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M. Marino, B. Rocchi, S. Severini

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DISEI, Università degli Studi di Firenze
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The farm income problem in the European Union: a research framework and a longitudinal empirical evaluation.

Maria Marino[a], Benedetto Rocchi[a], Simone Severini[b]

a Department of Economics and Management - Università degli Studi di Firenze
b Department of Agriculture and Forest Science - Università degli Studi della Tuscia

Abstract

In this paper we first discuss the several empirical challenges that researchers had to face when considering the farm income problem. Therefore, we offer a brief but systematic review of the empirical literature on the farm problem since the seminal Gardner's paper of 1992. Taking into consideration the state of the art, we use data for the European countries from EU-SILC (Statistics on Income and Living Conditions) survey for the period 2005 - 2015 to carry out an empirical evaluation of the farm income problem in the European Union using a longitudinal panel approach to estimation and considering alternative definitions of the group of farm households.

Similar to previous studies we don't find a strong evidence for the farm income problem in the European Union. The only exception is the group Central Eastern countries, where farm households are poorer that the rest of the population but only when they are defined according to a broad definition. Conversely, families mainly relying on farming as a source of income (narrow definition of agricultural households) show income levels similar to the rest of the population both at the EU level and across different geographic areas.

Keywords: Farm income problem, European Union, EUSILC, Panel estimation

JEL Classification codes:D31, Q12, Q18

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1. Introduction

The future of agricultural policy in the European Union is close to be re-discussed and a lot of uncertainties surround the farm sector in terms of the extent and type of support it will getin the next future.

It is important to stress that public support to the sector has been justified given the low and unstable level of farm income, compared to population or non-farm income.Such issue, known as the farm income problem, is discussed by Gardner (1992) who provides the most extensive theoretical and empirical review of the literature. He shows that the farm income problem has been first supported by the scientific community, and then scaled back. Most studies, especially conducted in the United States, have indeed shown a disappearance of the farm income problem under any available method of analysis (e.g., Mishra et al., 2002, Katchova, 2008; Hopkins and Morehart, 2004).

According to some authors, the role of the state's intervention has been crucial to reduce the distance between farm and nonfarm incomes (e.g., Mishra and El-Osta, 2008; Mishra et al., 2009). Many others instead claim that the decision of farmers to supplement their income with off-farm work is the true determinants of the income gap reduction (Ahearn, 1986; Findeis and Reddy, 1987; Mishra and Goodwin, 1997; Mishra and Sandretto, 2002).

Despite most studies show a convergence between farm and nonfarm income, policy statements in many countries arestill aimed at ensuring equal standard living to farmers compared to the rest of the economy or to other industries. An attempt to explain such incongruence between empirical studies and policy actions was given by Bonnen and Schweikhardt (1998). Accordingly, "*While we have greater empirical and conceptual advantages than our peers of the Thirties, we seemnot inclined, in our different modem context, to reexamine with care the issues that have long been known to lie behind the so-called "farm problem." At least to date there has not been any comprehensive or systematic effort to do so. Emblematic of this reluctance, perhaps, is the fact that the profession has ceased even to use the term "farm problem.*" This is particularly true when considering the European Union since there is no systematic empirical assessment on the so-called farm problem.

Such concern drives our work. If there is no evidence of the farm problem, we need to overcome such reluctance and discuss a potential reduction of the public support for the sector. Or, if the evidence is not so strong or is not conclusive, we need to re-address such old question possibly using new statistical tools. For such aim, we first enumerate the several empirical challenges that researchers had to face when considering the farm income problem. Therefore, we offer a brief but systematic review of the empirical literature on the farm problem since Gardner (1992). Taking into consideration the state of the art, we propose employing new data for the European countries from EU-SILC (Statistics on Income and Living Conditions) that allows assessing the farm problem using a longitudinal panel.

The paper is organized as follows. Section 2 shows which are the challenges posed by the farm income problem. Section 3 contains a brief and systematic review of the empirical literature. Section 4 proposes a new empirical strategy to deal with some of the main challenges found in the previous Sections. Section 5 presents the main findings. Some conclusions and suggestions for further studies get the paper to a close in Section 6.

2. Main challenges in the empirical analysis of the farm income problem

The empirical analysis to assess if a farm problem exists comes with many difficulties. Gardner (1992) indeed claim that "*comparing farm and nonfarm household income is a complicated matter, due to factors such as income source, family demographics, tax rates, capital depreciation, commodity inventories, etc*.". We here provide a brief description of the challenges that researchers have to deal with when analysing the farm income gap.

a) Data

Farm units are generally assessed through farm accounts surveys (Hill, 1996; 1999; Hilland Bradley, 2015).Although the latter are suited for a detailed analysis on the farm income, using them does not help to assess the farm income problem since one needs to compare the farm unit with a nonfarm unit. In other words, sector specific surveys do not allow a comparison with other societal groups. Alternatively, general surveys are more recently employed which offer the potential for a promising test of the farm income problem. However, some limitations may also arise: data on the farm income may not be accurate at least in certain countries; the number of farmers may be too small to be representative of all the farm population[1]; the decomposition among different income sources does often not allowed investigating the impact of policy interventions; important variables are not collected (e.g., the amount of land owned or rented by the farm household); data comparison among countries might be complicated by the different accounting systems with some countries not reporting certain income components; finally, self-employed income tend to be underreported.

b) The unit of analysis

To assess the farm income problem, one must identify the unit of analysis, namely the farm and the nonfarm unit to be compared .Considering the first, consensus exists that income problems must be assessed at the micro level instead of aggregate (industry/sector) level[2] because important decisions on farm investments are taken at the individual level (Hill, 1996; Mishra et al, 2002).[3] At the beginning, the research focus was on farm businesses but many doubts were raised with respect to such a choice. First, the definition of farm business has been changing over time for legal or economic reasons, exacerbating comparability issues. Second, there was a certain agreement that the farm problem can be better assessed considering farm households (Mishra et al, 2002; Hill, 2012; Hill and Bradley, 2015).[4]Households have a greater command over the consumption of goods and services; moreover they can adopt diversification strategies to cope with increasing pressure on the sector; finally, taking into account the wealth of households improves the analysis on the farm income problem.

When considering farm households, several definitions can be adopted (United Nations, 2011). There is a "narrow definition" (Hill, 1996) according to which the household's farm self-employment income is equal or greater than half of its factor incomes or more than half of the

1Nevertheless, according to United Nations (2011) the sub-sample of farmers in general surveys is likely to be biased toward small production units, meaning that the comparisons can also only lead to a possible under-estimation of farm incomes.

2 As an example of national aggregate, Eurostat collects the Economic Accounts for Agriculture (EAA) within the EU's statistical system aggregate.

3 As an example of individual units, at the European level, the Farm Accountancy Data Network (EU-FADN) collects data on individual farms and EU Statistics on Income and Living Conditions (EU-SILC) on households.

4 Gardner (1992) notes that that using as unit the business entity "*causes no problems as long as there is one farm household per farm. But about one-fifth of farm operators do not reside on their farms, and an even larger fraction of households residing on farms obtain essentially all their income from nonfarm sources. Moreover, an increasing proportion of farms, especially the largest and most remunerative livestock operations, has adopted an economic structure in which the income generated goes largely to people other than the farm residents.*"

income of the head of household comes from farming. There is a "broad definition" where the household's farm self-employment income is not zero (UNECE, 2007). Once the farm unit is defined, one must define the nonfarm unit. Some analysis focus both on difference among the farm and the population (e.g., El-Osta et al., 2007); others consider a more similar group since most farm units derive their income from self-employment laboour (e.g., Mishra et al, 2002; Hopkins and Morehart, 2004). Although the most precise comparison is farm against a group that also derive its income from self-employment,[5] the comparison farm against population is also important for policy intervention.

c) Methodology

Testing the differences between farm and nonfarm income has relied so far on methods like parametric and nonparametric tests (Katchova, 2008; Peake and Marshall, 2009; Mishra and Moss, 2008) or on simple regression analysis with the inclusion of observable characteristics to explain the income gap (El-Osta et al., 2007). Less explored are several other empirical strategies, generally employed in the literature on inter-sectoral wage gaps.[6] For instance, we refer to quasi-eperimental methods like the propensity or other matching techniques (e.g. Rocchi, 2014; Rocchi et al., 2018) that allows improving the similarity of the comparison group; and to longitudinal analysis that exploits a panel structure that would also allows overcoming the problem of unobservable factors that are likely to affect the analysis; to decomposition methods like the Oaxaca-Blinder that allow discriminating, on the one hand, the specific role of certain characteristics of the farm sector (low education, many family components and so on); on the other hand, the role of the returns to these characteristics (Chan, 2012; Stefani et al., 2012).

d) Dependent variable

Income is clearly the most common indicator of the economic well-being of farm households. However, not only scholars have focused on mean differences among the farm and non-farm households, but also on volatility, inequality and poverty. Considering the first issue, farm income is known to be very volatile (Mishra and Sandretto, 2002) because of huge fluctuations in farm output, commodity prices, business cycles, vulnerability and instability of export demand and macroeconomic policies (Tweeten, 1983). This has pushed farm households to rely also on off-farm activities that have had the main advantage of reducing such variability especially when the nonfarm economy is robust and there is investment in human capital (Ahearn, 1986; Ahearn et al., 1993). Several solutions have been proposed in the literature to deal with volatility. Some authors have used smoother indicators such as expenditures (Chan, 2012). However, such measure is not always available in surveys. More recently, other scholars have particularly stressed the need to use panel data to analyze income dynamics (Key et al., 2017) since the cross-sectional data can only provide limited information about within-unit income variability. Considering inequality, most studies have focused on the Gini index (Katchova, 2008; Peake and Marshall, 2009; Mishra and Moss, 2008). However, more recently, there is an increasing focus on the household income distribution at particular quintiles. Chan (2012) has proposed to employ an unconditional quintile regression to distinguish the performance at the upper, middle and lower extreme of the distribution. While new in the literature on the farm income, such method is widely used to explain differences between rural and urban inequalities and inter-sectorial differences (e.g., Agyire-Tettey et al., 2017; Thu Le and Booth, 2014). Finally, another strand of this literature explores poverty

5 Mishra et al. (2002) claim that the comparison of farm and nonfarm proprietor households is more appropriate since both sectors are likely to be exposed to similar macroeconomic shocks and types of risk.

6Sample selection is a major issue in these empirical strategies since only subsets of individuals are observed within the category of interest. Given that such selectivity could be notat random, coefficients may be biased if the problem is not addressed.

since two groups with equal population mean income could have different probabilities of extreme poverty (Kurashige and Cho, 2001; Hill, 1999). A part from the above income measures, other scholars have analyzed the farm income problem also comparing indicators of wealth and finding that farmers are generally better off than nonfarmers (Hopkins and Morehart, 2004;El-Osta et al., 2007).[7]

e) The independent variables

The farm income problem has often been considered as a simple comparison between farm and nonfarm average income. However, the farmers and the nonfarmers may be very different groups (Gardner, 1992). For such reason, other studies have analyzed the determinants of farm household income (e.g., El-Osta et al., 2007) or the effects of government programs on household income (e.g., Dewbre and Mishra, 2007). According to Katchova (2008) in a study on the US, the role of government in term of farm price and income support programme has decreased the difference between farm and non-farm income with farm households even richer than others from 1996 (see also Ahearn et al., 1993). She also considers other determinants to explain the gap between farm and nonfarm incomes. In particular, she focuses on business involvement and life stages.

3. Review of empirical studies on the farm income problem

The Table below summarize the most relevant empirical studies on the farm income problem since the seminal contribution of Gardner (1992). Note that since then we consider only works focusing on a comparison between the farm units and another group, either from a general population or from nonfarm self-employed units. We do not take into consideration studies whose analyses are confined only to farm samples, since they do not really provide evidence on how the farm income differs from the income of a comparison group. However, some of them are considered if they provide at least some descriptive evidence on raw comparisons between farm and nonfarm units (e.g., Mishra and Sandretto, 2002 and El-Osta et al., 2007).

The Table contains the name of the scholars analyzing the farm income problem in the first column, the years and the countries analyzed in the second and third columns while the fourth one indicates where the data comes from. The fifth column shows the main methodologies adopted, in particular if scholars rely on descriptives or on more sophisticated econometric or statistical tools. Moreover, we specify if the study refers to micro or macro data. The sixth column points out at the study's focus. Some studies indeed analyze the farm income problem from the pure income perspective only, while others provide additional information also on expenditure, inequality, income variability and so on. The seventh column provides more details on which dependent (DV) and independent variables (IV) are taken into consideration in the empirical analysis. Finally the last column indicates the most important findings in term of empirical evidence with respect to the farm income problem.

The general picture that emerge from the the literature review is that the average income of the farm units are generally in line or higher that nonfarm ones. When considering wealth, such results is even more striking since farm units are much richer that nonfarm ones. A different story emerges when considering poverty and consumptions since many studies show that farm units are more likely to be poorer and consuming less than nonfarm unit. Finally, contrasting results emerge when

7 For the sake of completeness, others have also considered the rate of returns to investment in agriculture compared with the rate of return to investment of industrial equity finding that nonfarm businesses perform better than farm business except when considering big farms (Mishra et al., 2002). Finally, others have considered the rate of saving showing that farm households have a higher savings rate than nonfarm households (Mishra and Morehart, 2002).

considering inequality and income variability.

Despite the above highlighted main findings, it should be stressed that most analysis is conducted on the USA and on cross-country analysis. Relatively few studies consider European countries. One the reason have been highlighted by Hill and Bradly (2015) who claim that *"(...) despite the apparent need for income statistics to be availablethat relate to agricultural households and to agricultural activity, in practice there is no working system for agricultural household income statistics in the EU."* According to these authors, this is partly due to lack of political demand depending either on perceptions that the farm sector is disadvantaged or fear of electoral consequences. Moreover, they claim that several studies of the European Commission claim that farm incomes are 40 per cent lower than the rest of thepopulation (European Commission, 2010) but such information is not related to income but to rewards to factors engaged in agricultural production compared with those in the broader economy. This can be problematic for two main reasons. First, comparing self-employment with the entire economy can be misleading. Second, national policies are not aimed at comparing returns to factor but standard of living, so the most correct comparison would be among farm self-employed households and self-employed households from another sectors (Hill and Bradly, 2015).

Considering the empirical strategies adopted by authors, a part from two studies, longitudinal settings are rare. Clearly, this depends on data and the lack of available statistics on the same units over time, especially when considering farm units. This point also emerged when we consider the main empirical challenges in the analysis of the farm income problem.

For such reasons, in the following we devote our attention to European countries and we provide the first attempt to exploit a dataset that allows identifying farm households over time. The present work is limited only to income figures and we cannot provide an extensive overview on all other main issues here reviewed for space reasons, but they are on our future research agenda.

Selected empirical studies on the Farm Income problem
1992 - 2017

Study	Years	Countries	Data	Methodology	Focus	DV and IV	Results
Gardner, 1992	1934-1989	USA	Census and Census of Agriculture; USDA; ERS.	Descriptives (MICRO - CROSS-SECTION)	**Income**	DV: Farm as percentage of nonfarm income (raw) at the individual and household level.	Farm income is chronically lowthrough the 1960s. But there is convergence with farm income substantially higher than nonfarm in the last half of the 1980s.
	1962-1984-1989		Federal Reserve Board survey Farm Wealth		**Wealth**	DV: Mean net worth	Farmers are relatively richer than nonfarmers.
			U.S. Department of Commerce		**Poverty**	DV: Poverty rate	In the late 1980s, the poverty rate for farm households was below the poverty rate for non-farm households.
Kurashige and Cho (2001)	1982-1995	14 OECD countries	Luxembourg Income Study (LIS)	Descriptives (MICRO - CROSS-SECTION)	**Income**	DV: unadjusted disposable income	In 8 (or 5) of 14 countries, the average farm household's unadjusted disposable income is higher than non-farm households, respectively broad definition and narrow definition.
					Poverty	DV: Low income rate (cumulative proportions below percentiles of the median) (50% as standard)	When the broad (narrow) definition is considered, 9 (12) over 14 countries have a higher incidence of low income than the rest of the population. This is consistent over time.
						DV: The low income gap	The intensity of poverty is much higher in farm households with respect to other households.
						DV: Cumulative decile shares — Lorenz curve	In most countries, either broad or narrow definition, nonfarm households

					Inequality	DV: Gini coefficient	have more unequal distribution. In most countries, both broad and narrow definition, farm households have more unequal distribution.
						Dv: Sen index	The degree of poverty among farm householdsis higher than nonfarm and the results are even greaterif the narrow definition of a farm household is used.
EUROSTAT (2002)	1972-1999	15 member states of the European Union (EU)	Income of the Agricultural Households Sector (IAHS)	Descriptives (MICRO - CROSS-SECTION)	**Income**	DV: Mean income of farm and all other households	On average income close or higher than other households(narrow definition). But some disparities exist across countries.
Mishra and Sandretto (2002)	1967-1999	USA	U.S. Department of Agriculture	Descriptives (MICRO - CROSS-SECTION)	**Income**	DV: Mean income of farm and all U.S. households	Farm households' average income has has exceeded that of all U.S. households since 1996.
Mishra et al.(2002)	1967-2000	USA	Ahearn (1986); Agricultural Resource Management Survey (ARMS); Expenditure: USDA, Economic Research Service; U.S. Bureau of the Census, Current Population Survey; Survey of Consumer Finances	Descriptives (MICRO - CROSS-SECTION)	**Income**	DV: Average income of farm, all U.S. households and nonfarm businesses IV: education, family size, size of the farm, location	Farm households have a similar or higher income than all US population, even if differences emerge when controlling forIV.When the focus is only on nonfarm household (self-employed), average incomes are similar.
					Wealth	DV: Current market value of assets minus debt	Farm households appear to be relatively wealthy comparedto society in general and tononfarm households.
					Expenditure	DV: Average expenditure of farm and U.S. households IV: income, age, location, and size of farm	Consumption expenditures of farm households are lower than for all U.S. and nonfarm households, even when controlling for differences in income, age, location, and size of farm (with very few exceptions).
					Income	DV: Coefficient of variation	Variability of farm household income

					Variability	defined as the ratio of standard deviation of income to the mean of income.	far exceeds thatof all U.S. households, mostly due to variabilityin income from farming.
					Rate of return on business	DV: Median Return on assets of farm and nonfarm business	Nonfarm businesses have a higher median rate of return on assets than all farm businesses and slightly lower than that of farmbusinesses with sales greater than $250,000.
					Inequality in income and wealth	DV: P20 and P80 measure, P80/P20, Gini coefficient	For farm households,wealth is more equally distributed than income. Fornonfarm households, income is more equally distributedthan wealth.
OECD (2003)	Several years from the 90s to the 2000s.	OECD member countries	Eurostat + national statistics + LIS + OECD Structural Database	Descriptives (MICRO - CROSS-SECTION)	**Income**	DV: disposable household income in term of average Farm/Population ratio (raw)	Farm households(broad definition) enjoy, on average, income levels closer (or higher) to those in the rest of the society. Nevertheless, there are exceptions in some countries.
					Wealth	DV: Total stock of tangible or intangible possessions	Farm households(broad definition) often possess significant wealth, in particular from farm assets.
					Income Variability	DV: The standard deviation divided by the average for the period.	The total income of farmhouseholds is generally not significantly more variable than that of other households, withthe notable exception of Australia.
					Inequality	DV: average net operating income (NOI) at	In most countries, there is great inequality between the different

						different quintiles; low income rate, the low income gap and the Sen index	quintiles. Such inequalities are greater when considering the narrow definition and are smaller when off-farm income is included. Moreover, there is a higher incidence of low income among farm households than other households and the low-income gap (between low incomes and average incomes) is wider for farm households than for others.
Hopkins and Morehart (2004)	2004	USA	USDA's Agricultural Resource Management Survey and the Federal Reserve's Survey of Consumer Finances	Descriptives(MICRO - CROSS-SECTION)	**Wellbeing (a mix of Income and wealth)**	DV: Median Income DV: Median net worth	Self-employed nonfarm households have higher median income, and the same holds throughout the distribution—except at the lowestlevels, where farm households are more likely than nonfarm households to experience negative incomes. The median net worth of farm households exceeded that of self-employed nonfarm households. This holds true along all distribution.
El-Osta et al. (2007)	2001	USA	Agricultural and Resource Management Survey (ARMS); Bureauof Economic Analysis income files, the 2000 Bureau of Economic Analysis employment files, the 2000 Bureau of Labor Statistics, and the 1990Census of Population, STF-3 file.	Descriptives(MICRO - CROSS-SECTION)	**Wellbeing (a mix of Income and wealth)**	DV: Index made up of 4 categories computed at the median (lower income, higherWealth; higher income, lowerwealth; higher income, higher wealth; lower income, lower wealth). Wealth is defined as the current market value of all fungible assets less the current value of debts.	Almost 50% of farm households have a higher median income than US households; almost 90% have a higher median wealth. Nearly half of farm households have both higher incomes and greater wealth than U.S. households as a whole.
Mishra and	1996	USA	Agricultural	Theil's	**Inequality**	DV: consumption	Farm households have a lower

Moss (2008)	and 1998		Resource Management Survey (ARMS)	informational approach(MICRO - CROSS-SECTION)		expenditures (divided by typology) IV: regions, farm size	consumption expenditure inequality when compared to all population.
Katchova (2008)	2004	USA	Agricultural Resource Management Survey (ARMS) and the Survey of Consumer Finances (SCF)	Descriptives; Parametric and nonparametric tests; Regression Analysis (MICRO - CROSS-SECTION)	**Income** **Inequality**	DV: Mean and median of Household income and net worth wealth. IV: involvement; age of the household head; education and size of the family. DV: Gini index	On average, farms have higher economic income than nonfarm households but there are some differences across covariates. Income inequalities are similar for farm andnonfarm households, while wealth inequalitiesare higher for nonfarm households.
Peake and Marshall (2009)	2004	USA	Integrated Public Use Microdata Series - American Community Surveys	Descriptives, Parametric and nonparametric techniques (t-tests and Kruskal-Wallis tests)and instrumentaltobit regression controlling for endogeneity(MICRO - CROSS-SECTION)	**Income**	DV:household income and self-employment income IV: region, size of the family, gender, age, education , race , number of weeks worked, marital status	Raw data show that nonfarm self-employed groups have higher income than farm self-employed ones. The tests instead find no significant differences between household income levels of the farm and nonfarm self-employed. However, when considering differences in self-employment income levels, the farm self-employed have a significantly higher level ofincome than the nonfarm self-employed. Finally, regressions with households' income as DV show that, even controlling for several IV, there are no differences between the two groups.
Chan (2012)	2005 and 2006	Taiwan	Surveys of Family Income and Expenditure (SFIEs)	Blinder and Oaxaca decomposition; unconditional quantile regression (MICRO - CROSS-SECTION)	**Inequality**	DV: household consumption expenditures IV: age, education, house size, the number of cars owned and a dummy variable indicating home ownership, urban, regions.	The average expenditure per capita of the farm households is lower than that of the nonfarm households (especially at the higher quintiles). In addition, the expenditure of the nonfarm households is more variable than that of the farm. Differences in the observed sociodemographiccharacteristics of the

							household head, family structure,and regional heterogeneity can explain most of the differencesin household expenditure between farm and nonfarm households.In addition, these effects are robust across the entiredistributions.
Stefani et al. (2012)	2007	Italy	Italian Households Budget (ISTAT)	Oaxaca decomposition(MICRO - CROSS-SECTION)	**Expenditure**	DV: equivalent monthly consumption expenditure in log (broad definition) ID: age, education, proportion of working adults, rural, region	A difference in the level of expenditure is found with farm households consuming less than the rest of the population. According to the Oaxaca decomposition, such difference is not explained by the sector: about two thirds of the difference is due to differences in household characteristics while the remaining part is due to the different yield of characteristicsin terms of expenditure between the two groups.
Rocchi (2014)	2009	Italy	Eu-Silc	Propensity score Matching(MICRO - CROSS-SECTION)	**Income**	DV: Equivalized Household disposable income IV: age, education, size and composition of the family, presence of other source of income	Raw data show that farm families in a broader sense have a similar level of income with respect to total population, but they are poorer than a counterfactual group with similar characteristics.
Hill and Bradley (2015)	2010-2012	Denmark, Finland, France, Ireland, Italy, Poland, Sweden, and the United Kingdom (England).	Mix of sources (farm accounts surveys, taxation data, household surveys, etc., either singly or in combination); FAO (2011) and Hill (2012) - Luxembourg Income Study (LIS)	Descriptives (MICRO - CROSS-SECTION)	**Income**	DV: Average of Family Farm Income expressed per business or per work unit of family (unpaid) labour (FFI/FWU) (narrow definition)	The average incomes of households headed by farmers are similar to society. In some countries they are lower (Portugaland Poland for example), most of themaresubstantially higher.
De Frahan et	From 1970s to	Australia,	**LIS dataset**	Descriptives	**Income**	DV: Equivalized Household	The data shows that, on average, the

al (2017)	2000s	Canada, Finland, France, Germany, Ireland, Italy, Luxembourg, Norway, UK and US.		(MICRO - CROSS-SECTION) and Error components model (MACRO - PANEL)		disposable income - ratio farm-nonfarm (narrow and broad definition) IV: agricultural terms of trade; Subsidies for farm direct payments and general agricultural services; unemployment in the general economy; economic growth; population density in rural areas; education; age.	farm households income is not lower than non farm, especially with the broad definition. The narrow definition shows a broader variation but the picture is similar. When considering covariates at the macro level, the authors show that the income gap is strongly influenced by the general labor market conditions in the economy and the marketable skills of farm household heads; it weakly correlates with farm direct payments or there is no correlation with other government interventions.
		Canada, Finland, France, Germany and the US			**Inequality**	DV: low income rate, the low income gap, the Gini income distribution index and the Sen index (relative to all the population)	Except for Germany, all the 4 measures indicate that farm households are generally poorer and have a more unequal distribution with respect to other groups.
Key et al. (2017)	**1996 - 2013**	USA	ARMS; Hertz (2006); Dahl et al. (2011); Dynan et al. (2012); Congressional Budget Office study (2008); Shin and Solon, 2011; Moffit and Gottschalk, 2011; Hardy and Ziliak, 2014Ziliak et al., 2011.	Panel analysis(MICRO - CROSS-SECTION)	**Income Variability**	DV:farm household income in standard deviation of absolute value of the change; absolute value of the arc percent change (AAPC); standard deviation of the arc percent change IV: size of the farm, education	Using different measures, total farm household income results to be much more volatile than nonfarm households. Moreover, the authors find that volatility increases with the farm size (differently from nonfarm sector) and decreases with the education of the principal operator (as for the nonfarm sector).

4. An empirical longitudinal strategy

The previous Sections show the main challenges when analyzing income differences between farm and nonfarm population and the state of the empirical literature so far. Some important points deserve attention. First, most scholars shift their attention from farm business to farm households since families employ different tools to face the problem of low and unstable income and it is crucial to take this factor into account. This is also in line with the main recommendations provided by Hill (2012). Second, it appears that policy makers would mostly benefit from empirical analyses that offer a comparison between farm households and nonfarm households. This is even more relevant since public interventions are aimed at ensuring that farm households do not lag behind with respect to others. Third, agricultural economists and policy makers would benefit from empirical strategies similar to those employed in the literature on inter-sectorial wage gaps (public-private; rural-urban; formal-informal etc) which address sample selection problems and the presence of unobservable factors. While quasi-experimental methods have recently started to be employed (e.g. Rocchi, 2014; Rocchi et al., 2018) in order to increase the comparability among groups, farm-nonfarm comparisons would also benefit from longitudinal analysis, which would provide additional tools to account for the effect of unobserved individual heterogeneity, and would provide more consistent estimates than is possible with cross-sectional data. In particular, taking into account the role of household's unobserved characteristicson both income and selection may change previous results or confirm more robustly those already existent.

For the above reasons, we here provide some preliminary evidence on how to improve previous analysis. First, we propose an identification strategy based on time variation in individual income and other observable characteristics. Second, we exploit the EU-SILC data, which gives the possibility to create three groups (farm households, nonfarm self-employed households, other households) and follow them for a period of 4 years. Finally, we compare estimates from pooled OLS and fixed effects panel regressions to analyse the income gap. While we focus here only on income gap at the mean as a preliminary analysis, further research is needed to assess if such gaps exist also along the distribution using quintile and quintile fixed effect regression.

We present below a brief description of the data, more details on the methodology and some preliminary results, which have the merit to be the first contribution in the analysis of the farm income problem on a longitudinal basis and pave the way for future research.

4.1 Data

Our main data source is the EU-SILC (Statistics on Income and Living Conditions), which is a micro-level dataset representative of a sample of the European population. It has a longitudinal design from 2005 to 2015 with a rotating structure that covers the same individuals over 4 years.

Despite the EU-SILC includes all European countries, our analysis is limited to countries belonging to the European Union which are also divided in three geographical areas (Western Continental, Mediterranean and Central Eastern Europe) in order to partially overcome the problem of small samples at the country level.[8]

8Similarly to the Euro Barometer, we divide the EU sample in three areas. Austria, Belgium, Germany, Denmark, Finland, France, Eire, Luxembourg, Netherland, Sweden and United Kingdom are included in Western Continental Europe; Bulgaria, Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania, Slovenia and Slovakia in the Central Eastern Europe; Cyprus, Malta, Greece, Spain, Italy and Portugal are included in the area of the Mediterranean country. Note that the Euro Barometer would set apart Sweden, Finland and Denmark in another area (Nordic countries), but for simplicity we pool them within the Continental countries.

Given the detailed information on individual labor, we identify respondents working in the agricultural sector and then characterize two different definitions of farm households from a broader to a narrower as already standard in the literature (United Nations, 2011).

The broad definition considers as farm households all those that have at least one self-employed member working in the agricultural sector. Conversely, the narrow definition of the agricultural household sector considers as farm households only those that have a farm income that is at least half of the total household income. The two definitions allow improving our understanding of the farm problem and give policy makers a more informative picture on the sector.

Before defining farm households, we need to identify who are the farm self-employed individuals since farm income is generated by self-employment. We used the EU-SILC variables PL030 (before 2008) and PL031 (after 2008) to define self-employed individuals. In particular, those reporting to work as part-time and full time self-employed are considered. Among them we look for those working in agriculture using the ISCO-88 classification used at EU-level to identify the individual main occupation.[9] Consequently, among the self-employed, individuals are classified as farmer if they respond to variables PL050 (before 2011) and PL051 (after 2011) that they are Market-oriented Skilled Agricultural Workers (61); Subsistence Farmers, Fishers, Hunters and Gatherers (63) and Agricultural, Forestry and Fishery Labourers (92).

Once farmers are identified, the broad definition of farm households is created selecting those households in which there is at least one farmer. The narrow definition considers as farm households only those earning a total farm income[10] that is at least the half of the total disposable household income.[11]

Note that farm households (whatever the definition adopted) have been identified within the sub-sample of self-employed households, i.e. all the households earning at least some income from self-employed labour. This information is relevant to better identify the two groups of comparison, nonfarm self-employed and rest of population households. We start from the nonfarm self-employed households. Such subsample is defined simply excluding from the total of self-employed households those that have previously identified as farm. Consequently, we have also two groups of non-farm self-employed according to the two definitions of farm households. The rest of population households are finally defined as a residual group with respect to the self-employed households.

Once the farm, nonfarm self-employed and rest of population households are defined, one might compare incomes differential among the three groups. Our dependent variable is the level of equivalised disposable income (HX090).[12] As it is standard in the literature on income differences, the income variable need to be adjusted to compare different countries so we simply take into account purchasing power parities (PPPs). More specifically we take real values of the income variables from the price level indices and real expenditures for the European Standard of Accounts (ESA) (2010 aggregates -Eurostat).

In order to give robustness to our results, we follow two strategy. We first take into account the problems of zero (or negative) values as well the skewness of the distribution and follow Ravallion (2017) who propose a transformation of the income variable using the ordinary hyperbolic sine

9Note that in the cross-section version of the data, additional information can be employed to identify farmers. In particular, we refer to the sector NACE (see Rocchi et al. 2018). However, the difference between farm statistics in the cross-section and in the longitudinal structure are negligible.

10Eusilc dataset includes both gross and net individual self-employed income (PY050G/PY050N). We prefer the net figure unless the country has reported only the gross ones. This is however not a problem since the information are used not for comparing income across countries, but only for the identification of the farm families within countries.

11The last figure, total disposable household income (variable HY020) is computed summing not only incomes, but also pensions, benefits and allowances.

12 The variable refers to the total disposable household income (HY020) divided by the equivalized household size. The equivalence scale used in the EUSILC survey is equal to 1 for the reference person, 0.5 for other adult members (14 years old or elder) and 0.3 for members up to 13 years old.

transformation for negative values of income, and the inverse function for positive values. Second, we consider alternative definitions of income, which take into account also non-monetary sources, namely the implicit rents from dwelling and the in-kind incomes from self-consumption of produced goods, which are very likely to affect the farmers' income more than the income of their non-farm counterpart. Since EUSILC provides information also on these components of households' total income, we provide additional evidence on the income gap between the farm and nonfarm households. In particular, we consider three additional dependent variables: the level of equivalized disposable income plus in kind incomes from self-production; the equivalized disposable income plus imputed rents; the equivalized disposable income plus imputed rents and in kind incomes from self-production.

Finally, to reduce observable heteroegenity, we include a standard set of controls which are standard determinants of household income (e.g., De Janvry and Sadoulet, 2001; Mendola, 2007;Becerril and Abdulai, 2010). Some of them define the characteristics of the householder (age, education, marital status, gender, health)[13], while other define household's features (number of components and region of living).[14]

To control for geographical heterogeneity, we run regressions not only at EU level but also separate regressions by geographical area and inspect whether our coefficients of interest are different. In the next subsection, we show how the empirical strategy that we propose could help in solving the problems of unobservable factors and sample selection.

4.2 Econometric Approach

We start from cross-sectional methods and employ a common estimation approach that pools data across households of the three groups into a 'single equation' model. So we estimate a standard Mincer wage equation at the mean on pooled years data using complex survey weights.[15] Denote with$y_i$the real equivalised disposable income of households *I* and $x_i$the control variables, .

The model estimated by OLS is simply written as:

$$y_i = \alpha + \gamma_t + x_i\beta + F_i\delta + NF_i\rho + u_i \qquad (1)$$

where$F_i, (NF_i)$ represents a dummy taking value one if person i observed at time t is a farm (nonfarm self-employed) household; γ_t are time fixed effects and u_i are i.i.d. errors.The estimated coefficients on these two dummies can be interpreted as a measure of the conditional income differences experienced by farm households and nonfarm households, respectively, compared to the households of the rest of the population which is the base category.

The main problem with Equation (1) is that, despite being EUSILC a very rich dataset in terms of individual and households characteristics, still there may be other unobserved factors that determine both selection into a particular sector and income.This includes not only unobserved personal skills that may affect incomes, but also preferences determining the sorting of households

13 The householder is defined using the following criteria: he/she must be responsible of the accommodation; if there are two responsible of the accommodation, the one earning the greatest income is considered; if still no householder is identified, we consider the eldest.

14 We test for the presence of multicollineary using the variance inflation factor but we do not detect such problem in our data.

[15]Note that the failure to account for weighting in the survey sample design generally results in serious underestimation of standard errors (Kish 1992, 1995; Lohr 2009). Moreover, Kott (1991) shows that weighted estimates are more robust to omitted variable problems and to the heteroscedasticity that normally characterizes sample survey data. Moreover, since using simple weights does not resolve however the problem of outliers, we recalibrating their weights accordingly adopting the Van Kerm's rule of thumb (Kerm, 2007). The recalibration of weights has been performed following the approach proposed by Alfons and Templ (2013).

between the sectors.These unmeasured factors may generate self-selection into one of the sectors generating a potential endogeneity issue in cross-sectional estimates and biased estimates of the conditional income differences. A possible way to address the problem of time-invariant unobservables, is exploiting the rotating panel nature of the EUSILC data introducing fixed effects in the model. We can thus first compare the results of a fixed effects model (FE) to the results based on standard OLS that ignore such unobservables.

In other words, Equation (1) can be compared with Equation (2):

$$y_{it} = \alpha_i + \gamma_t + x_{it}\beta + F_{it}\delta + NF_{it}\rho + \varepsilon_{it} \qquad (2)$$

With x_{it} a set of controls similar to those of Equation (1) (except that time-invariant characteristics are dropped), $\alpha_i$is the individual fixed effect capturing time invariant unobserved heterogeneity and ε_{it} are idiosyncratic errors. A main advantage of fixed effect model is that estimates are consistent even if time-constant unobserved variables are correlated with both selection and incomes.[16]

While Equation (1) and (2) show the difference of farm and self-employed farm with respect to the population, another interesting way to show the income gap between farm and nonfarm sectors is employing the same above strategy into the subsample of the self-employed only. In this way, the base category corresponds to the nonfarm self-employed households while the only dummy left from Equation (1) and (2) is related to farm self-employed.The coefficientδ would thus represent the income gap of the farm household with respect to their most similar group, the nonfarm self-employed. Note that in this case the coefficient δ would represent a pure sector effect.

5. Results

After showing the description of the variables and the estimated means, we provide two sets of results. First, we consider the entire sample of households divided in three groups (population, farm and nonfarm) and provide estimates for the pooled OLS and the fixed effect as shown in Equation (1) and (2) at the EU level, for the three geographical areas and for the broad and narrow definition. We show such results according to the five specifications of income indicated above. Second, we replicate the above estimates restricting the sample to self-employed households only. In this way, farm households are compared to a more similar group, nonfarm self-employed households. Note that our coefficient of interest, δ, has a different meaning according to the sample considered. In the first set of results, it represents the premium/penalty of working in the farm sector with respect to the rest of the population. In the second, it represents the premium/penalty of working in the farm sector with respect to self-employed households only.

While Table 1 provides the description of the variables employed in our empirical analysis, Table 2 shows the estimated means for such variables divided by the population, farm and nonfarm self-employed groups.[17]

[16]Generally, selection bias is purged by 'fixed effect', but coefficients may still be inconsistent if sector choice depends on time-variant unobservables.

17 Table 2 reports the estimated means taking into account the broad definition of farm households. This is relevant also because it define the other group, the nonfarm self-employed household.

Table 1
Variables description

Name of the variable	Description
requdispincome	real equivalized household income
incomerav	transformed income (Ravallion, 2017)
rfullincome1	real equivalized household + imputed rent
rfullincome2	real equivalized household + inkind production
rfullincome3	real equivalized household + imputed rent + inkind production
agehead	age of the household
malehead	gender of the household, 1 male, 0 otherwise
healhead	health status of the headholder, 1 if good, 0 otherwise
marriedhead	marital status, 1 if married, 0 otherwise
rural	residence, 1 if rural, 0 otherwise
hhsize4	size of the family (quintiles)

Table 2
Estimated means of variables by household group

Variable	Household group	Mean	Linearized s.e.	[95% Conf.	Interval]
	population	14 344.15	20.19	14 304.57	14 383.73
requdispincome	farm	7 164.30	71.70	7 023.77	7 304.84
	selfnofarm	18 481.71	101.31	18 283.14	18 680.29
	population	8.913	0.002	8.908	8.917
incomerav	farm	7.768	0.015	7.739	7.798
	selfnofarm	9.076	0.008	9.060	9.091
	population	16 873.42	22.07	16 830.16	16 916.67
rfullincome1	farm	8 875.84	82.44	8 714.26	9 037.42
	selfnofarm	21 776.48	105.92	21 568.87	21 984.08
	population	14 374.49	20.18	14 334.93	14 414.04
rfullincome2	farm	7 430.73	71.60	7 290.39	7 571.06
	selfnofarm	18 517.63	101.29	18 319.10	18 716.15
	population	16 903.75	22.06	16 860.51	16 946.99
rfullincome3	population	9 142.27	82.40	8 980.77	9 303.76
	selfnofarm	21 812.39	105.90	21 604.82	22 019.96
	population	51.533	0.024	51.487	51.580
agehead	farm	45.310	0.087	45.139	45.481
	selfnofarm	44.337	0.045	44.249	44.425
	population	2.966	0.002	2.962	2.969
educhead	farm	2.585	0.007	2.570	2.600
	selfnofarm	3.335	0.005	3.325	3.345
	population	0.602	0.001	0.600	0.603
malehead	farm	0.736	0.003	0.730	0.742
	selfnofarm	0.701	0.002	0.698	0.705
	population	0.442	0.001	0.441	0.443
healhead	farm	0.413	0.003	0.407	0.420
	selfnofarm	0.496	0.002	0.493	0.500
	population	0.337	0.001	0.336	0.338
marriedhead	farm	0.448	0.003	0.442	0.455
	selfnofarm	0.425	0.002	0.421	0.429
	population	0.249	0.001	0.248	0.250
rural	farm	0.775	0.003	0.769	0.781
	selfnofarm	0.242	0.002	0.239	0.245
	population	1.658	0.001	1.655	1.660
hhsize4	farm	2.457	0.008	2.442	2.472
	selfnofarm	2.148	0.004	2.140	2.156

Own calculations on EU-SILC data

Table 2 shows that there are big differences when considering the three groups. In particular, farm households are systematically poorer than the other groups whatever definition of income is considered. However, the table also shows that the three groups are different in terms of their observable characteristics. The older are concentrated among the population households, while farm households are older only with respect to nonfarm self-employed households. However, farm households are the less educated and healthy, the ones with more male and married head-holders, the more concentrated in the rural area and also the ones with larger families.

Such observed heterogeneity clearly indicates that most of the above income differences might be due to covariates. For such reason, we report below the OLS estimates which control for these observed characteristics and FIXED effects estimates which control also for time constant unobserved heterogeneity at the household level.

Table 3 and (4) refer respectively to the broad and narrow definitions of farm households at the EU level. The most striking result of these Tables is related to our coefficient of interest, δ, which represents the income gap of the farm households. While in the OLS, the farm households in the broad definition are definitely disadvantagedwith respect to the population (the coefficient is negative and significative across all income specifications), when controlling for unobservable characteristics, the differences disappear meaning that unobservable characteristics in this group explain most of the income difference. Interestingly, when shifting to the narrow definition in Table 4, OLS estimates again indicates that farm households are poorer than the rest of the population, but fixed effectsnow show that farm households in a stricto sensu are richer than the rest of population.

The following Table 5 reports the δ coefficient for the five income specifications across geographical areas both for the broad and narrow definition and for the OLS and FIXED effects.

The picture emerging from Table 5 is very similar to the results obtained at the EU level, but still there are differences when considering the broad definition. For instance when considering the Western Continental countries, OLS estimates show a positive sign in some specifications, meaning that farm households (narrow and broad definition) are richer than the rest of the (non-self-employed) population when ignoring unobserved factors. However, when looking at fixed effects estimates, differences disappear similarly to the EU level. Most interestingly, Mediterranean farm households in a broad sense are richer than the rest of the population when considering the fixed effects estimates, while Central Eastern farm households are poorer than the rest of the population when considering the broad definition also in the fixed effects. This holds however not for all income specifications.

Table 3
OLS and FIXED effect estimates for the EU - broad definition of farm households
Whole sample

	POOLED - OLS					FIXED EFFCTS				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
VARIABLES	requdispincome	incomerav	rfullincome1	rfullincome2	rfullincome3	requdispincome	incomerav	rfullincome1	rfullincome2	rfullincome3
δ	-2,671***	-0.642***	-3,095***	-2,474***	-2,898***	105.8	-0.0230	148.2	118.8	161.2
	(73.18)	(0.0155)	(83.83)	(73.24)	(83.89)	(132.4)	(0.0269)	(135.9)	(132.8)	(136.4)
ρ	3,346***	0.123***	4,054***	3,348***	4,056***	792.9***	0.0732***	844.2***	796.6***	847.8***
	(88.44)	(0.00845)	(93.47)	(88.43)	(93.46)	(111.7)	(0.0167)	(115.4)	(111.8)	(115.4)
agehead	422.6***	0.0182***	485.9***	422.7***	486.0***	119.1***	0.00816***	121.5***	119.0***	121.4***
	(6.643)	(0.000882)	(7.294)	(6.641)	(7.293)	(9.839)	(0.00165)	(10.40)	(9.844)	(10.40)
agehead2	-3.715***	-0.000148***	-4.091***	-3.717***	-4.093***	-1.651***	-0.000119***	-1.649***	-1.652***	-1.650***
	(0.0626)	(8.31e-06)	(0.0690)	(0.0626)	(0.0690)	(0.107)	(1.71e-05)	(0.112)	(0.107)	(0.112)
educhead	2,227***	0.0906***	2,382***	2,221***	2,376***	172.2***	0.0263***	182.5***	173.6***	184.0***
	(16.26)	(0.00168)	(17.60)	(16.26)	(17.60)	(26.51)	(0.00466)	(28.01)	(26.52)	(28.02)
malehead	2,491***	0.223***	2,662***	2,496***	2,667***	1,566***	0.193***	1,615***	1,569***	1,618***
	(41.71)	(0.00507)	(45.39)	(41.70)	(45.39)	(56.96)	(0.00866)	(59.53)	(56.97)	(59.55)
healhead	1,068***	0.152***	1,202***	1,056***	1,190***	-270.8***	-0.0364***	-273.9***	-271.9***	-274.9***
	(38.91)	(0.00456)	(42.32)	(38.91)	(42.31)	(34.49)	(0.00579)	(36.35)	(34.50)	(36.36)
marriedhead	-781.2***	-0.0821***	-614.7***	-770.5***	-604.0***	-254.7***	-0.0157	-270.2***	-255.3***	-270.8***
	(46.42)	(0.00524)	(50.57)	(46.41)	(50.56)	(65.94)	(0.00987)	(68.88)	(65.97)	(68.91)
rural	-5,575***	-0.835***	-6,609***	-5,529***	-6,563***	487.9***	0.0403***	493.2***	496.0***	501.3***
	(35.21)	(0.00472)	(39.16)	(35.19)	(39.14)	(105.2)	(0.0139)	(112.9)	(105.2)	(112.9)
hhsize4	-1,191***	-0.0411***	-1,001***	-1,182***	-992.5***	-627.7***	0.00142	-513.7***	-629.3***	-515.3***
	(23.77)	(0.00241)	(25.59)	(23.76)	(25.59)	(38.77)	(0.00624)	(41.57)	(38.78)	(41.59)
Constant	-1,238***	8.594***	-4,105***	-1,256***	-4,122***	8,302***	8.108***	7,214***	8,317***	7,229***
	(194.0)	(0.0233)	(209.4)	(193.9)	(209.4)	(246.6)	(0.0417)	(264.1)	(246.6)	(264.2)
R-squared	0.119	0.070	0.123	0.118	0.122	0.208	0.072	0.220	0.208	0.220

Own calculations on EUSILC data
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4
OLS and FIXED effect estimates for the EU - narrow definition of farm households
Whole sample

	POOLED - OLS					FIXED EFFCTS				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
VARIABLES	requdispincome	incomerav	rfullincome1	rfullincome2	rfullincome3	requdispincome	incomerav	rfullincome1	rfullincome2	rfullincome3
δ	-2,057***	-0.449***	-2,258***	-1,871***	-2,073***	2,190***	0.710***	2,252***	2,186***	2,248***
	-135.2	-0.0203	-154.4	-135.1	-154.4	-162.3	-0.057	-165.8	-162.6	-166.2
ρ	4,504***	0.227***	5,189***	4,511***	5,195***	3,759***	0.638***	3,824***	3,757***	3,822***
	-129.2	-0.00821	-135.6	-129.2	-135.6	-215.9	-0.0254	-219.5	-215.9	-219.5
agehead	420.9***	0.0175***	485.7***	421.0***	485.8***	97.71***	0.00359**	99.92***	97.73***	99.93***
	-6.655	-0.000889	-7.307	-6.653	-7.305	-9.89	-0.00163	-10.45	-9.894	-10.45
agehead2	-3.702***	-0.000139***	-4.096***	-3.705***	-4.098***	-1.443***	-7.30e-05***	-1.439***	-1.445***	-1.441***
	-0.0626	-0.0000084	-0.0691	-0.0626	-0.069	-0.107	-0.000017	-0.113	-0.107	-0.113
educhead	2,269***	0.0947***	2,433***	2,262***	2,426***	182.6***	0.0285***	193.4***	184.1***	194.8***
	-15.73	-0.00167	-17.11	-15.72	-17.11	-26.33	-0.00462	-27.84	-26.34	-27.85
malehead	2,431***	0.219***	2,591***	2,436***	2,595***	1,403***	0.162***	1,450***	1,406***	1,453***
	-41.66	-0.00509	-45.33	-41.65	-45.33	-56.71	-0.0086	-59.29	-56.73	-59.31
healhead	1,012***	0.151***	1,134***	999.0***	1,121***	-289.0***	-0.0398***	-292.5***	-290.0***	-293.6***
	-38.11	-0.00457	-41.57	-38.1	-41.57	-34.37	-0.00574	-36.22	-34.38	-36.23
marriedhead	-818.0***	-0.0830***	-649.1***	-807.5***	-638.7***	-256.4***	-0.0162*	-272.5***	-257.0***	-273.1***
	-46.75	-0.00523	-50.86	-46.74	-50.85	-65.54	-0.0098	-68.5	-65.56	-68.53
rural	-5,724***	-0.867***	-6,787***	-5,670***	-6,732***	492.5***	0.0409***	498.2***	500.6***	506.3***
	-34.28	-0.00467	-38.26	-34.25	-38.23	-104	-0.0138	-111.8	-104	-111.8
hhsize4	-1,166***	-0.0471***	-965.3***	-1,154***	-953.8***	-592.0***	0.00658	-476.6***	-593.5***	-478.1***
	-21.12	-0.00238	-23.09	-21.11	-23.08	-38.43	-0.00624	-41.24	-38.44	-41.25
Constant	-1,223***	8.605***	-4,114***	-1,241***	-4,132***	8,641***	8.176***	7,559***	8,656***	7,574***
	-186.9	-0.0234	-202.7	-186.8	-202.6	-246.6	-0.0414	-264.2	-246.7	-264.3
R-squared	0.121	0.067	0.124	0.12	0.124	0.213	0.082	0.224	0.213	0.224

Own calculations on EUSILC data
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5
OLS and FIXED effect estimates of income differential with the rest of the population
Broad and narrow definition of farm households

	POOLED - OLS					FIXED EFFCTS				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
Geographic areas	requdispincome	incomerav	rfullincome1	rfullincome2	rfullincome3	requdispincome	incomerav	rfullincome1	rfullincome2	rfullincome3
					Broad definition of farm households					
δ - WEC	897.2***	-0.0865*	1,699***	988.4***	1,791***	-480.9	-0.149	-432.4	-450.3	-401.8
	(219.7)	(0.0462)	(235.0)	(220.1)	(235.3)	(494.1)	(0.0948)	(505.1)	(494.4)	(505.6)
δ - MED	-1,291***	-0.310***	-1,058***	-1,032***	-800.1***	578.2***	0.0634	658.2***	562.2***	642.2***
	(127.0)	(0.0316)	(135.8)	(127.3)	(136.0)	(205.1)	(0.0438)	(211.5)	(206.8)	(212.7)
δ - CEE	-925.5***	-0.145***	-1,029***	-754.3***	-858.3***	-27.30	-0.0338**	-38.90**	-0.699	-12.30
	(14.37)	(0.00939)	(16.59)	(15.13)	(17.13)	(19.04)	(0.0155)	(19.84)	(21.27)	(21.78)
					Narrow definition of farm households					
δ - WEC	1,979***	0.221***	3,050***	2,070***	3,141***	3,719***	0.789***	3,967***	3,720***	3,969***
	(368.1)	(0.0360)	(395.1)	(368.5)	(395.7)	(462.3)	(0.160)	(474.5)	(462.7)	(475.3)
δ - MED	-1,075***	-0.145***	-717.7***	-835.3***	-478.1**	2,990***	1.088***	3,031***	2,937***	2,977***
	(222.3)	(0.0261)	(233.4)	(222.0)	(233.0)	(310.8)	(0.113)	(314.6)	(311.4)	(314.7)
δ - CEE	-663.9***	-0.173***	-731.2***	-504.7***	-572.0***	312.6***	0.342***	312.4***	341.8***	341.6***
	(29.66)	(0.0163)	(33.15)	(32.16)	(35.32)	(27.57)	(0.0224)	(28.04)	(29.91)	(30.21)

Own calculations on EUSILC data
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The second set of results restricts the sample to self-employed households only. Thus, the δ coefficient now represents the income gap of the farm household with respect to nonfarm self-employed ones.

Consider first Table 6 and 7 which show the estimates of OLS and FIXED effects respectively for the broad and narrow definition in the EU context. The picture is very similar to the previous one, with farm households more likely to be poor than their nonfarm self-employed counterpart only in the OLS. Such negative gap disappears in the fixed effects estimates when considering the broad definition and it becomes positive when we shift our attention to the narrow definition. In other words, households earning more than 50% of their income from farming in the EU are richer than other self-employed families once unobserved factors are taken into account.

Finally, Table 8, provides the same estimates but for the three geographical areas.

The results are consistent also when considering the different geographical areas. On the one hand, the OLS negative gap disappears with fixed effects when considering the broad definition of farm households. On the other hand, farm households in the narrow definition are richer than their nonfarm counterpart when unobservable factors are considered.

Table 6
OLS and FIXED effect estimates for the EU - broad definition of farm households
Selfemployed households sample

	POOLED - OLS					FIXED EFFCTS				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
VARIABLES	requdispincome	incomerav	rfullincome1	rfullincome2	rfullincome3	requdispincome	incomerav	rfullincome1	rfullincome2	rfullincome3
δ	-5,717***	-0.877***	-6,772***	-5,554***	-6,608***	-605.1	-0.0609	-636.8	-592.0	-623.7
	(149.4)	(0.0304)	(164.3)	(149.7)	(164.5)	(706.1)	(0.144)	(708.2)	(708.1)	(710.2)
agehead	-54.74	-0.00763	-22.91	-55.03	-23.21	93.48	0.0486***	96.69	94.84	98.04
	(52.15)	(0.00528)	(54.76)	(52.16)	(54.77)	(75.58)	(0.0136)	(78.06)	(75.58)	(78.07)
agehead2	3.294***	0.000221***	3.316***	3.296***	3.317***	-1.144	-0.000563***	-1.172	-1.163	-1.191
	(0.607)	(5.52e-05)	(0.635)	(0.607)	(0.635)	(0.869)	(0.000162)	(0.900)	(0.869)	(0.900)
educhead	2,837***	0.0951***	2,961***	2,825***	2,949***	322.9	0.0224	374.7	328.2	380.0
	(98.41)	(0.00894)	(101.9)	(98.41)	(101.9)	(357.3)	(0.0283)	(359.3)	(357.3)	(359.3)
malehead	2,622***	0.184***	2,578***	2,626***	2,582***	1,359***	0.273***	1,324***	1,375***	1,340***
	(251.9)	(0.0286)	(263.9)	(251.9)	(264.0)	(427.0)	(0.0491)	(428.6)	(427.1)	(428.6)
healhead	1,388***	0.0412*	1,548***	1,379***	1,540***	1,263***	0.0180	1,346***	1,261***	1,344***
	(213.4)	(0.0230)	(223.2)	(213.5)	(223.3)	(270.4)	(0.0375)	(273.2)	(270.5)	(273.3)
marriedhead	-327.6	0.0493*	-162.3	-317.8	-152.4	613.9	0.212***	623.5	601.8	611.5
	(264.1)	(0.0291)	(275.4)	(264.1)	(275.5)	(522.2)	(0.0557)	(524.4)	(522.2)	(524.5)
rural	-6,084***	-0.693***	-7,178***	-6,048***	-7,141***	1,645**	0.300*	1,549**	1,644**	1,549**
	(183.0)	(0.0236)	(194.2)	(183.0)	(194.2)	(709.1)	(0.176)	(759.9)	(708.0)	(759.0)
hhsize4	-1,511***	-0.0386***	-1,351***	-1,501***	-1,341***	-1,071***	0.0293	-981.1***	-1,080***	-990.0***
	(92.99)	(0.00988)	(98.22)	(93.01)	(98.24)	(234.6)	(0.0284)	(238.7)	(234.7)	(238.7)
Constant	6,865***	9.054***	5,078***	6,851***	5,063***	9,036***	6.931***	8,071***	9,007***	8,043***
	(1,179)	(0.132)	(1,236)	(1,179)	(1,236)	(2,337)	(0.312)	(2,375)	(2,337)	(2,375)
R-squared	0.101	0.077	0.113	0.099	0.112	0.177	0.069	0.185	0.177	0.186

Own calculations on EUSILC data
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7
OLS and FIXED effect estimates for the EU - narrow definition of farm households
Selfemployed households sample

	POOLED - OLS					FIXED EFFCTS				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
VARIABLES	requdispincome	incomerav	rfullincome1	rfullincome2	rfullincome3	requdispincome	incomerav	rfullincome1	rfullincome2	rfullincome3
δ	-3,854***	-0.428***	-4,440***	-3,727***	-4,313***	748.5***	0.723***	745.9***	744.5***	742.0***
	(186.9)	(0.0269)	(206.9)	(187.2)	(207.2)	(257.5)	(0.109)	(264.3)	(257.7)	(264.4)
agehead	44.43	0.00770	95.38*	40.88	91.83*	86.91	0.0433***	90.06	88.31	91.47
	(52.51)	(0.00539)	(55.21)	(52.50)	(55.21)	(75.56)	(0.0135)	(78.07)	(75.57)	(78.08)
agehead2	2.158***	4.48e-05	1.961***	2.198***	2.000***	-1.075	-0.000509***	-1.102	-1.094	-1.121
	(0.610)	(5.63e-05)	(0.639)	(0.609)	(0.639)	(0.868)	(0.000161)	(0.900)	(0.868)	(0.900)
educhead	3,022***	0.125***	3,180***	3,005***	3,163***	329.9	0.0274	381.7	335.2	387.0
	(100.9)	(0.00884)	(104.3)	(100.9)	(104.3)	(357.2)	(0.0282)	(359.2)	(357.2)	(359.3)
malehead	2,691***	0.192***	2,660***	2,692***	2,662***	1,354***	0.265***	1,320***	1,370***	1,336***
	(254.9)	(0.0289)	(267.1)	(254.9)	(267.0)	(426.3)	(0.0489)	(427.8)	(426.3)	(427.9)
healhead	1,699***	0.0728***	1,900***	1,685***	1,885***	1,254***	0.0101	1,337***	1,252***	1,335***
	(215.1)	(0.0232)	(224.8)	(215.1)	(224.8)	(270.6)	(0.0374)	(273.3)	(270.7)	(273.4)
marriedhead	4.104	0.0891***	216.4	5.777	218.1	589.2	0.189***	598.9	577.3	587.0
	(267.1)	(0.0292)	(278.5)	(267.1)	(278.5)	(522.8)	(0.0554)	(525.1)	(522.8)	(525.1)
rural	-7,428***	-0.919***	-8,782***	-7,356***	-8,710***	1,639**	0.293*	1,544**	1,638**	1,543**
	(174.5)	(0.0222)	(185.4)	(174.4)	(185.3)	(708.8)	(0.173)	(759.7)	(707.7)	(758.8)
hhsize4	-1,707***	-0.0698***	-1,585***	-1,692***	-1,570***	-1,060***	0.0403	-970.9***	-1,069***	-979.9***
	(96.21)	(0.00986)	(101.3)	(96.21)	(101.3)	(234.7)	(0.0285)	(238.8)	(234.8)	(238.9)
Constant	3,966***	8.635***	1,670	4,036***	1,740	8,954***	6.955***	7,983***	8,927***	7,956***
	(1,207)	(0.135)	(1,264)	(1,207)	(1,264)	(2,327)	(0.311)	(2,366)	(2,327)	(2,366)
R-squared	0.093	0.063	0.105	0.092	0.104	0.177	0.073	0.185	0.177	0.186

Own calculations on EUSILC data
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8
OLS and FIXED effect estimates of income differential with other self-employed households
Broad and narrow definition of farm households

	POOLED - OLS					FIXED EFFCTS				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
VARIABLES	requdispincome	incomerav	rfullincome1	rfullincome2	rfullincome3	requdispincome	incomerav	rfullincome1	rfullincome2	rfullincome3
					Broad definition of farm household					
δ - WEC	-3,991***	-0.259***	-3,869***	-3,887***	-3,766***	-2,047	-0.0431	-1,879	-2,026	-1,858
	(398.6)	(0.0807)	(418.3)	(399.3)	(419.1)	(2,156)	(0.412)	(2,151)	(2,157)	(2,152)
δ - MED	-3,533***	-0.296***	-3,725***	-3,313***	-3,504***	-34.73	-0.0779	-184.9	-52.50	-202.6
	(224.9)	(0.0542)	(236.1)	(225.1)	(236.3)	(609.8)	(0.158)	(614.2)	(620.1)	(624.1)
δ - CEE	-735.7***	-0.0672***	-836.2***	-585.1***	-685.5***	126.0	-0.0325	87.97	191.4	153.3
	(34.69)	(0.0242)	(39.50)	(35.82)	(40.31)	(101.1)	(0.0582)	(99.50)	(119.4)	(117.2)
					Narrow definition of farm household					
δ - WEC	-2,855***	0.180***	-2,421***	-2,773***	-2,338***	1,993***	1.065***	2,033**	1,962**	2,002**
	(529.8)	(0.0454)	(561.6)	(531.0)	(563.3)	(766.9)	(0.317)	(794.1)	(768.0)	(795.4)
δ - MED	-2,768***	-0.0780**	-2,824***	-2,572***	-2,628***	1,151**	1.055***	1,193**	1,116**	1,158**
	(307.5)	(0.0382)	(321.3)	(306.9)	(320.6)	(554.6)	(0.226)	(559.7)	(554.3)	(559.0)
δ - CEE	-230.7***	0.0240	-253.0***	-147.3***	-169.5***	104.3***	0.340***	110.3***	132.1***	138.1***
	(36.26)	(0.0239)	(40.87)	(38.90)	(42.96)	(30.78)	(0.0312)	(31.63)	(34.81)	(35.25)

Own calculations on EUSILC data
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6. Conclusions

The farm income problem has traditionally justified government intervention for the agricultural sector. However, since the Gardner (1992) seminal contribution, the empirical evidence has shown an income convergence between the farm and the nonfarm sector. Subsequent studies have confirmed these results and in several circumstances have found that farm unites are even richer than their counterparts.

Nevertheless, a main reason for national and supranational government ignoring these results and keeping pouring resources in the farm sector may be found in the several challenges that empirical researcher have to face when addressing the farm income problem. We here provide a complete assessment of them as well as a review of the literature. Moreover, we propose to deal with some of these challenges both using longitudinal data.

Despite being the present study very preliminary and requiring further research and robustness tests, similarly to previous studies we also find that on average there is no such strong evidence for the farm income problem in the European Union. The only exception is the group Central Eastern countries where farm households are poorer that the rest of the population. However, this is true only for the broad definition of farm households. In general, our empirical analysis indicates that farm household are no different from other groups when considering the broad definition. Moreover, they are richer when considering the narrow definition, i.e. when farm households mainly rely on farming as a source of income.

Finally, it is important to stress that our analysis is limited only to income averages and does not explore the issue of the distribution of the income among the considered groups of households as well as poverty and income variability issues. However, we plan to address these issues soon to complement the presented analysis.

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