Commitment to sustainability or marketing strategy to increase profits? A preliminary analysis of startup practices in Argentina's AgTech sector

Navarro, Ana Inés* Camusso, Jorge** Varvello, Juan Cruz***

Abstract

We study how Argentine AgTech startups communicate sustainability on their websites and whether misalignment between symbolic and substantive actions ("greenwashing") relates to their economic performance. We code web disclosures into symbolic and substantive actions, construct firm-level scores for each dimension, and combine them into a greenwashing measure. Using interval regressions for revenues and probit models for foreign-market concentration, we find that greenwashing is negatively and significantly associated with revenues: customers appear to penalize symbolic claims that are not backed by substantive actions. Indeed, decomposition analysis shows that greater symbolic communication reduces revenues, whereas declared substantive actions have no statistically discernible effect. On the other hand, the relationship between the revenues and the level of greenwashing is non-linear—small amounts of greenwashing induce positive effects on revenues but these turn negative as greenwashing rises—and is heterogeneous by firm age: younger startups are more strongly penalized, consistent with reputational mechanisms. By contrast, stronger symbolic communication increases the likelihood that AgTech firms concentrate sales in foreign markets. Overall, the results underscore the economic costs of misaligned sustainability communication and the value of credible, action-based disclosure.

JEL classification: Q01, Q10, Q55

Keywords: Sustainable AgTech, Startups, Greenwashing, Sustainable Development Goals

* Departamento de Economía, Facultad de Ciencias Empresariales, Universidad Austral, Paraguay 1950, S2000FZF Rosario, Argentina. E-mail address: anavarro@austral.edu.ar.
** Departamento de Economía, Facultad de Ciencias Empresariales, Universidad Austral, Paraguay 1950, S2000FZF Rosario, Argentina. E-mail address: jcamusso@austral.edu.ar.
*** Departamento de Economía, Facultad de Ciencias Empresariales, Universidad Austral, Paraguay 1950, S2000FZF Rosario, Argentina. E-mail address: jvarvello@austral.edu.ar.

1. Introduction

Greater awareness of climate change and the environmental implications of expanding food production to meet the demands of a growing global population has intensified calls for greater transparency throughout the agri-food system. This concern is shared not only by consumers, but also by a broad spectrum of stakeholders—including investors, policymakers, environmental and social advocacy groups, and academic researchers—who are increasingly demanding detailed information about the origin of food, production methods, and associated health and nutritional effects. These "green stakeholders" are pushing companies to adopt principles of environmental, ethical and social responsibility. However, a recent report of United Nations Global Compact & Accenture[1] points out that business leaders' focus on the Social Development Goals (SDGs) has decreased, accompanied by growing skepticism about their achievability. This study points out that an overwhelming majority (94%) of business leaders support the vision of the SDGs, but only half (49%) believe that achieving them by 2030 is realistic.

Firms are clearly incentivized to adopt sustainable practices when such actions enhance profitability or serve as a strategic means to mitigate potential future regulatory costs. In the former case, companies may benefit from consumers' increased willingness to pay for products that comply with certain social or environmental standards, or from consumers' tendency to avoid products perceived as harmful to health or the environment.

Moreover, sustainability can function as a communication and marketing tool aimed at attracting both consumers and investors. The social motivations of stakeholders may, in turn, amplify traditional economic benefits. For example, the adoption of corporate social responsibility (CSR) practices can act as a signaling mechanism under conditions of information asymmetry or serve as a pathway to securing social and institutional legitimacy. Although the relationship between CSR and financial performance remains the subject of debate, most empirical studies indicate a positive correlation or, at the very least, no negative impact. (Khaled & Mohamed, 2021; Lassala et al., 2021; Manrique & Martí-Ballester, 2017).

Despite these incentives, many companies face difficulties in developing coherent sustainability strategies, often encountering challenges related to both communication and implementation. According to the United Nations Global Compact and Accenture, achieving meaningful progress toward the 2030 Agenda requires companies to embed sustainability within their core strategies and operations from the outset. This entails a fundamental shift in organizational mindset and decision-making processes.

On the other hand, many firms engage in sustainability-related actions or possess products with social or environmental attributes that are not easily observable to external stakeholders. Information asymmetries often hinder effective communication of sustainability performance, particularly in the absence of standardized benchmarks for measuring commitment or when targeting non-specialized consumers. This challenge is particularly pronounced among new and innovative companies in developing countries, such as startups, which generally lack the tools or knowledge necessary to credibly communicate their environmental and social commitment. Furthermore, these companies prioritize short-term financial viability and market positioning over transparent disclosure of sustainability information, especially in the early stages of growth.

Although sustainability can be an opportunity to shore up the profitability of companies, in a previous paper (Navarro et al., 2024) we found a relatively low commitment to sustainability for startups in the AgTech sector of Argentina and, in addition, we found empirical evidence that on average a greater commitment is associated with worse economic performance. However, the sign of this effect is reversed for high levels of sustainability scores, suggesting that consumers "asymmetrically value" different degrees of sustainability. This result is very interesting as it may suggest that consumers perceive low levels of sustainability as mere declarative actions, without the backing of substantive efforts or tangible results.

[1] https://info.unglobalcompact.org/sdg-stocktake

Companies can demonstrate their commitment to sustainability through substantive actions, investing in tangible resources and measurable actions, or through symbolic actions, which formally comply with regulatory rules and public expectations (de Freitas Netto et al., 2020; Li et al., 2023). In general, companies do both types of practices, but frequently they find more attractive or easier to communicate symbolic actions. Signaling theory suggests that projecting an image of adherence to green standards through symbolic actions or "green words" can effectively communicate a company's environmental values to external stakeholders. Although stakeholders are concerned about environmental issues, they may find it difficult to evaluate companies' green practices and environmental performance. In this context of asymmetrical information companies may find it optimal to seek legitimacy through symbolic rather than substantive means. This deceptive practice, referred in the literature as “greenwashing”, consists of profiting from environmental actions that do not imply a significant commitment to sustainability, which undermines genuine sustainability efforts and erodes consumer trust (Mendes et al., 2024). However, when the public detects greenwashing and perceives it as misleading and deceptive, this will be negative for the companies, undermining their profitability (Walker & Wan, 2012). Stakeholders may punish companies to the extent that they perceive the lack of substantive action as an attempt at opportunism by companies.

Communication strategies are now under scrutiny and many cases have been documented in the literature, focusing on public companies in different industries of developed countries. Some of these cases, mostly based on bibliometric analysis, show a presence of greenwashing practices in the food industry. According to the findings of Nugraha et al. (2024) greenwashing in this industry has expanded dramatically over the past ten years. The authors note that while greenwashing is an established phenomenon in the food industry and an emerging issue among consumers, there are relatively few research articles available on the topic. To our knowledge, no studies have examined these practices among emerging firms in the agrifood value chain measuring their impact on the companies’ revenues or on their foreign penetration. There is a strong motivation for extending this analysis to startups, as they are currently central actors in agrifood innovation. Therefore, it is valuable to examine the extent of greenwashing in the communication strategy of AgTech startups to understand their environmental commitment. In addition to measuring the extent of greenwashing, it is necessary to understand the economic implications of this practice in the sector, which, in turn, could affect the incentives for innovation in the AgTech sector and the technological transformation of the entire agrifood value chain.

This paper has two main objectives. First, using our own database on startups in the Argentine AgTech sector (Navarro et al., 2024), we analyze the information provided by these companies on their websites to identify "symbolic actions" and "substantive actions," explore the differences between them, and construct a measure of greenwashing. According to Walker & Wan (2012), we use the concept of greenwashing as the difference between companies' substantive actions to improve their environmental sustainability and their symbolic actions, but we add the social commitment dimension as many articles from the literature do. Second, we use interval regression and probit models to estimate the impact of social and environmental greenwashing on two indicators of the economic performance of the startups (revenues and foreign insertion).

Our work contributes to the literature on greenwashing and economic performance in the agrifood industry, providing empirical evidence on AgTech startups in Argentina. As it is a developing economy where the practice of greenwashing has little visibility, we contribute to the literature with an analysis of the textual statements made by companies on their websites and information collected through our own survey to measure substantive, symbolic actions and the practice of greenwashing.

Our main results suggest the presence of a moderate level of greenwashing among startups in Argentina's AgTech sector. When we estimate the impact of greenwashing on companies' revenues, we find a negative and statistically significant effect, indicating that customers penalize symbolic actions that are not supported by substantive actions. However, our results show some heterogeneity when we estimate the effect of greenwashing on revenues by level of sustainability and firms’ age. At the same time, we find that an increase in symbolic communication increases the likelihood that AgTech firms will concentrate their sales in foreign markets.

The document is structured as follows: Section 2 presents a literature review; Section 3 discusses the data source to be used, the methodological decisions adopted to measure symbolic, substantive actions and greenwashing, and also explains the econometric strategy adopted to quantify the degree of association between our variables of interest and the economic performance of startups; Section 5 presents the analysis of the main results; Section 6 concludes with final reflections.

2. Literature Review

This work falls within the theoretical and empirical literature on greenwashing, particularly that which explores this communication strategy in the agrifood industry and entrepreneurial settings. According to de Freitas Netto et al. (2020), some authors define greenwashing as the selective dissemination of information related to environmental performance by companies, with the aim of deceiving stakeholders, mainly consumers. According to this approach, companies hide negative information about their environmental performance and communicate only the positive aspects (Baum, 2012; Delmas & Burbano, 2011; Lyon & Maxwell, 2011;). Similarly, other authors (Li et al., 2023; Walker & Wan, 2012) consider greenwashing as a mismatch between what the company communicates regarding its environmental performance and the actions it implements to improve these results. Although the statements made by the company are merely symbolic actions, they could allow it to build a "green discourse" to achieve legitimacy. However, the information provided is not backed by its actions, which remain hidden from stakeholders. According to both approaches, greenwashing is a strategy that takes place in markets with asymmetric information; more precisely, when the information is incomplete, which is the characteristic situation of sustainable product markets.

Most of the literature focuses on the analysis of greenwashing at the product or service level and to a lesser extent at the company level, considering only the environmental dimension, although some authors also incorporate the social dimension (Lyon & Maxwell, 2011). Similarly, the most extensively studied form of greenwashing involves the analysis of companies' textual statements and their underlying characteristics. For example, when a company provides information about the environmentally friendly features of its product or production process, but the statement lacks evidence, omits relevant details, or is false or ambiguous—attributes that can be detected in corporate disclosures and that may indicate potential greenwashing (Delmas & Burbano, 2011; de Freitas Netto et al., 2020; Tateishi, 2018). On the other hand, another type of greenwashing, less studied in literature, is based solely on the use of images, sounds, colors, etc., but without a textual statement. Using experimental methodology, Parguel et al. (2015) find empirical evidence that incorporating images related to sustainability improves the perception of non-expert consumers regarding the company's environmental performance, although it has no effects among better-informed consumers.

From a theoretical point of view, the adoption of a socially responsible approach (CSR) by companies does not necessarily imply renouncing traditional economic benefits. Green substantive actions can offer strategic benefits to firms by enhancing product differentiation, improving market access, and attracting customers or investors—especially under search costs or information asymmetries. These actions may also reduce future regulatory burdens, lower production costs through efficiency or technological gains, and strengthen stakeholder relationships (Mendes et al., 2024; Neumann, 2021; Nugraha et al., 2024). In this framework, traditional economic incentives support the achievement of a triple bottom line—economic, social, and environmental.

Alternatively, companies can achieve some of the benefits through symbolic actions. The green statements they make will not allow them to achieve efficiency gains, but they could serve to respond to stakeholder demands and achieve legitimacy. In the presence of asymmetric information, when stakeholders do not have access to precise information about the firms' sustainable performance or are not involved in their production processes, symbolic actions could act as a signal. Thus, when efficiency gains related to concrete sustainable efforts are relatively low, companies will find it rational to carry out symbolic actions without incurring the additional costs of substantive actions. In this way greenwashing is convenient for them compared to any other combination of "green talk" and "green walk" (Neumann, 2021; Walker & Wan, 2012).

Empirical literature analyzing the relationship between substantive, symbolic actions and greenwashing strategy with companies' financial performance finds mixed evidence. Walker & Wan (2012) show a negative correlation between greenwashing and financial performance in companies belonging to polluting industries in Canada, in line with Du (2015) and Ferrón-Vílchez et al. (2021). On the other hand, Li et al. (2021) find a positive relationship between greenwashing and the ROA of listed Chinese companies, as do other authors (Berrone et al., 2017; Schons & Steinmeier, 2016). These results are often conditioned by the explicit identification of greenwashing and by the level of economic development of the country, as legislation and consumer knowledge on sustainability issues tend to be higher in developed economies.

Although the food industry is considered one of the sectors most affected by greenwashing, academic literature is scarce compared to other sectors. Early works in this literature highlight the lack of commitment of companies to sustainability, indicating the absence of concrete actions and that companies' efforts were aimed at improving their corporate image, i.e., the implementation of symbolic actions and greenwashing. An extensive novelty literature analyzes the implementation of mechanisms to mitigate the practice of greenwashing in the agribusiness sector, such as government regulation, certifications, and labels (Mendes et al., 2024).

As Yang et al. (2021) point out; sustainable product markets are generally characterized by asymmetric information. Consumers and other stakeholders have limited knowledge and information, which favors the practice of greenwashing. In the absence of transparency from companies and weak legislation, mechanisms that act as signals -such as certifications, labeling or packaging, or companies' own reports- end up favoring the practice of greenwashing. Likewise, the lack of knowledge of business owners about sustainable products and processes, as well as the absence of standardized criteria, rules, and metrics for reporting also facilitate greenwashing.

Particularly in the food industry, the recent growth of sustainable products promoted through signaling mechanisms poses a challenge for consumers seeking to correctly identify triple-impact companies. Under stakeholder pressure, agrifood firms may resort to greenwashing as a means of gaining legitimacy. However, as greenwashing practices spread, stakeholders' trust in genuine sustainability commitments declines, harming companies that implement concrete actions and undermining the potential transformation of the agrifood system.

On the other hand, few studies have analyzed the effects of adopting CSR and greenwashing on the economic performance of new companies (Leoncini et al., 2019; Neumman, 2021; Shrivastava & Tamvada, 2019). Although from a theoretical point of view it is expected that substantive actions generate the same benefits in startups as in established companies, they may face obstacles - financing constraints, lack of experience or market recognition - that prevent them from capitalizing on the benefits of sustainability. Additionally, Mendes et al. (2024) point out that small agricultural companies often face budget constraints that limit the resources they can allocate to reporting on their sustainability efforts, which may affect the outcomes of substantive actions. With fewer resources, they do not usually maintain updated websites with detailed information, nor do they present annual reports or obtain environmental performance certifications. Neumman (2021) finds a positive correlation between substantive actions and increased sales in small EU companies belonging to a wide range of industries. Likewise, their results suggest that symbolic actions and greenwashing are not correlated with sales.

3. Data and Methodology

In this paper, we use socioeconomic and business model data on AgTech startups in Argentina, initially collected by Fundación Endeavor Argentina in 2022. This dataset covers a sample of companies across the country and is based on a survey conducted between May and July 2022, targeting startup founders, primarily CEOs. The survey includes information on firm revenues (reported in ranges), year of foundation, number of employees, sources of financing, target markets and products, and growth obstacles, among other variables. To expand the number of observations and capture companies not included in the original Endeavor report, we conducted ad hoc online searches and consulted with industry experts. For these newly identified startups, we administered an additional survey between July and October 2023 to collect comparable socioeconomic and business model data.

However, the original dataset lacked information on the startups' commitment to sustainability. To address this, between July and October 2023, we distributed a separate questionnaire to all companies, aimed at assessing their level of commitment to, and contributions toward, the SDGs, particularly those related to social and environmental dimensions. After merging the two datasets and performing a final round of data cleaning, our consolidated database comprises 197 AgTech startups in Argentina. Approximately 85% of these companies were part of the Endeavor report, while the remaining 15% were newly identified companies.

In the present study, we use the dimensions of sustainability from Navarro et al. (2024) as a basis for defining the symbolic and substantive actions taken by startups, as well as the possible practice of greenwashing. It's worth clarifying that, in both cases, the actions are based on public information provided by the companies, as is customary in the literature on greenwashing; specifically, information shared on their websites (Li et al., 2023; Schons & Steinmeier, 2016; Walker & Wan, 2012). Since we are focusing on the communication strategies of AgTech startups and their content, we construct the same variables as in the survey of our previous paper (Navarro et al., 2024), but now exclusively based on the information that the companies provide on their website. However, one of the survey variables relating to the company's degree of subjective commitment to sustainability cannot be observed on the company's websites. Therefore, we replaced it with the number of SDGs to which the company publicly commits on its website. In addition, our survey asked in binary form whether the company's technology targets vulnerable social groups, but in the web-based data collection we replaced it with the number of vulnerable social groups targeted by the technology to achieve greater variability in this dimension.

The analysis of startups websites was carried out between November and December 2024, including textual content, videos, reports, newspaper articles, among others. The collection process was structured in two phases. In the first, the data collection criteria were established, which included not only explicit mentions of the sustainability and social dimensions addressed, but also contextual references, even if exact terms were not used. In the second phase, the data collection was distributed between two assistant researchers, who exchanged part of the assigned companies to compare the results of the criteria applied and ensure consistency in the classification, minimizing individual bias. Once the data collection was completed, a cross-check and reevaluation of criteria was carried out to reduce the margin of error and ensure consistency in the decisions made during the collection process. In addition, to ensure the traceability and replicability of the analysis, a copy of the HTML code of each analyzed web page was saved.

Using this new information, we determine the degree of symbolic actions implemented by each startup based on two factors. First, we evaluate the number of SDGs that the company claims to contribute to on its website and we constructed a numerical variable to range from 0 (no SDGs mentioned) to 9, based on the SDGs included in the survey. Additionally, we assess the level of public commitment to sustainability, derived from the information shared on the company's website. This commitment is categorized as follows: zero (if the website does not mention sustainability), medium (if the mention is vague and is not mentioned in a specific section of the website), or high (if there is a clear and explicit mention, typically in a dedicated section). Both variables were normalized using the min-max method to express them on a common numerical scale. The simple average of the two was then calculated, and the result was rescaled into a continuous score ranging from 0 to 10, where the value 10 indicates the highest level of symbolic actions. We call this variable "green talk score".

Similarly, we constructed a measure of the substantive actions that startups take and communicate on their websites based on four variables.[2] Two are numerical: the number of carbon-smart outcomes achieved by the company's technology (ranging from 0 to 3) and the number of vulnerable social groups targeted by that technology (such as micro, small and medium enterprises, indigenous peoples, or family producers), ranging from 0 to 4. The other two are binary: whether the company has sustainability certifications and whether it implements metrics to measure its social and environmental impact. These four variables were processed using the same normalization and rescaling procedure as the symbolic actions variable, resulting in a substantive actions score (referred to as the "green walk score"), which also ranges from 0 to 10, with 10 indicating the highest level of substantive actions.

For comparison purposes, we also constructed a substantive actions score using the information collected in our surveys. Its components are practically identical to those derived from the website analysis, with the difference—mentioned earlier—that our surveys captured, in a binary way, whether the company's technology targets vulnerable social groups. Unfortunately, we could not do the same for symbolic actions, as our surveys did not include enough variables to measure the actions taken by startups to formally comply with regulatory rules and public expectations regarding sustainability.

Finally, following Walker & Wan (2012), we define the greenwashing variable as the difference between symbolic and substantive actions communicated through the web, after normalizing both scores. This variable was also rescaled to a continuous scale from 0 to 10, where 10 represents the highest level of greenwashing.

Regarding the analysis of the data, we used traditional methods of descriptive statistics for a first inspection of the information, and then we estimated regression models to quantify the relationships between the level of sustainability of the firms and economic performance variables (revenues and insertion in foreign markets). Concerning the first economic performance variable, since startups' revenues are measured in ranges, we are dealing with interval-coded data. Let y be the (unobserved) log-revenue and $r_1 < r_2 < \cdots < r_J$ the known interval limits. Then we have:

$$w = 0 \text{ if } y < r_1, w = 1 \text{ if } r_1 \leq y < r_2, \ldots, w = J \text{ if } y \geq r_J$$

Although we do not observe y, we are still interested in modelling $\mathrm{E}(y|\mathbf{x}) = \mathbf{x}\boldsymbol{\beta}$, where $\mathbf{x}$ is a vector of explanatory variables and $\boldsymbol{\beta}$ is a vector of parameters to be estimated. Under the normality assumption of the error term in the equation $y = \mathbf{x}\boldsymbol{\beta} + u$, the vector $\boldsymbol{\beta}$ can be estimated through maximum likelihood.

We apply this methodology to estimate the marginal effect of greenwashing on firms' revenues, controlling for employment (in logarithms), year of foundation, technology group (binary variables) and year to which the socioeconomic information corresponds (binary variable). We use the same methodology to estimate the marginal effects of symbolic and substantive actions (communicated through the web) in a disaggregated way, i.e., by allowing variations in one variable while controlling for the others. Additionally, we test an alternative functional form in which the effect of greenwashing is not constant, since the score is introduced both linearly and quadratically. In another model specification, we also include an interaction between the year of founding and greenwashing to test whether the greenwashing effect follows a pattern related to the startup's age.

[2] It is important to emphasize that we measure only declared substantive actions, leaving out of the analysis substantive actions that are not declared but could have an impact on the economic performance of the startups (Li et al., 2021; Neuman, 2024).

Finally, we use probit models to estimate the marginal effect of greenwashing on the probability that the firm's sales are concentrated in foreign markets, conditional on the vector $\mathbf{x}$. The specification is as follows:

$$\mathrm{P}(y = 1|\mathbf{x}) = \Phi(\mathbf{x}\boldsymbol{\beta})$$

where $y = 1$ if the firm's sales are concentrated in foreign markets, $\mathbf{x}$ is the same vector as before, $\boldsymbol{\beta}$ is a vector of parameters to be estimated through maximum likelihood, and Φ is the standard normal cumulative distribution function. Since the marginal effect depends on the values of the vector $\mathbf{x}$, we compute the average effect across all the observations of the regression sample.

4. Results

In the first place, we describe the symbolic and substantive actions of Argentine AgTech startups, based on our analysis of their websites (Table 1). As can be seen, the collected data suggest that startups show some degree of symbolic actions, with a green talk score that has an average and median value of around 3 points, on a scale ranging from 0 to 10 points. However, we also detect a high variability in this indicator, with a standard deviation that is practically identical to the average value, reflecting some degree of heterogeneity regarding the level of green talking of AgTech companies. An examination of the dimensions comprising the green talk score indicates that over half of the startups publicly disclose a commitment to sustainability on their websites. Approximately one-third do so in a diffuse manner, whereas about one-quarter present this commitment explicitly through a dedicated section. The extent of this engagement is further reflected in references to the SDGs: 60% of firms acknowledge contributing to at least one goal, while 40% report contributions to two or more.

Unlike symbolic actions, our data suggest that most startups do not communicate substantive actions ("green walk") on their website, which is reflected in a very low score value (0.8 points, on average, on a scale of 0 to 10 points). Again, we observe a high heterogeneity in the level of green walk, with a standard deviation in the score that more than doubles the average value. A more specific analysis shows that the low level of substantive actions is relatively uniform along all dimensions of the score. First, we observe that between 95% and 97% of the companies do not declare measuring their social and environmental impact, nor have sustainability certificates. In turn, 84% do not declare contributing to carbon-smart outcomes and only 5% contribute to two or more of these types of outcomes. In line with these findings, our analysis of websites shows that 97% of AgTech firms are not oriented to any vulnerable social group.

On the other hand, it is interesting to compare the substantive action variables between what AgTech startups declare on their website and what they declared in our surveys (Table 2). From this comparison we detect noticeable differences since a higher level of substantive actions is observed in our surveys. For example, more than half of the companies declare in our survey that they target vulnerable social groups, which contrasts with the very low value (3%) that emerges from the analysis of the websites. Similar qualitative conclusions are obtained by comparing other substantive actions, such as the measurement of social and environmental impact and the number of carbon-smart outcomes achieved. Therefore, by comparing the data of our own surveys with those obtained from the website analysis, we observe a green walk score that, on average, is four times higher in the former. These differences could be suggesting that AgTech companies have insufficient web communication about the substantive actions they carry out. This might be reasonable if there are no metrics to justify their actions, so they avoid communication to prevent stakeholders from seeing them as symbolic actions and penalizing them. The absence of standardized indicators complicates firms' sustainability communication. Resource constraints may further limit some startups' ability to maintain websites with sufficient, up-to-date information on their contributions (Mendes et al., 2024). In addition, because our survey was administered online—via web forms and without face-to-face interviewer contact—self-reports may be upward-biased: items touching on socially sensitive behaviors (e.g., social fraud) are prone to misreporting driven by social desirability bias (Fisher, 1993; Krumpal, 2011).

Table 1 shows that, due to the partial discrepancy between symbolic and substantive actions observed on the companies' websites, a moderate degree of greenwashing is present among AgTech startups. The average score is 5 points (on a 0–10 scale), with lower variability than when the green walk and green talk are analyzed separately (standard deviation of 2 points). However, a quarter of the companies have a high degree of greenwashing, with a score equal to or greater than 6.2 points. Hence, overall, our results suggest that in the Argentine AgTech sector symbolic actions tend to predominate over substantive ones. This result is in line with bibliometric analysis studies, which show the relevance of greenwashing in the agri-food industry as a response to stakeholder pressure (Mendes et al., 2024; Nugraha et al., 2024).

Table 1. Symbolic and substantive actions about the social and environmental sustainability of AgTech startups

Information collected from website analysis

PANEL A: DIFFERENT DIMENSIONS OF SOCIAL AND ENVIRONMENTAL SUSTAINABILITY OF AGTECH COMPANIES									
Variable	**Type of action**	**Obs.**	**Mean**	**Std. Dev.**	**Min.**	**25th pct.**	**Median**	**75th pct.**	**Max.**
Number of SDGs addressed	Symbolic	175	1.4	1.5	0.0	0.0	1.0	2.0	8.0
Variable	**Type of action**	**Obs.**	**% of companies**						
Number of vulnerable social groups targeted	Substantive								
None		171	97.2%						
One vulnerable social group		3	1.7%						
Two vulnerable social group		2	1.1%						
Number of carbon-smart outcomes achieved	Substantive								
None		148	84.1%						
One carbon-smart outcome		19	10.8%						
Two carbon-smart outcomes		7	4.0%						
Three carbon-smart outcomes		2	1.1%						
Degree of public commitment to sustainability	Symbolic								
Null		75	42.6%						
Medium		58	33.0%						
High		43	24.4%						
Measurement of social and environmental impact	Substantive								
No		167	94.9%						
Yes		9	5.1%						
Does the company have any sustainability certification?	Substantive								
No		170	96.6%						
Yes		6	3.4%						
PANEL B: GREEN TALK | WALK | WASHING									
Variable		**Obs.**	**Mean**	**Std. Dev.**	**Min.**	**25th pct.**	**Median**	**75th pct.**	**Max.**
Green talk		175	2.9	2.8	0.0	0.0	3.1	5.0	10.0
Green walk		176	0.8	1.9	0.0	0.0	0.0	0.0	10.0
Greenwashing		175	5.0	2.0	0.0	3.3	4.4	6.2	10.0

Source: calculations based on data obtained from the analysis of companies' websites.

Table 2. Substantive actions about the social and environmental sustainability of AgTech startups

Information collected from own surveys

PANEL A: DIFFERENT DIMENSIONS OF SOCIAL AND ENVIRONMENTAL SUSTAINABILITY OF AGTECH COMPANIES			
Variable	**Type of action**	**Obs.**	**% of companies**
Does the company's technology/innovation target vulnerable social groups?	Substantive		
No		64	45.1%
Yes		78	54.9%
Number of carbon-smart outcomes achieved	Substantive		
None		23	16.2%
One carbon-smart outcome		46	32.4%
Two carbon-smart outcomes		44	31.0%
Three carbon-smart outcomes		24	16.9%
Four or more carbon-smart outcomes		5	3.5%
Measurement of social and environmental impact	Substantive		
No		105	73.9%
Yes		37	26.1%
Does the company have any sustainability certification?	Substantive		
No		137	96.5%
Yes		5	3.5%

PANEL B: GREEN WALK								
Variable	**Obs.**	**Mean**	**Std. Dev.**	**Min.**	**25th pct.**	**Median**	**75th pct.**	**Max.**
Green walk	142	3.3	2.4	0.0	1.3	3.3	4.7	10.0

Source: calculations based on data from own surveys.

The next step in our analysis is to estimate the effects of symbolic and substantive actions, as well as the impact of greenwashing, on the economic performance of Argentine AgTech startups. Figure 1 shows that our base econometric models suggest that greenwashing has a negative and statistically significant effect on the revenues of companies, a result that is consistent with part of the previous literature (Du, 2015; Ferrón-Vílchez et al., 2021; Walker & Wan, 2012). On average, we estimate that a 1-point increase in the greenwashing score reduces revenue by about 21%.

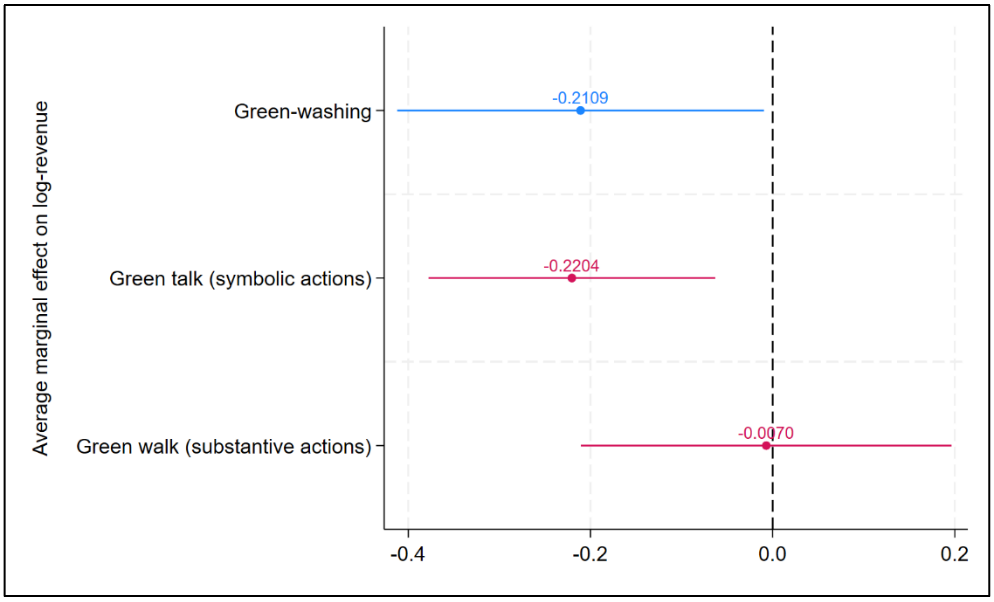
Disaggregating the effects of symbolic and substantive actions (i.e., we hold one of the variables constant while allowing variation in the other), we find that green speeches have a negative and significant effect (reducing income by about 22% on average), while green walk has virtually no effect and is not statistically significant. This suggests that stakeholders penalize symbolic actions but do not reward stated substantive actions, a result also consistent with other empirical findings, mainly in industries for developed economies where pollution is evident and greenwashing practices are easily identifiable (Walker & Wan, 2012). Additionally, we are unlikely to find an effect from sustainability actions because they are not sufficiently communicated. Another important factor to consider when evaluating these results is that agricultural producers may have little knowledge of AgTech startup products. A recent survey of agricultural producers in Argentina (AgBarometer – Universidad Austral) revealed that only 29% had ever purchased a product from an AgTech startup. Among those who had never made such a purchase, 89% indicated that they lacked information about these products[3]. This could also explain why symbolic actions are penalized, since producers generally have little information about startup products, meaning that green speeches may seem implausible to them and generate mistrust.

On the other hand, it is striking that the partial correlation between substantive actions and revenues turns out to be statistically insignificant, which contrasts with part of the literature. This could be due to the dependent variable, as it is likely that revenues do not capture some economic benefits of substantive actions that theoretical literature suggests, such as the ability to secure financing.

[3] https://www.austral.edu.ar/wp-content/uploads/2025/08/Informe-AgBarometer-Julio-25-VF.pdf

Figure 1. Effect of symbolic and substantive actions and greenwashing on AgTech companies' revenues

Models with linear scores



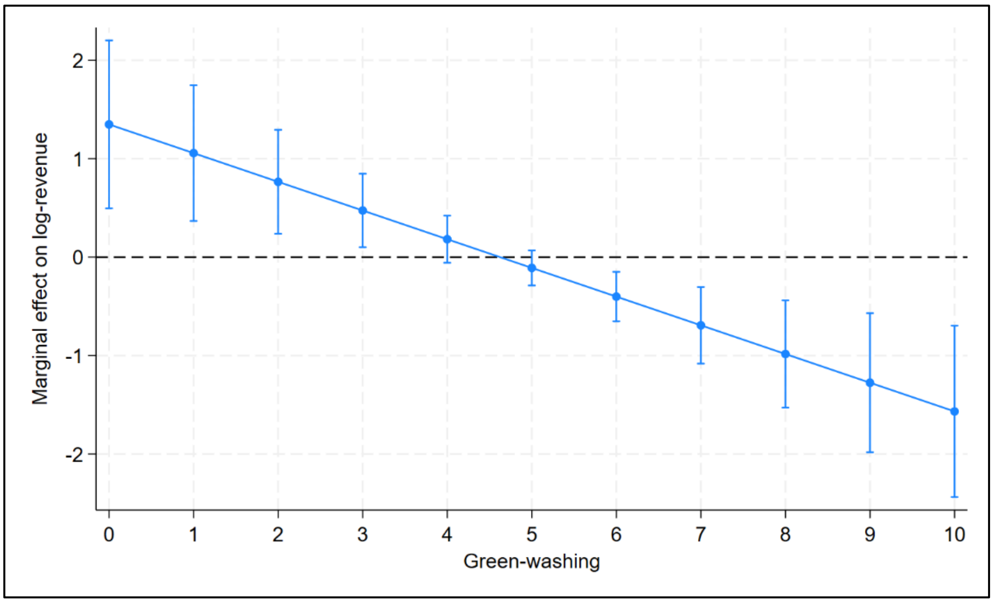
Source: calculations based on data obtained from the analysis of companies' websites.

Note: circles represent point estimates, while horizontal lines show 95% confidence intervals with robust standard errors.

One way of capturing heterogeneities in the impact of greenwashing on startups revenues is to estimate models that include non-constant effects. On the one hand, if we allow the impact of greenwashing on revenues to depend on its level, we find that the effect is positive for low greenwashing values and is reduced -even becoming negative- as symbolic actions are not supported by substantive actions (Figure 2). These findings imply that companies that can largely support their symbolic actions and, therefore, have a low level of greenwashing, could increase their green talk and their revenues, although with a decreasing rate that, on higher levels of greenwashing, leads to a fall in revenues.

Figure 2. Effect of greenwashing on AgTech companies' revenues

Model with linear and quadratic greenwashing score



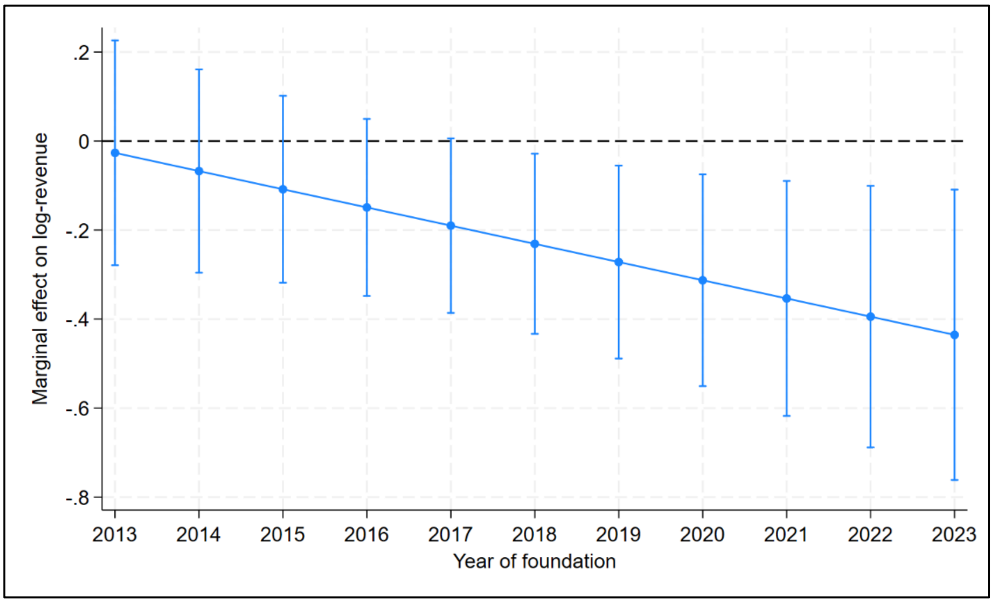
Source: calculations based on data obtained from the analysis of companies' websites.

Note: circles represent point estimates, while vertical lines show 95% confidence intervals with robust standard errors.

On the other hand, if we allow the effect of greenwashing on revenues to depend on the age of the firm, we find a negative effect for most startups, but with an increasing pattern with age (Figure 3). This pattern implies that younger firms are penalized more for not backing up their symbolic actions with substantive actions. A possible hypothesis is that older firms have built up a reputation in the market, which leads to greater credibility and consequently less punishment. This suggests that firms improve their ability to capitalize on communication efforts and investments related to sustainability as they progress through their development stages as startups, a result that is in line with Neuman (2021).

Figure 3. Effect of greenwashing on AgTech companies' revenues by year of foundation

Model with interaction between greenwashing score and year of foundation

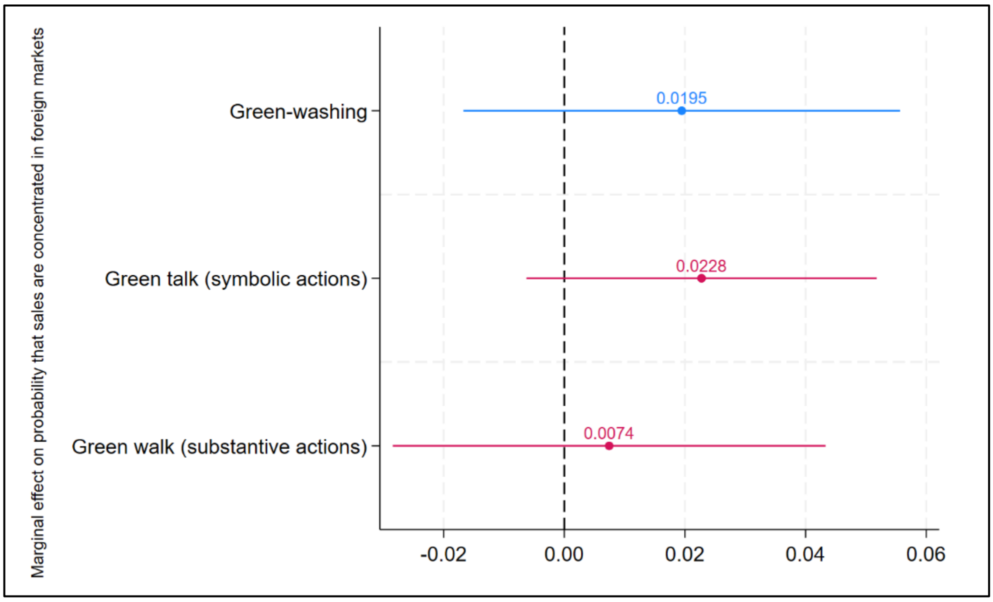


Source: calculations based on data obtained from the analysis of companies' websites.

Note: circles represent point estimates, while vertical lines show 95% confidence intervals with robust standard errors.

Finally, the analysis of the effect of greenwashing on firms' external insertion reveals a positive impact, i.e., a higher degree of greenwashing increases, on average, the probability of concentrating sales in foreign markets (Figure 4), although this effect is not statistically significant at conventional significance levels (p-value = 0.29). However, disaggregating the effects of green talk and green walk, we find that while substantive actions have no statistically significant effect, a unit increase in the score of symbolic actions increases the probability of foreign sales concentration by 2.3 percentage points, an effect that is significant at a level of significance slightly above 10%. Hence, these results suggest that foreign stakeholders reward symbolic actions communicated through websites, while substantive actions are not. These results are in line with Schons & Steinmeier (2016), who find evidence suggesting that the low proximity of stakeholders hinders their ability to distinguish between symbolic and substantive actions.

Figure 4. Effect of symbolic and substantive actions and greenwashing on insertion of AgTech firms into foreign markets



Source: calculations based on data obtained from the analysis of companies' websites.

Note: circles represent point estimates, while horizontal lines show 95% confidence intervals with robust standard errors.

5. Concluding remarks

In this paper, we analyze the communication strategies related to sustainability of Argentine AgTech startups, based on the content they publish on their website. Then, we classify the information into symbolic and substantive actions and construct two scores that measure these dimensions of the companies' communication strategies. From these dimensions, we also construct a greenwashing score, which indicates the degree to which symbolic actions are not supported by substantive actions.

Our findings suggest that startups demonstrate a certain level of symbolic actions related to sustainability, either by making a public commitment or by declaring that their actions contribute to specific SDGs. At the same time, however, we find a low level of substantive actions, as a smaller percentage of companies have certifications, perform impact measurements, contribute to achieving carbon-smart outcomes, or target vulnerable social groups. Therefore, we observe a moderate level of greenwashing among startups in Argentina's AgTech sector. On the other hand, we find significant differences when we compare the level of substantive actions declared in our survey with those communicated on their website, with the latter being lower than the former.

When we estimate the impact of greenwashing on companies' revenues, we find a negative and statistically significant effect, indicating that customers penalize symbolic actions that are not supported by substantive actions. In fact, when we disaggregate the effect of this type of action, we find that an increase in symbolic communication harms firms' revenues, while an increase in declared substantive actions does not seem to have a significant effect. We also find some heterogeneity in the effect of greenwashing on sales, as it is positive for low levels of greenwashing and decreases until it becomes negative as the level increases. At the same time, younger firms are more penalized when their symbolic actions are not supported by substantive actions, probably due to a reputational effect. On the other hand, an increase in symbolic communication increases the likelihood that AgTech firms will concentrate their sales in foreign markets.

These results are valuable because they show that stakeholders in the Argentine AgTech sector do not value purely symbolic communication in the same way as those that can be supported with quantifiable information and that require a substantial investment of resources. However, firms seem to improve their chances of overcoming local barriers by engaging in more symbolic communication. These findings may be relevant for AgTech firms in designing communication strategies because of their implications for the business model. At the same time, the differences between the substantive actions communicated to stakeholders and those collected in our survey could be the result of poor communication by firms, leading to unnecessarily high levels of greenwashing that could be corrected at low cost. However, it is also possible that companies voluntarily choose not to communicate all of their substantive actions due to a lack of quantifiable indicators, creating an information asymmetry problem with their stakeholders, who need stronger signals to identify the companies most committed to sustainability.

Stakeholder perceptions about AgTech startups' communication strategies are a relevant aspect in determining which type of actions and communication outcomes are rewarded, and which are penalized. This aspect should be of interest to those companies because their communication choices and the type of signals they send to the market have implications for different dimensions of their economic performance, such as their revenues and their penetration of foreign markets. These implications are particularly relevant for the startup universe, as they are in the early stages of their development as companies, driving innovations and building reputations.

Finally, sometimes companies do not communicate the results of their sustainable actions because they lack credible metrics and signaling mechanisms, so it is not optimal for them to provide such information from the perspective of private benefits. In this sense, policy makers could mitigate information asymmetries by providing companies with tools to improve the signals they send, for example by standardizing certain certifications or facilitating interaction between ecosystem actors to improve the measurement of the impacts they generate.

References

Baum, L. M. (2012). It's not easy being green… or is it? A content analysis of environmental claims in magazine advertisements from the United States and United Kingdom. *Environmental Communication: A Journal of Nature and Culture*, *6*(4), 423-440.

Berrone, P., Fosfuri, A., & Gelabert, L. (2017). Does greenwashing pay off? Understanding the relationship between environmental actions and environmental legitimacy. *Journal of Business Ethics*, *144*(2), 363-379.

de Freitas Netto, S. V., Sobral, M. F. F., Ribeiro, A. R. B., & Soares, G. R. D. L. (2020). Concepts and forms of greenwashing: A systematic review. *Environmental Sciences Europe*, *32*(1), 19.

Delmas, M. A., & Burbano, V. C. (2011). The drivers of greenwashing. *California management review*, *54*(1), 64-87.

Du, X. (2015). How the market values greenwashing? Evidence from China. *Journal of Business Ethics*, *128*(3), 547-574.

Ferrón-Vílchez, V., Valero-Gil, J., & Suárez-Perales, I. (2021). How does greenwashing influence managers' decision-making? An experimental approach under stakeholder view. *Corporate Social Responsibility and Environmental Management*, *28*(2), 860-880.

Fisher, R. J. (1993). Social desirability bias and the validity of indirect questioning. *Journal of consumer research, 20*(2), 303-315.

Khaled, R., Ali, H., & Mohamed, E. K. (2021). The Sustainable Development Goals and corporate sustainability performance: Mapping, extent and determinants. *Journal of Cleaner Production*, *311*, 127599.

Krumpal, I. (2013). Determinants of social desirability bias in sensitive surveys: a literature review. *Quality & quantity, 47*(4), 2025-2047.

Lassala, C., Orero-Blat, M., & Ribeiro-Navarrete, S. (2021). The financial performance of listed companies in pursuit of the Sustainable Development Goals (SDG). *Economic Research-Ekonomska Istraživanja*, *34*(1), 427-449.

Leoncini, R., Marzucchi, A., Montresor, S., Rentocchini, F., & Rizzo, U. (2019). 'Better late than never': the interplay between green technology and age for firm growth. *Small Business Economics*, *52*(4), 891-904.

Li, W., Li, W., Seppänen, V. & Koivumäki T. (2023). "Effects of greenwashing on financial performance: Moderation through local environmental regulation and media coverage," *Business Strategy and the Environment,* Wiley Blackwell, vol. 32(1), pages 820-841.

Lyon, T. P., & Maxwell, J. W. (2011). Greenwash: Corporate environmental disclosure under threat of audit. *Journal of economics & management strategy*, *20*(1), 3-41.

Manrique, S., & Martí-Ballester, C. P. (2017). Analyzing the effect of corporate environmental performance on corporate financial performance in developed and developing countries. *Sustainability, 9*(11), 1957.

Mendes, J. A. J., Oliveira, A. Y., Santos, L. S., Gerolamo, M. C., & Zeidler, V. G. Z. (2024). A theoretical framework to support green agripreneurship avoiding greenwashing. *Environment, Development and Sustainability*, 1-57.

Navarro, A. I., Camusso, J., Soler, M. J., Arraigada, J., & Varvello, J. C. (2024). Sustainability and economic performance of startups in the AgTech sector: empirical evidence from Argentina. *Available at SSRN 4974629*.

Neumann, T. (2021). Does it pay for new firms to be green? An empirical analysis of when and how different greening strategies affect the performance of new firms. *Journal of Cleaner Production*, *317*, 128403.

Nugraha, W.S., Szakos, D., Süth, M.& Kasza, G.(2024). Greenwashing in the food industry: A systematic review exploring the current situation and possible countermeasures, *Cleaner and Responsible Consumption*, Volume 15.

Parguel, B., Benoit-Moreau, F., & Russell, C. A. (2015). Can evoking nature in advertising mislead consumers? The power of 'executional greenwashing'. *International Journal of Advertising*, *34*(1), 107-134.

Schons, L., & Steinmeier, M. (2016). Walk the talk? How symbolic and substantive CSR actions affect firm performance depending on stakeholder proximity. *Corporate social responsibility and environmental management*, *23*(6), 358-372.

Shrivastava, M., & Tamvada, J. P. (2019). Which green matters for whom? Greening and firm performance across age and size distribution of firms. *Small Business Economics*, *52*(4), 951-968.

Tateishi, E. (2018). Craving gains and claiming "green" by cutting greens? An exploratory analysis of greenfield housing developments in Iskandar Malaysia. *Journal of Urban Affairs*, *40*(3), 370-393.

Walker, K., & Wan, F. (2012). The harm of symbolic actions and green-washing: Corporate actions and communications on environmental performance and their financial implications. *Journal of business ethics*, *109*, 227-242.

Yang, N. H. N., Bertassini, A. C., Mendes, J. A. J., & Gerolamo, M. C. (2021). The '3CE2CE'framework—Change management towards a circular economy: Opportunities for agribusiness. *Circular Economy and Sustainability*, *1*(2), 697-718.