

The integration impact of Agile and ERM on firm Sustainability

تأثير تكامل الاستجابة السريعة وإدارة المخاطر للشركات على
استدامة الشركة

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Abstract

This research aims to examine the relationship between Agility and Enterprise Risk Management (ERM) besides the impact of this relationship on sustainability. The researcher collected annual data for 5 years from 37 company listed companies in EGX₉₀ but there are two companies dropped due to missing data, thus the final sample size is 35 companies for different industrial sectors and each company has an annual time series from year 2017 till 2021, so the total number of observations is 175 observations. The results found that there is a significant and inverse relation between ERM and Agility. Besides, there is a significant and inverse relation between ERM and Sustainability. and There is a significant and inverse relation between Agility and Sustainability

Key words: Enterprise Risk, Agility, firm Sustainability.
Stakeholder theory.

الملخص

تهدف هذه الدراسة إلى فحص العلاقة بين الاستجابة السريعة وإدارة المخاطر للشركات، وتأثير هذه العلاقة على الاستدامة. جمع الباحث بيانات سنوية لمدة ٥ سنوات من ٣٧ شركة مدرجة في البورصة، ولكن انسحبت شركتان بسبب نقص البيانات. بالتالي، يكون حجم العينة النهائية هو ٣٥ شركة تنتمي إلى قطاعات صناعية مختلفة، وكل شركة لديها سلسلة زمنية سنوية من عام ٢٠١٧ حتى ٢٠٢١، وبالتالي فإن إجمالي عدد الملاحظات هو ١٧٥ ملاحظة. أظهرت النتائج وجود علاقة عكسية ومعنوية بين إدارة المخاطر التجارية والاستجابة السريعة. بالإضافة إلى ذلك، هناك علاقة عكسية ومعنوية بين إدارة المخاطر للشركات، والاستدامة، وهناك علاقة عكسية ومعنوية بين الاستجابة السريعة والاستدامة.

كلمات مفتاحية: الاستجابة السريعة، الاستدامة، إدارة المخاطر، مخاطر الاعمال، نظرية أصحاب المصالح

Introduction

Nowadays, the industrial world is very aggressive, forcing firms to convey new ways of thinking to set apart from the rest (Balaji et al., 2015). The persisting environment, concentrate only on the concept of optimization around both production process and associated costs, changed its direction to a more demanding market, where customers are looking for customized products more applicable to their new needs and thinking ways.

Based on some of firms' impotence to quickly respond and adapt to the new market requirements, a new paradigm emerged, agile production supported by the agile project

management (APM). This signifies both strong adaptability and response speed by the main management body of the firms, following the market trends as well, dealing with the customers self-assertive searching for new products and services (Shewchuk, 1998).

Because of business benefit priority, credible stakeholder involvement and quick incorporation of changing requirements, agile methodologies are becoming increasingly significant in the current context (Kasauli et al., 2021; Kussunga et al., 2019). Even though, when using agile methodologies there is an upgrade on firm's production system and, because of that, an overall product quality improvement of the can be observed clearly (Costa et al., 2019). However, perfection is unattainable (Rodrigues et al., 2019).

Thus, compelled by legislation and the increasing consumer pressure, firms found in sustainability a new way to get closer to the consumer, making firm policies and communication more legal and transparent (Silva and Gouveia, 2020). Through these policies, firms show to the community in general, and the business market in particular, the respect they have for the social and environmental pillars of sustainability, since the economic pillar was the one that all firms had previously sought to enhance in a continuous way (Sáet al., 2020; Santos et al., 2021).

The concept of sustainability is a necessity for each one in each field, as environmental aggressions that cause climate change keep on growing, and due to the importance of taking measures to eliminate such situations (Faraz et al., 2021; Lee et al., 2013). The application of sustainability in firms has been considered of great necessity for the success of the firms'

outcome, giving rise to a series of research whose have identified positive correlations between sustainability, the firms' success, and image (Teixeira et al., 2021; Teixeira et al., 2022).

This previous cause, combined with the goals set by the United Nations Sustainable Development Goals, 2015 (Diaz, 2021), can illustrate the cause of why sustainability and sustainable development have become the focus for many firms. For a firm to be considered sustainable it is necessary to consider the impact of its activities on the environment, trying to eliminate them and, consequently, developing their social actions that benefit both its internal employees and the overall society (Fourati, 2021; Gangi et al., 2020; Karwowski, 2021; Santos et al., 2018; Santos et al., 2021).

In addition, sustainable development is an evolutionary and systematic process. It is expected that when incorporated into the firms' management techniques, it will be possible to generate more profit and consequently increase in both social and environmental goals (Carvalho et al., 2019; Hrazdil et al., 2021). This is achieved through the integration of social responsibility, as a strategic investment, at the core of its business strategy in its management instruments and their operations, also adding value to their products (Kucharska and Kowalczyk, 2018).

Theoretical background

Literature review

Agility

Agility is an approach beyond both flexibility and leanness (Dingsøyr et al., 2012). According to Conboy (Conboy, 2009), flexibility associated with the ability of a systems

development method to “create change, or proactively, reactively, or inherently embrace change in a timely manner, through its internal elements and its association with its environment.” Moreover, leanness captures the “contribution to perceived customer value through economy, quality, and simplicity.”

The presence of enormous time lag between market requirements and the delivery of technology in the 1990s cause a frustration in the industry world. Many Projects were being canceled and, in some cases, the final product did not meet the previously requirements. Moreover, the Waterfall model was the basis for the software development models at the beginning of this time; but this model cannot adapt with fast requirements changes. The Agile Manifesto and the 12 Principles of Agile Software were the outcomes of these problems (Bermejo et al., 2014).

Furthermore, Traditional methods considered change as an expense, so they must be avoided. The trend was to develop detailed and elaborate plans, with a defined set of features considering everything. In addition, with Agile, the small-time iteration means that priorities can be shifted from iteration to iteration and new features can be added into the next iteration. Agile point of view is that any change will always provide additional value, which in consequence will improve the project (Beck et al., 2013).

Above that, various Agile scaffolding have been developed, and each has their own terminology and structure (Lei et al., 2017). The scaffolding to be utilized will be determined by the firm orientation. Many specialized scaffoldings have a generic structure that can be split into three groups as following: Roles,

Processes, and Products. There are at least four key responsibilities in most of the frameworks: consumer, team, agile lead, and the overall stakeholders (Musura, 2016).

Moreover, one of the most used agile methodologies is Scrum. Scrum is a framework for delivering, developing, and sustaining most complex products. It is considered as a single-team process outline which is used to manage product development which runs on time-boxes with a consistent duration, usually named 'sprints,' where a potentially releasable increment of product is produced (Basile et al., 2021). It consists of Scrum roles, artifacts, and rules (Freitas et al., 2020). Scrum is based on a team composed of three scrum roles: the product owner, the development team, and the scrum master (Schwaber et.al, 2017).

Sustainability

The term sustainability, nevertheless. having a specific definition, it becomes popular after the appearance of the concept of sustainable development in the Brundtland Report in 1987, and after that many definitions have appeared (Gupta et al., 2018; Ruggerio, 2021). Sustainability is not just environmentalism; it is also necessary to bear in both mind economic development and social equity (Talapatra et al., 2019).

Moreover, sustainability presents a highly positive implication, and when combined its three dimensions form what is currently known as the tripod of sustainability, which is also known as "the triple bottom line" (TBL) (Boyer et al., 2016). It is critical that all the three pillars of sustainability interact in a harmonic manner, because sustainability cannot exist without

these three pillars. One of those pillars depicts an environment in which sustainability is implemented, while each is reliant on the other for survival (Ranjbari et al., 2021).

Moreover, TBL seeks to measure the financial, social, and environmental performance of a company over time. It is one of the best indicators on how sustainable the business is, and how profitable it truly is (Stanitsas, 2021). In addition, it is possible to determine how close or far the firm is to being sustainable using these pillars that evaluate its sustainability (Teixeira et al., 2022). As a result, the sustainable firm is one that, at the end of its evaluation, maintained or promoted activities to increase its development level in the three areas (Gimenez et al., 2012).

In addition, the second pillar is economical which is concerned with the manufacture, distribution, and consumption of commodities and services. It is also related to the profit in a direct way, to the positive economic-financial result of a firm. When thinking about TBL, it is essential that this pillar bears in mind the aspects of the other two pillars, that is, there is no point in profiting from deforesting (Bueno, 2012; Ferreira, et. al, 2012).

Moreover, the environmental pillar is based on a variety of approaches to environmental preservation, natural resource conservation, and the reduction of environmental damage over time (Santos et. al, 2017; Silva, 2020). The firm must follow environmental regulations when utilizing water and energy reduce liquid effluent and solid waste emissions, recycle trash, invest in biodiversity, and preserve the environment (Santos, 2017; Silva et al., 2014; Ferreira, et al., 2012; Bravi et al., 2020; Fonseca et al., 2021; Purvis et al., 2019; Vieira et al., 2021).

The last one is social pillar that related to the development of human capital, such as the production of tools to improve people' quality of life, laws to support population needs, and the development of better policies in areas such as education and security. Furthermore, to promote the personal and collective development of all employees engaged, it is critical to create an environment that encourages real and healthy work relationships (Ferreira et al., 2022; Morgado et al., 2019; Purvis et al., 2019).

Enterprise risk management (ERM)

ERM in a business covers methods and processes which are used to assess and mitigate risk. ERM prepares the main conceptual framework, which covering identification of cases or events relevant to firm's objective, which might either be threat or opportunity, assessing the probability to happen and potential effect, and preparing the strategies for responding. By proactively dealing with the potential risk, each firm could protect its stakeholder's value, either economically from stakeholder's side, or environmentally or socially from the rest of stakeholders.

From literature review, it could be assumed that association between ERM and firm performance are still inconclusive. The results of several research documented either positive and significant, or insignificant. Based on premise, this research aims to introduce sustainability reporting as a moderating variable into the existing relationship of ERM toward business performance.

The size of ERM impact as an independent variable on firm performance can be enhanced by introducing several firm's internal and external factors. This might include the firm's

strategy and characteristics, which could show the firm's ability to deal with internal risk and increase its firm's performance. Meanwhile, other factors such as environmental change and social welfare could also affect firms in reaching their strategic objective or long-term goals.

In line with the above argument, the researcher decides to use sustainability reporting as moderating variable. Within sustainability report, we can commonly find information related to firm's profile and management (internal factors), in addition to projects and activities toward realizing social and environmental welfare (external factors). Within sustainability report, are also covered discussion on either internal or external factor which can support ERM in increasing firm performance.

The researcher will use stakeholder theory to explain the moderating role of sustainability reporting. According to this theory, management has the responsibility to create value for all stakeholders. Freeman in 1984 emphasizes morals and values needed to achieve social and economic responsibility in a firm. Sustainability reporting and ERM implementation are done as an effort to fulfill this responsibility toward stakeholders, whether internal or external.

Related theory

Stakeholder theory

To investigate the association between stakeholder theory and sustainability management, it is necessary to define the core elements of stakeholder theory. which requires as a first step to define the term stakeholder. One of the most common and general definitions is provided by (Freeman, 1984; Freeman et al.,

2010), who describes stakeholders as those groups and individuals who can affect or be affected by the actions connected to value creation. Rhenman in 1995 defines stakeholders in a narrower sense as “the individuals and groups who are depending on the firm in order to achieve their personal goals and on whom the firm is depending for its existence.”.

In this context, it is essential to note that the unit of analysis for stakeholder theory is not the company itself but the relationships between an organization and its stakeholders (Freeman et al., 2010). Many researchers investigated descriptive and empirical aspects of stakeholder theory, which helps describe how firms are managed and identify relevant stakeholders with their expectations that related to sustainability (Mitchell and Sonnenfeld, 1999; Jawahar and McLaughlin, 2001; Sangle and Ram Babu, 2007; Wallis, 2006).

According to, Freeman (1994) as well as Freeman et al. (2010), stakeholder theory might entail numerous different normative cores, whatever normative core is used, it is important to keep in mind that the version of stakeholder theory we are referring to focuses on ‘managing stakeholder relationships’ as a difference to ‘stakeholder management’ that would imply the illusion of manipulating stakeholders.

The gravity of sustainability-related problems, such as climate change, suggests that simply acknowledging the (systematic) existence of numerous trade-offs is unlikely to solve the most relevant challenges of sustainability management. In this sense, our understanding of stakeholder theory differs from purely instrumental interpretations that test the existence of an empirical link between differing stakeholder interests (e.g.,

stakeholder involvement and corporate financial performance), as we aim to explore opportunities for installing positive links between stakeholder interests.

Research problem

Companies face new challenges needing to find ways to stand out from their competitors. All companies face new projects, which need to be managed assertively and faster, launching new products on the market ahead of competitors. This strategy requires enormous dexterity and agility within teams, which are increasingly multifaceted, multidisciplinary, and multifunctional. However, team need to conciliate apparent freedom for creation with the sustainability rules, which are increasingly demanding, such as legislation and image that companies want to pass on to the market in terms of corporate social responsibility, ensuring a sustainable development of the companies.

In addition to investigate and correlate agile project management and sustainability, considering that there are strong relationships, as well as to learn how agile project management affects organization's social, environmental, and economical dynamics from the triple bottom line standpoint. The research examines how agile project management ideas are connected to the triple bottom line concepts based on the literature.

As failing to manage ESG risks can lead to material business impacts, including missed profits, operational impacts, and loss of license to operate. Meanwhile, mainstream investors are increasingly emphasizing disclosure of ESG risks monitoring ESG performance.

Choosing this challenge because with COP'27 approaching, the environmental sustainability element has received the most attention. Incorporating sustainability into ERM can strengthen a company's understanding of its full site of risks, improve its sustainability management, and enhance overall business performance. Likewise, incorporating an ERM lens into materiality assessments can help to translate results into language relevant to the business.

Research objectives

1. Identify the full spectrum of company's risks—including environmental, social, and governance risks. Use ESG risk identification methods, megatrend analysis, and media monitoring to comprehensively identify both established and emerging risks.
2. Investigate and correlate agile project management and sustainability to learn how agile project management affects the organization's social, environmental, and economical dynamics from the triple bottom line standpoint.
3. Align on priority ESG issues for inclusion in ERM and modify your ERM inventory accordingly. Conduct a gap assessment of your existing risk inventory, translate specific emerging and existing material issues across priority ESG issues and existing ERM issues, and make necessary adjustments to your materiality analysis and risk inventories.
4. Evaluate relevant risks for likelihood, vulnerability, and impact. Use high-level risk assessments that consider less conventional criteria like impacts to reputation, speed of onset, persistence, and ability to mitigate to help enhance understanding of difficult-to-measure sustainability risks. You can also leverage forecasting and futures scenario

analysis to assess the unique characteristics of longer-term and rapidly emerging sustainability risks.

5. Maintain ongoing ERM and materiality alignment.

Research hypotheses

H1: there is a significant relationship between Agility and ERM

H2: the relationship between Agility and ERM has a positive impact on sustainability.

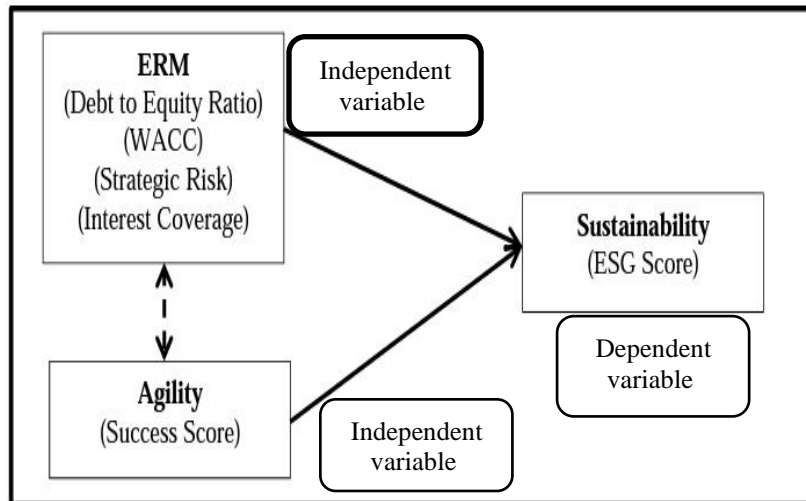
Methodology

Population and sample size

The researcher collected annual data for 5 years from 37 company listed companies in *EGX90*, but there are two companies dropped due to missing data, thus the final sample size is 35 companies for different industrial sectors and each company has an annual time series from year 2017 till 2021, so the total number of observations is 175 observations.

Variables and measures

Variables and Measures	
Independent Variable	
Enterprise risk management	Debt to Equity Ratio WACC Strategic Risk Interest coverage
Dependent Variable	
Sustainability	Success Score
Independent Variable	
Agility	ESG score



Research model

Enterprise risk management

Leverage is considered as the use of fixed costs in a firm's cost structure. Business risk is the risk associated with operating earnings and reflects both sales risk (uncertainty with respect to the price and quantity of sales) and operating risk (the risk related to the use of fixed costs in operations). Financial risk is the risk associated with how a company finances its operations (i.e., the split between equity and debt financing of the business). Therefore, Leverage Ratios can be used to obtain information about the risk and potential return from investing in a firm or its inventory. Changes in average debt ratios across sectors can also give investors an overall picture of the health of the economy and help them make portfolio decisions.

In addition, the weighted average cost of capital (WACC) tells us the return that both lenders and shareholders expect to receive in return for providing capital to the firm. Therefore, it helps to measure the firm risk by determining whether a company is building or shedding value. Moreover, Strategic risk which arises when a firm does not operate according to its business plan. When the firm does not operate according to its business model, its strategy becomes less effective over time, and it may struggle to reach its defined goals.

Above that, the interest coverage ratio which calculated by dividing the firm's earnings before interest and taxes (EBIT) by its interest expense during a given period to measure how well a firm can pay the interest due on outstanding debt and avoid the risk.

Sustainability

Environmental, Social and Governance (ESG) initiatives have become a strategic imperative for every organization over the last year. Increased focus and pressure from investors, regulators, employees, and other stakeholders make ESG an indicator that is not only critical at the board level, but also essential to cascade throughout firm operations.

ESG, which stands for Environmental, Social, and Governance are metrics, is used to illustrate the transparency, sustainability, and performance of a firm. In other words, they measure the firm's ability to survive over the long term. In addition, it refers to a financially sustainable approach to business. It is an effort to reduce the amount of risk associated with investments by thoroughly assessing the impact of a company's operations.

Moreover, ESG plays a key role because it encourages companies to operate ethically and be conscious of their impact on the environment, society, and its stakeholders. As investors move further towards ESG investing, this type of analysis is becoming critical to properly assess corporate behavior and improve sustainability-related practices. By upholding ESG standards, organizations are creating long-term value for themselves and for the global economy.

1. The environmental component of ESG knowledge looks at how firms are impacting the environment. These may include waste management, energy use and water conservation.
2. The social aspect emphasizes how companies treat their employees, clients, and other stakeholders. This may include diversity and inclusion, human rights, and employee engagement.
3. The governance component focuses on how companies are managed and regulated. This may include board diversity, ethical leadership, and anti-corruption policies.

Agility

The following formula has several beneficial aspects. The first one, it is designed to make “0” the minimum possible agility score. The second is by dividing the turbulence score by five, the contribution of turbulence towards the final agility score is reduced. This accomplishes the goal of achieving an agility score that is not dominated by Measuring agility by either the success or turbulence components. Third, although the agility metric is theoretically unbounded, using the cube root of success causes the agility score to taper off, resulting in a practical maximum. This ensures that the agility score does not increase by substantial amounts for slight changes in success scores, especially at the high end of the range.

Success Score:

$$\begin{aligned}
 \text{Success score}_{it} &= \left(\frac{(BP_{it} * \text{Industry Median GM}) + 1}{\text{Industry Median GM}} \right) \\
 &* \left(\frac{IP_{it}}{\text{Industry Median IP}} \right)
 \end{aligned}$$

Where:

- Budgeted Performance:

$$BP_{it} = \frac{\text{budgeted expences}}{\text{Actual Production}}$$

- Inventory Performance:

$$IP_{it} = \frac{\text{Actual expences}}{\text{Average inventory}}$$

- Industry Gross Margin Median:

$$\text{Industry Gross Margin Median} = \text{median of } GM_{it}$$

- *i*: Company number.
- *t*: year number.

The Descriptive Analysis

The main study variables will be analyzed to determine measures of location like mean, maximum and minimum values, and their measures of dispersion, standard deviation, and coefficient of variation for each variable.

Table (1): Variables descriptive analysis.

Variable	N	Minimum	Maximum	Mean	Standard Deviation	Coefficient of Variation
Debt to Equity Ratio (ERM)	175	-3.1379	8.6254	1.1989	0.5252	0.4381
WACC (ERM)	175	-0.6883	16.1116	7.1349	0.7200	0.10091
Strategic Risk (ERM)	175	-0.1790	3.4662	1.3551	0.0832	0.06142
Interest coverage (ERM)	175	0.0340	15.8631	6.1818	0.2441	0.03949
LN Success Score (Agility)	175	0.0188	1.3465	0.6285	0.2571	0.4091
LN ESG Score (Sustainability)	175	0.0015	1.8021	0.8921	0.2565	0.2875

Source: prepared by the researcher from Gretl software output.

From table (1) it is concluded that:

- All study variables have 175 observations which means that there is no missing data.
- The independent variable **Debt to Equity Ratio** which presents (ERM) has a minimum value of -3.1379 and maximum value of 8.6254 with an arithmetic mean of 1.1989, and its standard deviation is 0.5252 and as a low coefficient of variation of 43.81% which indicates a moderate level of dispersion of values around the arithmetic mean.
- The independent variable **WACC** which presents (ERM) has a minimum value of -0.6883 and maximum value of 16.1116 with an arithmetic mean of 7.1349, and its standard deviation is 0.7200 and as a low coefficient of variation of 10.09% which indicates a moderate level of dispersion of values around the arithmetic mean.

- The independent variable **Strategic Risk** which presents (ERM) has a minimum value of -0.1790 and maximum value of 15.8631 with an arithmetic mean of 1.1989, and its standard deviation is 0.0832 and as a low coefficient of variation of 6.14% which indicates a moderate level of dispersion of values around the arithmetic mean.
- The independent variable **Interest coverage** which presents (ERM) has a minimum value of 0.0340 and maximum value of 8.6254 with an arithmetic mean of 6.1818, and its standard deviation is 0.2441 and as a low coefficient of variation of 3.95% which indicates a moderate level of dispersion of values around the arithmetic mean.
- The independent variable **LN (Success Score)** which presents (Agility) has a minimum value of 0.0188 and maximum value of 1.3465 with an arithmetic mean of 0.6285, and its standard deviation is 0.2571 and as a low coefficient of variation of 40.91% which indicates a low level of dispersion of values around the arithmetic mean.
- The dependent variable **LN ESG Score** which presents (Sustainability) has a minimum value of 0.0015 and maximum value of 1.01802 with an arithmetic mean of 0.8921, and its standard deviation is 0.2526 and as a low coefficient of variation of 28.75% which indicates a low level of dispersion of values around the arithmetic mean.

Test of normality

The researcher applied Shapiro-Wilk test to determine whether the main variables of study follow the normal distribution or not, Shapiro-Wilk test is a Chi-squared test of normality which its null

hypothesis states that variables are not normally distributed if the test *p-value* is less than or equal 0.05, while its alternative hypothesis states that variables are normally distributed if the test *p-value* is more than 0.05.

Table (2): Shapiro-Wilk test of normality.

Variable	Statistic	DF	<i>P-value</i>
Debt to Equity Ratio (ERM)	0.741	175	0.000
WACC (ERM)	0.26	175	0.00
Strategic Risk (ERM)	0.30	175	0.00
Interest coverage (ERM)	0.06	175	0.00
LN Success Score (Agility)	0.723	175	0.000
LN ESG Score (Sustainability)	0.990	175	0.292

Source: prepared by the researcher from Gretl software output.

From table (2) it is concluded that Debt to Equity Ratio, WACC, Strategic Risk, Interest Coverage and LN Success Score variables are not normally distributed as their *p-value* of Chi-square statistic is less than 0.05, so the alternative hypothesis will be accepted that the variables are not follow the normal distribution, while LN ESG Score variable is normally distributed as it has *p-value* of Chi-square statistic is more than 0.05, so the null hypothesis will be accepted.

Correlation Matrix

After applying test of normality for the main dimensions of the independent, the dependent variables of study and founding Debt to Equity Ratio and LN Success Score variables don't follow the normal distribution, So Spearman correlation coefficient will be the most appropriate coefficient for determining the relation strength and direction between each two variables, then the correlation coefficient is tested by a t-test

which its null hypothesis states that correlation does not exist if the test *p-value* is greater than 0.05.

Table (3): Spearman correlation coefficient matrix

Variable	Debt to Equity	WACC	Strategic Risk	Interest coverage	ESG Score	Success Score
Debt to Equity	1					
<i>P-value</i>	-					
WACC	-0.0140	1				
<i>P-value</i>	0.8570	-				
Strategic Risk	-0.0670	0.1100	1			
<i>P-value</i>	0.3770	0.1460	-			
Interest coverage	0.0890	0.0560	0.0310	1		
<i>P-value</i>	0.2410	0.4590	0.6880	-		
ESG Score	-0.4116	-0.2940	-0.1490	-0.3580	1	
<i>P-value</i>	0.0015	0.0028	0.0300	0.0000	-	
Success Score	-0.3262	-0.1920	-0.0460	-0.0080	0.3800	1
<i>P-value</i>	0.0060	0.0110	0.0460	0.0170	0.0030	-

Source: prepared by the researcher from Gretl software output.

From the correlation matrix in table (3) it is concluded that:

- There is a significant, inverse, and weak relation between **Debt-to-Equity Ratio** which presents (ERM) and **LN Success Score** which presents (Agility) with a correlation coefficient value of -0.3262 and *P-value* 0.0060.

- There is a significant, inverse, and weak relation between **WACC** which presents (ERM) and **LN Success Score** which presents (Agility) with a correlation coefficient value of -0.1920 and *P-value* 0.0060.
 - There is a significant, inverse, and weak relation between **Strategic Risk** which presents (ERM) and **LN Success Score** which presents (Agility) with a correlation coefficient value of -0.0460 and *P-value* 0.0060.
 - There is a significant, inverse, and weak relation between **Interest Coverage** which presents (ERM) and **LN Success Score** which presents (Agility) with a correlation coefficient value of -0.0080 and *P-value* 0.0060.

- There is a significant, inverse, and weak relation between **Debt-to-Equity Ratio** which presents (ERM) and **LN ESG Score** which presents (Sustainability) with a correlation coefficient value of -0.4116 and *P-value* 0.0060.
- There is a significant, inverse, and weak relation between **WACC** which presents (ERM) and **LN ESG Score** which presents (Sustainability) with a correlation coefficient value of -0.2940 and *P-value* 0.0060.
- There is a significant, inverse, and weak relation between **Strategic Risk** which presents (ERM) and **LN ESG Score** which presents (Sustainability) with a correlation coefficient value of -0.1490 and *P-value* 0.0060.

- There is a significant, inverse, and weak relation between **Interest Coverage** which presents (ERM) and **LN ESG Score** which presents (Sustainability) with a correlation coefficient value of -0.3580 and *P-value* 0.0060.
- There is a significant, direct, and weak relation between **LN ESG Score** which presents (Sustainability) and **LN Success Score** which presents (Agility) with a correlation coefficient value of 0.3800 and *P-value* 0.0030.

The Linear Multiple Regression Panel Model

Pooled linear Panel:

The following table presents the pooled panel linear regression model for **LN ESG Score** which presents (Sustainability) as a dependent variable and **Debt to Equity Ratio, WACC, Strategic Risk, and Interest Coverage** which presents (ERM) and **LN Success Score** which presents (Agility) as an independent variable as a primary model to determine the most fitted linear panel model to forecast **LN ESG Score** on long run.

Table (4): The pooled panel model of LN ESG Score.

Model	Pooled Panel	Dependent variable		LN ESG Score
		Coefficient	t-ratio	
Independent variables				Significance
Constant	0.223687	4.192	<0.0001	Significant
Debt to Equity Ratio (ERM)	-0.168057	-13.086	<0.0001	Significant
WACC (ERM)	-0.000238731	-0.3349	0.7381	Insignificant
Strategic Risk (ERM)	-0.00453789	-10.020	<0.0001	Significant
Interest coverage (ERM)	-0.00206905	-1.086	0.2788	Insignificant
LN Success Score (Agility)	0.689191	8.913	<0.0001	Significant
Adjusted R-squared			20.2790%	

Source: prepared by the researcher from Gretl software output.

From table (4) it is concluded that:

- The overall pooled panel model is significant with adjusted R-squared value of 20.2790% which means that the independent variables and the constant explain the change in the **LN ESG Score** (Sustainability) by 30.1074%.
- **Constant** and **LN Success Score** (Agility) have a direct and significant impact on **LN ESG Score** (Sustainability).
- **Debt to Equity Ratio** (ERM) and **Strategic Risk** (ERM) have an inverse and significant impact on **LN ESG Score** (Sustainability).

Pooled Panel model Diagnostics:

The following table (5) presents the diagnostics of the three-panel models to determine the most appropriate model for forecasting the LN ESG Score (Sustainability).

Table (5): The pooled panel model diagnostics for LN ESG Score (Sustainability).

Test	Purpose	Test-statistic result	p-value	Fitted panel model
F-test	Comparing between Pooled panel and Fixed Effect Panel	F = 5.3021	1.24122e-012	Fixed effect
Breusch-Pagan test	Comparing between Pooled panel and Random Effect Panel	LM = 68.1935	1.48212e-016	Random effect
Hausman test	Comparing between Fixed effect panel and Random Effect Panel	H = 5.84085	0.322014	Random effect

Source: prepared by the researcher from Gretl software output.

From the previous table shows that the Random effect panel model is the most fitted model to explain the impact between the independent variables (Debt to Equity Ratio, WACC, Strategic Risk, Interest Coverage and LN Success Score) and dependent variable LN ESG Score.

Random effect Panel:

The following table presents the random effect panel linear regression model for DR_E as a dependent variable and Industry Leverage ratio DR_Es as an independent variable and Firm size and liquidity are control variables obtain the most fitted linear relation that can forecast the firms' value on the long run.

Table (6): The random panel model of LN ESG Score (Sustainability).

Model	Random effect	Dependent variable		LN ESG Score
Independent variables	Coefficient	t-ratio	p-value	Significance
Constant	0.257554	4.997	<0.0001	Significant
Debt to Equity Ratio (ERM)	-0.0159867	-2.691	0.0078	Significant
WACC (ERM)	-0.00271966	-14.780	<0.0001	Significant
Strategic Risk (ERM)	-0.00459982	-2.954	0.0037	Significant
Interest coverage (ERM)	-0.00206858	-6.728	<0.0001	Significant
LN Success Score (Agility)	0.196021	3.551	0.0005	Significant
Adjusted R-squared			58.9839%	

Source: prepared by the researcher from Gretl software output.

From table (6) it is concluded that:

- The overall random effect panel model is significant with adjusted R-squared value of 58.9839% which means that the independent variables and the constant explain the change in the LN ESG Score (Sustainability) by 58.9839%.

- **Constant and LN Success Score (Agility)** have a direct and significant impact on **LN ESG Score (Sustainability)**.
- **Debt to Equity Ratio, WACC, Strategic Risk, and Interest Coverage** have an inverse and significant impact on **LN ESG Score (Sustainability)**.
- The overall equation for forecasting the firm **LN ESG Score (Sustainability)**:

$$\begin{aligned}
 \widehat{LN_ESG_Score}_{it} &= 0.257554 - 0.0159867Debt\ to\ Equity_{it} \\
 &\quad - 0.00271966WACC_{it} \\
 &\quad - 0.00459982Strategic\ Risk_{it} \\
 &\quad - 0.00206858Interest\ Coverage_{it} \\
 &\quad + 0.196021LN\ Success\ Score_{it}
 \end{aligned}$$

Heteroscedasticity Test for Residuals Stability:

The regression models and the OLS method are based on several assumptions, including the constancy of homoscedasticity by which the mean should be equal to zero, and if the Heteroscedasticity variation is used, some methods are used to overcome this problem, such as the White test. The null hypothesis is that the model has a problem of random error instability if p-value is less than 0.05.

Table (7): Heteroscedasticity test of residuals.

Overall test of Heteroscedasticity	Chi-square	P - value
	6.78977	0.99732

Source: prepared by the researcher from Gretl software output.

The above table shows that the chi-squared test of value 11.41293 has a *p-value* of 0.99732 which means accepting the null hypothesis which means that the study model does not suffer from the problem of random error instability.

Ramsey Reset Test:

This test is used to determine whether the model contains all the appropriate variables and excludes all irrelevant variables to ensure that the model estimated coefficients are not biased. This is done through the Ramsey RESET Test, and the decision criterion is to accept the null hypothesis that the study model includes all the appropriate variables *P-value* was greater than (0.05).

Table (8): Ramsey Reset test for independent variables.

Ramsey RESET overall Test	F-test	<i>P – value</i>
	1.1544	0.317748

Source: prepared by the researcher from Gretl software output.

Table (8) shows that *the P-value* of 0.317748 for the F test is greater than (0.05), which means that the study model does not contain any inappropriate variables included in the model.

Variance Inflation Factor (VIF) Test:

The minimum value equals to 1.0 and the values greater than 10.0 indicate a collinearity problem.

Table (9): VIF of the independent variables.

Variable	VIF
Debt to Equity Ratio (ERM)	1.012
WACC (ERM)	1.030
Strategic Risk (ERM)	1.015
Interest coverage (ERM)	1.004
LN Success Score (Agility)	1.043

Source: prepared by the researcher from Gretl software output.

From table (9) it is concluded that there is no variable that suffers from multi-collinearity as the VIF values do not exceed ten.

Normality of Residuals:

The following table presents the normal distribution of residuals as the model residuals must follow the normal distribution overall with mean equals zero and variance equals one.

Table (10): Normality of residuals.

Chi-square test of	test	<i>P – value</i>
Normality	8.781	0.09363050

Source: prepared by the researcher from Gretl software output.

From table (10) it is concluded that the chi-square test of normality its *p-value* is 0.09363050 which is greater than 0.05 which means that residuals are normally distributed.

Conclusion

This research aims to examine the relationship between Agility and Enterprise Risk Management (ERM) besides the impact of this relationship on sustainability. The researcher collected annual data for 5 years from 37 company listed companies in EGX₉₀ but there are two companies dropped due to missing data, thus the final sample size is 35 companies for different industrial sectors and each company has an annual time series from year 2017 till 2021, so the total number of observations is 175 observations.

From spearman correlation matrix it is concluded that:

- There is a significant and inverse relation between ERM and Agility.
- There is a significant and inverse relation between ERM and Sustainability.
- There is a significant and inverse relation between Agility and Sustainability

From Random Linear Regression panel model, it is concluded that:

- **Debt to Equity Ratio** (ERM) has an inverse and significant impact on **LN ESG Score** (Sustainability), as **debt to equity ratio** makes ESG score changes by -0.0159867 holding Success score constant.
- **WACC** (ERM) has an inverse and significant impact on **LN ESG Score** (Sustainability), as **WACC** makes ESG score changes by -0.00271966 holding Success score constant.
- **Strategic Risk** (ERM) has an inverse and significant impact on **LN ESG Score** (Sustainability), as **Strategic Risk** makes ESG score changes by -0.00459982 holding Success score constant.
- **Interest coverage** (ERM) has an inverse and significant impact on **LN ESG Score** (Sustainability), as **Interest coverage** makes ESG score changes by -0.00206858 holding Success score constant.
- **LN Success Score** (Agility) has a direct and significant impact on **LN ESG Score** (Sustainability), as **LN Success Score** makes ESG score changes by 0.386947 holding Success score constant.

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