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Assessment of Biogas Plant Firms by Application of Annual Accounts and Financial Data Analysis Approach

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Abstract: Firms operating biogas plants are often characterized by making significant investments in fixed assets financed by equity and, mainly, financial debt. These firms have experienced significant growth in Italy, partly as a result of public contributions. The objective of the research is to analyze the management of biogas plant firms by analyzing annual accounts as the main document of use to third parties for the evaluation of a firm's management. The research, conducted on a sample of 22 firms using 110 year-data, has highlighted that economic and financial margins are different, though often statistically correlated. The research shows that profitability and cash generation in the biogas plant industry are high, even if the generation of cash flow is less than the return on equity, and there are firm cases of having difficulty in financial debt repayment, even in the presence of positive economic margins. The research also shows that return on equity greatly exceeds the performance of Italian government bonds and of the majority of industrial sectors; this result points to the significant increase in returns on equity capital in the industry, potentially damaging other sectors, and highlighting the risk of the distortive use of public resources.

Keywords: plants assessment; ROE; FOE; externalities; biogas; renewable energies

1. Introduction

Agriculture has played a central role throughout history. It has served as a primary source of food and has had as major side effect, its impact on the environment [1–3]. Since the industrial revolution agriculture and its consequent contribution to the national income have decreased [4–6], and this has reduced the need for labor in the primary sector and agricultural employment [7]. Today, agriculture plays a central role in the socioeconomic system, particularly given its impacts on sustainability, the environment and health. The first studies on agricultural sustainability were German forestry studies in the eighteenth century [8,9]. Moreover, the actual definition of sustainability is attributable to the Brundtland Report (WCED, 1987). Today, the agricultural approach to sustainability is defined [10] as the most comprehensive approach to evaluating the relationships between many fields of sustainability studies; this line of research has only developed in recent years with the application of a multidisciplinary approach [11–14]. Several studies have shown that sustainable agricultural production could provide solutions to food, energy and environmental problems [15] given that the production of renewable energy, agriculture and land use are strictly related [16,17], in fact, energy production through renewable sources generates services which have a market price, such as energy, but it also produces environmental services that do not pass through market price systems; these effects are defined as externalities, as secondary effects of agricultural activity. To discourage negative externalities and to increase positive externalities, the economic literature and legislative interventions suggest a series of specific measures [18,19] by way of public aid in the form of direct subsidies. About this topic, renewable energy sources have had an increasing impact on the pean Union's (EU) electricity production after Directive 2001/77/EC to stimulate energy production in pe. The energy that renewable sources produced in 2014 was 21.4% of the EU' s total primary production, while that produced in 2000 was 10.3% of the EU's total primary production. pean policy aid for renewable sources continued with Directive 2009/28/EC that set a target that 20% of the EU's energy comes from renewable sources in 2020. Agricultural activity is particularly linked with biomass, which the EU defines as "biodegradable fraction of products, waste and residues of biological origin from agriculture (including vegetal and animal substances), forestry and related industries including fisheries and aquaculture, as well as the biodegradable fraction of industrial and municipal waste". As several studies have shown [20], biomass plants have a close relationship with land and agricultural production, and frequently they operate jointly with farm production. About this topic, the environmental role of renewable energy sources such as biomass, particularly in terms of sustainable development, was highlighted by several researchers [21–28]. The valuation of the use of biomass needs to consider environmental and socio-economic effects such as crop diversification, the restoration of abandoned land, maintenance of forests and the creation of jobs [29]. Furthermore, the use of biomass can be considered almost neutral [30] in considering greenhouse gases, typically CO_2. There are three types of power plants: (a) solid biomass that operates applying traditional technology as a combustion furnace for solid biomass and a boiler that supplies a turbine coupled to a generator; (b) liquid biomass that powers engines coupled to generators; (c) biogas working through a process of fermentation, digestion and gasification transforming the materials through anaerobic digestion, producing methane gas and digestate that is considered waste (EWC code: 190600-03-04-05-06). The methane gas collected is then introduced to gas engines of usually less than 1 MW and, via combustion, electricity and heat are produced. Plants that produce 1 MW or more experience significant reductions in public aid. Plants can meet incentive requirements if they comply with the sustainability criteria of the pean rules (Directive 2009/28/EC and Directive 2009/30/EC, applied in Italy with Legislative Decree no. 28/2011 and D. Decree no. 55/2011). Sustainability criteria are applied to define which bio liquids demonstrate a high environmental value and then could benefit from financial aid after 2012 matching several sustainability criteria: (a) reducing greenhouse gas emissions; (b) raw materials used to produce bio liquids must not come from high biodiversity land or from land with a high carbon stock. The incentive for production of electricity from plants using renewable sources other than photovoltaic systems was established by Ministerial Decree (DM) from the Ministry of Economic Development (MISE) on 6 July 2012. The DM outlines what is eligible for incentive systems with power not exceeding 1 MW. The incentives apply to plants that enter into operation starting on 1 January 2013. The incentives are recognized according to net production of electricity fed into the grid while self-consumed electricity is not eligible for incentives. Depending on the power provided by the system, a comprehensive feed-in tariff for power plants up to 1 MW applying two different incentive mechanisms: (1) determined by the sum of an incentive base rate and the amount of premiums for reducing emissions; (2) an incentive for power plants exceeding 1 MW and for those up to 1 MW that do not opt for the all-inclusive tariff, calculated as the sum of incentive base rate and the market price of energy. The DM ensures that the indicative cumulative cost of all types of incentives paid to renewable energy plants, other than photovoltaic, does not exceed a total value of 5.8 billion per year for the Italian territory. The new incentive system also introduced annual quotas for each year from 2013 to 2015. The value of the incentive payable base rate is applicable at the date of start of operation. Gestore dei Servizi Enegetici (GSE) Spa will pay the all-inclusive tariff (called "tariffa omnicomprensiva" in Italian), which is calculated based on the value of the incentive fee, from the date of start of operation.

The companies in Italy in the biogas production sector need large amounts of capital to finance investment, particularly in fixed assets such as property, plant and equipment [31]. A part of these capital investments are funded by entrepreneurs as equity capital; the firms can also attain debt capital with loans from banks. The firms in the sector use the following forms of financing investment, in addition to equity capital: (1) firms prefer bank loans with medium and long term repayments to finance investments in property, plant and equipment; these loans are frequently in the form of secured loans with guarantees on real estate property and, less frequently, are unsecured claims; in this case, there are often various collateral forms of guarantee. In the medium and long term loans, companies have the contractual obligation to repay debts considering an amortization schedule of debt plus interest expenses (so-called debt service); (2) firms prefer short-term lines of credit, such as credit to finance trade receivables, contracts and stock for the financing of working capital requirements. It is therefore necessary to assess the performance of equity capital and, at the same time, evaluate if the cash flow generated by operations is sufficient to pay debt service (principal and interest). In this way, it is possible to evaluate the return on equity capital and the sustainability of investments. This assessment is important in the renewable energies sector considering the relevant time lag that exists between the economic and financial cycles, as several researches have shown [32–34], and jointly the importance of analyzing operating cash flows, in comparison with accounting values, is highlighted by several studies [35–37].

Given this general overview, the objective of this research is to evaluate biomass plants analyzing annual account data in a sample of firms located in northern Italy (Lombardia, Veneto and Emilia Romagna regions). Annual accounts analyzed in the research are mandatory documents for firms and are public documents, freely available for third parties, such as banks and suppliers that analyze annual account data to define their credit lines to firms involved in their respective businesses; annual account analysis could then be useful as the basis for investment and finance assessments. The evaluation indices proposed in the research may then allow for a proper assessment of the sustainability of the management cycle in renewable energy firms, which are often capital intensive and frequently use financial debt to cover fixed asset investments [38–40]; the results of the research could also be useful to analyze the use of public aid.

2. Methods

2.1. Balance Sheet Analysis

Annual accounts are the main accounting document used for external reporting and are composed of three compulsory documents that are balance sheet, income statement and general notes; annual account is defined by the Italian Civil Code, from Article 2423 to Article 2435-bis. Italian civil law has introduced mandatory schemes for balance sheets and income statements via Articles 2424 and 2425. The model of the balance sheet was developed through the formation of homogeneous categories, active and passive, divided into further subcategories. The balance sheet assets assume a classification based on the destination of investments, where balance sheet liabilities are classified on the basis of the origins of sources of financing, divided between equity and debt capital. In our research, we apply the approach of annual account analysis used for the agri-food sector with capital-intensive characteristics [41], as follows:

$$\begin{aligned} &A + Bfa^{int} + Bfa^{tan} + Bfa^{fin} + Cwc^{ar<12m} + Cwc^{ar>12m} + Cwc^{o<12m} + Cwc^{o>12m} + Cwc^{i} + Cwc^{ql} + \\ &+ Cl + D = AE^{sc} + AE^{r} + AE^{\Pi} + A\Pi + B + C + Df^{<12m} + Df^{>12m} + Dwc^{ap<12m} + Dwc^{ap>12m} + \\ &+ Dwc^{o<12m} + Dwc^{o>12m} + E \end{aligned} \quad (1)$$

In Equation (1), the left side expresses the total investment (TA); the right side expresses the total sources of financing (TS). On the left side, A is receivables from shareholders for capital contributions, Bfa^{int} is intangible fixed assets, Bfa^{tan} is tangible fixed assets, Bfa^{fin} is financial fixed assets, and $Bfa^{int} + Bfa^{tan} + Bfa^{fin} = BFA$, where BFA is the total investment in fixed assets. $Cwc^{ar<12m}$ is working capital accounts receivable due within 12 months, $Cwc^{ar>12m}$ is working capital accounts is due after 12 months (12m), $Cwc^{o<12m}$ is working capital other credits due within 12 months (12m), $Cwc^{o>12m}$ is working capital other credits due after 12 months (12m), Cwc^{i} is working capital inventories, Cwc^{ql} is working capital of near liquid financial assets, Cl is working capital liquidity, and D is active accrued accruals and deferrals. In Equation (1), on the right side, AE^{sc} is share capital, AE^{r} is reserves, A^{Π} is retained profit from previous years, $A\Pi$ is net profit of the year, and $AE^{sc} + AE^{sc} + A^{\Pi} + A\Pi = ET$, where ET is total shareholder capital, namely equity, B is provisions for risks and charges, and C is termination indemnities paid to workers. $Df^{<12m}$ is financial debts due within 12 months (12m), $Df^{>12m}$ is financial debts due after 12 months (12m), $Dwc^{ap<12m}$ is accounts payable of working capital due within 12 months (12m), $Dwc^{ap>12m}$ is accounts payable of working capital due after 12 months (12m), $Dw^{co<12m}$ is other working capital debts expiring within 12 months (12m), and $Dw^{co<12m}$ is other working capital debts expiring after 12 months (12m). Equation (1) could be expressed in functional form to highlight four major functions of capital: investments in fixed assets (BFA), investments or financing in/with net working capital (NWC), investments or financing in/with net financial position (NFP), and financing with equity (ET). NWC is expressed as follows:

$$\begin{aligned} NWC = {} & (Cwc^{ar<12m} + Cwc^{ar>12m} + Cwc^{o<12m} + Cwc^{o>12m} + Cwc^{i}) - \\ & (Dwc^{ap<12m} + Dwc^{ap>12m} + Dwc^{o<12m} + Dwc^{o>12m}) \end{aligned} \quad (2)$$

NWC expresses the absorption of financial resources through purchasing, transformation and sales, and quantifies the resources created (NWC < 0) or absorbed (NWC > 0) within the working capital management cycle [42–45]. To express the role of financial debt between the sources of funds, net financial position (NFP) is:

$$NFP = (Df^{<12m} + Df^{>12m}) - (Cwc^{ql} + Cl) \quad (3)$$

If is NFP < 0, NFP absorbs financial resources, which means that the firm has active financial resources higher than financial borrowing. If it is NFP > 0, the firm uses financial debt as a source of funds. Considering Equations (1)–(3), we can express in Equation (4) the balance sheet in a strictly functional form, as follows:

$$BFA + NWC = NFP + ET \quad (4)$$

In Equation (4), we have the hypothesis that $BFA \geq 0$, $NWC \geq 0$, $NFP \geq 0$ and $ET \geq 0$. We have certainly verified this hypothesis for BFA, which may have a minimum value of zero, and for ET, which, if negative, determines the failure of the company. NFP is positive in cases where firms use financial debts as sources of capital; this applies to the firms considered in the sample. We express this as BFA + NWC = NIC, where NIC is the net invested capital, and NFP + ET = NTS, where NTS is the net source (of capital). We will use Equations (1) and (4) to analyze the balance sheets of the firms in the sample.

2.2. Income Statement Analysis

Again, Italian law requires the drafting of income statements aiming to quantify the result for the year in terms of net profit. In accordance with the principle of economic competence, income statement is articulated in operational management areas. Macro class A expresses the value of production as the value of production obtained by the firm. The total cost of production is presented in macro class B, in which costs are accounted on an accrual basis according to the nature of the cost. The difference between value and cost of production, macro classes A less B, is defined operating income or earnings before interest and tax (EBIT). To determine the cost of debt, the Italian legislation requires the insertion of macro class C, expressive of financial income and expenses. Additionally, Italian law has designated macro class D to be expressive of value adjustments of financial assets, where macro class E is expressive of extraordinary income and charges. The income statement required by Italian law has been used in this research with Equation (5) that follows:

$$\begin{aligned} &(\mathrm{S} \pm \Delta\mathrm{Cwc}^{\mathrm{i}} + \mathrm{Cp} + \mathrm{Os}) - (\mathrm{Mc} + \mathrm{Sc} + \mathrm{Rc} + \mathrm{Lc} + \mathrm{Oc}) = \mathrm{EBITDA} \\ &\mathrm{EBITDA} - (\mathrm{Dc} + \mathrm{Ac}) = \mathrm{EBIT} \\ &\mathrm{EBIT} + (\mathrm{Ir} - \mathrm{Ic}) + (\mathrm{Rr} - \mathrm{Dc}) + (\mathrm{Xr} - \mathrm{Xc}) = \Pi^{\mathrm{bT}} \\ &\Pi^{\mathrm{bT}} - \mathrm{T} = \Pi \end{aligned} \tag{5}$$

In Equation (6), S is the company' s sales, $\Delta\mathrm{Cwc}^{\mathrm{i}}$ is the change in inventory value, Cp is the capitalization of costs for internal construction of fixed assets, Os is other sales. Mc represents the costs of raw materials, Sc the costs of services, Rc the costs of renting and leasing, and Oc other costs. EBITDA is earnings before interest, tax depreciations, and amortizations and approximates the creation of liquidity without consideration of nonmonetary costs (Dc + Ac), where Dc and Ac are depreciations and amortizations. EBIT is earnings before interest and tax as an intermediate profit margin expressing the company's current operating income. Ir is interest revenue, Ic is interest charge, and is Ir − Ic = SF, where SF is the balance of financial management. Rr is revaluation and Dc devaluation, and is Rr − Dc = SR, where SR is the balance of revaluations and impairments of financial assets management. Xr is extraordinary revenue, while Xc is extraordinary charges, and Xr − Xc = SX, where SX is the balance of extraordinary management. Π^{bT} is profit before taxes, while T is income taxes. Π is net profit. AΠ in balance sheet is equal to Π of income statement. Income statement does not take into account timing of monetary operations, and income margins (EBITDA, EBIT, and Π) do not express necessary cash flow generation, as shown by several studies focusing on companies with large investments in fixed assets [46,47] and working capital [48–50].

Again, the joint application of economic and financial approaches to the assessment of management can give different results as several studies have shown [51–53]. To assess the sustainability of the firms' management, we frequently applied income values such as EBITDA and EBIT; these margins approximated the cash flow but did not consider the following: (1) the effect of the revenues to be collected from customers; (2) the purchases not paid to suppliers; (3) the change in value of inventories; then, only in a steady state we have equality, even with lag time, between income and financial margins.

2.3. Cash Flow Statement Analysis

Researchers apply two methods to draft cash flow statements [54,55]: the direct method [56,57] considers monetary revenues and costs as determinants of cash flow (CF), whereas the indirect method [58] derives the quantification of CF from an income margin. In our research, we have applied this second method and express cash flow statements as follows:

$$\begin{aligned} &\Pi + (\mathrm{Dc} + \mathrm{Ac}) + \mathrm{SF} = \mathrm{CF} \\ &\mathrm{CF} \pm \Delta\mathrm{NWC} = \mathrm{OCF} \\ &\mathrm{OCF} \pm \mathrm{BFA} = \mathrm{UFCF} \\ &\mathrm{UFCF} - \mathrm{SF} = \mathrm{FCFE} \end{aligned} \tag{6}$$

In Equation (6), CF is cash flow, OCF is operating cash flow; UFCF is unlevered free cash flow and represents cash flow available for the remuneration of financial debt and equity capital, while FCFE is free cash flow to equity and represents cash available for distribution to shareholders. In Equation (6), CF is the cash flow, and OCF is the operating cash flow. UFCF is the unlevered free cash flow and represents the cash flow available for the remuneration of financial debt and equity capital. Moreover, FCFE is the free cash flow to equity and represents the cash available for distribution to shareholders. OCF describes the cash flow from operations generated before changes in the working capital (ΔNWC). In fact, an increase in the working capital value (+ΔNWC) determines the absorption of liquidity that operations generate, while a decrease in the working capital value (−ΔNWC) determines the cash that operations generate. So, a change in working capital can lead to a reduction or increase in UFCF. If UFCF < 0, the firm is not able to pay the cost of debt even if the economic margins (EBITA, EBIT and Π) are positive. Only if FCFE > 0 is it possible to pay dividends to shareholders. Profit (Π), that is calculated with an economic approach, may differ from the cash flow available for distribution to shareholders (FCFE) in consideration of the time lag between economic value creation and occurrence of financial cash flows. It is therefore appropriate to compare income and financial margins to verify the significance of differences in return on equity, firstly calculated applying a traditional economic approach and then suggesting a financial approach of measure.

2.4. Ratio Analysis

Generally, the investment evaluation applies two distinct groups of ratios: (1) economic ratios, derived from annual account data and applying an accounting approach; (2) financial ratios, derived from financial statement data applying a financial approach. The economic ratios quantify the accounting return of capital taking into consideration the flow of economic values as positive and negative components of income. Applying an economic approach, the main measure of profitability is the Return on Equity (ROE), which is the ratio between profit and the equity capital:

$$ROE_t = \frac{\Pi_t}{ET_t} \quad (7)$$

In Equation (7), ROE expresses the economic annual return of equity capital [59,60]. This ratio measures profitability but is affected by accounting conventions that are the basis of the calculation of profit. In fact, economic ratios are calculated by applying values affected by the provisions of the laws of accounting. For instance, the principle of prudence could cause an underestimation of income and does not allow for evidence of the latent capital gain. In addition, the non-consideration of assets with positive latent capital gains has an influence by decreasing the denominator of economic ratios, such as ROE, with a potential increase in the rate of return estimated as an annual percentage. Again, flow values in the numerator are put in relation with stock values in the denominator. The numerator then considers the values of flow being formed during the reporting period, from the beginning to the end, while the denominator is the values of stocks that have instant quantification, generally at the end of the accounting period. The ratios have a maximum distortion in the case of assessments related to strongly seasonal activities, where the quantification of capital stocks at the end of the period is not expressive of the average stock value. It is therefore possible to have a situation in which equity holders, even in the case of positive profit, are not able to distribute dividends. In fact, economic ratios do not consider the time of the manifestation of financial flows, and an assessment considered adequate by equity holders in terms of income could suffer by lack of liquidity to share dividends, even in the case of positive profit. To overcome this problem, this work also proposes the application of the following ratio:

$$FOE_t = \frac{FCFE_t}{ET_t} \quad (8)$$

In Equation (8), the FOE (flow on equity) expresses the financial return on equity capital. The FOE ratio, which some researchers had already suggested [61,62], was recently applied to the analysis of capital-intensive firms [63]. In the article, we apply two linear regression models to determine the explanatory variables of ROE_t and FOE_t in the biogas plants firms of the sample.

3. Results and Discussion

3.1. Data Collection and Research Plan

The article analyzed a sample of 22 companies operating in the biogas plant sector in Italy, with the plants located in the Lombardia, Emilia Romagna and Veneto regions. All 22 companies in the sample operate under the ATECO 2007 code "351100 Production of electric energy". The firms in the sample are based in three regions of northern Italy. Fourteen companies are located in the Lombardia region (7 in the Province of Cremona, 3 in the Province of Brescia, 2 in the Province of Mantova, 1 in the Province of Milano and 1 in the Province of Pavia); 5 are located in the Emilia Romagna region (3 in the Province of Bologna and 2 in the Province of Ferrara) and 3 are located in the Veneto region (2 in the Province of Rovigo and 1 in the Province of Verona). All plants in the analysis are located in the Po Valley, which is the Italian area with the largest concentration of biogas plants. The plants are located in lowland areas at altitudes of between 35 meters above sea level and 210 meters above sea level. Vegetable biomass (primarily corn, sorghum and other cereals) and livestock effluent (particularly that resulting from dairy cattle and pig breeding) are fed to the plants. The production of cereals and the rearing of bovine and porcine livestock are especially prominent agricultural activities in Italy's Po Valley. The facilities are all fairly new, having begun operations in the period of 2007–2009. Five of them began operating in 2007, 14 began operating in 2008 and 3 began operating in 2009. For all of the plants, 2010 was a year of normal operations, and the associated data are considered normal operating data. The firms had a median installed electric capacity of 999 kW. In fact, 18 of the enterprises had 999 kW of installed power, 2 of them had 800 kW of installed power and 2 of them had 600 kW of installed power. Companies with an installed electrical capacity exceeding 1 MW each were not included in the sample. Such large companies, if included in the sample, would have had data that was not comparable to that associated with the firms in the sample. All the electricity produced at the plants considered in this article was fed into the national electric grid, and the company, Gestore Servizi Energetici (GSE) Spa, purchased it based on an incentive tariff of 280 € per MW per hour. The firms in the sample are legally considered as agricultural firms; in fact, Article 1 of the Decree of May 18, n. 228, "Orientation and modernization of the agricultural sector", redefines Article 2135 of the Italian Civil Code where the use of renewable energy is classified as agricultural activity; under the roles of Italian bankruptcy law, agricultural firms are not subject to bankruptcy. Data derive from "Computerized analysis of Italian firms" database (AIDA). The data analysis has been performed with SPSS statistical package (issue 19). The data cover a five year period, from 2010 to 2014, with 110-year data. In the article, the analysis is developed as follows: (a) We reclassify the annual accounts of 22 biogas plants firms included in the sample, applying descriptive statistics to balance sheets, income statements, and cash flow statements; (b) we test whether there are statistically significant correlations between economic margins (variables EBITA, EBIT, and Π) and financial margins (CF, OCF, UFCF, and FCFE); (c) we test whether there are statistically significant differences between economic margins (EBITA, EBIT, and Π) and financial margins (CF, OCF, UFCF, and FCFE); (d) we apply two linear regression models to determine the explanatory variables of ROE and FOE in the biogas plants firms of the sample.

3.2. Annual Account Data Analysis

The majority of the plants using bio energy (i.e., biomass, biogas and bio liquids) in Italy at the end of 2014 were small plants, with each one producing less than 1 MW of power as the Statistical Report of GSE Spa for the year 2014 (entitled "Energia da fonti rinnovabili in Italia") indicated. The 2014 report surveyed 2482 plants in total: Altogether, they produced 4044 MW of power and generated 18,732 GWh of gross electric energy. A large proportion of the plants (2104 of them) produced less than 1 MW of power each; altogether, these plants produced 1261 MW of power and 7700 GWh of energy. Moreover, 313 power plants produced between 1 MW and 10 MW of power each; altogether, they produced 893 MW of power and 3009 GWh of energy. Last but not least, 65 plants produced more than 10 MW of power each, giving a total power production of 4043 MW and a total energy production of 8024 GWh. In 2014, in Italy, the bio-energy production was 17,732 GWh, 15.5% of the total production of renewable energies. Also in 2014, out of a total of 2482 plants, there are 321 plants using solid biomass (municipal waste or other biomass), with a total power of 1610 MW and 6130 GWh of energy produced, 1796 plants producing biogas with a total power of 1406 MW and 8199 GWh of energy produced, 526 plants using bioliquids, with a total power of 1027 MW and 4341 GWh of energy produced. Among the 1796 plants producing biogas, 360 utilize waste (401 MW and 1638 GWh), 74 use sludge (44 MW and 121 GWh), 421 use animal manure (203 MW and 989 GWh) and 941 using scraps of agriculture and forestry (758 MW and 5451 GWh), thus confirming the impact of agricultural activity on bio-energy production. Between 2001 and 2014, the number of biomass plants increased from 202 to 2482, with an increase in installed power from 740 to 4044 MW; from 2009 it was noted, in particular, an increase in smaller systems, less than 1 MW, which benefited from higher public incentives, in the form of feed-in tariffs established by the Ministerial Decree (DM) of 18 December 2008. The geographical location, out of a total of 2482 plants (4044 MW and 18,702 GWh, of which 8199 GWh from biogas), 75.1% are in the northern regions of Italy, where the Lombardia region is the first region in Italy to have plants (657 plants) for power (918 MW) and energy output (4249 GWh of which 2702 GWh is from biogas), followed by the Veneto region, with 345 plants, totaling 359 MW of power and 1899 GWh of energy produced, of which 1158 GWh is from biogas, and the Emilia Romagna region with 289 plants, totaling 613 MW of power and 2759 GWh of energy produced, of which 1272 GWh is from biogas.

In total, 1291 plants (51.02% of the total) are located in the first three regions of Italy (according to the concentration of plants). Altogether, they produce 1890 MW of power (46.74% of the total). Moreover, they produce 8907 GWh of energy (47.63% of the total), of which 5132 GWh comes from biogas (62.59%), confirming the territorial concentration of Italian energy production in regions characterized by a greater intensity of agricultural activities.

The analysis of the 22 sample firms first considers annual account data (Table 1), which confirm the high level of capital intensity required for biogas plants activities (the median value of TA/S is 2.642 and NIC/S is 2.335); sector firms are capital intensive, particularly considering fixed assets (the median value of FA/S is 2.278). Capital absorption is relevant in fixed assets (the median value of FA is 86.20% of TA), and this confirms that biogas plants firms are characterized by relevant investments in fixed assets, particularly for Bfa^{tan} (86.09% of TA). FA investments have an effect on increasing the capital needed to finance long-term investments, to be covered with ET or $Df^{>12m}$. To cover their financial needs in FA, firms in the sample use $Df^{>12m}$ as the first source of capital, given the fact that the median value of $Df^{>12m}$ is 67.64% of TA while ET = 13.15% of TA and $Df^{<12m}$ = 9.45% of TA. The values of financial debt are quite symmetric (.269 for $Df^{<12m}$ and -0.312 for $Df^{>12m}$). Stable sources of capital (ET + $Df^{>12m}$) are 80.79% of TA, while FA is 86.20% of TA, and stable sources of finance are not able, in median values, to completely cover financial needs to finance FA investments. A part of FA investments is then financed with short-term loans, expressing a typical matter of financial risk, particularly with $Df^{<12m}$.

In Table 2, we express net invested capital (NIC) as the sum of FA and NWC. Data show that FA is 97.52% (the mean is 96.38%) of NIC, while NWC is 2.48% of NIC (the mean is 3.62%). These data are particularly interesting because they confirm that biogas plants do not have financial absorption to finance NWC investments. Out of 110 cases in the sample, NWC ≥ 0 in 64 and NWC < 0 in 56. ET is 14.88% of NIC (the mean is 19.20%), while NFP is 85.12% of NIC (the mean is 80.88%) as the main source of firms' capital. An analysis of balance sheets shows that the data have a high level of positive and negative skewness and kurtosis for the majority of values, therefore, the Kolmogorov–Smirnov D statistic on normality of distribution shows that the balance sheet values do not follow a normal distribution.

Table 1. Balance sheet data of the sample firms (110 years of data) with reclassification of balance sheets with financial forms, approach from Equation (1).

Value	Mean (€)	Mean (% TA)	Median (€)	Median (% TA)	Standard Deviation	Skewness	Curtosis
A	150	0.00%	-	0.00%	1325	0.824	1.291
Bfa^{int}	25,117	0.49%	-	0.00%	11,209	2.147	2.219
Bfa^{tan}	4,126,519	81.14%	4,325,550	86.09%	320,198	−0.902	1.206
Bfa^{fin}	25,697	0.51%	5,600	0.11%	9328	1.012	0.287
FA	4,177,483	82.14%	4,331,150	86.20%	215,087	−0.708	−0.115
$Cwc^{ar<12m}$	288,162	5.67%	250,193	4.98%	19,050	1.002	1.207
$Cwc^{ar>12m}$	26,490	0.52%	12,500	0.25%	11,397	−0.996	−0.731
$Cwc^{o<12m}$	189,328	3.72%	165,362	3.29%	22,035	0.436	2.592
$Cwc^{o>12m}$	15,679	0.31%	12,490	0.25%	4214	0.301	1.201
Cwc^{i}	156,308	3.07%	145,337	2.89%	11,066	0.215	−0.201
Cwc^{ql}	14,309	0.28%	1,255	0.02%	5235	2.052	−0.102
Cl	176,027	3.46%	91,759	1.83%	35,551	1.046	1.982
D	42,139	0.83%	14,550	0.29%	2116	1.365	1.531
TA	5,085,925	100.00%	5,024,596	100.00%	54,108	0.078	−0.743
AE^{sc}	155,037	3.05%	50,000	1.00%	101,023	0.739	0.421
AE^{r}	315,210	6.20%	264,509	5.26%	67,027	0.655	0.908
AE^{Π}	89,110	1.75%	75,990	1.51%	14,329	0.326	1.005
AΠ	272,881	5.37%	270,200	5.38%	1098	0.011	−2.920
ET	832,238	16.36%	660,699	13.15%	201,098	0.766	−1.452
B	78,997	1.55%	50,605	1.01%	23,281	0.421	2.735
C	48,016	0.94%	32,648	0.65%	16,282	0.326	−2.169
$Df^{<12m}$	497,719	9.79%	474,914	9.45%	21,363	0.269	3.336
$Df^{>12m}$	3,194,671	62.81%	3,398,627	67.64%	175,320	−0.312	4.190
$Dwc^{ap<12m}$	276,158	5.43%	256,309	5.10%	22,137	0.046	5.108
$Dwc^{ap>12m}$	34,056	0.67%	39,716	0.79%	5198	−0.322	11.003
$Dwc^{o<12m}$	98,037	1.93%	105,498	2.10%	7355	−0.010	0.209
$Dwc^{o>12m}$	10,006	0.20%	-	0.00%	3328	0.332	1.191
E	16,027	0.32%	5,580	0.11%	10,027	1.338	3.356
TS	5,085,925	100.00%	5,024,596	100.00%	54,108	0.078	−0.743

Table 2. Balance sheet data of the sample firms (110 years of data) with a reclassification of balance sheets in functional form, approach from Equation (4).

Value	Mean (€)	Mean (% TA)	Median (€)	Median (% TA)	Standard Deviation	Skewness	Curtosis
FA	4,177,483	96.38%	4,331,150	97.52%	215,087	−0.708	−0.115
NWC	156,959	3.62%	110,076	2.48%	32,008	2.108	4.309
NIC	4,334,442	100.00%	4,441,226	100.00%	102.298	−1.108	2.012
ET	832,238	19.20%	660,699	14.88%	201,098	0.766	−1.452
NFP	3,502,054	80.80%	3,780,527	85.12%	221.934	−1.252	3.023
TNS	4.334.292	100.00%	4,441,226	100.00%	102.298	−1.108	2.012

Further information on the typical characteristics of firms in the sector results from an analysis of economic data in Table 3. The median value of S amounts to 1,901,637 , and the major production factors are raw materials (Mc), 531,086 , 27.93% of S, and services (Sc), 371,328, 19.53% of S). EBITDA has a median value of 811,401 (42.67% of S) and a mean of 799,577 Ac + Dc absorbs a median value of 312,438% of S, and EBIT then has a median value of 498,963 (26.24% of S) and a mean of 494,542. The median values of EBITDA and EBIT are slightly higher than the mean values, as expressed by a comparison with mean values, having EBITDA ≥ 0 in 104 cases out of 110 and EBIT ≥ 0 in 98 cases. Financial management (SF) absorbs a median value 10.79% of S (i.e., 41.12% of EBIT and 25.29% of EBITDA) in mean values, and the data highlights that SF ≥ 0 in 10 cases out of 110, contributing to profit generation; Π has a median value of 274,013 (14.41% of S) and a mean of 272,881 , and Π ≥ 0 in 85 cases out of 110. It is useful noting that 5 cases of negative Π are concentrated in one firm, and 3 cases of negative Π are concentrated in a single other firm, thus confirming firms' capacity to generate income via biogas plants management in a large majority of cases. An analysis of income statements also shows that the Kolmogorov–Smirnov D statistic on normality of distribution highlights that income statements data do not follow a norma distribution.

Table 3. Income statement data of the sample firms (110 years of data) with reclassification of income statements using a value-added approach from Equation (5).

Value	Mean (€)	Mean (% TA)	Median (€)	Median (% TA)	Standard Deviation	Skewness	Curtosis
S	1,890,223	100.00%	1,901,637	100.00%	12,227	−0.043	0.208
ΔCwc^{j}	21,487	1.14%	7802	0.41%	1038	1.210	0.319
Cp	16,021	0.85%	-	0.00%	11,289	1.359	0.390
Os	35,907	1.90%	44,637	2.35%	12,388	−0.859	1.038
Mc	557,328	29.48%	531,086	27.93%	31,396	0.405	−0.399
Sc	365,167	19.32%	371,328	19.53%	6212	−0.690	1.028
Rc	158,031	8.36%	180,391	9.49%	21,442	−0.318	2.028
Lc	45,608	2.41%	24,063	1.27%	21,309	1.934	−0.439
Oc	37,927	2.01%	35,807	1.88%	2126	0.096	0.089
EBITDA	799,577	42.30%	811,401	42.67%	18,328	−0.561	0.438
Dc	24,099	1.27%	-	0.00%	16,019	1.089	2.029
Ac	280,936	14.86%	312,438	16.43%	29,037	−0.325	−0.308
EBIT	494,542	26.16%	498,963	26.24%	5018	−0.0190	0.029
SF	188,907	9.99%	205,193	10.79%	19,327	−0.366	−0.392
SR	215	0.01%	-	0.00%	239	0.119	1.337
SX	8036	0.43%	1248	0.07%	5134	0.369	1.381
Π^{bT}	313,886	16.61%	295,018	15.51%	7812	0.194	0.810
T	41,005	2.17%	21,005	1.10%	19,735	1.029	−1.327
Π	272,881	14.44%	274,013	14.41%	1957	−0.024	0.098

Given the high level of investment required to access the sector, this analysis of the differences between income and financial margins highlights necessary considerations to evaluate firms' capacity to cover the costs of financial debts and to ensure NFP repayment via mortgage plans. In fact, EBITDA and EBIT, as economic margins, are frequently applied to assess the sustainability of a business cycle and to approximate cash flow, particularly regarding interest coverage ratios (ICRs) application [64], even if some researchers have highlighted that ICRs could be improved applying a financial approach [65,66]. The analysis of cash flow statements (Table 4) calculated from 110 years of data highlights some typical management characteristics of firms in the biogas plants sector: (1) Income margin profit (Π) generates a significant amount of cash (274,013 as a median value, that is, 133.92% of FCFE); (2) CF, because of the high values of Dc + Ac, is relevant and amounts to 791,644 as a median value, that is 386.92% of FCFE; (3) the dynamic of NWC investment does not absorb a significant amount of liquidity; (4) OCF is then 386.92 as a median value, that is 379.78% of FCFE; (5) the dynamic of FA investments absorbs a relevant part of Dc + Ac, as expressed by UFCF values, making a median value of 607,802 , that is 297.07% of FCFE; (6) SF absorbs a great part of 195.86% of FCFE with a median value of 403,200. Given these results, the analysis shows that CF ≥ 0 in 109 cases out of 110, OCF ≥ 0 in 107 cases out of 110, UFCF ≥ 0 in 102 cases out of 110, and FCFE ≥ 0 in 63 cases out of 110. In the 110 considered cases, EBITDA ≥ 0 in 104 cases, EBIT ≥ 0 in 98 cases, and Π ≥ 0 in 75 cases. The analysis shows in several cases that the sample firms are not able to cover the cost of debt and FCFE available for NFP repayment is consequently reduced. In fact, the case in which FCFE < 0 expresses the inability of firms in the sample, on average, to proceed to a distribution of profits and eventually repay NFP.

Table 4. Cash flow statements of the sample firms (110 years of data) using an indirect approach from Equation (6).

Value	Mean (€)	Mean (% FCFE)	Median (€)	Median (% FCFE)	Standard Deviation	Skewness	Curtosis
Π	272,881	138.13%	274,013	133.92%	1,957	−0.024	0.098
+(Dc+Ac)	305,035	154.41%	312,438	152.71%	7,325	−0.320	2.371
+SF	188,907	95.62%	205,193	100.29%	19,327	−0.366	−0.498
CF	766,823	388.16%	791,644	386.92%	32,614	−0.890	0.998
±ΔNWC	−14,668	−7.42%	−14,610	−7.14%	933	0.031	1.285
OCF	752,155	380.74%	777,034	379.78%	21,148	−0.172	0.027
±ΔFA	−167,690	−84.88%	−169,232	−82.71%	2,328	−0.300	1.219
UFCF	584,465	295.86%	607,802	297.07%	21,309	−0.095	−0.311
−SF	−386,914	−195.86%	−403,200	−197.07%	19,327	−0.366	−0.392
FCFE	197,551	100.00%	204,602	100.00%	8,386	−0.036	−0.398

In Table 5, we show some ratios that analyze economic dynamics (ROE, FOE, ROS), turnover of capital (TURNOVER), cost of debt (ROD), level of financial indebtedness (NFP/E), and duration of the working capital cycle, given by average number of days of trade receivables (AR_DAYS) and trade payables (AP_DAYS). Analysis of the data indicates that companies in the sample had a profitability (ROE) median of 0.4147 (and a mean of 0.3279). This profitability was much higher than the average yield on Italian government bonds, which was equal to 0.0135 for the year 2014 (and 0.0208 for the year 2013). A recent survey [67] quantified the required return on equity in the Italian market at 0.070 for the year 2014. In the sample, the yield was still high, but it was lower in terms of FOE, with a median value of 0.3097 and a mean of 0.2374. It is confirmed that the biogas plants firms have high operating profitability (0.2624 as median value and 0.2616 as mean value) while the turnover of capital is below the net asset value (0.3785 and 0.3717 as the median value as the mean value). The return on capital employed (ROA) has the median value of 0.1123, higher than the median cost of debt, 0.0541, thus ensuring, on median values, that the leverage effect of debt has convenience. The ratio between NFP and ET (DER) is 5.722 (the mean is 4.208), expressing a high level of financial indebtedness, thus confirming the relevance of financial debt in biogas plant firms' capital management. Biogas plants firms have short delay in collecting their accounts receivable ($Cwc^{ar<12m} + Cwc^{ar>12m}$) but quite often have large delays in payment to suppliers. AR_DAYS, calculated as ($Cwc^{ar<12m} + Cwc^{ar>12m}$) × 365/S. has a median length of 50.421 days (the mean is 60.759 days). Accounts payable ($Dwc^{ap<12m} + Dwc^{ap>12m}$) are also an important source of capital (the mean value is 6.10%, and the median value is 5.89% of TA). AP_DAYS, calculated as ($Dwc^{ap<12m} + Dwc^{ap>12m}$) × 365/S, has a median length of 119.73 days (the mean is 59.902 days). The capital generation due to the length of AP_DAYS confirms the bargaining power of biogas plants firms with regard to their suppliers.

Table 5. Ratio analysis of the sample firms (110 years of data).

Value	Mean (€)	Median (€)	Standard Deviation	Skewness	Curtosis
ROE	0.3279	0.4147	0.0915	−0.098	0.018
FOE	0.2374	0.3097	0.0725	−0.318	1.128
ROS	0.2616	0.2624	0.009	−0.028	1.017
TURNOVER	0.3717	0.3785	0.941	−0.027	0.089
ROA	0.0972	0.1123	0.024	−0.782	0.048
ROD	0.0539	0.0541	0.087	0.091	0.177
DER	4.208	5.722	1.325	−0.881	1.128
AR_DAYS	60.7590	50.4213	10.021	1.158	1.017
AP_DAYS	59.9020	119.7334	60.407	−3.151	3.299

ROE = Π/ET; FOE = FCFE/ET; ROS = EBIT/S; TURNOVER= STA; DER = NFP/E; AR_DAYS = ($Cwc^{ar<12m} + Cwc^{ar>12m}$) × 365/S; AP_DAYS = ($Dwc^{ap<12m} + Dwc^{ap>12m}$) × 365/S.

3.3. Economic and Financial Margins Analysis

To verify whether margins calculated using an economic approach (EBITDA, EBIT, and Π) correlate with margins calculated using a financial approach (CF, OCF, UFCF, and FCFE), we apply a nonparametric approach, such as the Spearman's rho (ρ), given that Kolmogorov–Smirnov D statistic on normality of distribution shows that all distributions considered margins, both economic and financial, do not follow a normal distribution. The correlation calculated with the defined nonparametric approach (Table 6) shows several significant correlations between margins, with high significance (1.00%). EBITDA and EBIT are highly correlated with several margins, particularly with CF, OCF and UFCF, while they are slightly correlated with Π and not correlated with FCFE. FCFE is correlated only with OCF and Π but with a significance of only 0.05.

Table 6. Correlation between income and financial margins using a nonparametric approach (Spearman's ρ) applying a 2-tailed approach for correlation analysis.

Margin	Coefficient	EBITDA	EBIT	Π	CF	OCF	UFCF	FCFE
EBITDA	Corr. Spearman ρ	1.000						
	Sig. (2-tailed)	-						
	N	110	110					
EBIT	Corr. Spearman ρ	0.675 **	1.000					
	Sig. (2-tailed)	0.000	-					
	N	110	110					
Π	Corr. Spearman ρ	0.230 *	0.182	1.000				
	Sig. (2-tailed)	0.015	0.057	-				
	N	110	110	110				
CF	Corr. Spearman ρ	0.646 **	0.508 **	0.235 *	1.000			
	Sig. (2-tailed)	0.000	0.000	0.013	-			
	N	110	110	110	110			
OCF	Corr. Spearman ρ	0.628 **	0.529 **	0.252 **	0.810 **	1.000		
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	-		
	N	110	110	110	110	110		
UFCF	Corr. Spearman ρ	0.458 **	0.369 **	0.192 *	0.566 **	0.653 **	1.000	
	Sig. (2-tailed)	0.000	0.000	0.045	0.000	0.000	-	
	N	110	110	110	110	110	110	
FCFE	Corr. Spearman ρ	0.162	0.142	0.241 *	0.137	0.195 *	0.170	1.000
	Sig. (2-tailed)	0.090	0.140	0.011	0.154	0.041	0.076	-
	N	110	110	110	110	110	110	110

** The relation is significant at the 0.01 level (2-tailed). * The relation is significant at the 0.05 level (2-tailed).

The comparison between the mean values of the income and the financial margins could help to quantify the differences between the income and the financial approach in quantifying the sustainability of a firm's management cycle (Table 7). This analysis determines whether different margins can be applied as substitutes and even give information to apply correct margins to assess the sustainability of firms' cycles. The Kolmogorov–Smirnov D statistic on normality of distribution shows that all margins do not follow a normal distribution; it was necessary to apply a nonparametric approach, such as the Wilcoxon T statistic (Wilcoxon matched-pairs signed-rank test). The analysis, considering 12 comparisons, highlights that it is possible to reject the null hypothesis of equality between means by applying a two-sided test with significance at 1% in 10 cases out of 12. Only paired-sample comparisons of EBITDA and CF and EBITDA and OCF do not reject the null hypothesis of equality of means. The analysis thus confirms that income margins (EBIT, and Π) differ from financial margins (CF, OCF, UFCF, and FCFE), and it is not possible to evaluate firms' management cycles or financial sustainability by applying income margins instead of financial margins, with the only exception of EBITDA-CF and EBITDA–OCF approximations. On this topic, the data show that EBITDA > CF in 59 cases out of 110, EBITDA > OCF in 61 cases out of 110, EBITDA > UFCF in 87 cases out of 110, and EBITDA > FCFE in 98 cases out of 110. Additionally, EBIT > CF in 36 cases out of 110, EBIT > OCF in 40 cases out of 110, EBIT > UFCF in 45 cases out of 110, and EBIT > FCFE in 92 cases out of 110. Π > CF in 10 cases out of 110, Π > OCF in 12 cases out of 110, Π > UFCF in 36 cases out of 110, and Π > FCFE in 13 cases out of 110.

Table 7. Comparison of economic and financial margins using a nonparametric approach for paired samples (T Wilcoxon).

Couple	T-Wilcoxon for Paired Sample	Observations	Statistical Significance (2-tailed)
Couple 1 EBITDA-CF	−1,277 [a]	110	0.201
Couple 2 EBITDA-OCF	−1,490 [a]	110	0.136
Couple 3 EBITDA-UFCF	−7,991 [a]	110	0.000 **
Couple 4 EBITDA-FCFE	−9,077 [a]	110	0.000 **
Couple 5 EBIT-CF	6,322 [b]	110	0.000 **
Couple 6 EBIT-OCF	6,112 [b]	110	0.000 **
Couple 7 EBIT-UFCF	5,090 [b]	110	0.000 **
Couple 8 EBIT-FCFE	−7,339 [a]	110	0.000 **
Couple 9 Π-CF	9,721 [b]	110	0.000 **
Couple 10 Π-OCF	8,566 [b]	110	0.000 **
Couple 11 Π-UCFE	6,329 [b]	110	0.000 **
Couple 12 Π-FCFE	−4,622 [a]	110	0.000 **

** The relation is significant at the 0.01 level (2-tailed). * The relation is significant at the 0.05 level (2-tailed).
[a] expresses positive rank sign. [b] expresses negative rank sign.

3.4. Multiple Regression Analysis

The aim of the research is then to quantify the causal relationship between a variable to be explained (the dependent variable) and one or more explanatory variables (independent variables), as exposed in the models. In the article, we calculate the determinants of economic (ROE) and cash flow (FOE) ratios available for equity holders, in order to provide useful information for managing firms in the biogas plant firms. First, the research aims to analyze if there is a relationship between a financial return on equity capital for a given period, t (FOE_t), and some independent variables. FOE expresses the amount of cash available for equity holders as expressed in the methodological part of the article. To achieve this aim, we consider the explanatory capacity of a linear regression model (first model). The model, as expressed in Equation (9), considers FOE_t, which expresses the financial return available for equity holders, as an independent variable for a given time (t). In the first regression models, the constant term is α, the variables are: TO (turnover), AR_DAYS, AP_DAYS and DER. The model then considers EBITDA, EBIT, and Π as explanatory variables, considered in values for the years t and t−1 ($EBITDA_t$ and $EBITDA_{t-1}$, $EBIT_t$ and $EBIT_{t-1}$, and Π_t and Π_{t-1}, respectively). At the same time, CF, OCF, and UFCF are considered explanatory variables and considered in their values for years t and t−1, giving then another six explanatory variables (CF_t and CF_{t-1}, OCF_t and OCF_{t-1} and $UFCF_t$ and $UFCF_{t-1}$, respectively). The model could be expressed as follows:

$$\begin{aligned} FOE_t = {} & \alpha + \beta_1 TO + \beta_2 AR\_DAYS + \beta_3 AP\_DAYS + \beta_4 DER + \beta_5 ROS + \beta_6 EBITDA_t + \\ & \beta_7 EBIT_t + \beta_8 \Pi_t + \beta_9 EBITDA_{t-1} + \beta_{10} EBIT_{t-1} + \beta_{11} \Pi_{t-1} + \beta_{12} CF_t + \beta_{13} OCF_t + \\ & \beta_{14} UFCF_t + \beta_{15} CF_{t-1} + \beta_{16} OCF_{t-1} + \beta_{17} UFCF_{t-1} + \varepsilon \end{aligned} \quad (9)$$

The first model tries to explain actual FOE_t (at a given time, t) considering a set of explanatory variables that express capital intensity (TO), working capital cycle duration (AR_DAYS, AP_DAYS), debt level (DER), operative profitability (ROS), actual income margins (EBIT, EBITDA and Π), and their respective values considered at t−1 ($EBIT_{t-1}$, $EBITDA_{t-1}$, and Π_{t-1}), even considering actual financial margins (CF, OCF, and UFCF) and their respective values considered at t−1 (CF_t, OCF_t, and $UFCF_t$). Unless otherwise specified, all the explanatory variables are taken at a certain time, t. The first regression model, as expressed in Equation (9), is analyzed in Table 8 and assumes a significant statistical capacity to explain FOE_t values; the F statistic has high significance (F = 0.000); R^2 is 0.9310, while adjusted R^2 has a value of 0.8421, expressing the capacity of the model to explain a great part of the variability of FOE_t; the statistic DW is 2.118; and the majority of the variables are significant.

First, TO has a positive effect on FOE values, expressing that an increase in turnover (then a decrease in the capital-intensive structure of assets) has a positive effect on the FOE value. The explanatory variables of FOE generation are, in particular, values expressing the duration of the working capital (WC) cycle. AR_DAYS has a negative sign, expressing that an increase in WC durations has a negative effect on the FOE result. AP_DAYS has a positive sign on FOE, expressing the opposite situation. DER has a positive sign on FOE given that an increase in debt could generate cash. Even ROS is particularly important in increasing the FOE value. Income and financial margins at a certain time, t, have an effect on FOE at the same time, t (particularly OCF_t and $PROFIT_t$). Income and financial margins at $t-1$ have even effect on FOE, particularly $PROFIT_{t-1}$, OCF_{t-1} and $UFCF_{t-1}$ margins, even with a relation significant only at the 0.05 level (two-tailed).

Table 8. Extract of the multiple regression model that shows the impact on FOE_t of independent variables – first model, Equation (9).

Model	Unstandardized Coefficient		Standardized Coefficient	T	Statistical Significance
	B	Std. Error	Beta		
(Constant)	−1.1125	0.031	-	6.009	0.000 ***
1. TO	0.2336	0.043	0.135	6.056	0.000 ***
2. AR_DAYS	−330.980	12.228	−0.102	−4,932	0.000 ***
3. AP_DAYS	450.127	11.072	0.051	5.322	0.000 ***
4. DER	0.0098	0.097	0.921	5.001	0.000 ***
5. ROS	0.1255	0.098	0.802	9.892	0.000 **
6. $EBITDA_t$	0.1120	0.079	0.198	1.605	0.107
7. $EBIT_t$	0.1098	0.208	0.289	2.135	0.035 *
8. Π_t	0.9981	0.448	0.367	5.702	0.000 ***
9. $EBITDA_{t-1}$	0.0982	0.038	0.109	0.887	0.231
10. $EBIT_{t-1}$	0.1209	0.039	0.081	0.559	0.549
11. Π_{t-1}	0.1209	0.098	0.109	2.030	0.044 *
12. CF_t	0.1800	0.069	0.801	1.101	0.196
13. OCF_t	0.1301	0.038	0.136	2.314	0.028 *
14. $UFCF_t$	0.0905	0.032	0.130	1.360	0.175
15. CF_{t-1}	0.0809	0.035	0.104	1.363	0.172
16. OCF_{t-1}	0.0455	0.040	0.049	2.034	0.043 *
17. $UFCF_{t-1}$	0.1908	0.205	0.551	2.310	0.030 *

First model, Equation (9). Dependent variable: FOEt; *** The relation is significant at the 0.001 level (2-tailed). ** The relation is significant at the 0.01 level (2-tailed). * The relation is significant at the 0.05 level (2-tailed).

The research then considers a second regression model to analyze if there was a relation between economic return on equity capital for a given period, t (ROE_t), and a set of independent variables. ROE expresses the return available for equity holders as expressed in the methodological part of the article. It then proposes an explanatory linear regression model (second model). In the second regression model, the constant term is α, and are considered the explanatory variables: TO (turnover), AR_DAYS, AP_DAYS, DER. The model then considers EBITDA and EBIT as explanatory variables, considered in values for the years t and $t-1$ ($EBITDA_t$ and $EBITDA_{t-1}$, $EBIT_t$ and $EBIT_{t-1}$ respectively). At the same time, CF, OCF, UFCF and FCFE are considered explanatory variables and considered in their values for years t and $t-1$, giving then another six explanatory variables (CF_t and CF_{t-1}, OCF_t and OCF_{t-1}, $UFCF_t$ and $UFCF_{t-1}$, $FCFE_t$ and $FCFW_{t-1}$ respectively). Obviously, PROFIT is not considered as an explanatory variable. The set of explanatory variables is the same as those considered in Equation (10), with the exception of FCFE instead of Π. The model could be expressed as follows:

$$ROE_t = \alpha + \beta_1 TO + \beta_2 AR\_DAYS + \beta_3 AP\_DAYS + \beta_4 DER + \beta_5 ROS + \beta_6 EBITDA_t + \beta_7 EBIT_t + \beta_8 EBITDA_{t-1} + \beta_9 EBIT_{t-1} + \beta_{10} CF_t + \beta_{11} OCF_t + \beta_{12} UFCF_t + \beta_{13} FCFE_t + \beta_{14} CF_{t-1} + \beta_{15} OCF_{t-1} + \beta_{16} UFCF_{t-1} + \beta_{17} FCFE_{t-1} + \varepsilon \quad (10)$$

The second model tries to explain actual ROE_t (at a given time, t) considering a set of explanatory variables that express capital intensity (TO), working capital cycle duration (AR_DAYS, AP_DAYS), debt level (DER), operative profitability (ROS), actual income margins (EBIT, EBITDA), and their respective values considered at t−1 ($EBIT_{t-1}$, $EBITDA_{t-1}$), even considering actual financial margins (CF, OCF, UFCF and FCFE) and their respective values considered at t−1 (CF_t, OCF_t, $UFCF_t$, $FCFE_{t-1}$) Unless otherwise specified, all the explanatory variables are taken at a certain time, t. The second regression model, as expressed in Equation (10), is analyzed in Table 9 and assumes a quite good statistical capacity to explain ROE_t values; the F statistic has high significance (F = 0.000); R^2 is 0.8861, while adjusted R^2 has a value of 0.7455, expressing the capacity of the model to explain a good part of the variability of ROE_t; the statistic DW is 2.204; and the majority of the variables are significant. First, TO has a positive effect on ROE and values expressing duration of the working capital (WC) cycle (AR_DAYS) has a positive sign, expressing that an increase in WC durations has a positive effect on the ROE result. Even ROS is particularly important in increasing the ROE value. Income and financial margins at a certain time, t, have an effect on ROE at the same time, t (particularly OCF_t and $FCFE_t$). Income and financial margins at t−1 have, instead, an effect on ROE but are limited to $FCFE_{t-1}$, while $EBIT_{t-1}$ and $UFCF_{t-1}$ margins are significant only at the 0.05 level (two-tailed).

Table 9. Extract of the multiple regression model that shows the impact on ROE_t of independent variables – second model, Equation (10).

Model	Unstandardized Coefficient		Standardized Coefficient	T	Statistical Significance
	B	Std. Error	Beta		
(Constant)	−1.1022	0.054	-	6.391	0.000 ***
1. TO	0.2001	0.101	0.121	6.339	0.000 ***
2. AR_DAYS	312.009	11.968	0.098	5,002	0.000 ***
3. AP_DAYS	445.001	11.328	0.094	1.481	0.139
4. DER	0.0240	0.210	0.203	1.488	0.138
5. ROS	0.1950	0.108	0.907	9.405	0.000 **
6. $EBITDA_t$	0.1097	0.073	0.212	2.645	0.008 *
7. $EBIT_t$	0.2140	0.086	0.264	3.559	0.001 **
8. $EBITDA_{t-1}$	0.0990	0.012	0.037	0.990	0.322
9. $EBIT_{t-1}$	0.0706	0.108	0.059	2.065	0.041 *
10. CF_t	0.1502	0.059	0.701	1.301	0.190
11. OCF_t	0.3220	0.049	0.136	4.901	0.000 ***
12. $UFCF_t$	0.1002	0.021	0.167	0.980	0.212
13. $FCFE_t$	0.1322	0.226	0.099	5.216	0.000 ***
14. CF_{t-1}	0.0855	0.019	0.009	0.069	0.940
15. OCF_{t-1}	0.0395	0.058	0.061	0.261	0.798
16. $UFCF_{t-1}$	0.0781	0.209	0.048	2.069	0.040 **
17. $FCFE_{t-1}$	0.1200	0.167	0.059	5.581	0.000 ***

Second model, equation (10). Dependent variable: FOEt; *** The relation is significant at the 0.001 level (2-tailed). ** The relation is significant at the 0.01 level (2-tailed). * The relation is significant at the 0.05 level (2-tailed).

4. Conclusions

In Italy, the biogas plant industry is characterized by a high absorption of capital, particularly in fixed asset cycles. These funds are obtained by way of direct contributions from entrepreneurs, such as equity capital, and frequently via financial debt, particularly in the form of mortgage loans. It is therefore necessary to assess equity capital performance and jointly evaluate the cash flows generated by a firm's activity to quantify whether it is sufficient to ensure the sustainability of payment of debt. It is therefore essential to evaluate not only the return on capital for the remuneration of the equity holders, but also the financial sustainability of the management cycle. The analysis conducted in Italy has allowed us to qualify firms operating in the biogas plants sector as capital-intensive firms. Particularly, investments in FA are, in absolute values, higher than S and are financed primarily with NFP and ET. The shift between the economic and financial cycles in the biogas plants sector, particularly due to the cycle of investments in FA, highlights that financial margins cannot be approximated by applying economic margins in many cases. The analysis has thus shown that firms in the sector, although able to generate a high return on capital employed, may suffer from a lack of liquidity.

The sample data show that, even if income margins are positive, financial margins are worse than their economic margins (EBITDA, EBIT, and Π). Particularly, financial margins (especially UFCF and FCFE), although related, are statistically different from the economic margins represented by EBITDA, EBIT, and Π. The generation of FCFE is a critical element of biogas plant firms, given the result of FCFE ≥ 0 in 63 cases out of 110 in the analysis, compared with $\Pi \geq 0$ in 75 cases out of 110. The analysis of the regression models shows a better interpretation capacity with the application of the first model, Equation (9), to explain the FOE results. In fact, the first model has an F statistic with a high significance (F = 0.000) and R^2 = 0.9310, while the adjusted R^2 has a value of 0.8421. For the second model, even with the F statistic being highly significant (F = 0.000), R^2 has a lower value (0.8861) as does the adjusted R^2 (0.7455). The second model, Equation (10), considers ROE to be an independent variable at a given time (t), proposing as explanatory variables the actual financial margins (CF, OCF and UFCF) and their respective values considered at time t−1 (CF_t, OCF_t and $UFCF_t$). Particularly, the first model's result allows defining a guideline for managers with the aim to estimate cash flows for shareholders (FOE) in the sector. The results of the research could be useful for equity holders and for credit institutions to assess the sustainability of debt repayment; moreover, the reserarch could provide useful data to policy makers, operating with direct (loans) or indirect (mutual guarantee) aid in favor of companies, to evaluate with better accuracy the ability to use public funds. Again, the research could be extended to apply a discounted cash flow (DCF) approach to the quantification of the internal rate of return of equity capital (IRRe) even if it is necessary to quantify the initial equity capital investment when applying a DCF approach. In fact, median return on equity (FOE and ROE, as calculated) expresses values largely higher than treasury bonds issued in italy in the same period and higher even then the most part of industrial investment; the analyis could then point to the need to expand this field of research to define if the public aid given to the sector could distort the market, increasing the median return while damaging other sectors and artificially increasing equity returns in the biogas plant sector. Neverthless, the research has some limitations. Firstly, the sample analyzed is related to a small number of firms (22) on a time series of 5 years, with a total of 110 observations. It could be useful to extend the analysis to a larger sample; the analysis could even be repeated over the next few years, also considering the effects of current changes in pean rules about public aids in favor of biogas plant firms. Again, it could be possibile to improve the research by expanding on the topic of low levels of income taxation on agricultural firms, that could represent a distortion in favor of some categories of firms, such as biogas plant firms. These extensions could be pursued to enhance the impact of the achieved results.

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Abbreviations

The following abbreviations are used in this manuscript:

BFA	Investments in Fixed Assets
Π	Net profit
CF	Cash Flow
EBIT	Earnings Before Interest and Tax
EBITDA	Earnings Before Interest, Tax, Depreciations and Amortizations
ET	Equity (total shareholder capital)
FCFE	Free Cash Flow to Equity
FOE	Flow on Equity
NFP	Net Financial Position
NIC	Net Invested Capital
NWC	Net Working Capital
OCF	Operating Cash Flow
ROE	Return on Equity
UCFC	Unlevered Free Cash Flow

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