in non-ANC areas since about 2014 (See Table 2). It is clear from figure 2 that viability is now a major issue in both ANC and Non-ANC areas.

Figure 2: Headcount Viability Ratio in ANC and Non-ANC areas



Source: Teagasc National Farm Survey and Author's Calculations

4.1 Viability Gap

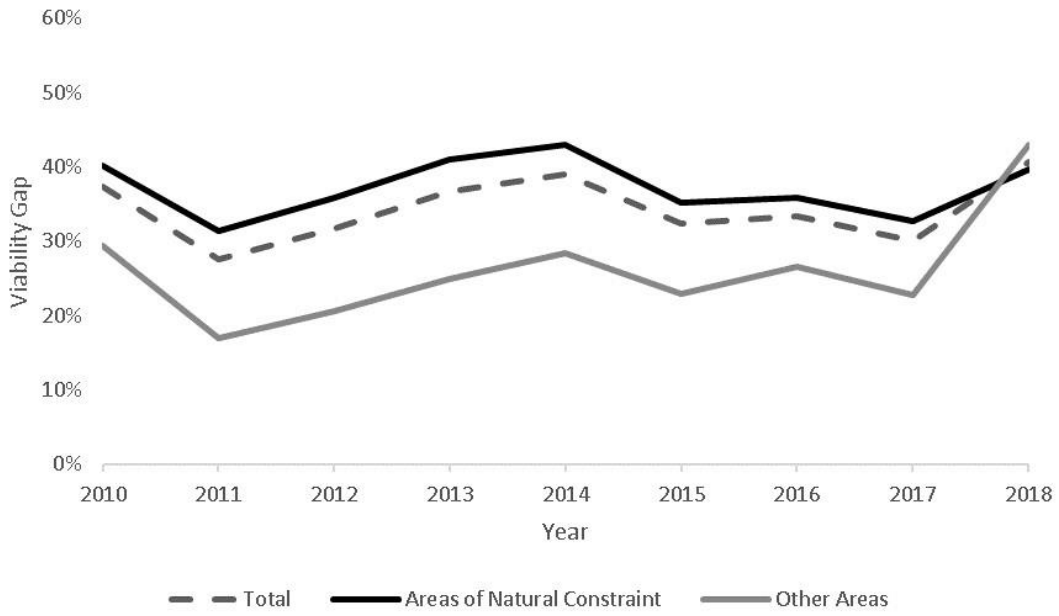
However, as discussed, the headcount ratio is only a headline measure for the state of viability. It is also of interest to understand those farms with less than viable incomes, how far beneath the threshold they are. To measure this, we utilise a measure known as the viability gap or the distance between the farm income and the level of viability (a function of the minimum agricultural wage and the investment on the farm) as a percentage of the viability threshold.

The viability gap measure represents the average distance of all farms from their viability threshold. In Figure 3, we show that for the sample, the viability gap ranges from 28 per cent in 2011 to 41 per cent in 2018. This suggests that the average non-viable farm is very far removed from the viability threshold. The magnitude of the non-viability problem cannot be easily eliminated through policy reforms or favourable changes in the ratio of output to input prices.

In Figure 3, we observe that the viability gap tends to be larger for farms in ANC areas relative to non-ANC areas. In ANC areas, the viability gap ranges from approximately 31 per cent in 2011 to 43 per cent in 2014. In other areas, the viability gap ranges from approximately 17 per cent in 2011 to 43 per cent in 2018. There is one very notable finding within these results. In particular, it seems remarkable that the viability gap in 2018 is lower for the ANC areas (40 per cent) relative to the Non-ANC areas (43 per cent). This underlines the damaging economic impact of the 2018 summer drought on Non-ANC areas.

This result does not conform to the headcount ratio as shown in Figure 2 where one can see that the headcount viability ratio in 2018 was lower for ANC areas (38 per cent) relative to Non-ANC areas (43 per cent). This confirms that alternative methodological approaches can provide some contrasting results. A portfolio of indicators should therefore, be considered before arriving with conclusions about economic changes, a conclusion which is also made in the poverty literature (Marlier and Atkinson 2010, p. 295). Overall, it appears that the differential between ANC areas and non-ANCs has narrowed over time. Some of this trend is may be attributable to policy changes, which can be the subject of future research.

Figure 3: Viability Gap in ANC and Non-ANC areas



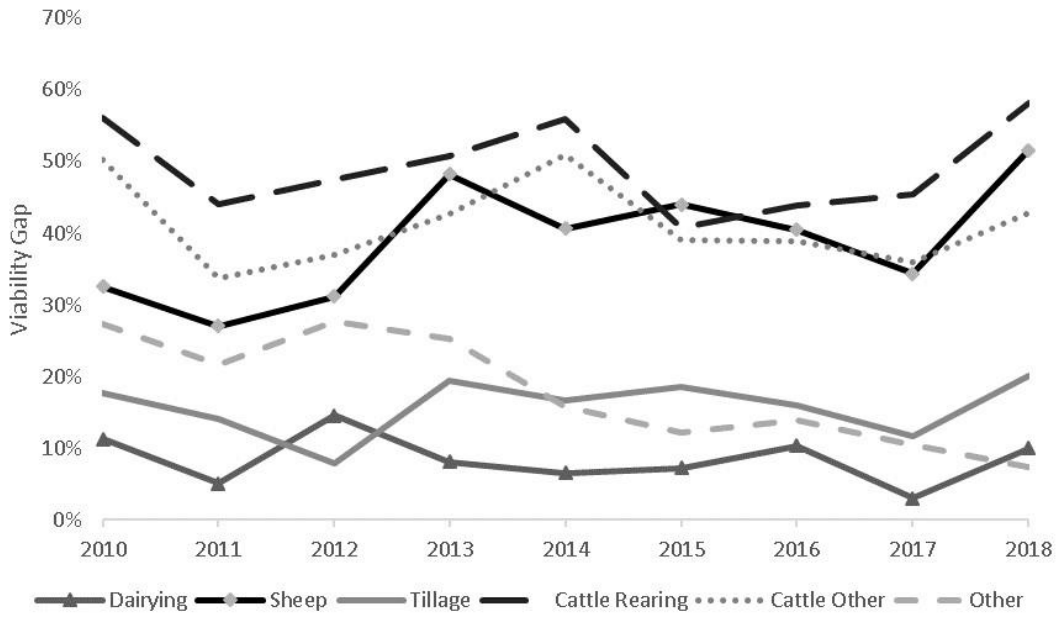
Source: Teagasc National Farm Survey and Author's Calculations

Figure 3 suggests that the viability gap is worsening slightly in the Non-ANC areas. These areas tend to have a higher proportion of specialist dairy farms relative to the ANC areas (Läpple et al 2017, p. 8). A rise in average farm income on Irish dairy farms is evident in the past decade (Loughrey et al 2018). It is therefore unlikely that the worsening viability can be traced to the economic situation on dairy farms.

In Figure 4, we illustrate the extent of the viability gap by farm system with dairy farms tending to perform better in recent years. Figure 4 shows that the viability gap on specialist dairy farms has declined through time. The viability gap tends to be relatively small on those dairy farms, which fall below the viability threshold. The results suggest that the milk price is not the sole determinant of dairy farm viability. The viability gap on specialist dairy farms was highest in 2012, when feed, fertiliser and fuel input prices reached elevated levels. Milk output prices were significantly lower in both 2015 and 2016 relative to 2012 (CS0 2020). The abolition of milk quota and the resulting increase in production is likely to have played some role in reducing the viability gap on specialist dairy farms over time. The low viability gap on specialist dairy farms contrasts with the situation on cattle rearing, cattle other and sheep farms. The viability gap on cattle farms appears remarkably high throughout the period. The rise in the viability gap in Non-ANC Areas is most likely attributable to

the economic situation on tillage and cattle other farms, which account for a large proportion of farms in the Non-ANC areas.

Figure 4: Viability Gap in different Farming Systems



Source: Teagasc National Farm Survey and Author's Calculations

The above results are based on methodological decisions and the choice of a relevant income threshold, which, in this case, involves the statutory minimum wage and a minimum return on non-land assets. It is still open to question as to whether or not this choice of threshold can be widely considered as fulfilling the income objective set out in the Treaty of Rome namely "to ensure a fair standard of living for the agricultural community".

Hirsch et al (2020) introduce a 'low income gap' indicator based on a Minimum Income Standard (MIS): an income threshold for each household type derived from a 'budget standard', based on lists of items that members of the public say people require to meet their basic material needs and to be part of contemporary society. This 'low income gap' indicator summarises the extent to which members of the population have household income below the MIS thresholds, combining incidence of below-MIS income with the average 'depth' of the shortfall. We draw from the budget standard approach to calculate the extent to which farm households in Ireland have incomes, which fall below a Minimum Income Standard. In Ireland, the 'living

wage' is the main example of a Minimum Income Standard derived from a budget standard. The rates of payment for the living wage are described by the Living Wage Technical Group (Living Wage Technical Group 2019).

In Table 3, we present the sensitivity of results to the alternative income thresholds. The living wage tends to be notably higher than the national minimum wage. In 2018, the living wage was €11.90 per hour while the national minimum wage was €9.55 per hour. We make the assumption of a one per cent return on non-land assets. Unsurprisingly, the results show that economic viability is estimated to be lower under the living wage relative to the minimum wage. Figure 1 showed that the headcount viability ratio was sensitive to the assumed return on investment. Table 1 shows that the headcount ratio is also sensitive to the treatment of the labour component both in terms of the headcount ratio and the viability gap. Interestingly, the difference in the headcount ratio between the minimum wage and the living wage is approximately 8 per cent. This difference is similar in magnitude to that found in comparing a 1 per cent return on non-land assets with a 5 per cent return. This further illustrates the importance of the methodology and the use of multiple indicators.

Table 3: Viability Indicators under Alternative Minimum Incomes

	Headcount Ratio Minimum Wage Per Hour	**Headcount Ratio Living Wage Per Hour**	**Viability Gap Minimum Wage Per Hour**	**Viability Gap Living Wage Per Hour**
2014	57.8%	65.7%	39.0%	44.5%
2015	53.1%	61.8%	32.4%	38.6%
2016	55.2%	63.2%	33.4%	38.5%
2017	50.8%	58.8%	30.0%	35.2%
2018	59.2%	66.5%	40.6%	44.8%

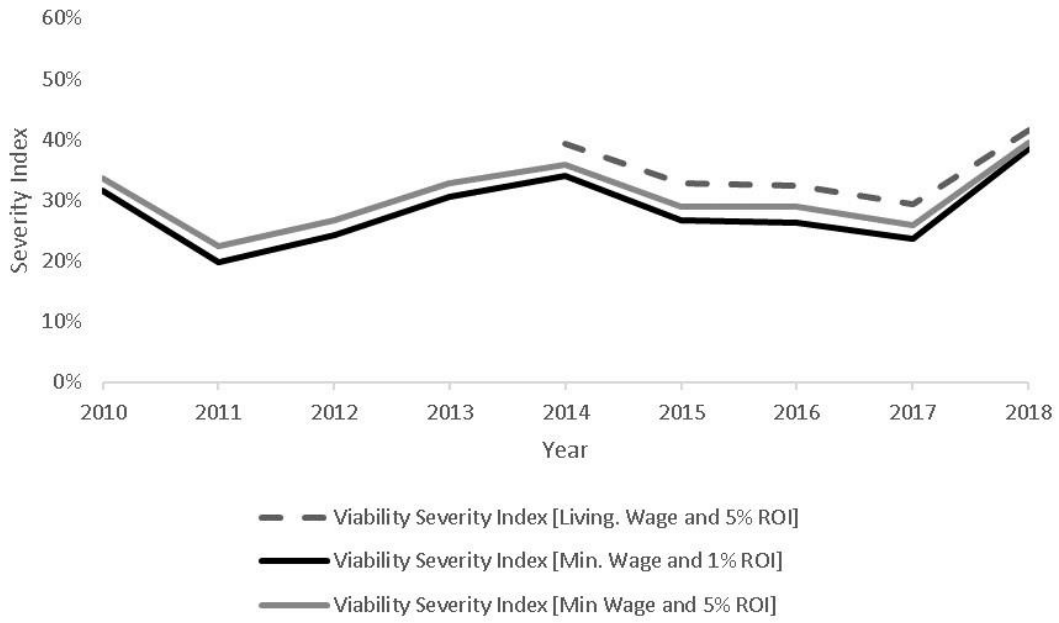
Source: Teagasc National Farm Survey and Author's Calculations

In Figure 5, we show the viability severity index for 2010 to 2018 under three alternative definitions for the viability threshold. This severity index is based on the Foster Greer Thorbecke (FGT) Index described in Equation 4. Under this severity measure, we find that 2018 was the most difficult year in terms of farm viability on the least viable farms. This result is consistent across all three definitions. In 2014,

large declines in beef prices led to an increase in the severity of non-viable cattle farms but this problem was largely confined to cattle farms. In 2018, problems emerged on both cattle and sheep farms due to a summer drought with significant increases in feed expenditures resulting in reduced farm incomes (Dillon et al 2018).

In 2018, the summer drought led to further declines in beef prices as beef supply increased across Western Europe. Cattle farm incomes declined as a result of both lower output prices and increased feed expenditures. In late 2018, the uncertainty around Brexit contributed further to reducing beef prices and farm incomes. In 2019, policymakers responded by introducing a Beef Exceptional Aid Measure (BEAM) scheme in order to compensate cattle farmers for lower prices during late 2018 and early 2019 (DAFM 2019). The annualised data may not provide a sufficiently detailed picture about the cyclical nature of farm viability and that the viability status of an individual farm may fluctuate over the course of the year. In addition, the exceptional aid measures introduced in 2019 show that policy interventions can emerge with a lag effect on farm income.

Figure 5: Farm Viability Severity Index 2010-2018



Source: Teagasc National Farm Survey and Author's Calculations

5 CONCLUSION

In this paper, we have introduced a new approach to the measurement of farm economic viability in a developed country. We have adopted an approach, which is widely applied in the poverty literature by estimating a farm viability gap and a farm severity index and we outline the theoretical foundations for this methodological approach. Selecting Ireland as a case study, we analyse the trends in the headcount ratio, the viability gap and the farm severity index from 2010 to 2018. We identify interesting results in relation to the impact of the summer drought on farm viability during 2018. The results suggest that multiple indicators should be considered in assessing the state of farm viability.

The results show that farm economic viability has fluctuated in recent years, but that a majority of farms in Ireland are economically non-viable. The magnitude of the estimated viability gap adds to our understanding about the scale of the viability challenge on farms in Ireland. Under the viability gap measure, the average non-viable farm appears to be far removed from the income threshold, which would render those farms economically viable. The improvement of farm viability in Ireland is multifaceted with solutions dependent on individual farm circumstances. Large viability gaps are likely to remain in the absence of structural changes or significant policy reforms, which target the reduction in the viability gap itself.

More positively, the viability gap in areas of natural constraints appears to have improved between 2014 and 2017, which may be partly attributable to the redistribution of farm subsidies under the CAP 2014-2020 programme. This positive development does not appear to be occurring in other more intensive agricultural regions. This less promising trend emerges despite the milk quota abolition and the improved farm viability on dairy farms. The viability gap on tillage farms has been relatively low and stable between 2010 and 2018. In more intensive agricultural regions, the dis-improvement in the viability of non-dairy cattle farms may also be linked to the spatial redistribution of subsidies but this requires further research. In addition, future research can examine the distinction between chronic non-viability and cyclical or short-term episodes of non-viability.

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